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CORRECTIVE MEASURES STUDY REPORT FOR SOLID WASTE MANAGEMENT UNIT (SWMU) 59 NAVAL ACTIVITY PUERTO RICO

4/14/2015

MICHAEL BAKER INTERNATIONAL

April 14, 2015

Attn: Mr. Phil Flax
Chief, Resource Conservation and Special Projects Section

Re: Contract N62470-10-D-3000
IDIQ for A/E Services for Multi-Media
Environmental Compliance Engineering Support
Delivery Order (DO) JM01
U.S. Naval Activity Puerto Rico (NAPR)
EPA I.D. No. PR2170027203
Final Corrective Measures Study Report
SWMU 59 – Former Vehicle Maintenance and Refueling Area

Dear Mr. Flax:

Michael Baker Jr., Inc. (Baker), on behalf of the Navy, is pleased to provide you with one hard copy and one electronic copy of the Final Corrective Measures Study Report – SWMU 59 – Former Vehicle Maintenance and Refueling Area.

If you have questions regarding this submittal, please contact Mr. Stacin Martin at (757) 322-4780.

Regards,

MICHAEL BAKER JR., INC.

John W. Mentz
Activity Coordinator

Attachments
cc: Ms. Debbie Sanders, BRAC PMO SE (letter only)
Mr. Pedro Ruiz, NAPR (electronic copy)
Mr. Stacin Martin, NAVFAC Atlantic (1 CD)
Mr. Doug Pocze US EPA Region II (2 hard copies and 2 CDs)
Mr. Jose Font, US EPA Caribbean Office (1 hard copy and 1 CD)
Mr. Felix Lopez, US F&WS (1 hard copy and 1 CD)
Ms. Gloria Toro Agrait, PREQB (1 hard copy and 1 CD)
Ms. Connie Crossley, Booz Allen Hamilton (1 hard copy and 1 CD)

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NAVY RESPONSE TO EPA AND PREQB COMMENTS ON THE DRAFT FINAL CORRECTIVE MEASURES STUDY REPORT FOR SWMU 59 – VEHICLE MAINTENANCE AND REFUELING AREA (DRAFT: APRIL 19, 2012; DRAFT FINAL: MAY 27, 2014) APRIL 14, 2015

This document provides a compilation of the Navy responses to EPA and PREQB comments on the Draft Final Corrective Measures Study Report for SWMU 59 – Vehicle Maintenance and Refueling Area (dated May 27, 2014; herein referred to as the Draft Final CMS Report). A timeline for this document, as well as the Request for Additional Sampling Necessary for Completion of the Corrective Measures Study Investigation of SWMU 59 (dated June 15, 2012; herein referred to as the Work Plan Letter) is provided below.

- Draft CMS Report for SWMU 59 submitted by the Navy to EPA on July 14, 2011.
- EPA and PREQB comments on the Draft CMS Report for SWMU 59 were provided to the Navy (Mark Davidson) in a letter from Timothy Gordon dated November 3, 2011
- Working draft Navy responses to EPA and PREQB comments on the Draft CMS Report for SWMU 59 submitted by the Navy to EPA on March 20, 2012.
- PREQB comments on the working draft Navy response to comments on the Draft CMS Report for SWMU 59 were provided to the Navy (Stacin Martin) in an electronic message from Wilmarie Rivera Otero dated April 19, 2012.
- A draft version of the Work Plan Letter submitted by the Navy to EPA on April 5, 2012.
- EPA approval (dated April 26, 2012) on the Work Plan Letter provided to the Navy on May 2, 2012.
- PREQB comments on the draft version of the Work Plan Letter received by the Navy via email from PREQB Gloria Toro on May 3, 2012.
- Working draft Navy responses to PREQB comments on the draft version of the Work Plan Letter submitted by the Navy to PREQB in an electronic message dated June 12, 2012.
- PREQB approval of the working draft response to comments on the draft version of the Work Plan were provided to the Navy in an electronic message from Gloria Toro Agrait dated June 14, 2012
- Final version of the Work Plan Letter, as well as Navy responses to PREQB comments on the draft version of the Work Plan Letter submitted by the Navy to EPA on June 15, 2012.
- Field work specified by the final version of the Work Plan Letter was implemented in September 2012.
- Navy Response to EPA and PREQB Comments on the Draft CMS Report for SWMU 59 and Draft Final CMS Report for SWMU 59 submitted to the EPA and PREQB on October 4, 2013.

- PREQB provided comments on the Draft Final CMS to EPA (Doug Pocze) and the Navy (Stacin Martin) on October 31, 2013.

- EPA provided comments on the Draft Final CMS to the Navy (Stacin Martin) on January 28, 2014.

- Navy Working Draft Response to EPA and PREQB Comments on the Draft Final CMS Report for SWMU 59 submitted to the EPA and PREQB on May 27, 2014.

- EPA indicated in an email to the Navy (Stacin Martin (May 28, 2014.) that they have no further comments on the Draft Final CMS.

- PREQB provided additional comments on the Draft Final CMS to EPA (Doug Pocze) and the Navy (Stacin Martin) on June 11, 2014.

- Navy Working Draft Response to PREQB Comments on the Draft Final CMS Report for SWMU 59 submitted to the EPA and PREQB on February 26, 2015, including a letter from the LRA indicating concurrence with the proposed reuse restrictions.
- In an email to the Navy (Stcin Martin) and PREQB (Gloria Toro) dated March 4, 2015, EPA (Doug Pocze) approved the Working Draft Response to Comments, including the outstanding comments previously referred to EPA by PREQB.

- Final compilation of all EPA and PREQB comments and Navy responses (this document).

As indicated by the last bullet item above, this document represents a compilation of all agency comments and Navy responses. For reference, dates corresponding to the above timeline are included in parenthesis after each comment (provided in italics) and Navy response (provided in regular print). Original EPA and PREQB comments are also underlined.

EPA COMMENTS

EPA GENERAL COMMENTS

EPA General Comment 1 (November 3, 2011): *As discussed in Section 10.1, Description of the Remedy, the extent of contamination has not been defined at any of the proposed excavation areas. Section 11.1, Conceptual Design, indicates that confirmation samples will be collected from the side walls of each excavation area; however, given that the excavations are being conducted to address surface soil contamination, this approach does not appear to be appropriate, as concentrations detected in samples collected from side walls (i.e., at depths potentially greater than zero to six inches) may not be truly indicative of surface soil conditions. The Corrective Measures Implementation (CMI) work plan (also referred to in the report as the corrective action work plan) should propose the collection of pre-excavation surface soil samples to delineate the extent of contamination prior to excavation in order to ensure that the proposed removal action adequately addresses surface soil contamination. In addition, the CMI work plan should address how any exceedances detected during the pre-excavation sampling event will be addressed (e.g., collection of step out samples to fully define the limits of excavation to be performed at what frequency and distance). The CMS Report should be revised to acknowledge the additional sampling requirements to be addressed in the CMI work plan.*

Navy Response to EPA General Comment 1 (March 20, 2012): The Navy agrees that pre-excavation surface soil samples should be collected prior to excavation to further refine the proposed excavation areas and minimize the uncertainty associated with the lateral extent of contaminated soil. Therefore, the Navy proposes to submit a Work Plan Letter under separate cover that provides the rationale and a brief

summary of the additional sampling. In addition, the Work Plan Letter will include a freshwater drainage ditch sediment investigation (see the Navy's response to EPA General Comment 2) and characterization of soils beneath the concrete pads and asphalt pavement (see PREQB General Comment 5). Data from this supplemental investigation will be incorporated into the Draft CMS, including revisions to the ERA and HHRA as appropriate, and will be submitted as a Revised Draft CMS Report. A schedule for implementing this approach is attached to these responses.

Supplemental Navy Response to EPA General Comment 1 (October 4, 2013): Pre-excavation surface soil samples, surface and subsurface soil beneath concrete pads and paved surfaces, and drainage ditch sediment were collected during the follow-on CMS field investigation conducted in September and November 2012 in accordance with the final version of the Work Plan Letter (dated June 15, 2012). Any deviations from the final version of the Work Plan Letter are identified within the Draft Final CMS Report.

EPA General Comment 1 (January 28, 2014): *The response and supplemental response requires further clarification. The Navy has conducted additional pre-excavation field work to more fully delineate the extent of contamination in surface soil. However, the scope and results of this effort should be clarified in the CMS Report. The lateral extent of contamination has to be fully delineated. Revise the CMS Report to address the following issues:*

- *Section 4.1 (bottom of page 4-4) indicates that the pre-excavation field effort included collection of 24 surface soil samples in September 2012 (59SS01 through 59SS24), and an additional 10 surface soil samples in November 2012 (59SS25 through 50SS34) to expand on the initial pre-excavation sampling results. Section 6.1 should present the results of both surface soil sampling events, but instead only presents the results for surface soil samples collected from 10 soil borings advanced as part of a separate "CMS Investigation" field effort in September 2012 (59SB24 through 59SB33). Surface soil data from the "CMS Investigation" is presented in Table 6-2, but data from the pre-excavation delineation effort are not included in any of the Section 6 data tables (except Table 6-11, which only presents associated blank data). Section 6 should thoroughly document the results of the pre-excavation field effort, including a usability discussion appropriate for the intended use of these data.*

- *Section 9.2 discusses the extent of contamination in surface soil above corrective action objectives (CAOs). For several proposed areas of excavation, the CMS acknowledges that full delineation has not yet been accomplished. Accordingly, post-excavation samples will be used in these areas to ensure that contaminated soil has been adequately removed. Because excavation will be limited to the ecologically active uppermost foot of soil, post-confirmation samples collected from excavation sidewalls should be appropriately reflective of surface soil conditions. However, NAPR should ensure that the lateral extent of contamination is sufficiently evaluated in the following areas: Area 1 – northwest of location 59SS31 and along the steep hillside; Area 2 – south and east of location 59SS15; Area 3 – around the southwestern edge of excavation; Area 4 – along the northwest, north, and northeast edges of excavation; and Area 5 – along the northern, western, and eastern edges of the excavation. The CMS Report should highlight these areas of uncertainty and targeted post-excavation confirmation sampling.*

- *Section 10.1 (page 10-3) indicates that post-excavation sampling will not be conducted in locations where contaminated soil was excavated up to structures (e.g., concrete slabs, asphalt surfaces, building foundations) because contaminated soil within the target depth of 0-1 foot below ground surface (bgs) will have already been removed. This approach is acceptable where the structure extends at least one foot below the adjacent ground surface. However, it seems unlikely that surfaces such as asphalt will be at least a foot thick. As a possible alternative EPA*

recommends that confirmation samples are collected from sidewalls where the proposed excavation exposes soil beneath man-made structures (between 4 and 12 inches bgs, for example). This sampling will confirm that contamination above CAOs does not extend into adjacent areas where ecological receptors could be exposed to unacceptable risk.

Navy Response to EPA General Comment 1 (May 27, 2014):

- Section 6.1 of the text has been revised to include discussion on the results of the 2012 September/November Pre-Excavation Delineation Sampling. Additionally, Table 6-3 – Summary of Detected Results – 2013 Pre-Excavation Delineation Sampling has been added.

- Section 9.2 was revised to specifically identify the uncertainties in each area of proposed excavation and to target these areas for post-excavation confirmation sampling.

- The third paragraph on page 10-3 will be revised to include the following:

  "However, samples will be collected from excavation sidewalls where excavation exposes 4 to 12 inches of soil beneath aforementioned manmade structures."

EPA General Comment 2 (November 3, 2011): *According to Section 9.5, Sediment, additional investigation is recommended to determine if copper, lead, and zinc have migrated beyond the pool at which these contaminants were detected. Details of this proposed investigation have not been provided. In addition, Figure 11-2, Conceptual CMI Schedule, does not reflect the need for additional sampling. As such, it is unclear if corrective action for sediment and surface water will be addressed separately from that of soil. Revise the CMS Report to clarify how corrective action for sediment and surface water is intended to be addressed relative to the site as a whole. In addition, clarify when the additional investigation will take place and if a separate work plan will be prepared which details the proposed investigation. Ensure that the CMS Report demonstrates a clear path forward for addressing all necessary corrective actions and that the schedule is revised to reflect each step.*

Navy Response to EPA General Comment 2 (March 20, 2012): The Navy recognizes the need for additional sediment sampling to determine if copper, lead, and zinc have migrated beyond the pool at ecologically important concentrations. Therefore, the Navy proposes including the requirements for the additional sediment investigation in the Work Plan Letter to be submitted under separate cover. Please refer to the Navy's response to EPA General Comment 1. A schedule for implementing this approach is attached to these responses.

Supplemental Navy Response to EPA General Comment 2 (October 4, 2013): Drainage ditch sediment samples were collected during the follow-on CMS field investigation conducted in September and November 2012 in accordance with the final version of the Work Plan Letter dated June 15, 2012. Any deviations from the final version of the Work Plan Letter are identified within the Draft Final CMS Report.

EPA General Comment 2 (January 28, 2014): *According to the supplemental response, the Navy conducted additional sediment sampling in September and November 2012. However, Sections 4 and 6 only discuss sampling conducted in September 2012. Revise the text, tables, and figures of the Report as needed to document sediment investigation activities conducted in November 2012.*

Navy Response to EPA General Comment 2 (May 27, 2014): The statement in the supplemental response that sediment samples were collected in September and November 2012 is an error. Sediment samples were collected during the follow-on CMS field investigation in September 2012. Pre-excavation

delineation soil sampling was conducted in September and November 2012. No changes to the CMS report as proposed.

EPA General Comment 3 (November 3, 2011): *The CMS Report does not adequately evaluate the selected remedial alternative. The CMS Report should be revised to convey how the selected remedy meets the following standards outlined in the May 1994 RCRA Corrective Action Plan (OSWER Directive 9902.3-2A):*

a. *Protect human health and the environment*
b. *Attain media cleanup standards*
c. *Control the source of releases so as to reduce or eliminate, to the extent practicable, further releases that may pose a threat to human health and the environment*
d. *Comply with any applicable standards for management of wastes*
e. *Other factors such as reliability, effectiveness, and cost.*

Revise the CMS to address these items as they relate to the proposed excavation and disposal of surface soil in a manner which clearly shows that the proposed excavations will achieve the objectives of the corrective measures process.

Navy Response to EPA General Comment 3 (March 20, 2012): This CMS Report was developed in accordance with the Resource Conservation and Recovery Act (RCRA) § 7003 Administrative Order on Consent (USEPA Docket No. 02-2007-7301; USEPA, 2007). Attachment IV – Scope of Work for a Corrective Measures Study in the Administrative Order specifically details the terminology and evaluation criteria that are required to be used and identified in the Corrective Measures Study Investigation and Report. This CMS Report is designed to provide a guide for selecting corrective measures to mitigate human health and ecological risks associated with contamination related to site operations in accordance with the aforementioned Administrative Order. Although the terminology is slightly different, the overall corrective measure requirements of the Administrative Order are generally consistent with other EPA guidance such as the Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (October 1988, EPA/540/G-89/004) and the Final RCRA Corrective Action Plan (May 1994, OSWER Directive 9902.3-2A). No revisions to the report are warranted.

References:

USEPA 1988. Guidance for Conducting Remedial investigations and Feasibility Studies Under CERCLA. October 1988. EPA/540/G-89/004.

USEPA 1994. RCRA Corrective Action Plan (Final). Office of Solid Waste Programs Enforcement. US Environmental Protection Agency OSWER Directive 9902.34-2A. May 1994.

USEPA, 2007. RCRA § 7003 Administrative Order on Consent. In the Matter of: United States The Department of the Navy, Naval Activity Puerto Rico formerly Naval Station Roosevelt Roads, Puerto Rico. Environmental Protection Agency, EPA Docket No. RCRA-02-2007-7301. January 29, 2007.

Supplemental Navy Response to EPA General Comment 3 (October 4, 2013): Section 10.2 of the Draft CMS Report (Justification of the Corrective Measure) has been re-organized and expanded. It is the Navy's opinion that Section 10.2 of the Draft Final CMS Report adequately conveys how the selected remedy meets the standards outlined in the May 1994 RCRA Corrective Action Plan (OSWER Directive 9902.3-2A).

EPA General Comment 4 (November 3, 2011): *Based on review of the CMS Report, it appears that surface topography is influencing the migration of contamination at the site, and that surface water is the*

driving release pathway; however, no figure has been provided which depicts surface contours at the site. The site should be surveyed such that a figure can be developed which depicts the contours of the site and supports the conceptual side model. Revise the CMS Report to address this data gap in support of the additional surface water and sediment sampling and the locations of the proposed soil excavations. Sample locations should take into account potential contaminant migration pathways and release points due to topographical features.

Navy Response to EPA General Comment 4 (March 20, 2012): The Navy concurs that topographic features are an important component of the site conceptual model. Topographic contours based on 2000 aerial photography were added to all relevant figures of the SWMU 59 CMS Report. The rationale and a brief summary of the additional sampling proposed at the SWMU are included in the Work Plan Letter, which is provided under separate cover (please refer to the Navy's response to EPA General Comment 1).

EPA General Comment 5 (November 3, 2011): *According to Section 4.1, Surface and Subsurface Soil Sampling, numerous soil borings were advanced at areas other than their proposed locations for various reasons. While the rationales for the selection of locations that were actually sampled appear to be adequate, no comment has been made as to whether these changes to the work plan have resulted in data gaps at the original sample locations. For example, 59SB06 was proposed to be located on the northwest portion of the fuel island, but was moved 50 feet southwest of the fuel island to "identify possible contamination that may have migrated from the fuel island." It is unclear whether this has resulted in a data gap in characterization of potential contamination on the northwest side of the fuel island. Revise the CMS Report to discuss whether the altered sample locations have resulted in any data gaps, and if so, how these data gaps will be addressed.*

Navy Response to EPA General Comment 5 (March 20, 2012): Many of the soil borings that were moved were a result of the presence of a concrete slab (59SB07, 59SB08, 59SB09, 59SB20, and 59SB21). The most likely accumulation of potential contaminants from spills on the concrete slabs would be at the edge of the concrete in the adjacent surface soil. This was the rationale behind collecting samples at the edge of the concrete pad verses drilling through the pad and sampling underneath. This did not result in a data gap, but rather a more common sense driven evaluation of potential contaminant accumulation areas.

The Navy does not believe moving 59SB06 results in a data gap (see PREQB Page-Specific Comment 7b and 7c). Moving this location, which included construction of a monitoring well, to a location directly downgradient of the potential UST and fueling islands was justified and helped to eliminate a data gap in that respect. The following text was added to the third bullet in Section 4.1 Surface and Subsurface Soil Sampling:

> "Moving this location will help to eliminate a potential data gap related to the potential UST and fuel islands at SWMU 59."

In addition, the following bullet was added to Section 4.1:

> "Soil boring 59SB12 was moved approximately 20 feet southwest to accommodate moving well 59SB02 downgradient of the fuel islands. Soil boring 59SB12 was moved to space out the sample collection points downgradient of the fuel islands. A soil pile was observed in the area and 59SB12 was located adjacent to the soil pile."

EPA General Comment 6 (November 3, 2011): *It was not possible to independently verify the wildlife Hazard Quotients (HQs) presented in Tables 7-22 to 7-24 because the CMS Report does not provide the receptor-specific Estimated Daily Doses (EDDs) used to calculate these HQs. The EDD for each*

receptor derived from the equation provided in Section 7.5.2.2.2 (Dietary Intakes) and using the Step 2 or Step 3a input parameters must be available to calculate the HQs by dividing the EDDs by their toxicity values. The exposure parameters and dietary compositions are provided in Tables 7-15 and 7-16, respectively, but the receptor-specific EDDs are not presented. Include a separate set of tables to show the EDDs for each receptor used to derive the HQs so that the calculations can be independently verified.

Navy Response to EPA General Comment 6 (March 20, 2012): The following tables were added to Section 7.0:

<u>Step 2 Screening Level Risk Calculation (Section 7.6.2.6)</u>

- Tables 7-22a through 7-22d show Step 2 prey item tissue concentrations and dietary intakes for mourning dove, American robin, red-tailed hawk, and brown flower bat exposures to chemicals in SWMU 59 surface soil. In addition, a table showing prey item tissue concentrations and dietary intakes for Norway rat exposures to chemicals in SWMU 59 surface soil was added to Section 7.6.2.6 (i.e., Table 7-22e). As discussed in Section 7.5.2.2.2, the Norway rat was selected as a food item for the red-tailed hawk. This table is necessary since Norway rat tissue concentrations for many chemicals were estimated using Norway rat dietary intakes and small mammal diet-to-whole-body BAF values (see Section 7.5.2.2.1 and Table 7-11). Only those chemicals with Norway rat tissue concentrations estimated using Norway rat dietary intakes and small mammal diet-to-whole body BAF values were shown.

- Tables 7-23a through 7-23d show Step 2 prey item tissue concentrations and dietary doses for mourning dove, American robin, red-tailed hawk, and brown flower bat exposures to chemicals in SWMU 59 subsurface soil. In addition, Table 7-23e shows prey item tissue concentrations and dietary intakes for Norway rat exposures to chemicals in SWMU 59 subsurface soil. This table is necessary since Norway rat tissue concentrations for many chemicals in SWMU 59 subsurface soil were estimated using Norway rat dietary intakes and small mammal diet-to-whole body BAF values. Only those chemicals with Norway rat tissue concentrations estimated using Norway rat dietary intakes and small mammal diet-to-whole body BAF values were shown.

- Table 7-24a will show Step 2 prey item tissue concentrations and dietary doses for green heron exposures to chemicals in drainage ditch sediment.

<u>Refined (Step 3a) Risk Calculation (Section 7.9.1.6)</u>

- Tables 7-40a through 7-40d show Step 3a prey item tissue concentrations and dietary doses for mourning dove, American robin, red-tailed hawk, and brown flower bat exposures to ecological chemicals of potential concern (COPCs) in SWMU 59 surface soil. In addition, Table 7-40e shows prey item tissue concentrations and dietary intakes for Norway rat exposures to those chemicals in SWMU 59 surface soil that were identified as ecological COPCs in the Step 2 screening level risk calculation for the red-tailed hawk. Only those ecological COPCs with Norway rat tissue concentrations estimated using Norway rat dietary intakes and small mammal diet-to-whole body BAF values were shown.

- Tables 7-41a through 7-41d show Step 3a prey item tissue concentrations and dietary doses for mourning dove, American robin, red-tailed hawk, and brown flower bat exposures to ecological COPCs in SWMU 59 subsurface soil. In addition, Table 7-41e shows prey item tissue concentrations and dietary intakes for Norway rat exposures to those chemicals in SWMU 59 subsurface soil that were identified as ecological COPCs in the Step 2 screening level risk calculation for the red-tailed hawk. Only those ecological COPCs with Norway rat tissue

concentrations estimated using Norway rat dietary intakes and small mammal diet-to-whole body BAF values were shown.

- Table 7-42a will show Step 3a prey item tissue concentrations and dietary doses for green heron exposures to ecological COPCs in drainage ditch sediment.

Other pertinent information included within each table includes media concentrations and bioaccumulation factors/uptake equations used to derive prey item tissue concentrations, as well as the toxicity reference values used in the derivation of risk estimates (i.e., HQ values). The footnotes to each table also include the dietary intake equation and receptor-specific input parameters used to derive exposure doses. The tables referenced above include all information requested by the EPA in an electronic message (email) from Mr. Timothy Gordon dated December 5, 2011.

It is noted that the working draft version of the Final CMS Report does not include Tables 7-24a and 7-42a. These two tables will be provided as part of the Final CMS Report once the PREQB has approved the Navy approach to address PREQB Page-Specific Comment No. 22.

Although not commented on, Tables 7-25, 7-40, and 7-41 were revised as follows:

- The percentage of the American robin diet comprised of terrestrial plants was incorrectly shown within Table 7-25 as 7.3 percent. This incorrect percentage also was used in the derivation of refined (Step 3a) risk estimates for American robin dietary exposures to ecological COPCs in surface and subsurface soil. Table 7-25 was revised to show the correct contribution that plants have to the diet of the American robin (8.3 percent). Risk estimates presented in Tables 7-40 and 7-41 were also revised, as necessary, to reflect the adjusted diet. It is noted that the revision to the diet of the American robin only affected risk estimates presented in Table 7-40 for surface soil (risk estimates presented in Table 7-41 for subsurface soil do not change). It is further noted that revisions to the risk estimates presented in Table 7-40 were minor. Specifically, risk estimates for endrin (MATC-based risk estimate), copper (NOAEL-based risk estimate), lead (MATC-based risk estimate), mercury (NOAEL-based risk estimate), and vanadium (MATC-based risk estimate) increased by 0.01. These minor changes to risk estimates have no impact on conclusions regarding American robin dietary exposures to chemicals in surface soil.

- The adjusted toxicity reference values listed within the fifth bullet item under Section 7.9 for selenium were derived using an incorrect body weight for the brown flower bat (i.e., a receptor body weight of 0.35 kg was used in scaling equation instead of 0.0183 kg). Tables 7-40 and 7-41 were revised to show hazard quotient values based on adjusted toxicity reference values derived using the correct body weight. The text in Section 7.9 also was revised to show adjusted toxicity reference values based on the correct receptor body weight. Note that toxicity reference value adjustments based on the incorrect receptor body weight resulted in an overstatement of potential risks to the brown flower bat in Step 3a of the BERA. As such, use of the correct receptor body weight had no impact on conclusions regarding brown flower bat dietary exposures to selenium in surface and subsurface soil.

- Tables 7-40 and 7-41 provided refined risk estimates for all chemical-receptor combinations listed even if a chemical was not identified as an ecological COPC for a given receptor. For example, refined risk estimates are provided within each table for brown flower bat dietary exposures to chemicals that were only identified as ecological COPCs for the American robin. For a given receptor, Tables 7-40 and 7-41 were revised to show refined risk estimates only for those chemicals identified as ecological COPCs in the screening level risk calculation. This ensured consistency with the new tables that were added to Sections 7.9.1.6.

Supplemental Navy Response to EPA General Comment No. 6 (October 4, 2013): The organization of the ecological risk assessment presented within the Draft CMS Report has changed due to the incorporation of soil and sediment analytical data from the follow-on CMS investigation conducted in September and November 2012. Tables presenting prey item tissue concentrations and dietary doses for ecological receptor exposures to chemicals in abiotic media at the SWMU are now presented within Appendix G (screening level risk calculation) and Appendix N (refined risk calculation) of the Draft Final CMS report.

The incorporation of analytical data from the follow-on CMS field investigation has also resulted in substantial table numbering changes throughout Section 7.0. As such, the table numbers referenced within the March 20, 2012 working draft response to EPA General Comment 6 above (i.e., Tables 7-11, 7-25, 7-40, and 7-41) are no longer accurate. Table designations used in the Draft Final CMS Report are identified below.

- Table 7-11 of the Draft CMS Report is now Table 7-12 of the Draft Final CMS Report
- Table 7-25 of the Draft CMS Report is now Table 7-31 of the Draft Final CMS Report
- Tables 7-40 and 7-41 of the Draft CMS Report are now Tables 7-51 and 7-53 of the Draft Final CMS Report

Also note that the issue related to the incorrect brown flower bat body weight used to adjust mammalian toxicity reference values within the Draft CMS Report is no longer applicable. Based on comments received for an ecological risk assessment conducted at SWMU 79, the Navy is no longer adjusting mammalian toxicity reference values to account for differences in test species and receptor species body weights. Step 3a risk estimates for brown flower bat dietary exposures, presented within Tables 7-51 and 7-53 of the Draft Final CMS Report, reflect this current approach.

EPA General Comment 7 (November 3, 2011): *Several analytical results were rejected during data validation, including groundwater and ditch surface water data points. These rejected data are not included in the frequency and range tables. The text explains that the analytes with rejected data were retained as chemicals of potential concern (COPCs) due to the unusable data. It would be helpful to include these rejected analytes in the frequency and range tables to show that these analytes were analyzed for but rejected, and therefore retained as COPCs, in step 3 of the CMS. Include the analytes in the tables with an "R" qualifier and explain in a footnote to the table why the analytes were retained.*

Navy Response to EPA General Comment 7 (March 20, 2012): The Navy does not believe that the inclusion of chemicals with rejected data into Tables 7-17 through 7-21 is necessary since all rejected data are shown within the data sets used to conduct the ecological risk assessment (see Appendix D of the Draft CMS Report). However, for clarity, those chemicals lacking useable data will be identified within a footnote on each table. The footnote will also reference the location within the document where rejected data are presented (i.e., Appendix D) and indicate that chemicals lacking any useable data are identified as ecological COPCs.

Supplemental Navy Response to EPA General Comment 7 (October 4, 2013): The Draft Final CMS report reflects the revisions indicated by the Navy's working draft response to EPA General Comment 7. However, the incorporation of analytical data from the follow-on CMS field investigation has resulted in the addition of new tables, as well as table numbering changes throughout Section 7.0. The frequency and range tables for abiotic media referenced in EPA General Comment 7 are numbered 7-18 through 7-24 within the Draft Final CMS Report.

EPA General Comment 7 (January 28, 2014): *EPA's comment requested additional presentation on analytes that were rejected (i.e., qualified as "R" during data validation). Because of the high number of rejected analyte samples (all of which were non-detects), project completeness criteria were not met for volatile organic compounds (VOCs) in surface water, or for VOCs and total metals in groundwater (as per Section 6.7.1, Data Completeness Summary). Because of this lack of compliance with data completeness criteria, assurances should be presented that the rejected non-detected samples would not be expected to be major contributors to risk, e.g., by comparison of detection limits with screening criteria. Such comparison is presented in the tables at the end of Appendix B, but presently the comparison does not include those analytes with 100% rejected values. The limits of detection (LODs) for rejected analytes should be added to the tables at the end of Appendix B, with notes where all samples were rejected. Of concern are those analytes with a very high percentage of rejected samples across multiple media including, but not limited to, acrolein and 1,4-dioxane.*

Navy Response to EPA General Comment 7 (May 27, 2014): The LOD comparison tables for soil, groundwater, surface water, and sediment presented in Appendix B will be revised to include evaluation of the limits of detection for rejected data. In addition, a note will be made next to analytes where all results were rejected.

EPA General Comment 8 (November 3, 2011): *Section 6.6.3 indicates that results for volatile organic compounds (VOCs) and for total metals did not meet the 90% completeness goal. While the section states that 1,4-dioxane, acrolein, isobutyl alcohol and methyl methacrylate are not likely related to SWMU 59, it does not discuss how the rejection of 2-butanone, acetone, acryonitrile, propionitrile, total mercury and total zinc results affects the risk assessment process and the ability to meet project data quality objectives (DQOs). Please revise the CMS to discuss if these rejected analytes are considered COPCs and how the rejections affect the project DQOs and the risk assessment process.*

Navy Response to EPA General Comment 8 (March 20, 2012): Table 6-12 shows the results of percent completeness for SWMU 59 CMS. The overall data completeness was over 96 percent with a goal of 90 percent and meeting the DQOs. Three matrix parameter classes were reported as just under 90 percent including groundwater VOCs, groundwater metals, and surface water VOCs.

The Navy offers the following points of clarification relative to the ecological risk assessment. As discussed in Section 7.6.2.3, 1-4-dioxane, 2-butanone, acetone, acrolein, acrylonitrile, isobutyl alcohol, propionitrile, 1,4-phenylenediamine, mercury, and zinc were identified as ecological COPCs for SWMU 59 groundwater based on the lack of any usable data with which to evaluate potential risks. An evaluation of these ten chemicals is also provided in Section 7.9.1.3 of the Draft CMS Report. As the ecological risk assessment already takes into consideration chemicals that lack usable analytical data, the Navy does not believe the rejected analytical data for these chemicals impact the ecological risk assessment process.

With respect to the HHRA, the last paragraph of Section 8.3.2.4 was revised to include the following statements:

> "Although some data were rejected (flagged "R"), the overall data completeness for the project was 96% (refer to Table 6-12). Those data that were flagged "R" were not chemicals of potential concern for SWMU 59. It is not expected that this will impact the results of this HHRA (i.e., underestimate potential risks)."

Supplemental Navy Response to EPA general Comment 8 (October 4, 2013): All analytes without usable analytical data for a given medium were identified as ecological chemicals of potential concern (COPCs) in the Step 2 screening level risk calculation. These analytes were further evaluated in Step 3a

of the baseline ecological risk assessment (BERA) to determine if they warrant identification of ecological chemicals of concern (COCs).

PA General Comment 9 (November 3, 2011): *The data validation reports (DVRs) do not provide the extent of all quality control (QC) outliers. For example, SDG 1004194, page 10 states that sample 59SB04-01 was re-analyzed due to high internal standard area recoveries and that re-analysis exhibited similar results. However, the results of the internal standard area recoveries are not listed. Revise the DVRs to provide the extent of all QC outliers.*

Navy Response to EPA General Comment 9 (March 20, 2012): It is the practice of the data validator to only provide the results of the sample that was used in the body of the data validation report. Whenever a sample is re-analyzed due to non-compliant surrogate or internal standard area recoveries and both samples have non-compliant recoveries, the sample with the more compliant results is used. When both non-compliant results are similar usually the initial analysis is used. Both initial analysis and re-analysis sample results are always provided in the worksheet portion of the report. No revisions to the data validation reports are proposed.

EPA General Comment 10 (November 3, 2011): *The "R" qualifier is defined in the data tables (e.g., Table 6-6) footnotes to indicate that the result has been rejected. To ensure that rejected concentrations are not used, the associated numeric values should be removed from the tables. Revise these tables to remove the numeric values associated with the rejected results.*

Navy Response to EPA General Comment 10 (March 20, 2012): The data tables will not be revised to eliminate the numeric values associated with rejected results. It is acknowledged that these results are rejected and not usable, which is clearly indicated in the notes/qualifiers of the data tables. However, the reported concentrations of the rejected results can provide insight into potential contaminant concentrations exceeding screening values at those locations. The rejected results were not used in any way to characterize the extent of contamination at this site nor were they used in the human health or ecological risk calculations.

EPA SPECIFIC COMMENTS

EPA Specific Comment 1: Section 5.2.2, Hydrogeology, Page 5-2 (November 3, 2011): *This section states that groundwater elevation measurements were collected on May 24, 2010, following groundwater sample collection and hydraulic conductivity testing. Given the disturbance to the water table prior to data collection, this elevation data is not likely representative of actual conditions. This is further supported by the fact that this "snap shot" of groundwater conditions contradicts the January 13, 2011 "snap shot." Therefore, elevation data collected on May 24, 2010 and presented on Figure 5-3, Groundwater Contour Map – May 24, 2010, should be removed from the CMS Report. Discussions regarding groundwater elevation and flow should be based on the data collected on January 13, 2011. Additionally, ensure that water level measurements are collected during the next field mobilization to confirm the January 13, 2011 portrayal of groundwater conditions.*

Navy Response to EPA Specific Comment 1 (March 20, 2012): The groundwater contour map from May 24, 2010 (Figure 5-3) was eliminated from the report given the disturbance to the water table prior to data collection. As a result, Figure 5-4 (Groundwater Contour Map – January 13, 2011) was changed to Figure 5-3. A new groundwater contour map from August 30, 2011 was prepared and included in the report as Figure 5-4. Although groundwater elevations from August 30, 2011 are elevated due to the extensive precipitation during the Spring/Summer of 2011, overall flow to the west remains unchanged when compared to the January 2011 data. Section 5.2.2 of the report was revised to incorporate this information as indicated in the Navy's response to EPA Specific Comment 2. In addition, the supporting

field logbook notes for Jay Oliver that list the groundwater level measurements from August 30, 2011 were added to Appendix A.

EPA Specific Comment 2: Section 5.2.2, Hydrogeology, Page 5-2 (November 3, 2011): *The second paragraph in this section indicates that there is a groundwater divide in the western portion of the site. Based on review of Figure 5-4, Groundwater Contour Map – January 13, 2011, it appears that the groundwater divide is actually located on the eastern portion of the site. Revise this section to either revise the statement or more clearly describe the divide.*

Navy Response to EPA Specific Comment 2 (March 20, 2012): Based on the newly developed groundwater contour map from data collected on August 30, 2011, groundwater is collected within SWMU 59 from the topographic high hills surrounding it to north, south and east. Groundwater then flows west toward the topographic low to the west. The text in Section 5.2.2 was revised as follows:

> "Groundwater levels were measured in each monitoring well using an electronic water level meter to the nearest 0.01 foot as previously discussed in Section 4.3. Measurements were taken on May 24, 2010 at the end of the field activities following groundwater sample collection and hydraulic conductivity testing and again on January 13, 2011 to evaluate and confirm equilibration of the water table. Another round of groundwater levels were taken on August 30, 2011 during the SWMU 74 investigation for comparison. Following this comparison, the May 2010 data was found to not be at equilibrium and was not used in the evaluation of groundwater flow at SWMU 59.
>
> SWMU 59 was cut into hillsides and is bound to the north, east, and south by the hills with elevations in excess of 200 feet msl. A local recharge area along the eastern side of the facility's concrete pad is likely due to storm water drainage from the adjacent hills. The anticipated flow direction for the SWMU 59 area is toward the west southwest and the drainage system of the recreational fields that were constructed on a former mangrove (United States Geological Survey [USGS], 1957). The water level measurements are provided in the field logbooks in Appendix A and the water level measurements and calculated groundwater elevations are summarized on Table 4-4.
>
> Groundwater elevation contours for SWMU 59 using the January 13, 2011 and August 30, 2011 data are provided on Figures 5-3 and 5-4, respectively. Figure 5-3 shows a relatively flat gradient flowing from the southeast to the northwest and then turning due west. The area of the former underground storage tank shows the groundwater flow from east to west.
>
> The groundwater levels collected in August 2011 represent high groundwater levels at SWMU 59 due to abnormally high precipitation during Spring/Summer 2011. Water levels were approximately 4 feet higher than the January 2011 measurements and approximately 8 feet higher than the May 2010 groundwater levels. Groundwater contours are shown on Figure 5-4 for August 2011 and show groundwater flow generally from east to west.
>
> The hydraulic gradient was calculated between wells 59SB10 and 59SB06 on Figures 5-3 and 5-4 and was 0.0006 and 0.002, respectively. The average of these two gradients is 0.0013. These wells were chosen because of the east to west flow direction and the gradient was taken generally perpendicular to the flow lines."

Supplemental Navy Response to EPA Specific Comment No. 2 (October 4, 2013): The Draft Final CMS report reflects the revisions indicated by the Navy's working draft response to EPA Specific Comment 2. However, the table presenting water level measurements and calculated groundwater elevations within the Draft CMS Report (i.e., Table 4-4) is now Table 4-3 of the Draft Final CMS Report.

EPA Specific Comment 3: Section 7.9.1.3, Step 3a Evaluation for Groundwater, Page 7-65 (November 3, 2011): *Endrin aldehyde is missing from the list of non-detected pesticides identified as ecological*

COPCs, even though the maximum reporting limit exceeds the screening value. Table 7-19 lists endrin aldehyde as a non-detect selected as a COPC. Edit the text in this section to include endrin aldehyde and change the total number of non-detect pesticides identified as COPCs from 15 to 16.

Navy Response to EPA Specific Comment 3 (March 20, 2012): The text in Section 7.9.1.3 (Page 7-67) was revised to include endrin aldehyde. Text identifying the number of non-detected pesticides selected as ecological COPCs was also revised from fifteen to sixteen.

Supplemental Navy Response to EPA Specific Comment 3 (October 4, 2013): The Draft Final CMS report reflects the revisions indicated by the Navy's working draft response to EPA Specific Comment 3. However, the page number within the Draft CMS Report affected by this revision (i.e., Page 7-65) is now Page 7-87 of the Draft Final CMS Report.

EPA Specific Comment 4: Section 7.9.1.4, Drainage Ditch Surface Water, Page 7-73 (November 3, 2011): *The maximum HQ for non-detected metals (8.73) is not the HQ for silver as stated in this section. Table 7-20 lists the HQ for silver as 1.94. The maximum HQ for non-detected metals is 8.73, but represents cadmium. Edit the text in this section to list the maximum HQ (8.73) as the HQ for cadmium.*

Navy Response to EPA Specific Comment 4 (March 20, 2012): The text in Section 7.9.1.4 was revised to indicate that the maximum HQ for non-detected metals in drainage ditch surface water is the HQ for cadmium.

Supplemental Navy Response to EPA Specific Comment 4 (October 4, 2013): The Draft Final CMS Report reflects the revision indicated by the Navy's working draft response to EPA Specific Comment 4. However, the page number within the Draft CMS Report affected by this revision (i.e., Page 7-73) is now Page 7-93 of the Draft Final CMS Report.

EPA Specific Comment 5: Table 7-19, Frequency and Range of Groundwater Data (Maximum Concentrations) Compared to Groundwater Screening Values (November 3, 2011): *Hexachlorobenzene has a maximum HQ of 68.83, even though it is not listed as an Ecological COPC in the table. Hexachlorobenzene is correctly included as a COPC in Section 7.6.2.3 Groundwater. Amend Table 7-19 by listing hexachlorobenzene as an ecological COPC.*

Navy Response to EPA Specific Comment 5 (March 20, 2012): Table 7-19 was revised to indicate that hexachlorobenzene is an ecological COPC for SWMU 59 groundwater.

Supplemental Navy Response to EPA Specific Comment 5 (October 4, 2013): The Draft Final CMS report reflects the revision indicated by the Navy's working draft response to EPA Specific Comment 5. Please note that Table 7-19 of the Draft CMS Report is now Table 7-22 of the Draft Final CMS Report

EPA MINOR COMMENTS

EPA Minor Comment 1: Section 7.9, Step 3a of the BERA, Page 7-50 (November 3, 2011): *A screening value for dissolved copper was derived using the screening value for total recoverable copper listed in Table 7-6 (i.e., 3.46 µg/L) multiplied by a saltwater conversion factor of 0.830. The dissolved copper screening value listed in the text is 3.10 µg/L, even though 3.46 µg/L x 0.830 = 2.87µg/L. Either the equation is incorrect or an incorrect dissolved metal value was used. Correct this discrepancy.*

Navy Response to EPA Minor Comment 1 (March 20, 2012): The dissolved screening value and its method of calculation are correct. However, reference to Table 7-6 within the first full paragraph on Page 7-50 of the Draft Report is incorrect. The text should have referenced Table 7-5. The total recoverable

copper screening value in Table 7-5 (i.e., 3.73 µg/L), when multiplied by the saltwater conversion factor (i.e., 0.830), gives a dissolved screening value of 3.10 µg/L. The text in the first full paragraph on Page 7-50 was revised to provide the correct table reference. Also note that the third sentence within this paragraph was revised by deleting the text within parentheses. This text is inaccurate as the copper PRWQS for Class SB coastal and estuarine water is not expressed as a regression equation. Also, please see the Navy response to EPA Minor Comment No. 2 below.

Supplemental Navy Response to EPA Minor Comment 1 (October 4, 2013): EPA Minor Comment 1 and the Navy's working draft response dated March 20, 2012 are no longer applicable. The discussion within Section 7.9 of the Draft CMS Report pertaining to the derivation of a dissolved groundwater screening value for copper is not included within the text presented in Section 7.9 of the Draft Final CMS Report. The discussion was omitted because the lines of evidence employed in the refined risk evaluation for groundwater (see Section 7.9.1.3 of the Draft Final CMS Report) do not include a comparison of dissolved copper concentrations in SWMU 59 groundwater to a dissolved screening value. Also note that the tables referenced in the Navy's working draft response (i.e., Tables 7-5 and 7-6) are now Tables 7-6 and 7-7 of the draft Final CMS report, respectively.

EPA Minor Comment 2: Section 7.9.1, Refined Risk Evaluation, Pages 7-1 to 7-93 (November 3, 2011): *Several tables referenced in the subsections of Section 7.9.1 are incorrect. For example, Section 7.9.1.1 references Table 7-13 as providing screening level risk estimates (i.e., HQs). Table 7-13 actually provides literature-based biota-sediment accumulation factors. Table 7-17 provides the screening level risk estimate (HQ values). Table 7-13 is incorrectly referenced throughout this section. Review all table references in the subsections under 7.9.1 and correct to reference the intended tables.*

Navy Response to EPA Minor Comment 2 (March 20, 2012): All table references throughout Section 7.0 were reviewed and corrected as necessary. Revisions addressing this comment were made to the following Sections: 7.9 (see Navy response to EPA Minor Comment No. 1 above), 7.9.1.1, 7.9.1.2, 7.9.1.3, 7.9.1.4, 7.9.1.6.2, 7.9.3.5, and 7.9.3.6.

Supplemental Navy Response to EPA Minor Comment 2 (October 4, 2013): Please note that the organization of the ecological risk assessment presented within the Draft CMS Report has changed significantly due to the incorporation of analytical data from the follow-on CMS investigation conducted in September and November 2012, including section and table numbering. Section 7.0 of the Draft Final CMS Report now contains a total of 58 tables. This compares to a total of 44 tables presented within the Draft CMS Report.

EPA Minor Comment 3: Section 7.9.1.2, Step 3a Risk Evaluation for Subsurface Soil, Page 7-63 (November 3, 2011): *This paragraph references Table 7-35 as providing the arithmetic mean and the 95% UCL of the mean for selenium in surface soil at SWMU 59 and for NAPR background. The values listed in the text for the SWMU 59 arithmetic mean and 95% UCL (i.e., 3.79 mg/kg, and 1.35 mg/kg, respectively) and the value for the NAPR background arithmetic mean (i.e., 0.64 mg/kg) correspond to the values presented in Table 7-35. However, the value in the text for the 95% UCL for the NAPR background (0.87 mg/kg) does not appear in the table. Table 7-35 lists NA for this value. Resolve this discrepancy by correcting Table 7-35 or editing the text in Section 7.9.1.2.*

Navy Response to EPA Minor Comment 3 (March 20, 2012): Based on the criteria discussed in the first bullet item within Section 7.9 and the low number of detected selenium results within the background data set (total of six detections), a 95 Percent UCL of the mean selenium concentration for the background data set should not be calculated since the number of detected results within the background data set (six) is less than the minimum number of detected results recommended by the EPA. Therefore, Section 7.9.1.2 was revised to remove text that compares 95 percent UCL of the mean

selenium concentrations in SWMU 59 and background subsurface soil. It is noted that this revision has no impact on the conclusions associated with this metal.

Supplemental Navy Response to EPA Minor Comment 3 (October 4, 2013): The Draft Final CMS report reflects the revisions indicated by the Navy's working draft response to EPA Minor Comment 3. However, Section 7.9.1.2 and Table 7-35 of the Draft CMS Report is now Section 7.9.1.2.1 and Table 7-38 of the Draft Final CMS Report.

EPA Minor Comment 3: Section 7.9.1.2, Step 3a Risk Evaluation for Subsurface Soil, Page 7-63 (January 28, 2014): The Draft Final CMS removed the reference to selenium background concentrations based on the argument that the number of detected values (6) was insufficient to calculate background statistics. This interpretation of USEPA recommendations is not clarified. ProUCL identifies a minimum of 5 detected samples as the recommended minimum for calculating UCLs, but recommends that background data sets consist of at least 8 samples for use in hypothesis testing approaches to compare site and background data sets. As such, the use of six samples to develop a selenium UCL would be described by ProUCL guidance as being below the minimum needed to compute reasonably reliable and accurate estimates of BTVs. However, given this understanding, ProUCL will calculate a UCL based on six detected samples. It can and be used for semi-quantitative comparison purposes for selenium at this site.

Navy Response to EPA Minor Comment 3 (May 27, 2014): The Navy agrees with this comment. A 95 percent UCL of the mean concentration for selenium in background subsurface soil will be calculated using USEPA ProUCL Version 4.1.01 software (version that was available during preparation of the Draft Final CMS Report). The background value will be added to Tables 7-42 and 7-44. The text in Sections 7.9.1.2.1 pertaining to selenium will also be revised to include a comparison of 95 percent UCL of the mean selenium concentrations for background and SWMU 59 subsurface soil (2010 data set). Finally, the ProUCL Version 4.1.01 output showing 95 percent UCL of the mean calculations will be incorporated into Appendix J and Appendix K.

EPA Minor Comment 4: Section 7.9.1.2, Step 3a Risk Evaluation for Subsurface Soil, Page 7-64 (November 3, 2011): *The value for the refined risk estimate for zinc in subsurface soil (HQ = 0.55) is incorrect. Table 7-34 Frequency and Range of Subsurface Soil Data (95% UCL of the mean concentrations) lists a zinc HQ of 0.87. The text in this section needs to be corrected to provide the correct HQ for zinc in subsurface soil.*

Navy Response to EPA Minor Comment 4 (March 20, 2012): Section 7.9.1.2 was revised to show the correct refined risk estimate for zinc in subsurface soil.

Supplemental Navy Response to EPA Minor Comment 3 (October 4, 2013): The Draft Final CMS report reflects the revision indicated by the Navy's working draft response to EPA Minor Comment 4. However, Section 7.9.1.2 and Table 7-34 of the Draft CMS Report are now Section 7.9.1.2.1 and Table 7-42 of the Draft Final CMS Report. It is also noted that the HQ value for zinc, calculated using the 95 percent UCL of the mean concentration, is now 0.88. The minor increase in the HQ value is likely attributable to the Version of ProUCL used in the Draft Final Report to calculate 95 percent UCL of the mean concentrations (ProUCL Version 4.00.05 was used by the ecological risk assessment presented in the Draft CMS Report, while ProUCL Version 4.1.01 was used by the ecological risk assessment presented in the Draft Final CMS Report

EPA Minor Comment 5: Table 7-40 Hazard Quotient Values for Avian and Mammalian Dietary Exposures to Chemicals in Subsurface Soil: Step 31 Calculation (November 3, 2011): *Table 7-40 should be titled surface soil instead of subsurface soil. Table 7-41 is correctly labeled subsurface soil. Section 7.9.1.6 references Table 7-40 as surface soil and Table 7-41 as subsurface soil. Section 7.9.1.6.1 Avian and Mammalian Dietary Exposures: Surface Soil summarizes the data presented in Table 7-40.*

The title of Table 7-40 should be changed to surface soil. Also, change Step 3 Calculation to Step 3a Calculation.

Navy Response to EPA Minor Comment 5 (March 20, 2012): The electronic version of the Draft CMS Report contained a draft version of Table 7-40 with the errors identified by EPA Minor Comment No. 4 above. However, the hard copy of the Draft CMS Report included the final version of Table 7-40 without these errors. To address this discrepancy, the electronic version of the Final CMS Report will include the correct version of Table 7-40.

Supplemental Navy Response to EPA Minor Comment 5 (October 4, 2013): The Draft Final CMS report reflects the revisions indicated by the Navy's working draft response to EPA Minor Comment 5. Please note that Table 7-40 of the Draft CMS Report is now Table 7-51 of the Draft Final CMS Report, while Table 7-41 of the Draft CMS Report is now Table 7-53 of the Draft Final CMS.

EPA Minor Comment 6 (November 3, 2011): *Table 7-39 is listed in the table of contents and is referenced several times in section 7.9.1.5 Drainage Ditch Sediment. The CMS Report, however, does not provide Table 7-39. Correct this inconsistency.*

Navy Response to EPA Minor Comment 6 (March 20, 2012): The electronic version of the Draft CMS Report did not include Table 7-39; however, the hard copy of the Draft CMS Report included Table 7-39. To address this discrepancy, the electronic version of the Final CMS Report will be revised to include Table 7-39.

Supplemental Navy Response to EPA Minor Comment 6 (October 4, 2013): The Draft Final CMS report reflects the revisions indicated by the Navy's working draft response to EPA Minor Comment 6. However, Table 7-39 of the Draft CMS Report is now Table 7-50 of the Draft Final CMS Report.

EPA ADDITIONAL SPECIFIC COMMENTS ON THE DRAFT FINAL CMS REPORT

EPA Additional Specific Comment 1: Section 7.1.2, Page 7-3 (January 28, 2014): *Revise the second and third paragraphs on Page 7-3 to clarify whether seagrass beds are present in the vicinity of SWMU 59 and, if so, how close they are to SWMU 59 boundaries.*

Navy Response to EPA Additional Specific Comment 1: Section 7.1.2, Page 7-3 (May 27, 2014): The information requested by this comment is provided within the fourth paragraph of Section 7.1.2 and shown on Figure 7-2. However, for transparency, the second sentence in this paragraph will be revised to indicate that the area of the Ensenada Honda immediately downgradient from SWMU 59 contains sea grass.

EPA Additional Specific Comment 2: Section 7.1.2, Page 7-4 (January 28, 2014): *The statements in the first full paragraph on page 7-4 that water was both present and absent from the drainage ditch during the 2010 investigation are contradictory. Clarify whether the reference to the absence of water intended to refer to the 2012 investigation*

Navy Response to EPA Additional Specific Comment 2: Section 7.1.2, Page 7-4 (May 27, 2014): The reference to the absence of water within the drainage ditch was intended to describe conditions encountered during the 2012 investigation. The text in Section 7.1.2 will be revised accordingly.

EPA Additional Specific Comment 3: Section 7.1.2, Page 7-4 (January 28, 2014): *Clarify in the second full paragraph on page 7-4 as to whether discharges to the drainage ditch from other SWMUs and potential sources occur before or after discharges from SWMU 59.*

Navy Response to EPA Additional Specific Comment 3: Section 7.1.2, Page 7-4 (May 27, 2014): The last paragraph in Section 7.1.2 will be revised to indicate if storm water inputs from other potential sources occurs upstream or downstream of the SWMU 59 storm water discharge point.

EPA Additional Specific Comment 4: Section 7.9.1.5, Step 3a Evaluation of Drainage Ditch Sediment, Page 7-105 (January 28, 2014): *The finding that data distributions for copper and zinc in site ditch sediments fall along straight lines is not a definitive indication that the data are at background, only that the samples contained both background levels and an increasing trend of contaminated levels. For both copper and zinc in ditch sediments, independent comparisons of site data with background data using the statistical tests in ProUCL conclude that site data are elevated above background. In addition, Q-Q plots show that the site data are elevated, and that the combined data display two populations of sources that are distinguished by breaks in the lines (>120 milligrams per kilogram [mg/kg] for copper, and >100 mg/kg for zinc). Based on these considerations, zinc and copper in ditch sediments should not be screened out as being no different from background, and should be identified as constituents of concern (COCs) for SWMU 59. Tables should be modified to show these results, and appropriate CAOs should be identified. In addition, specific areas of ditch sediments with elevated concentrations above background and screening levels should be identified for cleanup action during the CMI.*

Navy Response to EPA Additional Specific Comment 4: Section 7.9.1.5, Step 3a Evaluation of Drainage Ditch Sediment, Page 7-105 (May 27, 2014): The Navy agrees that copper and zinc warrant identification as ecological COCs for drainage ditch sediment. Sections 7.9.1.5 and 7.9.4.5, as well as Table 7-57, will be revised to reflect their identification as ecological COCs. Section 7.10 will also be revised to include text describing the derivation of CAOs for copper and zinc in drainage ditch sediment. As part of the revisions to Section 7.10, a new table showing CAOs for drainage ditch sediment will be cited (i.e., Table 7-59 - Ecological-Based Corrective Action Objectives for Drainage Ditch Sediment).

EPA Additional Specific Comment 5: Table 7-13, Bioaccumulation Factors for the Estimation of Chemical Concentrations in Fish: Step 2 Screening Level Risk Calculation (January 28, 2014): *The reference for PTI 1995 is missing. The data from Pascoe et al 1996 should not be used to develop fish BSAFs, as per the Navy response to PREQB Page-Specific Comment 22 on Section 7.5.2.2.1 (November 3, 2011).*

Navy Response to EPA Additional Specific Comment 5: Table 7-13, Bioaccumulation Factors for the Estimation of Chemical Concentrations in Fish: Step 2 Screening Level Risk Calculation (May 27, 2014): The list references in Table 7-13 will be revised to include PTI (1995). In addition, references for Pascoe et al. (1996) and Krantzberg and Boyd (1992) will be removed from the table.

EPA Additional Specific Comment 6: Section 7, References to Various Tables and Text (January 28, 2014): *Clarify in text and footnotes that the citation "Ministry of Housing, Spatial Planning and Environment" refers to the governmental agency from Ontario, Canada.*

Navy Response to EPA Additional Specific Comment 6: Section 7, References to Various Tables and Text (May 27, 2014): The Navy offers the following points of clarification relative to this comment. The Ministry of Housing, Spatial Planning and Environment refers to a government ministry from the Netherlands, not Canada. For clarity, the Ministry of Housing, Spatial Planning and Environment will be referred to as the Dutch Ministry of Housing, Spatial Planning and Environment throughout Section 7.0. Tables 7-4, 7-5, 7-18 through 7-21 will also be revised as necessary. It is noted that text and table citations for the Ministry of Housing, Spatial Planning and Environment will not be changed from the format currently used (i.e., MHSPE, 2000).

PREQB COMMENTS

PREQB GENERAL COMMENTS

PREQB General Comment 1 (November 3, 2011): *Development plans for NAPR are presented in the 2004 Reuse Plan and the 2010 Addendum to the 2004 Reuse Plan (which updates the reuse plan for Parcel III). PREQB requests that the future development plans presented in these Reuse Plans be included in this document as well as all other NAPR documents where future land uses are discussed. As future land use for this site is different than current land use, where future land uses include residential and recreational use of the area within which SWMU 59 is located, please revise this document, including the human health risk assessment and corrective action objectives, to reflect the anticipated future uses.*

Navy Response to PREQB General Comment 1 (March 20, 2012): Future land use at NAPR has not been confirmed based on what is contained in the 2004 Reuse Plan or the 2010 Addendum to the 2004 Reuse Plan. However, it is noted that the Navy evaluated residential exposure scenarios to provide information on unrestricted land use along with industrial exposure scenarios during the evaluation of the Corrective Measures Study at SWMU 59. It is the Navy's position that Corrective Action Objectives (CAOs) for SWMU 59 be developed based on an industrial land use scenario and the SWMU remediated as such. The Navy does not intend to remove the existing buildings or concrete slabs prior to release of the property associated with SWMU 59. As such, no revisions to the document are proposed.

PREQB Evaluation of Navy Response (April 19, 2012): *It is unclear to PREQB that the consent order only requires the Navy to clean up to industrial land use for sites where land use plans call for residential and recreational development unless the property has been transferred to a third party who is willing to conduct the necessary cleanup. As discussed in EPA's Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A), master plans (city or county projections of future land use) are considered pertinent information in determining potential future uses. The statements made in the report that "future property use of this site is expected to remain industrial" are not consistent with publically available future land use plans. Please remove these statements from the report and please clarify if this property has been transferred to a third party willing to conduct the cleanup for future uses. If not, PREQB requests that the Navy obtain EPA concurrence with their response to this comment.*

Navy Response to PREQB Evaluation (October 4, 2013): Please note the following language included within Section 10.0 of the Draft Final CMS Report:

> "SWMU 59 is located within Sale Parcel III, which was transferred from the Navy to the Commonwealth of Puerto Rico on January 25, 2012. However, SWMU 59 was not included in the transfer at the time. Rather, it was "carved out" of the transfer while the Navy continues with implementation of the remaining corrective action obligations in accordance with the RCRA §7003 Administrative Order on Consent (USEPA, 2007). Nonetheless, in accordance with Section VIII, Paragraph 27(G)(a) of the Administrative Order, the Navy continues to provide annual certification that acceptable LUCs have been implemented at SWMU 59 (and other SWMUs) and are being maintained to preclude unacceptable usage of the land and groundwater. Once ownership of the SWMU 59 parcel has been transferred, the following LUCs pertinent to soil and groundwater will be included in the Quitclaim Deed of Transfer.
>
> - Covenant and Restriction regarding Non-residential Use: …no permanent residences shall be constructed or otherwise developed on the property, and that no portion of the property shall be used as a permanent residence.

- Covenant and Restriction regarding Excavation Prohibited: …excavation, drilling, or other disturbance or removal of soils or other invasive activities on the property shall be prohibited.

- Covenant and Restriction regarding Groundwater: …installation of any groundwater extraction wells or the use of any groundwater drawn from the property shall be prohibited.

If the new property owner wishes to remove the LUCs from the deed in the future, they are required to work with the USEPA and PREQB to establish any additional investigation, risk assessment, and/or remediation activities and to demonstrate the impacted media meet all federal and state requirements for increased protectiveness to human health and the environment. The property owner must obtain approval from the Navy, USEPA, and PREQB prior to removal of the LUCs."

PREQB Evaluation of Response (October 31, 2013): *The response indicates that this site has not been transferred to a third party as of yet. Section 8.2 of the draft final CMS Report states, "It is assumed that long-term plans for the facility would be similar to those that had been in place prior to closure with land use also generally the same. As such, future property use of this site is expected to remain industrial... However, an updated Reuse Plan has been published where future land uses planned for this area are recreational and residential. Therefore, PREQB considers that the assumption that land use is expected to remain industrial is not appropriate. In addition, this section references potential human receptors/exposure pathways identified in Attachment II of the consent order as forming the basis for the HHRA. Attachment II describes potentially complete exposure pathways assuming that future land use is the same as Navy's use of the site. However, Section V, paragraph 13.9 of the Consent Order specifically acknowledges that other land uses may occur, resulting in additional receptors, such as residential receptors. This section states:*

> *"The complete exposure pathways described in Attachment II are based on expected future land usage being similar to the land usage patterns currently in place. However, changes in future land usage from the present pattern of development/land usage at the Facility could result in additional receptors (such as on - site residents, if new housing areas are established; or on - site child-care or school populations, if new child-care or school facilities are established on-site) being impacted via complete exposure pathways that currently are not considered complete...*

Section 9.0 of the CMS goes on to state, "It should be noted that the Navy identifies future land use as aligned with current use (industrial) for the purpose of developing remedial alternatives and <u>intends to clean the site only to an industrial level…</u>" PREQB requests that this site be cleaned up to levels protective of anticipated future land uses documented in the current Reuse Plan, which are recreational and residential. However, PREQB will defer to USEPA on whether the Navy is required to clean up sites that have not been transferred to a third party to levels protective of planned future uses documented in the current Reuse Plan.

Navy Response to PREQB Evaluation (May 27, 2014): The fourth paragraph of Section 9.0 will be revised as follows:

> "As noted in the 2010Supplemental Environmental Assessment for the Disposal of Naval Activity Puerto Rico (SEA), the Navy identifies future land use as aligned with current use (industrial) for the purpose of developing remedial alternatives and intends to clean the site to historic land use (industrial). Since the risk estimates exceeded target limits for future adult and child residential receptors, and the property will not allow for Unrestricted Use/Unrestricted Exposure (UU/UE), Land Use Controls (LUCs) were developed as a human health qualitative CAO. These LUCs will be included in any lease or transfer deed to ensure protection of human health and the environment. The restrictions placed on the SWMU ultimately changes the proposed re-use of the property. The re-use needs to account for the LUCs rather than the Navy having to clean up the site to proposed land use.

PREQB Evaluation of Response (June 11, 2014): *As stated in our latest evaluation of the Navy's response to PREQB's comment, "PREQB requests that this site be cleaned up to levels protective of anticipated future land uses documented in the current Reuse Plan, which are recreational and residential. However, PREQB will defer to USEPA on whether the Navy is required to clean up sites that have not been transferred to a third party to levels protective of planned future uses documented in the current Reuse Plan." Please note that Page-Specific Comments 23 and 38* [included below for reference] *present similar issues and refer back to this response.*

Navy Response (February 26, 2015): The Roosevelt Roads Local Redevelopment Authority (RRLRA) has issued a letter to the Navy (February 20, 2015) indicating their acceptance of the industrial land use scenario and the resultant land use restrictions for SWMU 59. The fourth paragraph of Section 9.0 will be further revised as follows:

> As noted in the 2010 Supplemental Environmental Assessment for the Disposal of Naval Activity Puerto Rico (SEA), the Navy identifies future land use as aligned with current use (industrial) for the purpose of developing remedial alternatives and intends to clean the site to historic land use (industrial). Since the risk estimates exceeded target limits for future adult and child residential receptors, and the property will not allow for Unrestricted Use/Unrestricted Exposure (UU/UE), Land Use Controls (LUCs) were developed as a human health qualitative CAO. These LUCs will be included in any lease or transfer deed to ensure protection of human health and the environment. In a letter to the Navy (February 20, 2015) the Roosevelt Roads Local Redevelopment Authority (RRLRA) agrees that the remedial alternative will be developed based on an industrial land use scenario and acknowledges and accepts the recommendation of Land Use Controls for SWMU 59. The RRLRA letter is provided in Appendix U.

PREQB General Comment 2 (November 3, 2011): *Please clarify why soil and groundwater samples were not analyzed for TPH-GRO and TPH-DRO, considering that USTs may have been present in support of fueling activities. Puerto Rico's Underground Storage Tank Regulation is an applicable, relevant and appropriate requirement for former UST sites.*

Navy Response to PREQB General Comment 2 (March 20, 2012): An underground storage tank was not found during the Phase II ECP Investigation and therefore was not a focal point of the CMS Investigation. Both soil and groundwater were analyzed for VOCs and SVOCs in accordance with the approved work plan. The results from these analyses would reveal the presence of petroleum hydrocarbon contamination. No revisions to the report are warranted.

PREQB Evaluation of Navy Response (April 19, 2012): *As this site is reported to be a former vehicle refueling area, TPH contamination is of concern and additional information is needed to address this datagap, considering that PREQB UST regulations are an ARAR. Please clarify were the fuel for the fueling stations was stored if not in on-site underground storage tanks. Note that there is no mention of aboveground storage tanks being identified in the historical photos, so it appears that the fuel was stored in underground storage tanks or was piped from off-site. Note also that VOCs and SVOCs include constituents of petroleum fuels, but TPH includes constituents not reported in these analyses.*

Navy Response to PREQB Evaluation (October 4, 2013): No additional information regarding the presence of underground or above ground storage tanks at the site is available and as indicated in Section 2.3.1, the final disposition of the suspected USTs has not been determined. However, it is important to note that no visual or olfactory evidence of petroleum contamination in the soil or groundwater was noted during boring installation or groundwater sampling. To address the data gap regarding the disposition of the suspected tanks, the Navy proposes including an UST evaluation as part of the corrective action for this SWMU. Section 10.0 will be revised to include the following:

"As noted in Section 2.3.1, the final disposition of the suspected USTs at the fuel islands was not determined. Therefore, the corrective measure also will include efforts by the remedial contractor to locate the suspected tanks. These efforts may include, but not be limited to, geophysical methods (e.g., ground penetrating radar, radiodetection, electromagnetics, magnetics) and excavation of test trenches. If the location of the suspected tanks is identified and confirmed, their condition will be assessed and a corrective action plan developed, as appropriate. Specific activities and protocols associated with the UST investigation will be defined in the Corrective Measures Implementation (CMI) Project Plan."

PREQB General Comment 3 (November 3, 2011): *Please provide further details on the efforts made to locate the USTs that supplied fuel to the fuel islands. Please include a figure showing the path of the magnetometer and visual surveys and discuss what historical records were reviewed as part of the effort of finding the tanks. Please provide details on how the magnetometer survey was conducted (i.e., depths visualized, calibration procedures and how results were reported, etc.) Please clarify how it was determined that the pipes observed at the fueling island were vent pipes and there is no possibility that they are the remains of fill pipes.*

Navy Response to PREQB General Comment 3 (March 20, 2012): A "magnetometer" was not used during the Phase II ECP as was inadvertently reported in the summary of the Phase II ECP field efforts, although a metal detector was used as a field screening tool to trace underground pipelines from vent pipes back to a UST. The word "magnetometer" was replaced with "metal detector" in the second paragraph of Section 2.2. The Phase I/II Environmental Condition of Property Report (NAVFAC, 2005) provides a detailed discussion of the ECP field activities. Additionally, the pipes observed were assumed to be vent pipes due to their height; fill pipes are not generally 8 feet high. The second paragraph of Section 8.2 was revised as follows:

"The field team located four 8-foot vent pipes protruding from the concrete pad. It was assumed that these were vent pipes since fill pipes are not generally 8 feet high. However, after thoroughly searching the area visually and with a metal detector, the UST was not identified."

PREQB Evaluation of Navy Response (April 19, 2012): *Please clarify the depth to which a metal detector could detect metal objects and discuss the depths at which a UST may have been buried based on the site geology (i.e., depth to bedrock). Also, please designate on a map the area in which a metal detector was used to search for the UST. Please comment on why a metal detector was used as opposed to other geophysical methods more commonly used to identify subsurface anomalies.*

Navy Response to PREQB Evaluation (October 4, 2013): As indicated in Section 5.2.1- Geology, the depth to bedrock at the site is generally greater than 10 feet bgs. Further, additional specifics regarding the metal detector field screening conducted during the Phase II ECP are not available. The Navy acknowledges that the final disposition of the suspected tanks at SWMU 59 has not been determined and proposes conducting an UST evaluation as part of the corrective measures for this SWMU. Refer to the Navy's October 4, 2013 response to PREQB General Comment 2.

PREQB General Comment 4 (November 3, 2011): *There appears to be a data gap for groundwater characterization downgradient from the fuel islands. SB06 and SB02 were collected immediately downgradient from the islands; however, based on groundwater velocity, groundwater moves at approximately 10 feet per year, indicating that contamination may have moved significantly to the west over time. SB01 only captures some groundwater flow from the fuel islands, and it does not appear that 74VP07b was sampled during the CMS. Please address.*

Navy Response to PREQB General Comment 4 (March 20, 2012): Although the estimated groundwater linear velocity is approximately 10 feet per year, it should be noted that the velocity estimate does not take contaminant attenuation factors (e.g., retardation, adsorption, degradation) into account. As

a result, it is unlikely that actual contaminants would migrate 10 feet per year. The Navy does not believe there is a data gap in the groundwater characterization. Based on the revised groundwater contour maps (see Figures 5-3 and 5-4), groundwater flow in the vicinity of the former fueling islands is to the west, and wells 59SB02 and 59SB06 are located directly downgradient. If there was a release of fuel from the fueling islands via groundwater migration, there would be residual signs still at wells 59SB02 and 59SB06. Although well 74VP07b (associated with a valve pit along the SWMU 74 fuel pipeline) was not sampled during the SWMU 59 CMS Investigation, this well was sampled during Phase I of the SWMU 74 CMS Investigation in May 2008. Results showed low levels of TPH DRO (5.4 mg/L) and GRO (0.076 mg/L). In addition, acetone, carbon disulfide, and ethylbenzene were detected just above reporting limits or at estimated "J" values. These TPH and VOC detections were well below any type of action level and are not indicative of wide-spread petroleum contamination associated with a release from the former fueling islands or the SWMU 74 valve pit.

Supplemental Navy Response to PREQB General Comment 4 (October 4, 2013): It should be noted that the slug test data were revised to reflect the correct well penetration depths. As a result, the groundwater linear velocity was estimated at approximately 0.002 feet per day (0.7 feet per year) (see Section 5.2.3).

PREQB General Comment 5 (November 3, 2011): *Based on the information presented in this report, characterization of soils beneath the buildings present at the site was not conducted. Please clarify when these buildings were constructed or how long they have been in place. As future land use is likely to result in the demolition of these buildings and associated infrastructure, additional information is needed concerning what may be below the buildings, concrete pads or pavement.*

Navy Response to PREQB General Comment 5 (March 20, 2012): As stated in Section 2.2, the Vehicle Maintenance and Refueling Area was in operation from the 1940s to the 1980s. Historical aerial photography shows most of the infrastructure at SWMU 59 in place in the 1958 photo. Although the Navy does not intend to remove any structures, concrete pads, or asphalt pavement prior to release of the property associated with SWMU 59, the Navy recognizes that additional information is needed concerning the presence/absence of contaminants below these surfaces to support defensible site and risk management decisions. Therefore, the Navy proposes including the requirements for the additional sampling in the Work Plan Letter to be submitted under separate cover (please refer to the Navy's response to EPA General Comment 1).

Supplemental Navy Response to PREQB General Comment 5 (October 4, 2013): Surface soil (0.0 to 1.0-foot depth interval) and subsurface soil (1.0 to 3.0-foot depth interval) were collected at locations beneath concrete pads and paved surfaces during the follow-on CMS field investigation conducted in September and November 2012 in accordance with the final version of the Work Plan Letter dated June 15, 2012. Any deviations from the final version of the Request for Additional Sampling are identified within the Draft Final CMS Report.

PREQB PAGE-SPECIFIC COMMENTS

PREQB Page-Specific Comment 1: Page 1-1, Section 1.0 (November 3, 2011)*: Revise the last sentence of the section to include that the field work was conducted with some deviations from the approved work plan that are detailed later in the report.*

Navy Response to PREQB Page-Specific Comment 1 (March 20, 2012): The last sentence in Section 1.0 was revised to say work was conducted "with some deviations that are detailed later in the report."

Supplemental Navy Response to PREQB Page-Specific Comment 1 (October 4, 2013): The Draft Final CMS report reflects the revisions indicated by the Navy's working draft response to PREQB Page-

Specific Comment 1 with minor adjustments. The revised sentence within the Draft Final CMS Report is shown below:

> "The work for both phases of investigation was conducted in accordance with the approved Work Plans; minor deviations from the Work Plans are detailed in subsequent sections of this report."

PREQB Page-Specific Comment 2 - Page 1-2, Section 1.2 (November 3, 2011): *Please include information at the last paragraph regarding that the CMS will provide not only the quickest remediation of SWMU 59, the corrective action is also seeking the most effective remediation.*

Navy Response to PREQB Page-Specific Comment 2 (March 20, 2012): The last sentence in Section 1.2 was changed to include "most effective" to the description of the remediation at SWMU 59:

Supplemental Navy Response to PREQB Page-Specific Comment 2 (October 4, 2013): The sentence referenced within the Navy's working draft response to PREQB Page-Specific Comment 2 is now the last sentence within Section 1.1 of the Draft Final CMS Report:

> "The corrective measure selected and documented in this CMS Report will provide the quickest and most effective remedy for SWMU 59."

PREQB Page-Specific Comment 3 - Page 2-2, Section 2.2: Paragraph 2 (November 3, 2011): *Please include a figure that shows the path taken during the magnetometer survey. This information is needed, as no UST was found based on this survey as well as a visual survey.*

Navy Response to PREQB Page-Specific Comment 3 (March 20, 2012): Please refer to the Navy's response to PREQB General Comment 3.

PREQB Evaluation of Navy Response (April 19, 2012)*: Please refer to PREQB's evaluation of response to General Comment 3.*

Navy Response to PREQB Evaluation (October 4, 2013): Please refer to the Navy's October 4, 2013 response to PREQB General Comment 2 and 3.

PREQB Page-Specific Comment 4 - Page 2-3, Section 2.3.1 (November 3, 2011)*: Please clarify in the text whether the subsurface soil sample interval with the highest PID reading was selected for off-site analysis.*

Navy Response to PREQB Page-Specific Comment 4 (March 20, 2012): The text of Section 2.3.1 – Phase I/II ECP Sampling Summary was modified to clarify the sample selections as follows:

> "No screening results were detected that would indicate anything above background conditions. The only exceptions were minimal detections at borings 5E-05 and 5E-08 from 1 to 12 ppm. Soil samples were collected from the zones of these slightly elevated screening results. These borings were constructed into temporary monitoring wells."

Supplemental Navy Response to PREQB Page-Specific Comment 4 (October 4, 2013): Please note that PREQB concerns are addressed within Section 2.3.1 (third paragraph, last sentence) of the Draft Final CMS Report:

> "The subsurface samples from borings 5E-05 and 5E-08 were collected from depth intervals exhibiting the highest PID/FID measurements."

PREQB Page-Specific Comment 5 - Page 4-1, Section 4.0, Phase I ECP (November 3, 2011)*: Please include the depth to groundwater and the depth of the well screens in this summary. This information is needed to more fully understand the analytical results from the two temporary wells. If groundwater was observed in unconsolidated material but the well screens were positioned in bedrock discuss if the purpose was to sample across the water table or within the bedrock.*

Navy Response to PREQB Page-Specific Comment 5 (March 20, 2012): The following text was added to the last paragraph of Section 4.0 – CMS Investigation Activities:

> "Groundwater was first observed at 5E-TW05 at 15 feet within weathered rock and at 5E-TW08 at approximately 22 feet within weathered rock. Groundwater well screens were placed from 10 to 20 feet and 15.5 to 25.5 feet, respectively."

Supplemental Navy Response to PREQB Page-Specific Comment 5 (October 4, 2013): The ECP discussion presented in Section 4.0 is not included within the Draft Final CMS Report. All information pertaining to the Phase II ECP field investigation is provided in Sections 2.3.1 and 2.3.2 of the Draft Final CMS Report, including the information requested by PREQB Page-Specific Comment 5 (see Section 2.3.1, fourth paragraph).

PREQB Page-Specific Comment 6 - Page 4-2 and 4-3, General Comment (November 3, 2011)*: The CMS Work Plan for SWMU 59 proposed many soil sampling that once in the field resulted to be located on concrete surface. This triggered a deviation from the work plan since most locations were relocated to allow for surface soil sampling collection. Please discuss why no samples of soil beneath the concrete were taken, since thisresults will provide more information in the contamination delineation and source identification or if the samples taken during the Phase II ECP are considered enough to clearly delineate and identify the source of contamination.*

Navy Response to PREQB Page-Specific Comment 6 (March 20, 2012): The most likely accumulation of potential contaminants from spills on the concrete slabs would be at the edge of the concrete in the adjacent surface soil. Most of the concrete slabs and buildings were in existence throughout the operation of this area as a vehicle maintenance area. This was the rationale behind collecting samples at the edge of the concrete pad verses drilling through the pad and sampling underneath. The concrete would in effect act as a barrier to protect the underlying soil. Overall, moving these sample locations did not result in a data gap, but rather a more common sense driven evaluation of potential contaminant areas.

However, the Navy recognizes that additional information is needed concerning the presence/absence of contaminants below these surfaces to support defensible site and risk management decisions. Therefore, the Navy proposes including the requirements for the additional sampling in the Work Plan Letter to be submitted under separate cover (please refer to the Navy's response to EPA General Comment 1 and PREQB General Comment 5).

Supplemental Navy Response to PREQB Page-Specific Comment 6 (October 4, 2013): Surface soil samples (0.0 to 1.0-foot depth interval) and subsurface soil samples (1.0 to 3.0-foot depth interval) were collected at locations beneath concrete pads and paved surfaces during the follow-on CMS field investigation conducted in September and November 2012 in accordance with the final version of the Work Plan Letter dated June 15, 2012. Any deviations from the final version of the Work Plan Letter are identified within the Draft Final CMS Report.

PREQB Page-Specific Comment 7 - Page 4-2, Section 4.1 (November 3, 2011):

a. Bullets 2 and 3: Please acknowledge in these bullets, as has been acknowledged in the subsequent bullets, that the borings were moved in the presumed down-gradient direction of the referenced features. Ground water elevation contours were not generated until after the borings were installed.

Navy Response to PREQB Page-Specific Comment 7a (March 20, 2012): Bullets 2 and 3 were modified to include the presumed downgradient description.

b. Bullet 3: Please address whether a data gap exists as a result of moving SB02 approximately 70 feet west.

Navy Response to PREQB Page-Specific Comment 7b (March 20, 2012): The Navy does not believe moving this location results in a data gap. Moving this location, which included construction of a monitoring well, to a location directly downgradient of the potential UST and fueling islands was justified and helped to eliminate a data gap in that respect. The following text was added to the bullet:

"Moving this location will help to eliminate a data gap related to the potential UST and fuel islands at SWMU 59."

c. Please add a bullet for sample 59SB12 which was moved according to the May 18, 2010 (Page 38) field notes by Robert Roselius in Appendix A.

Navy Response to PREQB Page-Specific Comment 7c (March 20, 2012): The following bullet was added to Section 4.1:

"Soil boring 59SB12 was moved approximately 20 feet southwest to accommodate moving well 59SB02 downgradient of the fuel islands. Soil boring 59SB12 was moved to space out the sample collection points downgradient of the fuel islands."

PREQB Page-Specific Comment 8 - Page 4-3, Section 4.1, Paragraph 3 (November 3, 2011): *Please provide additional details regarding the method of collection for the VOC aliquots, as well as a brief rationale for failing to homogenize the soil sample aliquots for all non-volatile analyses.*

Navy Response to PREQB Page-Specific Comment 8 (March 20, 2012): Samples were homogenized for aliquots other than VOCs. The last paragraph of Section 4.1 – Surface and Subsurface Soil Sampling will be revised to read as follows:

"VOC samples were collected immediately after the sample liner was cut and the sample was screened with the PID. VOCs samples were collected using Terra Core kits. The Terra Core kits included one disposal syringe, one dry weight container, two-40 milliliter (ml) VOA vials (with stir bar) including 5 ml of sodium bisulfate solution, and one-40 ml VOA vials (with stir bar) including 5 ml of methanol solution. Following VOC sampling, soil was homogenized and soil samples for Appendix IX SVOCs (including LLPAHs), pesticides, and metals were transferred directly into pre-labeled sample jars and placed on ice."

PREQB Page-Specific Comment 9 - Page 4-3, Section 4.2 (November 3, 2011): *Please add sample location 59SB12 to the locations mentioned at the last sentence of the first paragraph. It is unclear that monitoring well locations approved in the work plan were moved based on field conditions. It appears that the movement of the sample location was to allow for the collection of a surface soil sample based on the information presented in Section 4.1. Since subsurface and groundwater samples were also to be*

collected from these locations, please include information detailing the reasons for the movement. Also, please address the data gaps resulting from not collecting the subsurface and groundwater samples in the locations presented in the work plan.

Navy Response to PREQB Page-Specific Comment 9 (March 20, 2012): The sample location 59SB12 is a soil boring that was not constructed into a groundwater monitoring well, therefore it will not be added to the last sentence of the first paragraph in Section 4.2. The following text was added to Section 4.2 justifying the movement of monitoring well locations:

> "Movement of these groundwater monitoring wells was practical with regards to soil sample collection and still provided adequate spacing and positioning to delineate potential groundwater contamination."

PREQB Page-Specific Comment 10 - Page 4-4, Section 4.2 (November 3, 2011):

> *a. Paragraph 2: Please re-iterate in this paragraph what the well development criteria are or reference the section and paragraph which presents this information.*

Navy Response to PREQB Page-Specific Comment 10a (March 20, 2012): The following text was added to Section 4.2 – Monitoring Well Installation and Groundwater Sampling:

> "In most cases, more than three well volumes of water were removed in an effort to reduce turbidity and improve clarity to ensure successful low flow sampling parameter equilibrium. An attempt was made to reduce turbidity to less than 20 Nephelometric Turbidity Unit (NTUs), as specified in the work plan."

> *b. Last Paragraph: Please complete the first sentence of this paragraph.*

Navy Response to PREQB Page-Specific Comment 10b (March 20, 2012): The sentence was completed as follows:

> "Ten groundwater monitoring wells (newly installed wells 59SB01 through 59SB10) were sampled at SWMU 59 during the CMS Investigation."

PREQB Page-Specific Comment 11 - Page 4-5, Section 4.4.1 (November 3, 2011): *It is indicated that all three surface water samples were collected from an appropriate depth determined in the field. Please include to the extent possible the appropriate depth from where the samples were collected.*

Navy Response to PREQB Page-Specific Comment 11 (March 20, 2012): The pool is approximately three feet deep, see Section 7.1. The samples were collected using a direct dip method reaching into the pool as far as possible. Due to the size of the pool (approximately 12 feet in diameter) three samples were collected to characterize the entire pool. The following text was added to Section 4.4.1 – Surface Water Sampling:

> "Three samples were collected from the pool to fully characterize the pool due to its size (approximately 12 feet in diameter). All three surface water samples were collected using the direct-dip method from approximately the top one foot of the three foot deep pool."

PREQB Page-Specific Comment 12 - Page 4-6, Section 4.4.2, Paragraph 1 (November 3, 2011): *Please provide further information as to why the laboratory was not able to fulfill the request for analysis of the sediment samples 59SD02 and 59SD03 for low-level PAHs.*

Navy Response to PREQB Page-Specific Comment 12 (March 20, 2012): LLPAH analysis via SIM could not be performed by the laboratory for sediment samples 59SD02 and 59SD03 due to sample matrix and the large amount of organic material present in the samples. Instead, only the full scan analysis was used (8270D), which is a less sensitive method looking at a broader range of response. The text of Section 4.4.2 – Sediment Sampling was revised as follows:

> "Please note that LLPAH analysis was requested for sediment samples 59SD02 and 59SD03. However, the lab was not able to run the LLPAHs via Selected Ion Monitoring (SIM) analysis due to sample matrix and the large amount of organic material present in the samples. Instead, SVOCs were only reported for samples 59SD02 and 59SD03 using the full scan analysis (8270D)."

PREQB Page-Specific Comment 13 - Page 4-6, Section 4.5 (November 3, 2011): *When available, please submit evidence of the investigation derived waste disposal (copy of manifests).*

Navy Response to PREQB Page-Specific Comment 13 (March 20, 2012): The IDW from SWMU 59 was transported off-site and disposed at an approved solid-waste landfill on March 31, 2011. Documentation, including waste manifests, will be included in the Final CMS report submittal. The last paragraph of Section 4.5 was revised as follows:

> "…..following the field work completion. On March 31, 2011, five drums of soil IDW and one drum of liquid IDW from SWMU 59 (as well as IDW drums from a number of other SWMUs) were transported by AquaClean to Peñuelas Valley Landfill in Ponce, Puerto Rico and disposed of as a non hazardous waste. The IDW disposal documentation is included in Appendix A."

PREQB Page-Specific Comment 14 - Page 6-1, Section 6.0, Phase II ECP (November 3, 2011):

> *a. The first sentence states that contaminants detected in surface soil included VOCs, SVOCs, pesticides and inorganic compounds. However, Table 6-1 only presents detected inorganics. Please clarify.*

Navy Response to PREQB Page-Specific Comment 14a (March 20, 2012): The first sentence was edited to state contaminants detected in surface soil during the Phase II ECP investigation were only inorganics.

Supplemental Navy Response to PREQB Page-Specific Comment 14a (October 4, 2013): PREQB Page-Specific Comment 14a and the Navy's working draft response dated March 20, 2012 are no longer applicable. The ECP discussion presented in Section 6.0, as well as the tables showing detected analytes in surface, subsurface soil, and groundwater collected during the Phase II ECP field investigation (i.e., Tables 6-1 through 6-5), are not included within the Draft Final CMS Report. All information pertaining to the Phase II ECP field investigation is provided in Sections 2.3.1 and 2.3.2 of the Draft Final CMS Report. The Phase II ECP analytical data are also provided in Appendix B of the Draft Final CMS report.

> *b. The text refers to Tables 6-1 through 6-5 for subsurface soil sample results. Please revise to state Tables 6-2 and 6-3 only. Since Tables 6-4 and 6-5 presents groundwater results.*

Navy Response to PREQB Page-Specific Comment 14b (March 20, 2012): The text was revised to refer to Table 6-1 for surface soil, Tables 6-2 and 6-3 for subsurface soil, and Tables 6-4 and 6-5 for groundwater results from the Phase II ECP investigation.

Supplemental Navy Response to PREQB Page-Specific Comment 14b (October 4, 2013): PREQB Page-Specific Comment 14b and the Navy's working draft response dated March 20, 2012 are no longer

applicable. The ECP discussion presented in Section 6.0, as well as the tables showing detected analytes in surface, subsurface soil, and groundwater collected during the Phase Ii ECP field investigation (i.e., tables 6-1 through 6-5), are not included within the Draft Final CMS Report. All information pertaining to the Phase II ECP field investigation is provided in Sections 2.3.1 and 2.3.2 of the Draft Final CMS Report. The Phase II ECP analytical data are also provided in Appendix B of the Draft Final CMS report.

PREQB Page-Specific Comment 15 - Page 6-2, Section 6.1, Surface Soil, Last Paragraph (November 3, 2011): *Please include selenium in the list of metals detected above background screening levels in one sample (59SB20).*

Navy Response to PREQB Page-Specific Comment 15 (March 20, 2012): Selenium was added to the list of metals discussed above background screening levels. The following sentence was added to the last paragraph in Section 6.1:

> "Selenium was detected above the Base background screening value in one sample (59SB20)."

PREQB Page-Specific Comment 16 - Pages 6-3 and 6-4, Section 6.2, Subsurface Soil (November 3, 2011):

> *a. Paragraph 2 on Page 6-3: Please change "dichloromethane" to dibromochloromethane".*

Navy Response to PREQB Page-Specific Comment 16a (March 20, 2012): "Dichloromethane" was changed to "dibromochloromethane" in paragraph two of Section 6.2 – Subsurface Soil.

> *b. Paragraph 2 on Page 6-3: The text states that all VOC detections were relatively low (near the detection limit) with the exception of acetone. However, methyl iodide was detected approximately 5x higher than the detection limit in sample 59SB02/1-3 and bromoform was detected approximately 7x higher than the detection limit in sample 59SB02/7-9. Please revise the text to also include these exceptions to the relatively low detections of VOCs.*

Navy Response to PREQB Page-Specific Comment 16b (March 20, 2012): The additional exceptions were added to paragraph 2 in Section 6.2. The revised text reads as follows:

> "All VOC detections were relatively low (i.e., near the detection limits), with the exception of acetone (a common laboratory contaminant) which was detected in five samples at concentrations ranging from 26 µg/kg to 150 µg/kg, methyl iodide at location 59SB02 detected at a concentration of 21 µg/kg (30 J µg/kg DUP) from the 1 to 3 foot depth interval, and bromoform at location 59SB02 detected at a concentration of 35 µg/kg from the 7 to 9 foot depth interval."

> *c. Paragraph 3 on Page 6-3: Please change the reference from "Table 6-2" to "Table 6-7".*

Navy Response to PREQB Page-Specific Comment 16c (March 20, 2012): The table reference was changed from "Table 6-2" to "Table 6-7" in third paragraph of Section 6.2 – Surface Soil.

Supplemental Navy Response to PREQB Page-Specific Comment 16c (October 4, 2013): Please note that table referenced in PREQB Page-Specific Comment 16c of the Draft CMS Report is now Table 6-3 of the Draft Final CMS Report (Summary of Detected Results – Subsurface Soil, 2010 CMS Investigation).

d. Paragraph 4 on Page 6-3: The summary of samples with the primary detections of pesticides is not accurate. Please revise to include the following samples: 59SB03-04, 59SB05-01, 59SB08-01, 59SB15-01, and 59SB18-01.

Navy Response to PREQB Page-Specific Comment 16d (March 20, 2012): The summary of pesticide detections was revised to include the additional sample locations. Note that there were no exceedances in 59SB08-01; rather, the exceedances at this location were in 59SB08-05. The second sentence of the referenced paragraph was revised to read:

> "Pesticides were detected in 59SB01-03, 59SB02-01D, 59SB03-04, 59SB04-01, 59SB04-05, 59SB05-01, 59SB06-01, 59SB08-05, 59SB10-01, 59SB13-01D, 59SB15-01, and 59SB18-01."

e. Paragraph 1 on Page 6-4: Please revise the text to include the detections of mercury above the background screening values in samples 59SB06-03 and 59SB16-05.

Navy Response to PREQB Page-Specific Comment 16e (March 20, 2012): The text was edited to include the two detections of mercury above background screening values. The following text was added to the last paragraph of Section 6.2:

> "Mercury was detected above the Base background screening value (0.108 mg/kg) in samples 59SB06-03 and 59SB16-05 with concentrations of 0.15 mg/kg and 0.13 mg/kg, respectively."

PREQB Page-Specific Comment 17 - Page 6-4, Section 6.3 (November 3, 2011):

a. Paragraph 2: Please revise the text from "carbon dioxide" to "carbon disulfide."

Navy Response to PREQB Page-Specific Comment 17a (March 20, 2012): The text was revised to change "carbon dioxide" to "carbon disulfide".

b. Please include a discussion on the alpha-chlordane detection.

Navy Response to PREQB Page-Specific Comment 17b (March 20, 2012): A brief discussion of the alpha-chlordane detection was added to Section 6.3 and reads as follows:

> "The pesticide, alpha-chlordane was detected in one groundwater sample (59GW04) at a concentration of 0.016 JN µg/l. The JN qualifier means the analyte was tentatively identified and has an estimated value."

PREQB Page-Specific Comment 18 - Page 6-6, Section 6.5, Sediment, Paragraph 3 (November 3, 2011): *Please include sample 59SD01 in the list of samples where fluoranthene and pyrene were detected.*

Navy Response to PREQB Page-Specific Comment 18 (March 20, 2012): The third paragraph of Section 6.5 - Sediment was modified as follows:

> "Fluoranthene and pyrene were also detected in both 59SD01 and 59SD03."

PREQB Page-Specific Comment 19 - Page 6-7, Section 6.6.1, Summary of Detected Compounds in Field QA/QC Samples, Paragraph 2 (November 3, 2011): *Please change "methyl chloride" to "methylene chloride".*

Navy Response to PREQB Page-Specific Comment 19 (March 20, 2012): In Section 6.6.1, paragraph 2 "methyl chloride" was revised to "methylene chloride".

Supplemental Navy Response to PREQB Page-Specific Comment 19 (October 4, 2013): The Draft Final CMS Report reflects the revision indicated by the Navy's working draft response to PREQB Page-Specific Comment 19. However, the discussion of field QA/QC blank samples is now provided in Section 6.6 of the Draft Final CMS Report.

PREQB Page-Specific Comment 20 - Page 7-4, Section 7.1.2 (November 3, 2011): *Southern cat-tail (Typha domingensis) is described as being a type of hydrophobic vegetation. Please correct the text to indicate that this species is a hydrophytic plant. This comment also applies to Section 2.2, paragraph 2.*

Navy Response to PREQB Page-Specific Comment 20 (March 20, 2012): The text in Sections 7.1.2 and 2.2 was revised by replacing the word "hydrophobic" with "hydrophytic".

PREQB Page-Specific Comment 21 - Page 7-14, Section 7.3.2.1 (November 3, 2011): *For lower trophic level species please consider adding fish to appropriate ecological receptors that will be evaluated by assessing the aquatic community present within the drainage ditch.*

Navy Response to PREQB Page-Specific Comment 21 (March 20, 2012): The Navy offers the following points of clarification relative to this comment. As evidenced by Table 7-2, survival, growth, and reproduction of fish was selected as an assessment endpoint for the drainage ditch associated with SWMU 59. The preliminary conceptual model for the SWMU (see Figure 7-8) also shows that fish were selected as an aquatic receptor group evaluated by the ERA. It is noted that the text within the first paragraph on Page 7-4 was not intended to list every lower trophic level receptor group selected for evaluation. Terrestrial and aquatic plants and invertebrates are simply listed within the first sentence of this paragraph as examples (hence the use of "e.g."), not a finite list of lower trophic level receptors evaluated by the ERA. Based on the discussion above, revisions to Section 7.3.2.1 are not deemed necessary.

Supplemental Navy Response to PREQB Page-Specific Comment 20 (October 4, 2013): For clarity, the Draft Final CMS Report was revised to include fish within the list of lower trophic level ecological receptors. Please note that Section 7.3.2.1 of the Draft CMS Report is now Section 7.3.3 of the Draft Final CMS Report.

PREQB Page-Specific Comment 22 - Page 7-29, Section 7.5.2.2.1 (November 3, 2011): *Fish tissue concentrations for inorganics are calculated using Biota: Sediment Accumulation Factors (BSAFs) derived from the literature. It is recommended that default BSAFs of 1.0 be used initially for inorganics (other than mercury) rather than rely on literature values that are unlikely to contain similar conditions as are present at SWMU 59. BSAFs are likely to be very site-specific and the application of reported values at one site may be inappropriate at another site. For example, Krantzberg and Boyd (1992) indicate that metals in their study may have low bioavailability due to complexing with iron and/or sulfur compounds as their site was a heavily polluted harbor. Thus, the BSAF values calculated from their study may significantly underestimate fish tissue concentrations at SWMU 59. Due to the conservative nature of a SLERA, default values of 1 should be initially used while Step 3A may consider alternative and site-appropriate BSAFs. An alternative approach would be to evaluate fish tissue concentrations based on BCFs and dissolved surface water concentrations.*

Navy Response to PREQB Page-Specific Comment 22 (March 20, 2012): The PREQB provided a similar comment regarding proposed sediment-to-fish BAF values for metals presented in a draft corrective measures study (CMS) work plan prepared for SWMUs 27, 28, and 29 (dated December 16, 2010). The PREQB comment, as well as Navy responses and PREQB's evaluation of Navy responses are provided in italics below:

PREQB Page-Specific Comment 23 (April 19, 2011): *Page 5-26, Section 5.5.2.2.1: The text states that fish tissue concentrations were estimated by multiplying maximum sediment concentrations by soil-to-invertebrate BAFs. Please revise this to sediment-to-fish BAFs. The selection of BSAFs for inorganics to fish is of concern. Chromium, copper and lead BSAFs to fish were obtained from Krantzberg and Boyd (1992) where freshwater sediments from a highly-contaminated harbor in freshwater Lake Ontario were evaluated. The bioavailability of metals in marine/estuarine sediments at the Naval Activity Puerto Rico (NAPR) are likely to be significantly different than in Lake Ontario. As noted by Krantzberg and Boyd (1992), although sediment metal concentrations were high in their study, complexation of these metals with iron or sulfur compounds may limit the bioavailability of these metals. Their study area had extremely high iron concentrations present in the sediment due to metal smelting and likely affected metal bioavailability via coprecipitation of metals with iron hydroxide. Similarly, arsenic, cadmium and zinc fish BSAFs were from a study evaluating metals contamination at a mine in Montana (Pascoe et al., 1996). Given that conditions at NAPR are significantly different, it is recommended that for arsenic, cadmium, chromium, copper, lead, and zinc, a fish BSAF value of 1 be selected as this would provide a more conservative and protective value that is appropriate for a screening level ecological risk assessment.*

Navy Response to PREQB Page-Specific Comment 23 (June 23, 2011): The text in Section 5.5.2.2.1 describing the methodology used to derive exposure point concentrations in fish tissue will be revised by replacing "soil-to-invertebrate BAFs" with "sediment-to-fish BAFs". With regard to the sediment-to-fish BAF values for arsenic, cadmium, chromium, copper, lead, and zinc, Table 5-10 will be revised to show that an assumed BAF of 1.0 will be used in the Step 2 screening level risk calculation. However, the sediment-to-fish BAF values listed in Table 5-19 of the draft work plan for these six metals will still be used in Step 3a of the baseline ERA, unless more appropriate values are identified from the literature.

PREQB Evaluation of Response (August 12, 2011): *The response partially addresses the comment. PREQB agrees that using a default sediment-to-fish BAF of 1.0 in Step 2 of the SLERA will provide an appropriate and conservative evaluation of risks to piscivorous receptors. The response further indicates that Step 3A of the SLERA will include the BAFs of arsenic, cadmium, chromium, copper, lead and zinc obtained from the literature. It is unclear whether additional literature will be reviewed or if the values presented in Krantzberg and Boyd (1992) and (Pascoe et al., 1996) will be used. If the BAFs from these two sources are used, then Step 3A of the SLERA should also discuss the uncertainties associated with using these BAFs as previously noted by PREQB.*

Navy Response to PREQB Evaluation (October 13, 2011): To address PREQB's concern regarding the BAFs from Krantzberg and Boyd (1992) and Pascoe et al. (1996), a search will be conducted to determine if alternate values are available from the literature. If alternative values are not identified from the literature, the ERA will include a discussion of the uncertainties associated with using the Krantzberg and Boyd (1992) and Pascoe et al. (1996) values in the refined risk calculation. The discussion will include the issues identified by the PREQB within Page-Specific Comment No. 23 above. Risk estimates for avian piscivore dietary exposures will also be derived using assumed BAFs of 1.0 to determine the impact the Krantzberg and Boyd (1992) and Pascoe et al. (1996) values have on estimated dietary intakes.

As evidenced by the PREQB comment dated April 19, 2011, the specific sediment-to-fish BAF values in question were those reported by Krantzberg and Boyd (1992) for chromium, copper, and lead, as well as the sediment-to-fish BAF values reported by Pascoe et al (1996) for arsenic, cadmium, ands zinc. The Navy's approach to address PREQB concerns regarding sediment-to-fish BAF values reported by Krantzberg and Boyd (1992) and Pascoe et al. (1996) was approved by the PREQB in an electronic message (email) from Wilmarie Rivera Otero to Vicki Kay (Baker) and Martin Stacin (Navy) dated October 17, 2012. To address PREQB's concerns regarding the sediment-to-fish BAF values used in the

ecological risk assessment (ERA) presented within the draft CMS report for SWMU 59, the Navy proposes a similar approach. This approach is presented within the paragraphs that follow.

A literature search identified a compilation of sediment-to-fish BAF values reported by PTI Environmental Services in their report titled Bioaccumulation Factor Approach Analysis for Metals and Polar Organic Compounds (PTI Environmental Services, 1995) for cadmium, lead, and zinc:

Cadmium	**Lead**	**zinc**
0.043	0.028	0.69
0.22	0.13	0.13
2	0.33	1.2
0.32	0.11	3.7
0.11	0.083	0.24
2	0.18	1.3
0.15	0.076	4.6
0.22	0.26	0.17
2	0.43	1.3
		5

For these three metals, the Navy proposes to use 95th percentile BAF values calculated from the above data sets in the screening level (Step 2) risk calculation (2.0 for cadmium, 0.39 for lead, and 4.82 for zinc). If cadmium, lead, and/or zinc are identified as ecological COPCs, median BAF values calculated from the above data sets will be used in the refined (Step 3a) risk calculation (0.22 for cadmium, 0.13 for lead, and 1.25 for zinc). In the case of arsenic, chromium and copper, assumed sediment-to-fish BAF values of 1.0 will be used in the screening level risk calculation. If arsenic, chromium, and/or copper are identified as ecological COPCs, the following sediment to fish BAF values will be used in the refined risk calculation:

- Arsenic: 0.126 (mean sediment-to-fish BAF value reported by Pascoe et al., 1996)
- Chromium: 0.038 (mean sediment-to-fish BAF reported by Krantzberg and Boyd, 1992)
- Copper: 0.10 (median sediment-to-fish BAF reported by Krantzberg and Boyd, 1992)

These values were presented within the EPA-approved CMS work plan for SWMU 59 (dated December 6, 2007). Use of these BAF values in the refined risk calculation is also consistent with the PREQB-approved Navy response presented above for SWMUs 27, 28, and 29. It is noted that PTI Environmental Services (1995) reported single sediment-to-fish BAF values for arsenic and chromium (0.12 and 0.038, respectively). These BAF values are similar to the Pascoe et al., 1996 sediment-to-fish BAF value for arsenic and the Krantsberg and Boyd (1992) sediment-to-fish BAF value for chromium. Consistent with the PREQB-approved Navy responses associated with SWMUs 27, 28, and 29, the ecological risk assessment for SWMU 59 will be revised to include a discussion of the uncertainties associated with using the Krantzberg and Boyd (1992) and Pascoe et al. (1996) values in the refined risk calculation. Risk estimates for avian piscivore dietary exposures will also be derived using assumed BAFs of 1.0 to determine the impact the Krantzberg and Boyd (1992) and Pascoe et al. (1996) values have on estimated dietary intakes for arsenic, chromium, and copper.

It is noted that the alternative approach presented by the PREQB to estimate fish tissue using BCFs and dissolved surface water concentrations is not considered appropriate because the vast majority of BCF values available from the literature are based on laboratory studies that used highly soluble, bioavailable

forms of metals. The use of BCF values based on highly, soluble and bioavailable forms to estimate fish tissue concentrations at SWMU 59 will likely result in an overestimation of potential risks.

As proposed changes to the sediment-to-fish BAF values will require significant revisions to the ecological risk assessment presented in the draft CMS report, all necessary changes to text and tables will be made upon PREQB approval of the Navy approach presented above.

PREQB Evaluation of Navy Response (April 19, 2012): *The response adequately addresses the comment although clarification is requested for one aspect of the Navy's proposed approach. The proposed approach for calculating cadmium, lead, and zinc BSAFs for fish in Step 2 and Step 3A are based on the 95th percentile BAT and median BAF, respectively, presented in PTI Environmental Services (1995). This proposed approach is acceptable to PREQB. For arsenic, chromium and copper, a fish BSAF of 1 will be assumed in Step 2. PREQB concurs with this approach. BSAFs for arsenic, chromium and copper in Step 3A will be based on the mean or median BAF reported by Pascoe et al. (1996) or Krantzberg and Boyd (1992). The median values are typically selected as less conservative BAFs and this approach was proposed by the Navy for cadmium, lead and zinc as well as for copper. Please present the rationale for selecting the mean BAFs for arsenic and chromium rather than the median BAF values.*

Navy Response to PREQB Evaluation (October 4, 2013): Reference to a median BAF value for copper within the Navy's working draft response to PREQB Page-Specific Comment 22 is incorrect. The value identified (0.10) is a mean BAF, not a median BAF. Mean BAFs for arsenic, chromium, and copper were selected since mean values have previously been used in ecological risk assessments conducted at NAPR without agency comment.

PREQB Page-Specific Comment 23 - Page 8-1, Section 8.2 (November 3, 2011): *Please revise the text of this section to reflect the likely future land uses for this area, and quantify a future recreational exposure scenario in the HHRA that evaluates exposure to surface soil, surface water and sediment.*

Navy Response to PREQB Page-Specific Comment 23 (March 20, 2012): Future land use at NAPR has not been confirmed based on what is contained in the 2004 Reuse Plan or the 2010 Addendum to the 2004 Reuse Plan. It is the Navy's position that CAOs for SWMU 59 be developed based on current land use (i.e., industrial) and remediate the SWMU as such. Note that in addition to evaluating potential risks to industrial receptors, the HHRA evaluates residential exposure scenarios (including exposure to soil, surface water, and sediment) to provide information on unrestricted land use. No revisions to the HHRA are proposed.

Supplemental Navy response to PREQB Page-Specific Comment 23 (October 4, 2013): Please see the Navy response to PREQB's evaluation of the working draft response under PREQB General Comment 1. Based on the Navy's position concerning the development of CAOs, a future recreational exposure scenario will not be included in the HHRA. For clarification, Sections 8.1, 8.2, and 8.3.2.1 of the Draft CMS Report have been revised to reflect the Navy's position on evaluation of human receptors for the purpose of developing remedial alternatives.

PREQB Evaluation of Response (October 31, 2013): *Please refer to PREQB's Evaluation of the Navy's Response to General Comment 1.*

Navy Response to PREQB Page-Specific Comment 23 (May 27, 2014): Please refer to Navy's Response to PREQB Evaluation of PREQB General Comment 1.

PREQB Page-Specific Comment 24 - Page 8-2, Section 8.3.1.1 (November 3, 2011): *Please indicate what version of ProUCL was used to calculation summary statistics on the data.*

Navy Response to PREQB Page-Specific Comment 24 (March 20, 2012): The second sentence of Section 8.3.1.1 - Data Evaluation was revised as follows:

> "A statistical analysis, including the minimum, maximum, mean, standard deviation, and 95% UCL (calculated using ProUCL Version 4.00.05), was run for applicable data sets…"

Supplemental Navy Response to PREQB Page-Specific Comment 24 (October 4, 2013): The Draft Final CMS Report reflects the revisions indicated by the Navy's working draft Response to PREQB Page-Specific Comment 20 with the exception of the specific ProUCL version used to calculate the summary statistics. The version used for the summary statistics presented within the Draft Final CMS Report was ProUCL Version 4.1.01.

PREQB Page-Specific Comment 25 - Page 8-3, Section 8.3.1.1 (November 3, 2011):

> *a. Please discuss whether there are data gaps in the site characterization by not including the Phase II ECP data in the HHRA.*

Navy Response to PREQB Page-Specific Comment 25a (March 20, 2012): The following discussion was added to Section 8.3.6.1 to address potential impacts of the exclusion of the Phase II ECP data.

> "As previously noted, the soil and groundwater data collected during the Phase II ECP Investigation were deemed unacceptable for use in the HHRA based on lack of third party validation. However, the exclusion of these data is not expected to impact the outcome of the HHRA because as shown on Figure 4-2, the spatial distribution of the soil boring/monitoring well locations from the CMS investigation provides adequate coverage of the excluded data."

> *b. Paragraph 2: Please clarify whether the soil immediately beneath the concrete (from 0-1 foot below the concrete) was sampled, as this interval should be included in the surface soil dataset for future exposure scenarios.*

Navy Response to PREQB Page-Specific Comment 25b (March 20, 2012): Soil immediately beneath the concrete was not sampled based on the rationale that the most likely accumulation of potential contaminants from spills on the concrete slabs would be at the edge of the concrete in the adjacent surface soil. Additionally, at the time of the field investigation the concrete slab was intact and in good condition. However, soil samples will be collected from beneath the concrete and asphalt as part of an additional investigation to provide information concerning what may be below the concrete pads or pavement, and those data will be included in the HHRA prior to finalization of the CMS report. Corresponding text, tables, and appendices will be revised accordingly.

Supplemental Navy Response to PREQB Page-Specific Comment 25b (October 4, 2013): Surface soil (0.0 to 1.0-foot depth interval) and subsurface soil (1.0 to 3.0-foot depth interval) were collected at locations beneath concrete pads and paved surfaces during the follow-on CMS field investigation conducted in September and November 2012 in accordance with the final version of the Work Plan Letter dated June 15, 2012. Any deviations from the final version of the Request for Additional Sampling are identified within the Draft Final CMS Report. The human health risk assessment has been revised to include the surface and subsurface soil data collected during the follow-on CMS field investigation.

c. Please specify the depths at which the second subsurface soil samples were collected, as it is unclear from this paragraph whether this data should be included in the HHRA.

Navy Response to PREQB Page-Specific Comment 25c (March 20, 2012): The third sentence of the third full paragraph on page 8-3 was revised as follows:

> "Subsurface soil samples were collected from the 1 to 3 foot interval and a deeper interval (i.e., 3.0 to 5.0-foot, 5.0 to 7.0-foot, 7.0 to 9.0-foot, or 9.0 to 11.0-foot depth intervals)."

PREQB Page-Specific Comment 26 - Page 8-4, Section 8.3.1.2.1 (November 3, 2011): *As this document was published in July 2011, please update the Regional Screening Levels used for screening purposes.*

Navy Response to PREQB Page-Specific Comment 26 (March 20, 2012): It is noted that the latest EPA RSLs were published in November 2011, and the HHRA will be updated to reflect this. COPC selection, as well as site-specific and background-specific risks, will be re-evaluated and corresponding text and tables will be revised as applicable upon finalization of the CMS Report.

Supplemental Navy Response to PREQB Page-Specific Comment 26 (October 4, 2013): Please note that the human health risk assessment presented within the Draft Final CMS Report used the most recent version of the EPA RSLs (published in May 2013).

PREQB Page-Specific Comment 27 - Page 8-5, Section 8.3.1.2.1, paragraph 2 (November 3, 2011): *Please remove the last sentence from this paragraph as residential development is planned for this area.*

Navy Response to PREQB Page-Specific Comment 27 (March 20, 2012): The last sentence of the third paragraph of Section 8.3.1.2.1 – COPC Selection Criteria, USEPA Regional Screening Levels was revised as follows:

> "It should be noted that although residential screening criteria were conservatively used in this HHRA, land use at SWMU 59 is currently industrial, not residential."

Supplemental Navy Response to PREQB Page-Specific Comment 24 (October 4, 2013): Please note that the revised sentence included within the Navy's working draft response to PREQB Page-Specific Comment 27 has been further revised within the Draft Final CMS Report:

> "It should be noted that residential screening criteria were conservatively used in this HHRA."

PREQB Page-Specific Comment 28 - Page 8-5, Section 8.3.1.2.2 (November 3, 2011): *Please also discuss whether there are natural processes occurring at the site that would produce Cr+6.*

Navy Response to PREQB Page-Specific Comment 28 (March 20, 2012): The following text was added to Section 8.3.1.2.2.

> "It should be noted that chromium will be present predominantly in the trivalent chromium oxidation state in most soils. While hexavalent chromium contamination is generally associated with industrial activity, it can occur naturally. Oxidation of trivalent chromium to hexavalent chromium can occur in the soil environment. The relation between trivalent chromium and hexavalent chromium strongly depends on pH (the process is enhanced at pH values greater than 6) and oxidative properties of the location, but in most cases, the trivalent chromium is the dominating species (Kotaś and Stasicka, 2000). Most trivalent chromium in soil is immobilized due to adsorption and complexation with soil materials. As such, due to the lack of availability of mobile trivalent chromium, a large portion of

chromium in soil will not be oxidized to hexavalent chromium even with favorable oxidation and pH conditions (ATSDR, 2008).

The following references were added to Section 8.5:

Agency for Toxic Substances and Disease Registry (ATSDR), 2008. Draft Toxicological Profile for Chromium. September 2008.

Kotaś, J. and Z. Stasicka. 2000. "Chromium occurrence in the environment and methods of its speciation". *Environmental Pollution* 107 (3): 263–283.

PREQB Page-Specific Comment 29 - Page 8-6, Section 8.3.1.2.3 (November 3, 2011): *Please verify that all chemicals detected above RSLs are presented on Figures 8-1 through 8-4. It appears that organic compounds were not included on the figures (e.g., PAHs in surface soil, naphthalene in groundwater).*

Navy Response to PREQB Page-Specific Comment 29 (March 20, 2012): Figures 8-1 through 8-4 were reviewed for accuracy and it was verified that all organic chemicals detected above RSLs appear on the figures. As noted in Section 8.3.1.2.3, only those detected concentrations that actually exceed corresponding RSLs are shown on the figures. For example, in the case of the PAHs in surface soil and total soil, only one detected concentration each of benzo(a)pyrene (57 µg/kg in sample 59SB09-00) and dibenzo(a,h)anthracene (92 µg/kg in sample 59SB04-00) exceeded corresponding residential soil RSLs. The remaining carcinogenic PAHs identified as COPCs in surface soil and total soil were retained based on chemical similarity and as such, were not shown on Figures 8-1 and 8-2. Naphthalene was detected in only one out of ten groundwater samples in sample 59GW06 and is included on Figure 8-3.

PREQB Page-Specific Comment 30 - Page 10-3, Section 10.1, Paragraph 2 (November 3, 2011)*: Please define what constitutes "clean fill". What level of sampling will be conducted and what criteria will be used to certify that the back-fill materials are "clean".*

Navy Response to PREQB Page-Specific Comment 30 (March 20, 2012): The following text was added to Section 10.1 regarding off site backfill sampling:

> "Soils brought in from off site for use as backfill and topsoil shall be tested for TPH, BTEX and full TCLP including ignitability, corrosivity and reactivity (IRC). Backfill shall contain less than 100 parts per million (ppm) of total petroleum hydrocarbons (TPH) and less than 5 ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and shall not fail the TCLP test. Samples will be collected from the borrow source area at a frequency of one sample per 500 cubic yards per borrow source. TPH-GRO, TCLP VOC, and BTEX analysis require grab sample collection. The remaining TCLP suite, TPH-DRO and IRC analysis will be performed on a composite sample."

Supplemental Navy Response to PREQB Page-Specific Comment 30 (October 4, 2013): Please note that Section 11.1.2 of the Draft Final CMS Report includes the sampling/testing requirements that will be used to ensure material is suitable for use as backfill. As indicated by the discussion presented in section 11.1.2, backfill material purchased from an off-site source(s) will be tested in accordance with Navy technical specifications.

PREQB Page-Specific Comment 31 - Table 4-1 (November 3, 2011):

a. Surface and subsurface soil samples at locations 59SB02 and 59SB06 show a sample date of 4/19/10. However, the field log book notes in Appendix A by Robert Roselius show a sample date of 4/20/10. Please revise.

Navy Response to PREQB Page-Specific Comment 31a (March 20, 2012): The surface and subsurface soil samples collected from locations 59SB02 and 59SB06 as shown on Table 4-1 were revised to show a collection date of April 20, 2010.

b. Surface and subsurface soil samples at location 59SB09 show a sample date of 4/21/10. However, the field log book notes in Appendix A by Robert Roselius show a sample date of 4/22/10. Please revise.

Navy Response to PREQB Page-Specific Comment 31b (March 20, 2012): The surface and subsurface soil samples collected from location 59SB09 as shown on Table 4-1 were revised to show a collection date of April 22, 2010.

c. Please correct the sample depth for sample 59SB09-01 to 1-3.

Navy Response to PREQB Page-Specific Comment 31c (March 20, 2012): The sample depth shown on Table 4-1 for 59SB09-01 was corrected to 1.0 to 3.0 feet.

d. Surface water sample 59SW01 shows a sample date of 4/19/10. However, the field log book notes in Appendix A by Robert Roselius and Adam Gailey show a sample date of 4/20/10. Please revise.

Navy Response to PREQB Page-Specific Comment 31d (March 20, 2012): The surface water sample 59SW01 collection date was revised to April 20, 2010 on Table 4-1.

e. Surface water samples 59SW02 and 59SW03 and sediment samples 59SD02 and 59SD03 show a sample date of 4/20/10. However, the field log book notes in Appendix A by Robert Roselius and Adam Gailey show a sample date of 5/20/10. Please revise.

Navy Response to PREQB Page-Specific Comment 31e (March 20, 2012): Surface water samples 59SW02 and 59SW03 and sediment samples 59SD02 and 59SD03 collection dates were revised to May 20, 2010.

PREQB Page-Specific Comment 32 - Table 4-2 (November 3, 2011):

a. This table states that equipment rinsate 59ER09 was collected from the Teflon-lined polyethylene tubing. The field notes in Appendix A by Adam Gailey confirm this. However, the field notes in Appendix A by Robert Roselius state that equipment rinsate 59ER09 was collected on 5/21/10 (not 5/22/10) and was collected from a Teflon bladder. Please confirm 59ER09 and whether all equipment rinsates were reported properly.

Navy Response to PREQB Page-Specific Comment 32a (March 20, 2012): Equipment rinsate sample 59ER09 is correctly recorded in Adam Gailey's field notes, and the field notes for Robert Roselius were annotated to show the correct date. Equipment rinsate sample 59ER09 was collected on May 22, 2010 using Teflon-lined polyethylene tubing. No changes will be made to Table 4-2 regarding 59ER09 and the other equipment rinsate samples are confirmed.

b. Please clarify why there were no trip blanks samples associated with the ground water sampling that took place on May 22 and 23. Also, please include a note on the table indicating what "RCI" stands for. The date associated with sample "59TB06" should be changed to 2010.

Navy Response to PREQB Page-Specific Comment 32b (March 20, 2012): Trip blank sample 59TB06 was included in the shipment of groundwater samples collected on May 22 and 23, 2010, which was

Saturday and Sunday. The FEDEX shipment on Monday May 24, 2010 included groundwater samples collected on May 22 and 23 with associated trip blank 59TB06 included in the cooler containing VOCs. The acronym for RCI (reactivity, corrosivity and ignitability) was included as a footnote on Table 4-2. In addition, the date for trip blank 59TB06 was changed from "3010" to "2010".

PREQB Page-Specific Comment 33 - Table 4-4 (November 3, 2011)*: Please correct the May 24, 2010 ground water elevations for wells 74VP07b and 13MW04.*

Navy Response to PREQB Page-Specific Comment 33 (March 20, 2012): The May 24, 2010 groundwater elevations shown on Table 4-4 for wells 74VP07b and 13MW04 were revised to include the addition of the 100 feet datum plan to the survey data.

Supplemental Navy Response to PREQB Page-Specific Comment 33 (October 4, 2013): The Draft Final CMS Report reflects the revisions indicated by the Navy's working draft response to PREQB Page-Specific Comment 33. However, Table 4-4 of the Draft CMS Report is now Table 4-3 of Draft Final CMS Report.

PREQB Page-Specific Comment 34 - Table 4-3 (November 3, 2011):

a. Please revise the preparation methods for TCLP VOCs to 5030B. The currently listed methods are applicable to SVOCs, not VOCs.

Navy Response to PREQB Page-Specific Comment 34a (March 20, 2012): Table 4-3 was revised to show the soil preparation method for TCLP VOCs to be 5030B.

PREQB Evaluation of Navy Response (April 19, 2012)*: Please eliminate the reference to 3550C as a preparation method for TCLP VOCs as this is a semivolatile preparation method.*

Navy Response to PREQB Evaluation (October 4, 2013): Please note that Table 4-3 is not included within the Draft Final CMS Report. Information presented in this table is now located within Appendix B.

b. Please include the TCLP method 1311 in the preparation methods for TCLP SVOCs.

Navy Response to PREQB Page-Specific Comment 34b (March 20, 2012): Table 4-3 was revised to show the soil preparation method for TCLP SVOCs to be 1311.

Supplemental Navy Response to PREQB Page-Specific Comment 34b (October 4, 2013): Please note that Table 4-3 is not included within the Draft Final CMS Report. Information contained in this table is now located within Appendix B.

PREQB Page-Specific Comment 35 - Table 4-4 (November 3, 2011): *There is a calculation error for the groundwater elevations for wells 74VP09b and 13MW04 for the May 24, 2010 round of water levels. The groundwater elevations shown are 5.95 ft and 3.32 ft, respectively. Please correct.*

Navy Response to PREQB Page-Specific Comment 35 (March 20, 2012): The calculation error for wells 74VP07b (not 74VP09b) and 13MW04 for the May 24, 2010 water levels was corrected on Table 4-4; refer to the Navy Response to PREQB Page-Specific Comment 33.

Supplemental Navy Response to PREQB Page-Specific Comment 35 (October 4, 2013): Please note that Table 4-4 of the Draft CMS Report is now Table 4-3 of the Draft Final CMS Report.

PREQB Page-Specific Comment 36 - Table 6-6, Page 1 of 9 (November 3, 2011): *Many of the PAHs in surface soil sample 59SB04-00 were qualified with an "R" indicating that the results are rejected. However, as per the data validation report for SDG 1004194 in Appendix C, the PAH/SIM results in this sample were rejected due to linear range exceedances but these results were to be replaced with the PAH results from the full scan analyses since these PAHs were detected within the calibration range in this analysis. Please revise this table to include the full scan PAH results for this sample. The full scan results for PAHs in this sample should be used for risk assessment. Currently, the risk assessment sections of the report state that rejected data were not utilized and therefore this sample was not properly represented in the risk assessments. In addition, the PAH totals in this sample for low-molecular weight and high-molecular weight PAHs in Appendix B need to include the accurate results for each PAH. Please revise the report, ecological and human health risk assessment tables, and Appendix B accordingly.*

Navy Response to PREQB Page-Specific Comment 36 (March 20, 2012): The surface soil PAH results, including low-molecular and high-molecular weight PAHs, for sample 59SB04-00 were revised on Table 6-6 and on the tables in Appendix B. PAH results were included from the full scan dilution run and/or the PAH run using the 8270C/SIM method, in addition to the original full scan run. In doing this, some of the PAH parameters that were originally reported as "rejected" for sample 59SB04-00 are now reported as validated reportable concentrations. Table 6-12 and the associated Data Completeness Summary (Section 6.6.3) were also revised to incorporate this change. The PAH results for surface soil sample 59SB04-00 were revised in the applicable ERA tables, including Appendix D. In addition, Sections 7.6.2.6.1 and 7.9.1.6.1 of the ERA were revised accordingly. With regard to the HHRA, the PAH results for surface soil sample 59SB04-00 were revised in the Appendix I tables. However, the HHRA will not be revised until after completion of the additional sampling as proposed in the attached Work Plan Letter (Please refer to the Navy's response to EPA General Comment 1).

Supplemental Navy Response to PREQB page-Specific Comment 36 (October 4, 2013): The Draft Final CMS Report reflects the revisions indicated within the Navy's working draft response to PREQB Page-Specific Comment 36. However, as indicated below, some section numbers, table numbers, and appendix letters referenced within the response have changed.

- Table 6-6 of the Draft CMS Report (Summary of Detected Laboratory Results – Surface Soil) is now Table 6-1 of the Draft Final CMS Report (Summary of Detected Results – Surface Soil, 2010 CMS Investigation)

- Appendix I of the Draft CMS Report is now Appendix O of the Draft Final CMS Report.

- Section 6.6.3 of the Draft CMS Report (Data Completeness Summary) is now Section 6.7.1 of the Draft Final CMS Report.

- Section 7.6.2.6.1 and 7.9.1.6.1 of the Draft CMS Report are now Sections 7.6.3.1.1 and 7.9.2.1.1 of the Draft Final CMS Report

PREQB Page-Specific Comment 37 - Figure 5-3 (November 3, 2011): *Please appropriately label the southern-most 103.3 contour line and change the labeling on the southern-most contour line to 103.2.*

Navy Response to PREQB Page-Specific Comment 37 (March 20, 2012): Figure 5-3, Groundwater Contour Map, May 24, 2010 was eliminated from the SWMU 59 CMS report (see the Navy's response to EPA Specific Comment 1). The new Figure 5-3 presents data from January 2011.

***PREQB Page-Specific Comment 38 - Figure 8-6 (November 3, 2011)*:**

a. Please add surface soil as a secondary source, where future recreational receptors, along with all other receptors would be exposed.

Navy Response to PREQB Page-Specific Comment 38a (March 20, 2012): The generic term "soil" is used in the CMS since the COPC exposure point concentrations (EPCs) may come from either surface soil or total soil (whichever is more conservative). Additionally, refer to Navy Response to PREQB Page-Specific Comment 23. No changes to the subject figure are warranted.

PREQB Evaluation of Navy Response (April 19, 2012): Please refer to PREQB's evaluation of response to Comment 23.

Navy Response to PREQB Evaluation (October 4, 2013): Refer to the Supplemental Navy response to PREQB Page-Specific Comment 23.

PREQB Evaluation of Response (October 31, 2013): *Please refer to PREQB's evaluation of response to Page-Specific Comment 23 and General Comment 1.*

Navy Response to PREQB Evaluation (May 27, 2014): Please refer to Navy's Response to PREQB Evaluation of PREQB General Comment 1.

b. Commercial/industrial workers are assumed to ingest 1 L of water per day while at work. Please revise the CSM to show this complete exposure pathway.

Navy Response to PREQB Page-Specific Comment 38b (March 20, 2012): Upon finalization of the CMS Report, the HHRA (which includes the CSM and all applicable text and tables) will be revised to include ingestion of groundwater as a complete exposure pathway for the commercial/industrial worker.

***PREQB Page-Specific Comment 39 - Figure 11-1 (November 3, 2011)*:** *Based on the data shown, it is presumed that the three soil removal areas in the northeast corner of the site should connect, making one larger area. As the available data shows elevated concentrations of lead with no data between the locations shown to support the understanding that concentrations decline to below cleanup levels. Section 10 of the report does state that additional delineation may occur. It is recommended if these areas continue to be treated as separate areas, that additional delineation effort occur in this area to support this. This additional delineation should include samples to be collected to the north and east to confirm the lateral limits. Additional delineation sampling should also occur near the three areas in the southeast corner of the site, which abut the edge of the clearing to confirm the extent of contamination in the south and east directions.*

Navy Response to Page-Specific Comment 39 (March 20, 2012): The Navy concurs with this comment. The three areas in the northeast corner of the site will remain separated on Figure 11-1; however, additional pre-excavation delineation samples will be collected around each of the seven proposed excavation areas to confirm the lateral limits of contamination (see the Navy's response to EPA General Comment 1). Upon completion of the additional sampling, Figure 11-1 will be updated accordingly and included in the Revised Draft CMS Report.

Supplemental Navy Response to Page-Specific Comment 39 (October 4, 2013): Pre-excavation delineation surface soil samples were collected in September and November 2012 in accordance with the final version of the Work Plan Letter dated June 15, 2012. The data is discussed in Section 9.0 of the

Revised Draft CMS Report and presented on Figure 9-1. In addition, the excavation limits were revised accordingly and now are shown on Figure 10-1.

PREQB Page-Specific Comment 40 - Appendix A, Field Log Book Notes (November 3, 2011):

a. The daily meter calibration record for 5/23/10 was not provided. Please submit since groundwater sampling was performed on this day.

Navy Response to PREQB Page-Specific Comment 40a (March 20, 2012): The missing daily meter calibration record for 5/23/10 was included in Appendix A.

b. The boring log for boring 59SB13 shows that a sample was collected at "59SB11-02". However, this should be 59SB13-05, per the field notes by Robert Roselius. Please revise accordingly.

Navy Response to PREQB Page-Specific Comment 40b (March 20, 2012): The boring log for 59SB13 was revised to show the subsurface soil sample 59SB13-05.

c. The date on the Low Flow Purge Data Sheet for sample 59GW01 should be 5/22/10 per the field notes by Robert Roselius. Please revise accordingly.

Navy Response to PREQB Page-Specific Comment 40c (March 20, 2012): The date on the Low Flow Purge Data Sheet was revised to May 22, 2010.

d. 59GW07: Please explain why the pump intake was set at 19.5 feet which is outside the screened interval of 8-18 feet.

Navy Response to PREQB Page-Specific Comment 40d (March 20, 2012): The measurements are taken from the top of the stick up of the PVC casing. The total depth is recorded for well 59SB07 as 20.95 feet and the pump was set 1.5 feet off the bottom at 19.5 feet. No revisions will be made to the sampling log for 59SB07.

PREQB Page-Specific Comment 41 - Appendix C, Data Validation Report Summaries (November 3, 2011):

a. Please eliminate or relocate the cover page for the SDG1002745, since it is placed and no information is presented following it.

Navy Response to PREQB Page-Specific Comment 41a (March 20, 2012): The cover page for SDG1002745 was removed from the report.

b. The cover page for SDG1005197 was incorrectly labeled SDG1005179, also the Puerto Rico Chemist certified SDG1005179 instead of SDG1005197. Please clarify.

Navy Response to PREQB Page-Specific Comment 41b (March 20, 2012): The correct SDG number is 1005179 and the cover page and Puerto Rico Chemist certification are correct. The footnotes on the bottom of the SDG1005179 data validation report pages were changed from SDG1005197 to SDG1005179. The original header on the data validation report is correct.

c. The cover page for SDG1005177 was labeled SDG1005117. Please clarify.

Navy Response to PREQB Page-Specific Comment 41c (March 20, 2012): The initial cover page for SDG1005177 is correct and contains the appropriate data validation report. However, a cover page was included for SDG1005517, which inadvertently contained a second copy of the data validation report for

SDG1005177. There was no SDG1005517 (or SDG1005117) for the CMS Investigation. Therefore, the cover page for SDG1005517 and the second copy of the data validation report for SDG1005177 were removed from the report.

d. SDG 1004194: Select PAH/SIM results in sample 59SB04-00 were rejected as these results were above the calibration range. The validation report states that the results for these rejected PAHs should be taken from the full scan analysis. However, as discussed in Comment # 36 above, this was not actually performed. SDGs 1005175 and 1005176: Based on these validation reports, the full scan SVOC and PAH/SIM analyses of all groundwater samples, surface water samples 59SW02 and 59SW03, and surface and subsurface soil samples collected at locations 59SB11, 59SB12, 59SB14, 59SB15, 59SB16 and 59SB17 were performed outside of the 40-day holding time. The analysis of samples outside of the 40-day holding time is a very rare occurrence. Please provide further detail on the cause of this exceedance. Based on the results, PAHs may have been the most affected by this issue. Please ensure that the report and risk assessments take the potential low bias of the PAHs in these samples into account for all decision-making.

Navy Response to PREQB Page-Specific Comment 41d (March 20, 2012): Please see the Navy's response to PREQB Page-Specific Comment 36 with regard to SDG1004194 and sample 59SB04-00. SDG1005175: The case narrative submitted within the SVOA worksheets (page 363) states that "due to instrumentation issues in the semivolatile laboratory, the samples in this SDG were analyzed outside of the 40 days analytical holding time". SDG1005176: The case narrative, submitted within the SVOA worksheets (page 350), states that "due to instrumentation issues in the semivolatile laboratory, the samples in this SDG were analyzed outside of the 40 days analytical holding time".

PREQB Evaluation of Response Navy Response (April 19, 2012)*: Please clarify if the Navy has discussed these occurrences with the laboratory and clarify what corrective measures the laboratory has put in place to ensure that these issues do not occur in the future.*

Navy Response to PREQB Evaluation (October 4, 2013): The Navy discussed the issues identified within the working draft response to PREQB Page-Specific Comment 41d with the analytical laboratory. If instrument issues arise in the future that prevent samples from being analyzed within holding times, the analytical laboratory has been directed to inform the Navy in a timely manner so an alternate laboratory can be identified.

PREQB ADDITIONAL COMMENTS ON THE DRAFT FINAL CMS REPORT

PREQB Additional Comment 1, Figure 8-8 (October 31, 2013): *Please clarify why residents, commercial/industrial and construction worker receptors are identified as being exposed to indoor air or trench air when the figure shows that the pathway from groundwater is incomplete.*

Navy Response to PREQB Additional Comment 1, Figure 8-8 (May 27, 2014): For clarity, Figure 8-8 has been revised to remove the "Future Exposure Pathway" symbol from the indoor air/trench air inhalation exposure route boxes for the resident, commercial/industrial and construction worker receptors.

FINAL
CORRECTIVE MEASURES STUDY
FINAL REPORT
SWMU 59 – FORMER VEHICLE MAINTENANCE AND REFUELING AREA

For NAVAL ACTIVITY PUERTO RICO
EPA I.D. No. PR2170027203
CEIBA, PUERTO RICO

Prepared for:

Department of the Navy
NAVFAC SOUTHEAST
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Contract No. N62470-10-D-3000
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April 2015

IQC for A/E Services for Multi-Media Environmental Compliance Engineering Support

FINAL

CORRECTIVE MEASURES STUDY FINAL REPORT
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APRIL 14, 2015

Prepared for:

DEPARTMENT OF THE NAVY
NAVFAC SOUTHEAST
North Charleston, South Carolina

Under:

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Prepared by:

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I certify under penalty of law that I have examined and am familiar with the information submitted in this document and all attachments and that this document and its attachments were prepared either by me personally or under my direction or supervision in a manner designed to ensure that qualified and knowledgeable personnel properly gather and present the information contained therein. I further certify, based on my personal knowledge or on my inquiry of those individuals immediately responsible for obtaining the information, that the information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowingly and willfully submitting a materially false statement.

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Date: 8 April 2015

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LIST OF ACRONYMS AND ABBREVIATIONS

ABS	Dermal Absorption
ADAF	Age-Dependent Adjustment Factors
AET	Apparent Effects Threshold
AF	Adherence Factor
AFWTF	Atlantic Fleet Weapons Training Facility
AOC	Area of Concern
APA	Aerial Photography Analysis
ASTM	American Society for Testing and Materials
AT	Averaging Time
ATSDR	Agency for Toxic Substances and Disease Registry
AUF	Area Use Factor
AUF_j	Area Use Factor for receptor j
AVS	Acid Volatile Sulfide
BAF	Bioaccumulation Factors
BSAF	Biota-Sediment Accumulation Factors
Baker	Michael Baker Jr., Inc.
BERA	Baseline Ecological Risk Assessment
bgs	below ground surface
BRAC	Base Realignment and Closure
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
BW_j	Body Weight of receptor j
CAC	Chronic Aquatic Criterion
$CaCO_3$	Calcium Carbonate
CADD	Computer Aided Design and Drafting
Cal EPA	California Environmental Protection Agency
CAOs	Corrective Action Objectives
CAV	Chronic Aquatic Value
CCC	Continuous Criteria Concentrations
CCME	Canadian Council of Ministers of the Environment
CDI	Chronic Daily Intake
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
cm^2	Square centimeters
CMC	Criteria Maximum Concentration
CMI	Corrective Measures Implementation
CMS	Corrective Measures Study
CNO	Chief of Naval Operations
COC	Chemical of Concern
COPC	Chemical of Potential Concern
CSF	Cancer Slope Factor
%D	Percent Difference
DAD	Dermally Absorbed Dose
DDT	Dichlorodiphenyltrichloroethane
DI	Deionized
DI_{xj}	Dietary Intake of chemical x by receptor j
DMMP	Dredged Material Management Program
DO	Delivery Order

LIST OF ACRONYMS AND ABBREVIATIONS
(continued)

DoD	Department of Defense
DoN	Department of the Navy
DPT	Direct Push Technology
DRO	Diesel Range Organics
DUP	Duplicate
E2SS3	Estuarine, Intertidal, Scrub-Shrub, Broad-Leaved Evergreen
E2US2	Estuarine, Intertidal, Unconsolidated Shore, Sand
E2US3	Estuarine, Intertidal, Unconsolidated Shore, Mud
E2US4	Estuarine, Intertidal, Unconsolidated Shore, Organic
EC	Exposure Concentration
EC_{50}	Median Effective Concentration
ECOSAR	Ecological Structure Activity Relationships
ECO-SSL	Ecological Soil Screening Level
ECOTOX	Ecotoxicology
ECP	Environmental Condition of Property
ED	Exposure Duration
EF	Exposure Frequency
EPA	Environmental Protection Agency
EPC	Exposure Point Concentration
EqP	Equilibrium Partitioning
ERA	Ecological Risk Assessment
ER-L	Effects Range-Low
ER-M	Effects Range-Median
ESCP	Erosion and Sediment Control Plan
ESL	Ecological Screening Level
ET	Exposure Time
eV	electron volt
F	Fahrenheit
FCVs	Final Chronic Values
FC_{xi}	Maximum Concentration of chemical x in food item i
FID	Flame Ionization Detector
FIR	Food Ingestion Rate
FIR_j	Food Ingestion Rate for receptor j
f_{oc}	fraction of organic carbon
FRV	Final Residual Value
FSAP	Field Sampling and Analysis Plan
GIS	Geographic Information System
GLI	Great Lakes Initiative
GMAV	Genus Mean Acute Value
GPS	Global Positioning System
GRO	Gasoline Range Organics
HASP	Health and Safety Plan
HEAST	Health Effects Assessment Summary Table
HHRA	Human Health Risk Assessment

LIST OF ACRONYMS AND ABBREVIATIONS
(continued)

HI	Hazard Index
HM	Hazardous Material
HMW	High Molecular Weight
HQ	Hazard Quotient
HSA	Hollow-Stem Auger
HSDB	Hazardous Substances Data Bank
i	Average Hydraulic Gradient
IC_{50}	Inhibition Concentration
ID	Inside Diameter
IDEM	Indiana Department of Environmental Management
IDW	Investigation-Derived Waste
IEUBK	Integrated Exposure Uptake Biokinetic
ILCR	Incremental Lifetime Cancer Risk
IR	Ingestion Rate
IRIS	Integrated Risk Information System
ISQGs	Interim Freshwater Sediment Quality Guidelines
IUR	Inhalation Unit Risk
K	Average Hydraulic Gradient
k_d	adsorption coefficient
kg	kilogram
kg/day	kilograms per day
k_{oc}	organic carbon partition coefficient
k_{ow}	octanol-water partition coefficient
K_{ww}	biota to soil water partition coefficient
L	liter
LC_{50}	Median Lethal Concentration
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LEL	Lowest Effect Level
LD_{50}	Median Lethal Dose
L/day	Liters per day
L/hour	Liters per hour
LLPAH	Low-level Polynuclear Aromatic Hydrocarbon
LMW	Low Molecular Weight
LOAEC	Lowest Observed Adverse Effect Concentration
LOAELs	Lowest Observed Adverse Effects Levels
LOD	Limit of Detection
LOEC	Lowest Observed Effect Concentration
LOEL	Lowest Observable Effects Levels
LUCs	Land Use Controls
MATC	Maximum Acceptable Toxicant Concentration
MC	Macro-Core
MDL	Method Detection Limit
$\mu g/m^3$	micrograms per cubic meter

LIST OF ACRONYMS AND ABBREVIATIONS
(continued)

µg/dl	microgram per deciliter
µg/kg	micrograms per kilogram
mg	milligram
mg/cm^2	milligrams per Square Centimeter
mg/day	milligrams per day
mg/kg	milligrams per kilogram
mg/kg-BW/day	milligrams per kilogram Body Weight per day
mg/kg/day	milligrams per kilogram per day
mg/L	milligrams per liter
mg/m^3	milligrams per cubic meter
MGD	Million Gallons per Day
$\mu g/m^3$	micrograms per cubic meter
µg/L	micrograms per liter
µmol/g OC	micromoles per gram Organic Carbon
MHSPE	Duth Ministry of Housing, Spatial Planning and Environment
MMOA	Mutagenic Mode of Action
MRL	Method Reporting Limit
MS/MSD	Matrix Spike/Matrix Spike Duplicate
msl	mean sea level
NAD	North American Datum
NAPR	Naval Activity Puerto Rico
NAVFAC	Naval Facilities Engineering Command
NAVY	U.S. Department of the Navy
NAWQC	National Ambient Water Quality Criteria
NCEA	National Center for Environmental Assessment
NCP	National Contingency Plan
n_e	effective porosity
NEESA	Naval Energy and Environmental Support Activity
NFESC	Naval Facility Engineering Service Center
NFPA	National Fire Protection Act
NOAA	National Oceanic and Atmospheric Administration
NOAEC	No Observed Adverse Effect Concentration
NOAELs	No Observed Adverse Effects Levels
NOEC	No Observed Effects Concentration
NOEL	No Observed Effects Level
NRWQC	National Recommended Water Quality Criteria
NSRR	Naval Station Roosevelt Roads
NTU	Nephelometric Turbidity Units
OAC	Ohio Administrative Code
OECD	Organization for Economic Co-Operation and Development
OEPA	Ohio Environmental Protection Agency
OPP	Office of Pesticide Programs
PAH	Polynuclear Aromatic Hydrocarbon
PCBs	Polychlorinated Biphenyls
PDF_i	Proportion of Diet Composed of Food Item i

LIST OF ACRONYMS AND ABBREVIATIONS
(continued)

PDS	Proportion of Diet Composed of Soil/Sediment
PEC	Probable Effect Concentration
PEF	Particulate Emission Factor
PEL	Probable Effect Level
PI	Photo Identified
PID	Photoionization Detector
PMO	Program Management Office
POL	Petroleum, Oils and Lubricant
ppm	parts per million
PPRTVs	Provisional Peer Reviewed Toxicity Values
ppt	parts per thousand
PRDNR	Puerto Rico Department of Natural Resources
PREQB	Puerto Rico Environmental Quality Board
PRWQS	Puerto Rico water Quality Standard
PRWQSR	Puerto Rico Water Quality Regulation
PSQGs	Provincial Sediment Quality Guidelines
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
%R	Percent Recovery
%RSD	Percent Relative Standard Deviation
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
RfC	Reference Concentration
RfD	Reference Dose
RL	Reporting Limit
RME	Reasonable Maximum Exposure
RPD	Relative Percent Difference
RRF	Relative Response Factor
RSL	Regional Screening Level
SACR	Secondary Acute-to-Chronic Ratio
SAR	Structure Activity Relationships
SAV	Secondary Acute Value
SCV	Secondary Chronic Value
SC_x	Maximum concentration of chemical x in soil/sediment
SDG	Sample Delivery Group
SEL	Severe Effect Level
SEM	Simultaneously Extracted Metals
SERA	Screening-level Ecological Risk Assessment
SIM	Selected Ion Monitoring
SOP	Standard Operating Procedure
SQAGs	Sediment Quality Assessment Guidelines
SQGs	Sediment Quality Guidelines
SQUIRTs	Screening Quick Reference Tables
STSC	Superfund Health Risk Technical Support Center
SVOC	Semi-Volatile Organic Compound
SWMU	Solid Waste Management Unit

LIST OF ACRONYMS AND ABBREVIATIONS
(continued)

TCLP	Toxicity Characteristic Leaching Procedure
TEC	Threshold Effect Concentration
TEL	Threshold Effect Level
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TRV	Toxicity Reference Value
UCL	Upper Confidence Limit
ULM	Upper Limit of the Means
UNEP	United Nations Environmental Program
USACE	U.S. Army Corp of Engineers
USCS	Unified Soil Classification System
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USTs	Underground Storage Tanks
UU/UE	Unrestricted Use/Unrestricted Exposure
V	groundwater velocity
VISLs	Vapor Intrusion Screening Levels
VOC	Volatile Organic Compound
WCx	Maximum concentration of chemical x in surface water
WIR_j	Water Ingestion Rate for receptor j

1.0 INTRODUCTION

This report presents the results of the Corrective Measures Study (CMS) Investigation and pre-excavation delineation sampling conducted for Solid Waste Management Unit (SWMU) 59 – Former Vehicle Maintenance and Refueling Area at Naval Activity Puerto Rico (NAPR), Ceiba, Puerto Rico. This report also presents an evaluation of corrective measures to mitigate potential human health and ecological risks at the SWMU. The report has been prepared by Michael Baker Jr., Inc. (Baker), for the U.S. Department of the Navy (Navy) Base Realignment and Closure (BRAC) Program Management Office (PMO) Southeast under contract with the Naval Facilities Engineering Command (NAVFAC) (Contract Number N62470-10-D-3000, Delivery Order [DO] JM01).

The U.S. Environmental Protection Agency (USEPA) issued a Resource Conservation and Recovery Act (RCRA) §7003 Administrative Order on Consent (Docket No. RCRA-02-2007-7301) (USEPA, 2007), which became effective on January 29, 2007. The Administrative Order identified documented releases of solid and/or hazardous waste or hazardous constituents at SWMU 59 (formerly referred to as Environmental Condition of Property [ECP] 5). The Administrative Order also required preparation of an acceptable work plan to complete the site characterization and a CMS to determine the final remedy for the SWMU.

The Final CMS Work Plan for SWMU 59 (Baker, 2007) was approved by the USEPA on April 10, 2008, and the initial CMS Investigation was conducted in April and May 2010. A follow-on CMS Investigation and pre-excavation delineation sampling were conducted in September and November 2012 in accordance with the work plan letter *Request for Additional Sampling Necessary for Completion of the Corrective Measures Study Investigation for SWMU 59* (June 15, 2012). The work for both phases of investigation was conducted in accordance with the approved Work Plans; minor deviations from the Work Plans are detailed in subsequent sections of this report.

1.1 Purpose of Report

The overall purpose of this report is to meet the requirement for conducting a CMS for SWMU 59 as specified in the RCRA §7003 Administrative Order on Consent (USEPA, 2007). This report has been prepared to complete the characterization process and serves as the basis for selection of a corrective measure alternative to protect human health and the environment. The report presents the environmental data collected, evaluates potential ecological and human health risks, develops chemicals of concern (COCs) and corrective action objectives (CAOs), and recommends a preferred corrective measure alternative to mitigate the identified risks.

Based on results from the CMS Investigation, it was determined that a streamlined CMS was appropriate. A highly focused or streamlined CMS is appropriate for SWMUs that have "straightforward remedial solutions" where standard engineering practices can be applied that have proved effective in similar situations (USEPA, 1994). The impacted environmental medium at SWMU 59 includes soil. Because the SWMU is located on the island of Puerto Rico, there are limited technologies that are time and cost effective in treating the contaminated soil. In addition, the contaminated soil has been sufficiently characterized/delineated and was found to be limited in extent. Therefore, the screening of corrective measure alternatives normally conducted in a CMS did not occur. The corrective measure selected and documented in this CMS Report will provide the quickest and most effective remedy for SWMU 59.

1.2 Objectives

The specific objectives of the CMS Investigation and the CMS Report for SWMU 59 were as follows:

- Complete the characterization and delineation of potential SWMU-related impacts
- Identify specific COCs and their extent
- Identify realistic ecological and human health exposure pathways that may be present
- Develop ecological and human health CAOs for each media/COC
- Evaluate potential corrective measures in the form of a streamlined CMS that could be implemented to meet the CAOs
- Recommend a preferred corrective measure alternative to mitigate the identified risks
- Develop the technical approach to implementing the recommended corrective measure alternative

1.3 Report Organization

This report is organized into 11 sections. Section 1.0 provides an introduction and presents the purpose of the report and objectives of the CMS. A brief summary of pertinent background information for NAPR and SWMU 59 is provided in Section 2.0. Section 3.0 discusses the climatology, topography, and regional geology, hydrology, and hydrogeology for NAPR. Section 4.0 provides a description of the activities associated with the CMS Investigation including soil, groundwater, surface water, and sediment sampling, quality assurance/quality control (QA/QC) sampling, and other investigation considerations. Section 5.0 discusses the physical results from the CMS Investigation including current conditions and area geology/hydrogeology. Section 6.0 discusses the analytical results of the samples collected during the CMS Investigation and presents a summary of the data validation/usability assessment. Section 7.0 provides an evaluation of ecological risks and develops CAOs based on protection of potential ecological receptors. Similarly, Section 8.0 provides an evaluation of human health risks and develops CAOs based on protection of potential human receptors. A summary of the CAOs developed for protection of potential ecological and human receptors and the extent of contamination are provided in Section 9.0. Section 10.0 provides justification for the recommended corrective measure. The technical approach to implementing the recommended corrective measure is provided in Section 12.0. Tables and figures are presented directly behind the text. Supporting information and documentation are presented in the appendices.

1.4 References

Baker. 2012. *Request for Additional Sampling Necessary for Completion of the Corrective Measures Study Investigation for SWMU 59.* Naval Activity Puerto Rico, Ceiba, Puerto Rico. June 15, 2012.

Baker. 2007. Final Corrective Measures Study Work Plan for SWMU 59. Naval Activity Puerto Rico, Ceiba, Puerto Rico. December 6, 2007.

USEPA. 2007. RCRA § 7003 Administrative Order on Consent. In the Matter of: United States The Department of the Navy, Naval Activity Puerto Rico formerly Naval Station Roosevelt Roads, Puerto Rico. Environmental Protection Agency, EPA Docket No. RCRA-02-2007-7301. January 29, 2007.

USEPA. 1994. RCRA Corrective Action Plan. Office of Solid Waste and Emergency Response. OSWER Directive 9902.3-2A. May 1994.

2.0 BACKGROUND

This section discusses the history and description of NAPR and SWMU 59. In addition, this section presents summary of results from previous investigations conducted at the SWMU.

2.1 NAPR Description and History

NAPR occupies over 8,800 acres on the northern side of the east coast of Puerto Rico along Vieques Passage (see Figure 2-1). Vieques Island lies to the east approximately 10 miles off the harbor entrance. NAPR also occupies the immediately adjacent islands of Piñeros and Cabeza de Perro (see Figure 2-2). The northern entrance to NAPR is approximately 35 miles east along the coast road (Route 3) from San Juan. The property consists of 3,938 acres of upland (developable) property and 4,955 acres of environmentally sensitive areas including wetlands, mangroves, and wildlife habitat. The closest large town is Fajardo (population approximately 37,000), which is about 5 miles north of NAPR off Route 3. Ceiba (population approximately 17,000) adjoins the western boundary of NAPR (see Figure 2-1).

The facility was commissioned in 1943 as a Naval Operations Base and re-designated as a Naval Station in 1957. Naval Station Roosevelt Roads (NSRR) operated from 1957 until March 31, 2004. NSRR was one of the largest naval facilities in the world with more than 100 miles of paved roads, approximately 1,300 buildings, a large-scale airfield (Ofstie Field), a deep water port, and over 30 tenant commands. NSRR played a major role in providing communication support to the Atlantic and Caribbean areas and also served as a major training site for fleet exercises.

Section 8132 of Fiscal Year 2004 Defense Appropriations Act, signed into law on September 30, 2003, directed that NSRR be disestablished within six months and the real estate disposal/transfer be carried out in accordance with procedures contained in the BRAC Act of 1990. NSRR has undergone operational closure as of March 31, 2004 and has been designated as NAPR. The mission of NAPR is to protect the physical assets remaining, comply with environmental regulations, and sustain the value of the property until its final disposal/transfer.

As of January 25, 2012, the majority of property at NAPR has been transferred from the Navy to various entities including the City of Ceiba, Commonwealth of Puerto Rico, Puerto Rico Port Authority, Puerto Rico Air National Guard, Department of Health and Human Services, Department of the Army Installation Management Command, and Department of the Interior. However, the Navy maintains responsibility for the investigation and cleanup and is implementing the remaining corrective action obligations in accordance with the RCRA §7003 Administrative Order on Consent (USEPA, 2007).

2.2 SWMU 59 Description and History

SWMU 59 consists of an approximate 10-acre parcel and is located in the east/central portion of NAPR east of Forrestal Drive (see Figures 2-2 and 2-3). The majority of the site is developed with concrete and asphalt paved surfaces throughout. Site features include Buildings 60, 258, and 377; abandoned fuel islands (a total of four), a wash pad, and an oil water separator.

Although most of the site is developed, vegetation is persistent in the southwestern portion of the SWMU (near the refueling islands) and within narrow bands along the outer perimeters of the concrete and asphalt paved surfaces. Dominant tree, shrub, and herbaceous vegetation documented during the CMS Investigation include white lead tree (*Leucaena leucocephala),* white indigoberry *(randia aculeata*), climbing day flower (*Commelina diffusa),* guinea grass

(Urochloa maxima), light blue snakeweed (*Stachytarpheta jamaicensis*), gumbo limo (*Bursera simaruba*), bretonica prieta *(Melochia nodiflora),* fringed windmill grass (*Chloris ciliata*), barrelier's woodsorrel (*Oxalis barrelieri*), tropical fimbry (*fimbristylis cymosa*), and ocean blue morning glory *(Ipomoea indica)*.

No aquatic natural resources (i.e., streams, wetlands, or drainage ditches) were observed within the SWMU 59 boundary. However, a small pool contiguous to a freshwater drainage ditch was identified west of the SWMU on the opposite side of Forrestal Drive. Storm water within the drainage ditch travels approximately one mile before discharging to an estuarine wetland system adjacent to Ensenada Honda via Outfall 002. It should be noted that in addition to SWMU 59, the drainage ditch also receives run-off from Area of Concern (AOC) F, SWMU 14 (JP-5 Hill Area), and a large portion of the Ofstie Airfield including SWMUs 56 and 69 (see Figure 2-4).

SWMU 59 is located within Sale Parcel III, which was transferred from the Navy to the Commonwealth of Puerto Rico on January 25, 2012. However, the SWMU was not included in the transfer at the time. Rather, it was "carved out" of the transfer while the Navy continues with implementation of the remaining corrective action obligations in accordance with the RCRA §7003 Administrative Order on Consent (USEPA, 2007).

2.3 Previous Investigations

Previous investigations conducted at SWMU 59 included the Phase I/Phase II ECP Investigation (NAVFAC Atlantic, 2005). A brief summary of the investigation activities and results is provided below; a detailed description of the investigation activities and results can be found in the report referenced herein. A complete set of analytical results is included in Appendix B.

2.3.1 Phase I/II ECP Investigation

In anticipation of operational closure of NSRR, NAVFAC Atlantic prepared a Final Phase I/Phase II Environmental Conduction of Property Report (NAVFAC Atlantic, 2005) to document the environmental condition of NSRR. The Phase I ECP Investigation included a review of readily available records, an analysis of historical aerial photographs, physical site inspections, and interviews with persons familiar with past and current operations and activities. The aerial photography analysis identified this area as Photo Identified Site 7 (later referred to as ECP site 5 and currently as SWMU 59) due to observations of drums, vehicle racks, stains, and fuel islands from 1958-1985. Results from this analysis are represented by the polygon features shown on Figure 2-3, which correspond to the respective aerial photographs. The records review confirmed that the area was historically used as a former vehicle maintenance and refueling area from the 1940s to the 1980s and that spills and leaks of petroleum, oils, and lubricant and hazardous materials occurred throughout the usage period. However, the final disposition of the suspected underground storage tanks (USTs) at the fuel islands was not determined.

The new ECP site (Site 5) had not been previously identified or investigated under existing environmental program areas. As a result, a Phase II ECP Investigation was conducted in 2004 to determine if a release/disposal actually occurred at the site. A total of eight soil borings (5E-01 through 5E-08) were advanced at the site to depths ranging from 10 to 25.5 feet below ground surface (bgs). Six of the borings (5E-01 and 5E-06) were advanced in former vehicle maintenance area, and two of the borings (5E-07 and 5E-08) were advanced in the former refueling area. During advancement of the borings, the soil cores were field-screened using a photoionization detector (PID) and flame ionization detector (FID). Minor PID/FID measurements (1 to 12 parts per million [ppm]) were detected at borings 5E-05 and 5E-08.

Surface soil samples (0 to 1 foot bgs) were collected from borings 5E-01 through 5E-06. Surface soil samples were not collected from borings 5E-07 and 5E-08 because they were located on a concrete pad. Two subsurface soil samples were collected from each boring location (5E-01 through 5E-08) from two-foot intervals (i.e., 1 to 3 feet bgs, 3 to5 feet bgs, etc.). The subsurface soil samples from borings 5E-05 and 5E-08 were collected from depth intervals exhibiting the highest PID/FID measurements.

Based on field screening results of the subsurface soils, two temporary monitoring wells were installed at borings 5E-05 and 5E-08 to monitor groundwater due to the observation of fractures in the weathered bedrock within the site area. These wells are identified as 5E-TW05 and 5E-TW08 respectively. Groundwater was first observed at 5E-TW05 at 15 feet within weathered rock and at 5E-TW08 at approximately 22 feet within weathered rock. Groundwater well screens were placed from 10 to 20 feet and 15.5 to 25.5 feet, respectively. Groundwater samples were collected from these two temporary wells and existing permanent well 13MW04.

The soil and groundwater samples were analyzed for Appendix IX volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides/polychlorinated biphenyls (PCBs), organophosphorus pesticides, chlorinated herbicides, and metals (dissolved fraction for groundwater).

2.3.2 Phase II ECP Investigation Results

Contaminants detected in surface soil included inorganic compounds. Contaminants detected in subsurface soil included VOCs, SVOCs, pesticides, chlorinated herbicides, and metals.

The Phase II ECP Investigation and subsequent analysis determined that VOCs detected in soil are associated with chlorinated compounds. In addition, acetone also was detected in subsurface soil. The SVOCs detected in soil primarily included polynuclear aromatic hydrocarbons (PAHs) associated with fuel contamination. Pesticides detected in soil likely are a result of the proximity and topographically downgradient location of SWMU 59 in relation to SWMU 13 and SWMU 53, both of which have documented incidences of pesticide spills (NAVFAC Atlantic, 2005).

Contaminants detected in groundwater included VOCs, SVOCs, a pesticide, and metals. During the field investigation, a petroleum odor was noted during groundwater sampling at monitoring well 5E-08, but petroleum-related constituents were not detected in the VOC fraction during the subsequent analysis. In addition, low dissolved oxygen (less than 1 milligram per liter [mg/L]) was noted in groundwater at well 13MW04, which may be indicative of biological activity in groundwater proximate to this area. However, no organic constituents were detected in groundwater from this well.

Based on analytical results from the Phase II ECP investigation, primarily detections of fuel related compounds, chlorinated compounds, and pesticides at this site, as well as exceedances of criteria for arsenic, lead, and heptachlor epoxide it was concluded that soil and potentially groundwater at the site has been impacted by previous activities. Additionally, based on field observations during the investigation, it was tentatively concluded that groundwater also may have been impacted by previous activities. Consequently, it was recommended that additional sampling be undertaken as part of the RCRA Corrective Action Program to permit a more detailed assessment, which was the basis for incorporating SWMU 59 into the RCRA §7003 Administrative Order on Consent (USEPA, 2007) and ultimately for conducting this CMS Investigation.

2.4 References

NAVFAC Atlantic. 2005. Final Phase I/II Environmental Condition of Property Report, Former U.S. Naval Station Roosevelt Roads, Ceiba, Puerto Rico. July 15, 2005.

USEPA. 2007. RCRA § 7003 Administrative Order on Consent. In the Matter of: United States The Department of the Navy, Naval Activity Puerto Rico formerly Naval Station Roosevelt Roads, Puerto Rico. Environmental Protection Agency, EPA Docket No. RCRA-02-2007-7301. January 29, 2007.

3.0 PHYSICAL CHARACTERISTICS OF STUDY AREA

The physical setting of NAPR was documented in the Initial Assessment Study of Naval Station Roosevelt Roads (Naval Energy and Environmental Support Activity [NEESA], 1984). Pertinent information is summarized in the following sections.

3.1 Climatology

The climate associated with NAPR is characterized as warm and humid with frequent showers occurring throughout the year. A major factor affecting the weather is the pattern of trade winds associated with the Bermuda High, the center of which is in the vicinity of 30° North, 30° West. The prevailing wind direction reflects the easterly trade winds. The area receives a surface flow varying between the northeast to the southeast about 75 percent of the year, and as much as 95 percent of the time in July when the easterly winds are strongest. The differential heating of the land and sea during the day tends to give a more northerly component to the flow on the northern side of the island and a more southerly component on the southern side. During the night, a land breeze causes a prevailing southeasterly flow in the north and a prevailing northeasterly flow over the southern coast. The mean annual wind velocity is 5.5 knots with a minimum in November and a maximum in August. Gales associated with westward moving disturbances in the trade winds or hurricanes passing either north or south of the area have the highest probability of occurrence from June through October.

Uniform temperatures prevail with small diurnal ranges as a result of insular exposure and the relatively small land areas. The warmest months are August and September, while the coolest are January and February. Mean annual maximum temperatures range from 82.0° Fahrenheit (F) in January to 88.2° F in August. The mean annual minimum temperatures vary from 64.0° F in January to 73.2° F in June. The highest maximum temperature recorded was 95.0° F, while the lowest minimum was 59.0° F. Rain usually occurs at least nine days in every month with an average of 60 inches per year, although a dry winter season occurs from December through April. About 22 thunderstorm-days occur per year with maximum frequencies of three days per month from May through October.

In late summer, the mean sky cover begins a steady decrease from a monthly maximum average of 6.5-tenths coverage in September to a minimum monthly average of 4.4-tenths coverage in February. From March through August, the monthly average cloud cover increases steadily from 4.5 to 6.0-tenths coverage. Over the open sea, a maximum of clouds (usually broken stratocumulus) occurs during early morning. The skies generally clear or become scattered with cumulus clouds by afternoon. Completely clear or overcast skies are rare during daylight hours, while clear skies frequently occur at night.

An average of two tropical storms per year occurs in the study area, one of which usually reaches hurricane intensity. The hurricane season is from mid-June through mid-September, and maximum winds exceed 95 knots during severe hurricanes.

3.2 Topography

The regional area of NAPR consists of an interrupted, narrow coastal plain with small valleys extending from the Sierra de Luquillo range, which has been severely eroded by streams into valleys several hundreds of feet deep. Slopes up to 60° are common.

In the immediate area of NAPR, elevations range from sea level to approximately 295 feet above sea level. Immediately north of the NAPR boundary, the hills rise abruptly to heights of 800 to 1,050 feet above sea level. The tallest peak is located within 2 kilometers of the NAPR boundary. There is a series of three hilly areas at NAPR, two of which separate the southern airfield area from the port/industrial, housing, and personnel support areas. The third set of hills is in the Fort Bundy area. These ridgelines not only separate sections of NAPR, but also dictate the degree of allowable development. Relief is low along the shoreline, and lagoons and mangrove swamps are common.

3.3 Geology, Hydrology, and Hydrogeology

The following sections present general descriptions of the geologic, hydrologic, and hydrogeologic conditions across NAPR. Specific geologic and hydrogeologic information for SWMU 59 is provided in Section 5.0.

3.3.1 Soils

The soil associations present at NAPR predominantly consist of the Swamps-Marshes Association and the Mabi-Rio-Arriba-Cayagua Association, which are typical of humid areas, and the Descalabrado-Guayama Association, which is typical of dry areas. In addition, isolated areas of the Caguabo-Mucara-Naranjito Association, the Coloso-Toa-Bajura Association, and the Jacana Amelia-Fraternidad Association are present at NAPR. The Swamps-Marshes Association and Mabi-Rio-Arriba-Cayagua Association cover over one half of NAPR's surface area and are equally distributed. The Descalabrado-Guayama Association and Caguabo-Mucara-Naranjito Association primarily cover the remaining area.

The Swamps-Marshes Association consists of deep, very poorly drained soils. This association is present in level or nearly level areas that are slightly above sea level but are wet, and when the tide is high, are covered or affected by saltwater or brackish water. The soils are sandy or clayey and contain organic materials from decaying mangrove trees. Coral, shells, and marl at varying depths underlie these soils. The high concentration of salt inhibits the growth of vegetation except mangrove trees and, in small-scattered patches, other salt-tolerant plants.

The Mabi-Rio-Arriba-Cayagua Association generally consists of deep, somewhat poorly drained and moderately well drained, nearly level to moderately steep soils present on foot and side slopes, terraces, and alluvial fans. Soils of this association are basically clayey.

The Descalabrado-Guayama Association generally consists of shallow, well drained, strongly sloping to very steep soils on volcanic uplands. Soils of this association are present primarily in the hilly areas located directly inland and adjacent to soils of the Swamps-Marshes Association.

The Caguabo-Mucara-Naranjito Association generally consists of shallow and moderately deep, well drained, sloping to very steep soils on volcanic uplands. The soils of this association formed in residual material weathered from volcanic rocks. The association is represented at NAPR by soils of the Sabana series, which are present on the side slopes and hilly terrain west of Langley Drive in the Fort Bundy area. These soils are suited for pasture and woodland. Steep slopes, susceptibility to erosion, and depth to bedrock are the main limitations for farming and for recreation and urban areas.

The Coloso-Toa-Bajura Association generally consists of deep, moderately well drained to poorly drained, nearly level soils present on floodplains. This soil association extends along the western boundary of NAPR and around the airfield. The soils of this association formed in fine-textured and moderately fine-textured sediment of mixed origin on floodplains. The Coloso soils are deep and somewhat poorly drained; the Toa soils are deep and moderately well drained; and the Bajura soils and Maunabo soils are deep and poorly drained. The Reilly soils, also part of this association, are shallow sands and gravels and are excessively drained. These soils lie adjacent to streams. The minor soils include Talante, Vivi, Fortuna, Vega Alta, and Vega Baja. The Talante, Vivi, Fortuna, and Vega Baja soils are present on floodplains, while the Vega Alta soils occupy slightly higher positions on terraces.

The Jacana-Amelia-Fraternidad Association generally consists of moderately deep and deep, well drained and moderately well drained, nearly level to strongly sloping soils on terraces, alluvial fans, and foot slopes. This association is represented at NAPR by soils of the Jacana series, which consist of moderately deep, well-drained soils present on the foot slopes and low rolling hills along Langley Drive and just east of the airfield. These soils formed in fine-textured sediment and residuum derived from basic volcanic rocks.

3.3.2 Regional Geology

The underlying geology of NAPR is predominantly volcanic (composed of lava and tuff) and sedimentary (rocks derived from discontinuous beds of limestone). These rocks all range in age from the early Cretaceous to middle Eocene periods. The volcanic rocks and interbedded limestone have been complexly faulted, folded, metamorphosed, and variously intruded by dioritic rocks. This complex geological structuring occurred sometime after deposition of the limestone during the middle Tertiary period when Puerto Rico was separated from the other major Antillean Islands by block faulting and was arched, uplifted, and tilted to the northeast. Culebra, Vieques, and the Virgin Islands are part of the Puerto Rican block. These islands are separated from the main island simply because of the drowning that resulted from the tilting. In addition to the predominant volcanic and sedimentary rock, unconsolidated alluvial and older deposits from the Quaternary period underlie the northwestern and western sectors of the base.

The primary geologic formations on and near NAPR include various beach deposits, alluvium, quartz diorite and granodiorite, quartz keratophyre, the Daguao Formation, and the Figuera Lava. The Daguao Formation consists of massive, andesitic, interbedded, volcaniclastic breccia, lava, and subordinate sandstone and crystal tuff (M'Gonigle, 1977a). The Figuera Lava consists of massive, andesitic lava that is locally pillowed and inter-layered with very minor autobrecciated lava, tuffaceous sandstone, siltstone, and hyaloclastite breccia. A thin unit of non-welded, ash-flow tuff is also present (Briggs, 1973). The Peña Pobre fault zone extends from the Humacao area northward towards the Naguabo area. From the Peña Pobre fault, one or more faults may trend northeast under the alleviated low lands through NAPR and past the town of Ceiba. This is based mainly on physiography since the Figuera Lava and Daguao Formations do not contain very many marker beds, and there is very little exposure of these formations (M'Gonigle, 1977b).

3.3.3 Regional Hydrology

The surface waters that flow across the northeastern plain of Puerto Rico, where NAPR is located, originate on the eastern slopes of the Sierra De Luquillo Mountains. Surface run-off is channeled into various rivers and streams that eventually flow into the Caribbean Sea. The Rio Daguao River and Quebrada Seca Stream (a tributary to Rio Daguao River) collect surface waters from the hills immediately north of NAPR, and during periods of heavy rain, flooding on NAPR occurs. The Daguao-Quebrada Seca watershed comprises an area of approximately 7.6 square

miles (4,900 acres), and the river falls some 700 feet from its source to sea level. Increased development in the town of Ceiba, especially in areas adjacent to NAPR's northern boundary, has significantly increased the surface run-off reaching NAPR, which results in ponding and erosion in the Boxer Drive area. Boxer Drive, for a major portion of its length, is subject to surface water flooding, as are Hangar 200, Hangar 379, and adjacent apron areas. This condition has been alleviated by construction of a new highway (Route 3) immediately outside the fence, realignment of Boxer Drive, and installation of storm water management features associated with both roadways.

In the low-lying shore areas, seawater flooding results from storms, wind, and abnormally high tides. The tidal ranges in the NAPR area are rather small with a maximum spring range of less than 3 feet. The tides are semidiurnal and have a usual range of about 1 foot in the main harbor of NAPR.

The quality of surface waters is variable, which is a reflection of the drainage area through which the water flows. Generally, surface waters have high turbidities and bio-organics (naturally occurring organics such as decay products of vegetable and animal matter) due to the periodic heavy rains that can easily erode soils from steep slopes, exposed areas, and disturbed streambeds.

Water from alluvial aquifers along the coast of NAPR is of a calcium bicarbonate type and has high concentrations of iron and manganese. The source of these minerals is unknown, but they may be derived from buried swamp or lagoon deposits. A seawater-freshwater interface is present in the aquifers throughout the coastal areas of Puerto Rico usually within a short distance inland of the coastline.

The NAPR potable water treatment plant receives raw water from the Rio Blanco through a 27-inch, reinforced concrete pipe that replaced the old, open channel. The intake is located at the foot of the El Yunque rain forest. This buried raw water line traverses a distance of 14 miles from the intake to the NAPR boundary. A raw water reservoir is located at the water treatment plant and has a 45 million gallon capacity. In addition, there are two fire protection storage reservoirs with a total capacity of 520,000 gallons.

NAPR has been served for over 30 years by the present treatment facility. The plant (Building 88) has a capacity of 4.0 million gallons per day (MGD). Water flows by gravity into a 45 million-gallon, raw water storage basin from which the plant draws its supply at a rate of 1.3 MGD on average. Treatment consists of pre-chlorination, coagulation sedimentation, filtration, and post-chlorination.

3.3.4 Regional Hydrogeology

Little information exists concerning the hydrogeology of NAPR. The only known potential sources of groundwater lie in lenticular beds of clay, sand and gravel, and rock fragments which occur at a depth of less than 30 meters. No wells have been developed on base from these layers. Some wells had been developed upgradient of NAPR in Ceiba, some three kilometers from base headquarters, but were abandoned due to high levels of salinity.

The hydrogeology can be better understood in context of the NAPR regional geology. For the sake of simplicity, the NAPR regional geology can be divided into the following three regions:

- Upland areas
- Near-shore flat land areas
- Inland flat land areas

The upland areas of NAPR include the hills encompassing the Tow Way Fuel Farm and hospital areas and the hills encompassing the area behind the exchange, the former Atlantic Fleet Weapons Training Facility Command, and the Fort Bundy area. These upland areas are underlain by bedrock which exhibits varying degrees of weathering. Typically, the bedrock is overlain by a relatively thin residual soil that originated from weathered-in-place bedrock. This residual soil generally consists of sand, silt, and clay.

The near-shore flat land areas include mangrove swamps and the shores of Ensenada Honda and Puerca Bay. The near-shore areas are typically underlain by marine sand layers with coral and shell fragments, silt and clay layers, and occasional peat layers. In some near-shore areas, particularly by the harbor and Camp Moscrip in the southeastern portion of NAPR, fill material overlays the marine layers. The fill consists of rock fragments, debris (e.g., brick), sand, silt, and clay.

The inland flat land areas generally encompass the airfield and golf course areas and are typically underlain by relatively thick residual soil. In general, the residual soil consists predominately of clay. Fill material overlays the residual soil in some areas, particularly the airfield, and generally consists of sand and gravel with lesser amounts of silt and clay.

3.4 References

Briggs, R.P. 1973. The Lower Cretaceous Figuera Lava and Fajardo Formation in the Stratigraphy of Northeastern Puerto Rico. U.S. Geological Survey Bulletin 1372-G. 10 pages.

M'Gonigle, J.W. 1977a. The Rio Abajo, Pitahaya, and Daguao Formations in Eastern Puerto Rico. U.S. Geological Survey Bulletin 1435-B. 10 pages.

M'Gonigle, J.W. 1977b. Preliminary Geologic Map of the Naguabo and part of the Punta Puerca Quadrangles, Puerto Rico. U.S. Geological Survey Open File 77-564.

NEESA. 1984. Initial Assessment Study of Naval Station Roosevelt Roads, Puerto Rico. NEESA 13-051.

4.0 CMS INVESTIGATION ACTIVITIES

This section summarizes the 2010 CMS Investigation and the 2012 CMS Investigation and pre-excavation delineation sampling field work, analytical, and data validation activities. The April/May 2010 CMS Investigation included:

- Advancement of 23 soil borings and collection of 19 surface soil samples and two subsurface soil samples (46 samples) per boring
- Installation of 10 monitoring wells and collection of 10 groundwater samples
- Hydraulic conductivity testing at eight of the 10 monitoring wells
- Collection of freshwater drainage ditch surface water and sediment samples from three locations

The September 2012 CMS Investigation included:

- Advancement of 10 soil borings within the concrete slab/asphalt paved areas and collection of 10 surface soil and 10 shallow subsurface soil samples per boring
- Collection of freshwater drainage ditch sediment samples from nine locations

The September/November 2012 pre-excavation delineation sampling included:

- Collection of 24 pre-excavation delineation surface soil samples during the September 2012 sampling event
- Collection of 10 additional pre-excavation delineation surface soil samples during the November 2012 sampling event

Other activities also were conducted in support of the investigations and included utility clearance, site clearing, groundwater elevation measurement, surveying, investigation derived waste (IDW) management, QA/QC sampling, laboratory analysis, and data validation. The investigations were conducted in accordance with the Final CMS Work Plan for SWMU 59 (Baker, 2007) as well as the Work Plan letter (*Request for Additional Sampling Necessary for Completion of the Corrective Measures Study Investigation for SWMU 59*) (Baker, 2012). Minor deviations from the Work Plan were made as a result of field conditions encountered during the investigations and are described within the appropriate sections that follow.

A summary matrix showing the primary environmental, field duplicate, and matrix spike/matrix spike duplicate (MS/MSD) samples collected and the associated analyses are presented in Table 4-1. Other QA/QC samples (e.g., trip blanks, field blanks, equipment rinsate blanks) collected and the associated analyses are presented in Tables 4-2. Site photographs, field logbook notes, daily meter calibration records, soil boring and monitoring well logs, groundwater sampling forms, chain-of-custody forms, slug test results, and IDW disposal documentation are included in Appendix A. The laboratory analytical results, parameter lists, and quantitation limits are included in Appendix B, and the data validation report summaries are included in Appendix C. The following sections present an overview of the investigation rationale and procedures.

4.1 Surface and Subsurface Soil Sampling

April/May 2010 CMS Investigation

A total of nineteen surface soil samples were collected from soil borings 59SB01 through 59SB04, 59SB06 through 59SB09, 59SB11 through 59SB15, 59SB17, 59SB18, and 59SB20 through 59SB23 (see Figure 4-1). Surface soil samples were collected using Macro-Cores® during boring advancement from a depth of 0 to 1 foot bgs. The samples were collected after removing any vegetation and topsoil/root zones. Surface soil samples were not collected from soil borings 59SB05 and 59SB16 since they were located on an asphalt roadway or from soil borings 59SB10 or 59SB19 since they were located on a concrete pad.

A total of forty-six subsurface soil samples were collected from twenty-three soil borings (59SB01 through 59SB23 as shown on Figure 4-1). Two subsurface soil samples were collected from each boring. Since impacts to subsurface soil were not evident based on visual, olfactory, or PID screening, subsurface soil samples were collected from the 1 to 3 feet bgs interval (immediately below the surface soil interval) and the interval just above the apparent water table. Therefore, twenty-three shallow (1 to 3 feet bgs) subsurface soil samples were collected from the soil borings. Two deeper subsurface soil samples were collected from 3 to 5 feet bgs; two deeper samples were collected from 5 to 7 feet bgs; two deeper samples were collected from 7 to 9 feet bgs; and 17 deeper samples were collected from 9 to 11 feet bgs. VOCs were re-collected on May 24, 2010 for subsurface soil sample location 59SB11-02; the original VOC vials for this sample collected on May 19, 2010 were not received by the laboratory. The samples were transferred directly into pre-labeled, laboratory provided sample jars and placed on ice.

The soil boring locations were proposed within and around the vehicle maintenance and refueling area to determine potential impacts from operations associated with the vehicle maintenance facility (i.e. underground storage tanks, oil/water separator, fueling islands, and equipment laydown area). The soil borings and associated monitoring wells were installed at the locations proposed in the Work Plan with the exception of soil borings 59SB15, 59SB20, and 59SB21 and monitoring wells 59BS02, 59SB06, 59SB07, 59SB08, and 59SB09. The rationale for relocating these sample locations are listed below:

- Soil borings 59SB08, 59SB09, 59SB20, and 59SB21 are located along the northern portion of the concrete pad as shown on Figure 4-1. These soil borings were proposed in the Work Plan (Baker, 2007) to be on the concrete pad however, were moved to locations immediately off of the concrete pad to allow for the collection of surface soil samples (i.e., to identify possible contamination that may have migrated from the concrete pad).

- Soil boring 59SB07 was proposed in the Work Plan to be located near the northwest corner of the concrete pad. Soil boring 59SB07 was moved approximately 40 feet southwest in the presumed downgradient location off of the concrete pad. This soil boring was moved to allow for the collection of a surface soil sample (i.e., to identify possible contamination that may have migrated from the concrete pad) and potentially identify groundwater impacts from the northwest portion of the facility and Building 258.

- Soil boring 59SB02 was proposed to be located on the asphalt roadway east of the fuel island in the work plan. Soil boring 59SB02 was moved approximately 70 feet west to a location in the presumed downgradient groundwater flow direction near the center of the fuel island. This soil boring was moved to allow for the collection of a surface soil sample (i.e., to identify possible contamination that may have migrated from the fuel island) and potentially identify groundwater impacts from the fuel island and/or USTs.

Moving this location will help to eliminate a potential data gap related to the potential UST and fuel islands at SWMU 59.

- Soil boring 59SB06 was proposed to be located on the northwest portion of the fuel island. Soil boring 59SB06 was moved approximately 50 feet southwest to a location in the assumed downgradient groundwater flow direction and off of the fuel island (near the southwest end of the fuel island). This soil boring was moved to allow for the collection of surface soil sample (i.e., to identify possible contamination that may have migrated from the fuel island) and potentially identify groundwater impacts from the fuel island and/or USTs.

- Soil boring 59SB12 was moved approximately 20 feet southwest to accommodate moving well 59SB02 downgradient of the fuel islands. Soil boring 59SB12 was moved to space out the sample collection points downgradient of the fuel islands. A soil pile was observed in the area and 59SB12 was located adjacent to the soil pile.

- Soil boring 59SB15 was proposed to be located on concrete (i.e., the floor of one of the former, small buildings in this area) in the Work Plan (Baker, 2007). Soil boring 59SB15 was moved approximately 40 feet southwest to a location in the assumed downgradient groundwater flow direction and off of the former concrete floor. This soil boring was moved to allow for the collection of a surface soil sample (i.e., to identify possible contamination that may have migrated from the former buildings) and potentially identify groundwater impacts from these former buildings.

Soil borings were advanced using a track-mounted Geoprobe rig (operated by GeoEnviroTech, Inc. of San Juan, Puerto Rico) and direct push technology (DPT) methods. The soil samples were collected using a Geoprobe sampler and disposable, clear acetate liners. A summary of soil boring and monitoring well specifications is provided in Table 4-3. Soil boring logs are presented in Appendix A.

Soil borings were advanced to depths ranging from 10 to 24 feet bgs. Soil samples were field-screened for non-specific, total VOCs using a PID equipped with an 11.7 electron volt (eV) probe and calibrated to isobutylene. The PID readings were recorded on the drilling logs for each boring (Appendix A). The field screening procedure for soils collected using the DPT Macro-Core® (MC) Sampler involved making a longitudinal cut along the entire length of the MC liner, separating the two edges of the liner, and screening the entire length of the soil core with a PID at approximately 0.5 foot intervals. Measurable organic vapors above background levels were not observed in any of the 23 boreholes or during the general PID air monitoring.

VOC samples were collected immediately after the sample liner was cut and the sample was screened with the PID. Soil for VOC analysis was collected using TerraCore® sampling devices and preserved in accordance with USEPA Method 5035 by placing 5 gram aliquots of the sample in one pre-weighed, 40-milliliter vial containing methanol and two pre-weighed, 40-milliliter vials containing sodium bisulfate (supplied with the TerraCore® sampling kit). Following VOC sampling, soil was homogenized and soil samples for Appendix IX SVOCs (including low level polynuclear aromatic hydrocarbons [LLPAHs]), pesticides, and metals were transferred directly into pre-labeled sample jars and placed on ice. All surface and subsurface soil samples were submitted for laboratory analysis of Appendix IX VOCs, SVOCs with LLPAHs, pesticides, and metals. Table 4-1 provides a summary of the surface and subsurface soil samples collected at SWMU 59 during the April/May 2010 CMS investigation. QA/QC samples collected during the soil sampling program are summarized on Table 4-2. Locations of these surface and subsurface soil samples are shown on Figure 4-1.

September 2012 CMS Investigation

Additional soil samples were collected during the September 2012 CMS Investigation to complete characterization of soils beneath the concrete pads and pavement. Prior to sampling, the concrete/asphalt was visually inspected for joints, cracks, holes, and other signs of deterioration that may have acted as a conduit for potential contaminant migration.

A total of ten surface soil samples were collected from borings 59SB24 through 59SB33 (see Figure 4-1). Surface soil samples were collected using Macro-Cores® during boring advancement from the 0 to 1-foot depth interval immediately below the concrete or asphalt surface and gravel sub-base.

A total of ten subsurface soil samples were collected from borings 59SB24 through 59SB33 from the 1 to 3-foot depth interval below the concrete or asphalt surface and gravel sub-base. Since impacts to subsurface soil were not evident based on visual, olfactory, or PID screening, subsurface soil samples were collected only from the 1 to 3-foot depth interval (immediately below the surface soil interval) as described in the June 15, 2012 Work Plan letter.

The borings were advanced using a track-mounted Geoprobe rig (operated by On-Site Environmental, Inc. of Dorado, Puerto Rico) and DPT methods. The soil samples were collected using a Geoprobe sampler and disposable, clear acetate liners. The Geoprobe rig utilized a carbide tip drill bit to break the concrete or pavement to gain access to the soils beneath the concrete or pavement with the soil sampling tools. A summary of soil boring specifications is provided in Table 4-3. Soil boring logs are presented in Appendix A.

VOC samples were collected immediately after the sample liner was cut and the sample was screened with the PID. Soil for VOC analysis was collected using TerraCore® sampling devices and preserved in accordance with USEPA Method 5035 by placing 5 gram aliquots of the sample in one pre-weighed, 40-milliliter vial containing methanol and two pre-weighed, 40-milliliter vials containing laboratory-grade deionized (DI) water (supplied with the TerraCore® sampling kit). Following VOC sampling, soil was homogenized and soil samples for Appendix IX SVOCs (including LLPAHs) and metals were transferred directly into pre-labeled sample jars and placed on ice. All surface and subsurface soil samples were submitted for laboratory analysis of Appendix IX VOCs, SVOCs with LLPAHs, and metals. Table 4-1 provides a summary of the surface and subsurface soil samples collected from beneath the concrete pads and pavement at SWMU 59 during the September 2012 CMS investigation; associated QA/QC samples are summarized on Table 4-2. Locations of these surface and subsurface soil samples are shown on Figure 4-1.

September/November 2012 Pre-Excavation Delineation Sampling

Pre-excavation delineation sampling was conducted to further refine the proposed excavation areas and minimize the uncertainty associated with the lateral extent of contaminated soil. The locations of the pre-excavation delineation samples (59SS01 through 59SS34) are shown on Figure 4-2. A summary of the sampling and analytical program is presented in Table 4-1. The samples were collected using the Geoprobe rig and DPT methods or stainless steel spoons from 0 to 1 foot bgs or below the concrete pad or asphalt/gravel sub-base as described below. Note that the originally proposed delineation samples (59SS01 through 59SS24) were collected during the September 2013 sampling event. The November 2013 samples (59SS25 through 59SS34) were located, as discussed below, based on the analytical results from the September event to complete the pre-excavation delineation at each of the areas.

Proposed Area 1 –Two surface soil samples (59SS01 and 59SS02) were collected approximately 25 feet north and east of boring 5E-02. In addition, one sample (59SS03) was collected south of boring 5E-02 from below the concrete pad/gravel sub-base. The samples were analyzed for lead and zinc. An additional delineation sample (59SS25) was collected approximately 35 feet west of 59SS01 for zinc analysis to complete the zinc delineation in this area.

Proposed Area 2 – One surface soil sample (59SS04) was collected approximately 25 feet west of boring 5E-03; two samples (59SS05 and 59SS06) were collected approximately 25 feet south of boring 59SB09 from below the concrete pad/gravel sub-base; one surface soil sample (59SS07) was collected approximately 25 feet south of boring 5E-04. The samples were analyzed for copper, lead, and zinc. An additional delineation sample, 59SS26 was collected west of 59SS04 for copper, lead and zinc analysis to complete the delineation between Areas 1 and 2. Two additional delineation samples (59SS27 and 59SS28) were also collected south of 59SS07, between 59SS07 and 59SS08 for lead and zinc analysis to complete the delineation of these parameters between Areas 2 and 3.

Proposed Area 3 – Two surface soil samples (59SS08 and 59SS09) were collected approximately 25 feet north and south of boring 5E-06. In addition, one sample (59SS10) was collected approximately 25 feet west of boring 5E-06 from below the concrete pad/gravel sub-base. The samples were analyzed for lead and zinc. As indicated above, two additional delineation samples (59SS27 and 59SS28) were collected between 59SS07 and 59SS08 for lead and zinc analysis to complete the delineation of these parameters between Areas 2 and 3. Two additional delineation samples (59SS29 and 59SS30) were also collected south of 59SS09 for lead analysis to complete the delineation between Areas 3 and 4.

Proposed Area 4 –Three surface soil samples (59SS11 through 59SS13) were collected approximately 25 feet north, west, and east of boring 59SB14. The samples were analyzed for copper and zinc. An additional delineation sample (59SS31) was collected west of 59SS12 for zinc analysis to complete the delineation of Area 4.

Proposed Area 5 –Two surface soil samples (59SS14 and 59SS15) were collected approximately 25 feet west and east of boring 59SB15. In addition, one sample (59SS16) was collected approximately 25 feet north of boring 59SB15 from below the asphalt pavement/gravel sub-base. The samples were analyzed for lead and zinc.

Proposed Area 6 –Four surface soil samples (59SS17 through 59SS20) were collected approximately 25 feet radially outward in the cardinal compass directions from boring 59SB17. The samples were analyzed for zinc. An additional delineation sample (59SS32) was collected was collected south of 59SS20 for zinc analysis to complete the southern delineation of Area 6.

Proposed Area 7 –Four surface soil samples (59SS21 through 59SS24) were collected approximately 25 feet radially outward in the cardinal compass directions from boring 59SB12. The samples were analyzed for zinc. Two additional delineation samples (59SS33 and 59SS34) were collected for zinc analysis north and west of Area 7 to complete the zinc delineation.

4.2 Monitoring Well Installation and Groundwater Sampling

Installation of monitoring wells and groundwater sampling took place during the April/May 2010 CMS Investigation. A summary of soil boring and monitoring well specifications is provided in Table 4-3. Soil boring logs and well construction records are presented in Appendix A. There were no additional monitoring wells installed or groundwater samples collected during the September 2012 CMS Investigation.

Monitoring wells were installed in ten (59SB01 through 59SB10) of the twenty-three soil borings using hollow-stem augers (HSAs). The locations of the monitoring wells are shown on Figure 4-1. The monitoring well array was proposed in order to delineate potential impacts to groundwater from former SWMU 59 activities. As stated in the previous section, the monitoring wells were installed at the locations proposed in the work plan with the exception of 59BS02, 59SB06, 59SB07, 59SB08, and 59SB09 which were moved based on field conditions. Movement of these groundwater monitoring wells was practical with regards to soil sample collection and still provided adequate spacing and positioning to delineate potential groundwater contamination.

The Work plan for SWMU 59 stated that depth to groundwater was expected to be within 10 to 15 bgs (Baker 2007). However, the total depths of the monitoring wells varied from approximately 15 feet bgs to 24 feet bgs depending on the interpreted depth to the saturated soil. Monitoring wells were constructed of 2.0-inch Inside Diameter (ID), Schedule 40 Polyvinyl Chloride (PVC), with flush joint threads. Each well was provided with 10-foot long well screens and attempts were made to install the screens to straddle the water table. The well screen and bottom cap were set at the bottom of the borehole and the screen was connected to a threaded, flush-joint, riser. The annular space around the well screen was backfilled with a well-graded, fine to medium sand as the augers were withdrawn from the borehole. The sand was extended to approximately two feet above the top of the screened interval. An approximately two-foot thick sodium bentonite seal was placed above the sand pack. The bentonite was hydrated with potable water. The annular space above the bentonite seal was backfilled with a cement/bentonite grout to prevent surface water from infiltrating into the screened groundwater monitoring zone. An expandable, water tight locking cap with a vent hole was placed at the top of the casing. The wells at boring locations 59SB01, 59SB02, 59SB03, 59SB04, 59SB06, 59SB07, 59SB08, and 59SB09 were completed at the surface with a stickup of approximately three feet; a five foot protective casing constructed of four-inch square steel was used. The protective casing was placed over the riser and surrounded by an approximate 2 feet by 2 feet (length x width) and 6 inches thick concrete pad. Steel bollards were installed at all wells that were completed at the surface with a stickup protective casing. As additional protection, the steel bollards were painted a bright color to aid in visibility. The wells at boring locations 59SB05 and 59SB10 were completed at the surface with a "flush" manhole type cover given their location on the asphalt roadway and concrete pad, respectively.

Monitoring well development consisted of surge and bail using a decontaminated bailer. In most cases, more than three well volumes of water were removed in an effort to reduce turbidity and improve clarity to ensure successful low flow sampling parameter equilibrium. An attempt was made to reduce turbidity to less than 20 Nephelometric Turbidity Units (NTUs), as specified in the work plan. A minimum of three well volumes were bailed from each of the newly installed wells, with the exception of 59SB03, meeting the development criteria. Well 59GW03 intercepted only approximately 2.0 feet of the water table and was identified as low yield during development. Well 59SB03 required several periods of recharge between individual development to remove the required three well volumes.

The groundwater was sampled using a decontaminated bladder pump equipped with a new Teflon bladder and low-flow sampling techniques at each well with the exception of well 59GW03 due to its insufficient groundwater yield observed during development. Well 59SB03 was sampled using a decontaminated bladder pump once it recovered sufficiently from presample dewatering.

For the wells sampled using low-flow techniques, field parameters of pH, temperature, turbidity, conductivity, dissolved oxygen, and oxidation-reduction potential were measured and recorded on individual Well Detail and Sample Logs, which can be referenced in Appendix A. The sampling

criteria were met as there were no significant deviations of the required sample purge field parameters (turbidity was slightly outside the suggested plus/minus 10 percent range for several samples). The groundwater samples for dissolved metals analysis were filtered in the field using new, disposable in-line filters (0.45 micrometer). The groundwater sample designations correspond to the representative soil boring location. For example, the groundwater sample collected from soil boring location 59SB01 was designated 59GW01.

Ten groundwater monitoring wells (newly installed wells 59SB01 through 59SB10) were sampled at SWMU 59 during the April/May 2010 CMS investigation. The samples were transferred directly into pre-labeled, laboratory provided sample jars and placed on ice. The samples were shipped in coolers with chain-of-custody forms (provided in Appendix B) to the fixed-base analytical laboratory for analysis. All groundwater samples were analyzed for Appendix IX VOCs, SVOCs with LLPAHs, pesticides, and total and dissolved metals as outlined in the Work Plan and on Table 4-1.

4.3 Groundwater Level Measurements

Depth to groundwater measurements were collected during the April/May 2010 CMS field investigation from each of the newly installed monitoring wells shortly after installation and prior to and after well development and sampling activities.

Additionally, groundwater measurements were collected from the ten newly installed monitoring wells and existing wells 13MW04 and 74VP07b at the end of the April/May 2010 field investigation on May 24, 2010 to allow for groundwater equilibration in the respective wells. Two additional rounds of groundwater elevation measurements were collected on January 13, 2011 and August 30, 2011 to provide an indication of the seasonal groundwater elevation. The water level measurements are provided in the field logbooks in Appendix A and the water level measurements and calculated groundwater elevations are summarized on Table 4-3.

Groundwater levels were measured from the top of PVC riser and the groundwater elevations were calculated from the surveyed elevation of the top of riser. A discussion of the survey activities are provided in Section 4.8. The groundwater level measurements were used during well development, groundwater sampling, and hydraulic conductivity testing activities (e.g., calculate well volumes and monitor draw down) and to develop a potentiometric surface/groundwater contour map. Potentiometric surface maps for SWMU 59 were developed using the May 24, 2010 and January 13, 2011 groundwater level data and are discussed in Section 5.2.2.

4.4 Surface Water and Sediment Sampling

April/May 2010 CMS Investigation

The approved Final SWMU 59 CMS Work Plan (Baker, 2007) did not identify surface water or sediment as a sampling media. However, during the April/May 2010 CMS field investigation the field team observed that an outfall was present across the street beyond the SWMU boundary (west of Forrestal Road). The field team determined that stormwater was being diverted through a series of culverts from the SWMU, underneath Forrestal Drive, to an outfall that drains into a small pool, contiguous to a freshwater drainage ditch. Therefore, the field team decided to collect three surface water and sediment samples, as follows:

- 59SW01/59SD01 - collected from the small pool of water near where the outfall discharges.

- 59SW02/59SD02 - collected on the north side of the pool of water across Forrestal Road.
- 59SW03/59SD03 - collected on the south side of the pool of water.

Surface water and sediment sample collection is discussed below.

4.4.1 Surface Water Sampling

April/May 2010 CMS Investigation

Three surface water samples were collected from the small pool; 59SW01 was collected on April 20, 2010, while surface water samples 59SW02 and 59SW03 were collected on May 20, 2010. Three samples were collected from the pool to fully characterize the pool due to its size (approximately 12 feet in diameter). All three surface water samples were collected using the direct-dip method from approximately the top one foot of the three foot deep pool. The direct dip uses a 1-liter laboratory certified clean, unpreserved amber glass bottle. The surface water was then decanted into appropriate laboratory supplied containers and placed on ice for laboratory-based chemical analysis. Surface water samples were submitted to the laboratory for analysis of Appendix IX VOC, SVOCs with LLPAHs, pesticides, and total and dissolved metals. All dissolved metal samples were field filtered into the appropriate container, and placed on ice prior to shipment. Table 4-1 provides a summary of the surface water samples collected at SWMU 59.

4.4.2 Sediment Sampling

April/May 2010 CMS Investigation

Three sediment samples were collected from the small pool; 59SD01 was collected on April 22, 2010, while sediment samples 59SD02 and 59SD03 were collected on May 20, 2010. All three sediment samples were collected by advancing a disposable 4-foot acetate liner into the sediment and extracting the first six inches of the sediment. The sediment sample was homogenized following the removal of debris and VOC sample collection, and then a portion was transferred into pre-labeled glass jars and placed on ice. Sediment characteristics such as texture and saturation were noted in the field logbook. The sediment samples were submitted to the laboratory for analysis of Appendix IX VOCs, SVOCs with LLPAHs, pesticides, metals, and total organic carbon (TOC). Acid Volatile Sulfide/Simultaneously Extracted Metals (AVS/SEM) was also requested for samples 59SD02 and 59SD03. Note that LLPAH analysis was requested for sediment samples 59SD02 and 59SD03. However, the lab was not able to run the LLPAHs via Selected Ion Monitoring (SIM) analysis due to sample matrix and the large amount of organic material present in the samples. Instead, SVOCs were only reported for samples 59SD02 and 59SD03 using the full scan analysis (8270D). Table 4-1 provides a summary of the sediment samples collected at SWMU 59.

September 2012 CMS Investigation

Additional sediment samples were collected from Freshwater Drainage Ditch No. 1 in order to determine if copper, lead, and zinc had migrated beyond the pool at ecologically important concentrations (i.e., concentrations greater than sediment screening values and background). The additional sampling included the collection of nine sediment samples (59SD04 through 59SD12 as shown on Figure 4-1) from Freshwater Drainage Ditch No. 1 downstream of the pool.

The furthest downstream sediment sample (59SD12) was collected first to prevent interference from disturbed, floating sediment caused by upstream sampling efforts. Sample 59SD12 was

collected from a location approximately 320 feet downstream from the confluence of the SWMU 59 storm water discharge and Drainage Ditch No. 1. The subsequent samples (59SD11 through 59SD04) were then collected from downstream to upstream at approximate 40-foot intervals along the length of the drainage ditch. The samples were collected from a depth of 0 to 0.5 feet bgs using disposable, stainless steel spoons and analyzed for copper, lead, and zinc (see Table 4-1).

4.5 Decontamination and Investigation Derived Waste

The Geoprobe® rods and MacroCore® samplers were decontaminated between borings by washing the equipment with Liquinox® detergent and potable water followed by a potable water rinse. Hollow-stem augers were decontaminated between borings/monitoring wells at a central decontamination pad using a high-pressure, hot water wash. Decontamination fluids were pumped regularly from the pad into Department of Transportation-approved 55-gallon drums.

Disposable sampling equipment (e.g., acetate liners and stainless steel spoons for soil and sediment sampling) was used to the extent practicable in order to minimize the potential for cross-contamination. Non-disposable sampling equipment (i.e., a stainless steel bucket auger used on May 24, 2010), other than the bladder pumps used for groundwater sampling, was decontaminated between each sample by washing with Liquinox® detergent, followed by a laboratory-grade DI water rinse, a 10 percent nitric acid rinse, a DI water rinse, a methanol rinse, and a final DI water rinse.

Prior to groundwater sampling each day, the bladder pumps were dismantled, and the components were decontaminated by washing with Liquinox® detergent followed by a laboratory-grade DI water rinse, a 10 percent nitric acid rinse, a DI water rinse, a methanol rinse, and a final DI water rinse. Between wells, the bladder pumps were dismantled, and the components were washed with Liquinox® detergent followed by a DI water rinse. New Teflon® bladders and Teflon®-lined polyethylene tubing were used for each well.

IDW associated with soil sampling and monitoring well installation, including soil cuttings, groundwater, and decontamination fluids from the 2010 CMS investigation, was containerized and stored in 55-gallon drums (no IDW was generated during the 2012 CMS Investigation or pre-excavation delineation sampling). However, the soil cuttings from the soil borings in which no wells were installed, were placed back into the boring from which they came, as contamination was not observed. As much as possible, soils last out of the hole were returned first, thereby, approximating original stratigraphy.

Two IDW samples were collected. One composite soil sample (59IDW01) was collected from drums containing drill cuttings, and one composite aqueous sample (59IDW02) was collected from drums containing decontamination fluid (from sampling equipment and drill rig). The soil and water IDW samples were analyzed for toxicity characteristic leaching procedure (TCLP) VOCs, SVOCs and metals, ignitability, reactive sulfide, and reactive cyanide. The IDW analytical data is presented in Appendix B. The drums were moved and stored at a secure location on base following the field work completion. On March 31, 2011, five drums of soil IDW and one drum of liquid IDW from SWMU 59 (as well as IDW drums from a number of other SWMUs) were transported by AquaClean to Peñuelas Valley Landfill in Ponce, Puerto Rico and disposed of as a non hazardous waste. The IDW disposal documentation is included in Appendix A.

4.6 Utility Clearance

All proposed boring locations were first checked for the presence of subsurface utilities. Base utility mapping revealed drop inlets, storm sewers, and stormwater manholes within the SWMU 59 boundary or vicinity. A number of these features were field verified in relation to the proposed sample locations. As described in Section 4.8, all proposed sample locations were field-located using a Global Positioning System (GPS). Underground utilities were not encountered during the sampling activity.

4.7 Site Clearing

Once the proposed sample locations were located using a GPS unit, minimal site clearing activities were performed to provide access routes for the drill rig to the proposed sample locations. The proposed sample locations were marked with pin flags and/or survey flagging.

4.8 Surveying

Prior to entering the field, an electronic "shape file" (which included each proposed soil boring location) was uploaded to the GPS data collector. Once in the field, the GPS unit was used to navigate to each sample location. Each sample location was flagged and identified using the numbering system as described in the soil sampling and analysis section of the Work Plan.

As a sub-consultant to Baker, PJDC conducted a site survey at NAPR from May 24 through May 28, 2010 at SWMU 59. After the permanent monitoring wells were installed, their coordinates were more accurately surveyed using conventional survey methods. Conventional surveying was selected specifically because of the accuracy of data they provide to produce groundwater contour mapping:

+/- 0.01 Vertical
+/- 0.05 Horizontal

Each permanent monitoring well installed at SWMU 59 was surveyed. Also, two existing monitoring wells adjacent to SWMU 59 (13MW04 and 74VP07b) were also surveyed. An elevation was obtained from the top of PVC riser for water level elevation calculations and a spot ground surface elevation was also obtained. All survey data was submitted to Baker for use in office application software such as Auto Computer Aided Design and Drafting (CADD). Coordinates were obtained and input into a CADD/Geographic Information System (GIS) to produce the maps used in this CMS report.

In addition to the monitoring well survey; soil boring samples, various site structures, and one storm water outfall were also surveyed by PJDC. The coordinate system used for the survey was U.S. State Plane 1983, Puerto Rico/Virgin Island 5200, and the NAD (North American Datum) 1983, with units in U.S. survey feet.

4.9 Quality Assurance/Quality Control Sampling

Field QA/QC samples were collected to assess the precision and accuracy/bias of the data and included field duplicate samples, MS/MSD samples, trip blanks, field blanks, and equipment rinsate blanks as described below. Although the MS/MSD is not typically considered a field QA/QC sample, it was included herein because location determination was established in the field. Summary matrices of the QA/QC samples collected and the associated analyses are presented in Table 4-2.

4.9.1 Field Duplicate Samples

Field duplicate samples were collected at a minimum frequency of 10 percent for each group of primary environmental samples of a similar matrix, as follows:

April/May 2010 CMS Investigation

- Soil – Eight duplicate samples corresponding to 65 samples
- Groundwater – One duplicate sample corresponding to 10 samples

September 2012 CMS Investigation

- Soil – Two duplicate samples corresponding to 20 samples
- Sediment – One duplicate sample corresponding to nine samples

September/November 2012 Pre-Excavation Delineation Sampling

- Soil – Four duplicate samples corresponding to 34 samples

The duplicate samples consisted of one unique sample, split into two aliquots, and analyzed independently for the same parameters as the corresponding original samples (see Table 4-1). Duplicate soil/sediment samples analyzed for parameters other than VOCs were homogenized and split. Samples for VOC analysis were not homogenized, but select segments of the soil were collected. Duplicate water samples were collected immediately after the corresponding primary sample for each analytical suite. The results were used during the data validation process to evaluate the consistency and reproducibility of the field sampling and analytical procedures (i.e., precision).

4.9.2 Matrix Spike/Matrix Spike Duplicate Samples

MS/MSD samples were collected at a minimum frequency of 5 percent for each group of primary environmental samples of a similar matrix, as follows:

April/May 2010 CMS Investigation

- Soil – Five MS/MSD samples corresponding to 65 samples
- Groundwater – One MS/MSD sample corresponding to 10 samples

September 2012 CMS Investigation

- Soil – One MS/MSD sample corresponding to 20 samples
- Sediment – One MS/MSD sample corresponding to nine samples

September/November 2012 Pre-Excavation Delineation Sampling

- Soil – Three MS/MSD samples corresponding to 34 samples

The samples were collected in the field using the same procedures as the duplicate samples and analyzed independently for the same parameters as the corresponding original samples (see Table 4-1). The results were used during the data validation process to evaluate analytical bias and precision for constituents in the specific sample matrices.

4.9.3 Trip Blanks

Trip blanks were samples of analyte-free water prepared at the laboratory before commencement of the sampling events and shipped to the sampling team along with the unopened sample containers. The trip blanks were then randomly selected and included in each cooler containing samples for volatile organics analysis. Six trip blanks (59TB01 through 59TB06) were analyzed for Appendix IX VOCs during the April/May 2010 CMS Investigation; one trip blank (59TB07) was analyzed for Appendix IX VOCs during the September 2012 CMS Investigation. The results were used during the data validation process to evaluate potential field or laboratory contamination introduced during sampling, storage, and transport (i.e., accuracy/bias). Trip blanks were not prepared/analyzed during the September/November 2012 pre-excavation delineation sampling because none of the samples were analyzed for volatile organics.

4.9.4 Field Blanks

One field blank (59FB01) was collected from the laboratory-grade DI water used for decontamination purposes and as the source water for the equipment rinsate blanks during the April/May 2010 CMS Investigation. In addition, one field blank (59FB02) was collected from the store-bought distilled water used for decontamination purposes during this investigation. Two field blanks (59FB03 and 59FB05) also were collected from the laboratory-grade DI water used for decontamination purposes and as the source water for the equipment rinsate blanks during the September 2012 CMS Investigation and September/November 2012 pre-excavation delineation sampling. No store-bought distilled water was used for decontamination purposes during the 2012 investigations, so additional field blanks were not necessary.

The field blanks were collected under representative field conditions and analyzed for parameters shown in Table 4-2. The results were used during the data validation process to evaluate potential contamination introduced during sampling, storage, and transport (i.e., accuracy/bias).

4.9.5 Equipment Rinsate Blanks

One equipment rinsate blank was collected per day of sampling for one piece of sampling equipment. Eleven equipment rinsate blanks (59ER01 through 59ER11) were collected from the disposable and non-disposable sampling equipment used during the April/May 2010 CMS Investigation, as follows:

- Acetate Geoprobe® Liner – 59ER01 through 59ER07
- Teflon® Bladder – 59ER08
- Teflon®-Lined Polyethylene Tubing – 59ER09
- Stainless Steel Bladder Pump – 59ER10
- Stainless Steel Bucket Auger – 59ER11

In addition, four equipment rinsate blanks (59ER12 through 59ER15) were collected from the disposable and non-disposable sampling equipment used during the September 2012 CMS Investigation and September/November 2012 pre-excavation delineation sampling, as follows:

- Acetate Geoprobe® Liner – 59ER12
- Disposable Zip-Lock Baggie – 59ER13
- Disposable Stainless Steel Spoon – 59ER14 and 59ER15

The equipment rinsate blanks were collected under representative field conditions by running laboratory-grade DI water over/through the sampling equipment and placing it into the

appropriate sample containers for laboratory analysis. The samples were analyzed for parameters shown in Table 4-2. The results were used during the data validation process to verify that the sampling equipment did not contribute to contamination of the samples (i.e., accuracy/bias).

4.10 Laboratory Analysis

Samples collected for laboratory analysis were stored on ice in coolers at approximately 4° Celsius and delivered by Federal Express to CompuChem in Cary, North Carolina (April/May 2010 CMS Investigation) or Test America in Savannah, Georgia (September 2012 CMS Investigation and September/November 2012 pre-excavation delineation sampling). Chain-of-custody forms (Appendix A) were completed and enclosed in the shipping packages. In addition, chain-of-custody seals were placed on each shipping package.

Summary matrices showing the primary environmental and QA/QC samples collected and the associated analyses are presented in Tables 4-1 and 4-2. A complete set of laboratory analytical results and supporting information, including laboratory quality assurance manuals, standard operating procedures (SOPs), parameter lists, quantitation limits, and non-detect Limit of Detection (LOD) values/screening criteria comparison, are included in Appendix B. The data was certified by a Puerto Rico-certified chemist; the certifications are included in Appendix C.

4.11 Data Validation

Independent, third-party data validation was conducted by DataQual Environmental Services of St. Louis, Missouri. Laboratory analytical data (except soil and liquid IDW data) were evaluated to assess the technical adequacy and usability of the data. The data were validated in accordance with the SW-846 methods used by the laboratory, specifications set forth in the USEPA Region 2 SOPs for validation of organic data acquired using SW-846 methods (USEPA, 2008a; USEPA 2008b; USEPA 2008c), and professional judgment. The Department of Defense (DoD) Quality Systems Manual for Environmental Laboratories (DoD, 2010) also was consulted. It should be noted that Region 2 has not developed validation checklist SOPs for the methods used to assess inorganics (SW-846 Methods 6010C/6020A/7470A/7471B for metals). Therefore, alternative worksheets were used. Non-compliant analytical results were qualified using Region 2 flagging conventions. The data validation report summaries for each Sample Delivery Group (SDG) are included in Appendix C.

4.12 References

Baker. 2012. *Request for Additional Sampling Necessary for Completion of the Corrective Measures Study Investigation for SWMU 59.* Naval Activity Puerto Rico, Ceiba, Puerto Rico. June 15, 2012.

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USEPA. 2008a. Validating Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry, SW-846 Method 8260B. SOP HW-24 Rev. 2. USEPA Region 2 Hazardous Waste Support Branch. August 2008.

USEPA. 2008b. Validating Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry, SW-846 Method 8270D. SOP HW-22 Rev. 4. USEPA Region 2 Hazardous Waste Support Branch. August 2008.

USEPA. 2008c. Validating Pesticide Compounds and Organochlorine Pesticides by Gas Chromatography, SW-846 Method 8081B. SOP HW-44 Rev. 1. USEPA Region 2 Hazardous Waste Support Branch. October 2006.

5.0 PHYSICAL RESULTS

The following sections provide a brief discussion of the site conditions at SWMU 59 at the time of the CMS investigations, conducted in April/May 2010 and September/November 2012. The site geology and hydrogeology, as ascertained from the soil boring program and other available information, is described herein.

5.1 Site Conditions

SWMU 59 is approximately 10 acres in size and is located east of Forrestal Drive (see Figure 4-1). The majority of the site is developed, with concrete and paved (asphalt) surfaces throughout. The center of the SWMU is at 18º 14' 14.48" north latitude and 65º 37' 16.01" west longitude respectively. Site features include Buildings 60, 258, and 377; abandoned fuel islands (a total of four), a wash pad, and an oil water separator.

Although most of the site is developed, vegetation is persistent in the southwestern portion of the SWMU (near the refueling islands) and within narrow bands along the outer perimeters of the concrete and paved surfaces around the site. Dominant tree, shrub, and herbaceous vegetation documented during the site visit included white lead tree (*Leucaena leucocephala),* white indigoberry *(randia aculeata*), climbing day flower (*Commelina diffusa),* guinea grass *(Urochloa maxima),* light blue snakeweed (*Stachytarpheta jamaicensis*), gumbo limo (*Bursera simaruba*), bretonica prieta *(Melochia nodiflora),* fringed windmill grass (*Chloris ciliata*), barrelier's woodsorrel (*Oxalis barrelieri*), tropical fimbry (*fimbristylis cymosa*), and ocean blue morning glory *(Ipomoea indica)*.

No aquatic natural resources (i.e., streams, wetlands, or drainage ditches) were observed within the SWMU 59 boundary. However, a small pool (Appendix A, Photo 10), contiguous to a freshwater drainage ditch was identified west of SWMU 59, on the opposite side of Forrestal Drive. During the CMS investigation, the field team determined that stormwater is diverted through a series of culverts from the SWMU, underneath Forrestal Drive, to an outfall associated with the small pool.

5.2 Geology/Hydrogeology

The following sections provide a discussion of the geology and hydrogeology of SWMU 59, based on observations made during the CMS field investigation.

5.2.1 Geology

SWMU 59 is located in an upland area within the Forrestal Area of the base. The upland areas of NAPR include the hills encompassing the Tow Way Fuel Farm and hospital areas, and the hills encompassing the area behind the Exchange, the former Atlantic Fleet Weapons Training Facility (AFWTF) Command, and the Bundy area. These upland areas are underlain by bedrock (predominately Gabbro) and exhibit varying degrees of weathering. Typically, the bedrock is overlain by a relatively thin residual soil originating from weathered-in-place bedrock. This residual soil generally consists of clay, silt, and/or sand. Ground elevations range between approximately seven feet mean sea level (msl) near the southwest corner of the SWMU and approximately 16 feet msl on the concrete pad in the northeast portion of the SWMU (i.e., 107 and 116 feet datum; note that the datum plan used is the Mean Low Water plus 100.00 foot as established by the U.S. Navy Survey Section [November 1941]).

Twenty-three soil borings were advanced at SWMU 59 during the April/May 2010 CMS field investigation to profile surface and subsurface conditions. Geologic cross sections were prepared to depict the shallow subsurface conditions at SWMU 59. The cross section locations are provided on Figure 5-1 and cross sections A-A' and B-B' are shown on Figure 5-2. Boring logs are provided in Appendix A.

Based on information obtained from the soil borings, the majority of SWMU 59 is underlain by fill material including varying combinations of clay to gravel. The eastern portion of SWMU 59, beneath the concrete pad, is underlain by weathered bedrock (59SB10 and 59SB19). Note that the presence of residual soil was not readily identifiable or observed during the drilling and logging activities. Consequently, the term weathered bedrock is used to describe weathered-in-place bedrock without regard to the degree of weathering. The shallow subsurface materials (i.e., fill and varying degrees of weathered bedrock,) encountered at SWMU 59 is not unusual considering the cut and fill construction methods likely employed for the development of the SWMU 59 facilities. The fill thickness ranged between approximately 0.3 feet at 59SB01 and 6.5 feet at 59SB15. Weathered bedrock was observed beneath the fill. DPT refusal, indicating a transition to more competent bedrock was encountered at locations 59SB04 (18.0 feet bgs), 59SB05 (24.0 feet bgs), 59SB08 (21.0 feet bgs), 59SB09 (15.0 feet bgs), 59SB10 (24.5 feet bgs), 59SB21 (11.0 feet bgs) and 59SB22 (10.0 feet bgs).

5.2.2 Hydrogeology

Groundwater levels were measured in each monitoring well using an electronic water level meter to the nearest 0.01 foot as previously discussed in Section 4.3. Measurements were taken on May 24, 2010 at the end of the April/May field activities following groundwater sample collection and hydraulic conductivity testing and again on January 13, 2011 to evaluate and confirm equilibration of the water table. Another round of groundwater levels were taken on August 30, 2011 during the SWMU 74 investigation for comparison.

SWMU 59 was cut into hillsides and is bound to the north, east, and south by the hills with elevations in excess of 200 feet msl. A local recharge area along the eastern side of the facility's concrete pad is likely due to storm water drainage from the adjacent hills. The anticipated flow direction for the SWMU 59 area is toward the west southwest and the drainage system of the recreational fields that were constructed on a former mangrove (United States Geological Survey [USGS], 1957). The water level measurements are provided in the field logbooks in Appendix A and the water level measurements and calculated groundwater elevations are summarized on Table 4-3.

Groundwater elevation contours for SWMU 59 using the January 13, 2011 and August 30, 2011 data are provided on Figures 5-3 and 5-4, respectively. Figure 5-3 shows a relatively flat gradient flowing from the southeast to the northwest and then turning due west. The area of the former underground storage tank shows the groundwater flow from east to west.

The groundwater levels collected in August 2011 represent high groundwater levels at SWMU 59 due to abnormally high precipitation during Spring/Summer 2011. Water levels were approximately 4 feet higher than the January 2011 measurements and approximately 8 feet higher than the May 2010 groundwater levels. Groundwater contours are shown on Figure 5-4 for August 2011 and show groundwater flow generally from east to west.

The hydraulic gradient was calculated between wells 59SB10 and 59SB06 on Figures 5-3 and 5-4 and was 0.0006 and 0.002, respectively. The average of these two gradients is 0.0013. These wells were chosen because of the east to west flow direction and the gradient was taken generally perpendicular to the flow lines.

5.2.3 Hydraulic Conductivity Testing and Groundwater Velocity

The hydraulic properties of the groundwater-bearing zone beneath SWMU 59 were characterized by conducting rising head slug tests in eight (59SB01, 59SB02, 59SB04 through 59SB06, and 59SB08 through 59SB10) of the ten new monitoring wells following completion of well installation, development, and groundwater sampling and the water level had returned to equilibrium. Slug tests were not conducted in wells 59SB03 and 59SB07 due to the limited water column thickness (less than 1.5 feet and 4.5 feet, respectively). However, the wells in which slug tests were conducted were representative of the various lithologies encountered and provided adequate data to characterize the hydraulic conductivity. Falling head slug tests also were not conducted because the water levels were recorded within the screened interval.

The slug tests were conducted using computerized data loggers/pressure transducers. Prior to slug testing, the water level was measured in the well. A data logger/pressure transducer was then placed near the bottom of the well, and a decontaminated slug (solid cylinder) was introduced into the well to displace an initial volume of water. Once the water level returned to static conditions, the data logger was started, and the slug was removed. The response to change in static conditions was measured using the data logger/pressure transducer (rising head slug test).

The slug test data were processed using Microsoft Excel, and Aqtesolv® Pro 4.0 was used to facilitate the data analysis. The Bouwer and Rice (1976) solution for unconfined aquifers was used when evaluating the slug test data since confining/semi-confining conditions were not evident based on lithology and comparisons of the depth to water observed in the associated soil cores and static water levels measured in the wells. The Bouwer and Rice solution addresses a variety of well and aquifer geometries and is widely accepted. The hydraulic conductivity estimates were then examined in context of site lithology.

Although the actual saturated thickness of the groundwater-bearing zone is unknown, a sensitivity analysis indicated that this variable did not impact the hydraulic conductivity estimates when multiple values ranging from 20 to 500 feet were used. Therefore, a saturated thickness of 20 feet was determined to be realistic and was used as the input value. The groundwater-bearing zone was assumed to be isotropic. Therefore, an anisotropy ratio of 1 was used. A borehole radius of 0.3021 feet and a well casing radius of 0.0833 feet also were used as input values for each of the tests since these values remained constant. The remaining input values, including total well penetration depth, static water column height, initial displacement, and displacement versus time, varied by well based on construction and water level. The test data and type curves, input data, and hydraulic conductivity estimates are included in Appendix A.

The hydraulic conductivity estimates of the groundwater-bearing zone beneath SWMU 59 ranged from 0.15 to 0.73 feet/day with an average of 0.37 feet/day (see Table 5-1). Overall, the hydraulic conductivity estimates were consistent with the known lithologies observed at the well locations.

The effective porosity of the groundwater-bearing zone was estimated to be on the order of 30 percent based on the general porosities of similar materials presented in Wiedemeier et al. (1995). A groundwater linear velocity estimate was calculated using a variation of Darcy's equation:

$V = Ki/n_e$

where: V = groundwater velocity (feet/day)
K = average hydraulic conductivity (0.37 feet/day)
i = average hydraulic gradient (0.0013 feet/foot)
n_e = effective porosity (30 percent)

The groundwater linear velocity estimate is 0.002 feet/day. It should be noted that the velocity estimate does not take contaminant attenuation factors (e.g., retardation, degradation) or physical properties (e.g., density, solubility) into account, but it provides a potential transport rate for contaminants not subject to attenuation in the aquifer.

5.3 References

Bouwer, H. and R.C. Rice, 1976. A Slug Test Method for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells, Water Resources Research, vol. 12, no. 3, pp. 423-428.

U.S. Geological Survey. Punta Puerca, Puerto Rico [map]. Photorevised 1982. 1:24,000. 7.5 Minute Series (Topographic). Reston, Virginia: United States Department of the Interior, USGS, 1957.

Wiedemeier, T., J.T. Wilson, D.H. Kampbell, R.N. Miller, and J.E. Hansen. 1995. Technical Protocol for Implementing Intrinsic Remediation with Long-Term Monitoring for Natural Attenuation of Fuel Contamination Dissolved in Groundwater, Volume 1. November 1995.

6.0 ANALYTICAL RESULTS

This section discusses the results of the laboratory chemical analysis of environmental samples collected from SWMU 59 including the April/May 2010 CMS Investigation and the September 2012 CMS Investigation (Tables 6-1 through 6-11). The laboratory analytical data for both the 2010 and 2012 CMS Investigations went through a formal, third party data validation process. Complete validated data tables for the 2010 and 2012 CMS Investigations (excluding the 2012 pre-excavation delineation sample data) are included in Appendix B. Data validation narratives for the 2010/2012 CMS for SWMU 59 are provided in Appendix C; a summary discussion of the necessary laboratory level data adjustments to the data is presented in Section 6.7. Data from the pre-excavation delineation samples collected during the 2012 sampling investigation are discussed in Section 9.0.

This section presents a summary of the results of the detected compounds in surface and subsurface soil, groundwater, surface water and sediment as well as a comparison to NAPR Basewide background concentrations, where applicable for the 2010 and 2012 CMS Investigations. The detected concentrations of metals in environmental media (specifically, surface and subsurface soil, groundwater, surface water, and sediment) sampled at SWMU 59 were compared to NAPR-specific background concentrations (Upper Limit of the Mean [ULM] for each inorganic) established in the Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds (Baker, 2013), for NAPR.

6.1 Surface Soil

April/May 2010 CMS Investigation

As part of the April/May 2010 CMS investigation, surface soil was collected from nineteen locations (59SB01-00 through 59SB04-00, 59SB06-00 through 59SB09-00, 59SB11-00 through 59SB15-00, 59SB17-00 through 59SB18-00 and 59SB20-00 through 59SB23-00). There were two duplicates collected (59SB01-00D and 59SB17-00D) and one MS/MSD (59SB13-00 MS/MSD). Surface soil samples were not collected from soil borings 59SB05 and 59SB16 since they were located on an asphalt roadway, or from soil borings 59SB10 and 59SB19 since they were located on a concrete pad. The surface soil samples were analyzed for Appendix IX VOCs, SVOCs (with LLPAHs), pesticides and metals. The detected organic compounds and inorganics as compared to the applicable NAPR basewide background value in the surface soil data set are provided in Table 6-1.

Twelve VOCs were detected in the surface soil data set including 2-hexanone, acetone, acrylonitrile, benzene, bromomethane, carbon disulfide, chloromethane, methyl acrylonirile, methyl iodine, propionitrile, m,p-xylene and total xylenes. Except for acetone, these VOCs were detected in low concentrations in a few samples. Acetone was detected in fifteen of twenty-two samples ranging from 24 J micrograms per kilogram (µg/kg) to 190 µg/kg. It is important to note that acetone is a common laboratory contaminant.

Twenty SVOCs (including 17 LLPAHs) were detected in the surface soil samples as shown on Table 6-1. Most of the SVOCs were detected at low concentrations (i.e., near detection limits). The surface soil samples that had the most SVOCs detected were the duplicate sample of 58SB01-00, 59SB02-00, 59SB04-00, 59SB09-00 and 59SB15-00, the highest concentrations detected being in sample 59SB04-00.

Nine pesticides were detected in the surface soil data set including: 4,4'-DDD, 4,4'-DDE. 4.4'-DDT, beta-BHC, alpha-chlordane, gamma-chlordane, endosulfan sulfate, endrin aldehyde and methoxychlor. The pesticides detected in general were low in concentration (not much above reporting limits). Surface soil samples 59SB09-00 and 59SB15-00 resulted in the highest detections of pesticides 4,4'-DDD, 4,4'-DDE and 4,4'DDT, as shown on Table 6-1.

Seventeen metals were detected in the surface soil samples including:

- Antimony
- Arsenic
- Barium
- Beryllium
- Cadmium
- Chromium
- Cobalt
- Copper
- Lead
- Mercury
- Nickel
- Selenium
- Silver
- Thallium
- Tin
- Vanadium
- Zinc

Of these seventeen metals, twelve were detected in one or more samples at concentrations in excess of the NAPR basewide background screening value, as shown on Table 6-1. Antimony, arsenic, barium, beryllium, and vanadium were detected above the basewide background screening value in one sample; and chromium and copper in two samples as shown on Table 6-1. Cadmium was detected in three samples slightly above the basewide background screening value (1.02 milligrams per kilogram [mg/kg]) ranging from 1.3 mg/kg to 2.6 mg/kg. Nickel and zinc were detected above basewide background screening values in five samples. Nickel was detected only slightly above its basewide background screening value (20.7 mg/kg), while zinc concentrations detected above background (115 mg/kg) ranged from 123 mg/kg to 747 mg/kg (59SB15-00). Lead was detected above its basewide background screening value of 22.0 mg/kg in seven samples; the highest concentrations were 654 J mg/kg (sample 59SB09-00) and 638 mg/kg (59SB15-00). Selenium was detected above the basewide background screening value in one sample (59SB20). Tin was detected above its basewide background screening value in nine samples; the highest detection was 36.5 mg/kg from sample 59SB09-00. Surface soil samples 59SB09-00 and 59SB15-00 resulted in the most exceedances of inorganics detected above base background screening values and in most cases the highest detected concentrations.

September 2012 CMS Investigation

As part of the September 2012 CMS investigation, surface soil was collected from ten locations under the concrete/asphalt pads (59SB24-00 through 59SB33-00). There was one duplicate collected (59SB24-00D) and one MS/MSD (59SB24-00 MS/MSD). The surface soil samples were analyzed for Appendix IX VOCs, SVOCs (with LLPAHs), and metals. The detected organic compounds and inorganics as compared to the applicable NAPR basewide background value surface soil data set are provided in Table 6-2.

One VOC, acetone, was detected in the surface soil data set. Acetone was detected in four of eleven samples ranging from 15 J µg/kg to 45 J µg/kg. As previously noted, acetone is a common laboratory contaminant.

One SVOC (bis[2-ethylhexyl]phthalate) and two LLPAHs (2-methylnaphthalene and phenanthrene) were detected in the surface soil samples as shown on Table 6-2. Bis(2-ethylhexyl)phthalate was detected in six of eleven samples ranging from 11 J µg/kg to 78 J µg/kg. 2-Methylnaphthalene and phenanthrene were detected in one sample (59SB31-00) at concentrations of 6.4 J µg/kg and 6 J µg/kg, respectively.

Fifteen metals were detected in the surface soil samples, as follows:

- Arsenic
- Barium
- Beryllium
- Cadmium
- Chromium
- Cobalt
- Copper
- Mercury
- Nickel
- Selenium
- Silver
- Thallium
- Tin
- Vanadium
- Zinc

Of these fifteen metals, seven were detected in one or more samples at concentrations in excess of the NAPR basewide background screening value, as shown on Table 6-2. Barium, beryllium, and tin were detected above the basewide background screening value in one sample; and copper and vanadium in two samples as shown on Table 6-2. Chromium was detected in seven samples above the basewide background screening value (49.8 mg/kg) ranging from 51 mg/kg to 150 mg/kg. Nickel was also detected above the basewide background screening value in seven samples. Nickel concentrations detected above background (20.7 mg/kg) ranged from 23 mg/kg to 47 mg/kg.

September/November 2012 Pre-Excavation Delineation Sampling

As part of the September/November 2012 Pre-Excavation Delineation sampling, thrity-four surface soil samples, four duplicate samples, and three MS/MSD samples were collected and analyzed during the CMS investigation for SWMU 59. Twenty-four samples (59SS01 through 59SS24) were collected in September 2012 and an additional ten samples (59SS25 through 59SS34) were collected in November 2012. All of the pre-excavation delineation samples were analyzed for copper, lead, and/or zinc. The detected results for the pre-excavation delination data set as compared to the applicable CAOs are provided in Table 6-3.

Proposed Area 1 – A total of twenty samples (59SS01 through 59SS13 and 59SS25 through 59SS31) plus one duplicate (59SS04D) were collected to delineate the Proposed Area 1.
Nine samples (59SS01 through 59SS03, 59SS08 through 59SS10, 59SS25, 59SS29, and 59SS30) were collected and analyzed for lead and zinc. Lead and zinc were analyzed for and detected in

samples 59SS01 through 59SS03 and 59SS08 through 59SS10. Detected concentrations oflead and zinc exceeded their respective CAOs (96 mg/kg and 120 mg/kg) in 59SS03. Zinc exceeded the CAO of 120 mg/kg in sample 59SS01 and lead exceeded its CAO in 59SS09. The additional samples 59SS25, 59SS29, and 59SS30 were collected in Novebmer 2012 to complete delineation in this area. Sample 59SS25 was analyzed for zinc; however, the detected result did not exceed the CAO. Both 59SS29 and 59SS30 had detected concentrations of lead that exceeded its CAO (96 mg/kg).

Seven samples (59SS04 through 59SS07 and 59SS26 through 59SS28) plus one duplicate (59SS04D) were collected and analyzed for copper, lead, and zinc. Copper, lead, and zinc were detected in samples 59SS04 through 59SS07. The detected concentartions of copper, lead, and zinc in samples 59SS04 and 59SS04D all exceeded their respective CAOs (168 mg/kg, 96 mg/kg, and 120 mg/kg, respectively). Additionally, the detected concetnartion of zinc in sample 59SS07 exceeded its respective CAO. Sample 59SS26 was collected in November 2012 to complete the delineation and was analyzed for copper, lead, and zinc. All three metals were detected in the sample, but the detected concetnrations did not exceed the CAOs. Two additional samples, 59SS27 and 59SS28, were collected in November 2012 and analyzed for lead and zinc in order to complete delineation. Both metals were detected in both samples with zinc exceeding its CAO in sample 59SS27 and lead and zinc exceeding their respective CAOs in sample 59SS28.

Four samples (59SS11 through 59SS13 and 59SS31) were collected and analyzed for copper and zinc. Copper and Zinc were detected in samples 59SS11 through 59SS13. All detected concentrations in these three samples were below their respective CAOs with the exception of the zinc detection in sample 59SS12 which exceeded the CAO of 120 mg/kg. An additional sample, 59SS31, was collected in November 2012 and analyzed for zinc in order to complete delination in this area. The detected concentration of zinc in this sample exceeded its CAO of 120 mg/kg.

Proposed Area 2 – Three samples (59SS14 through 59SS16) plus one duplicate (59SS14D) were collected to delineate the Proposed Area 5 for surface soil removal. Lead and zinc were analyzed for and detected in all the samples. All detected concentrations were below their reseptive CAOs with the exception of zinc in sample 59SS15. Zinc exceded the CAO of 120 mg/kg in sample 59S15.

Proposed Area 3 – Five samples (59SS17 through 59SS20 and 59SS32) were collected to delineate the Proposed Area 6 for surface soil removal. Lead was analyzed for and detected in samples 59SS17 through 59SS20. Only one detected concentration of lead (sample 59SS20) exceeded the CAO of 96 mg/kg. An additional sample (59SS32) was collected and anzlyed for lead in order to complete delineation in this area. The detected concentration of lead exceeded the CAO.

Proposed Area 4 – Six samples (59SS21 through 59SS24, 59SS33, and 59SS34) plus one duplicate (59SS21D) were collected to delineate the Proposed Area 7 for surface soil removal. Zinc was analyzed and detected in samples 59SS21 through 59SS24. The detected concentrations of zinc in samples 59SS21, 59SS21D, and 59SS22 exceeded the CAO for zinc (120 mg/kg). An additional two samples (59SS33 and 59SS34) were collected and analyzed for zinc in roder to complete delineation in this area. Only the detected concentration in sample 59SS33 exceeded the CAO for zinc.

6.2 Subsurface Soil

April/May 2010 CMS Investigation

As part of the April/May 2010 CMS investigation, forty-six subsurface soil samples, four duplicate samples, and three MS/MSD samples were collected and analyzed during the CMS investigation at SWMU 59. All of the subsurface soil samples were analyzed for Appendix IX VOCs, SVOCs (including LLPAHs), pesticides, and metals. The detected results for the subsurface soil data set as compared to the applicable NAPR basewide background value are provided in Table 6-3.

Ten VOCs were detected in the subsurface soil data set including acetone, benzene, bromoform, bromomethane, carbon disulfide, chloromethane, dibromochloromethane, methyl iodine, m,p-xylene, and total xylenes. All VOC detections were relatively low (i.e., near the detection limits), with the exception of acetone (a common laboratory contaminant) which was detected in five samples at a concentration ranging from 26 µg/kg to 150 µg/kg, methyl iodide at location 59SB02 detected at a concentration of 21 µg/kg (30 J µg/kg DUP) from the 1 to 3 foot depth interval, and bromoform at location 59SB02 detected at a concentration of 35 µg/kg from the 7 to 9 foot depth interval.

Nineteen SVOCs (including 17 LLPAHs) were detected in the subsurface soil samples as shown on Table 6-3. Most of these compounds were detected at low concentrations (i.e., near detection limits), with a few exceptions (mainly PAHs, as shown on Table 6-3). The PAHs were detected primarily in the following subsurface soil samples: 59SB02-01, 59SB05-01, 59SB08-01, 59SB09-01, 59SB17-01 and 59SB18-01.

Nine pesticides were detected in the subsurface soil data set as follows: 4,4'-DDD, 4,4'-DDE, 4.4'-DDT, beta-BHC, delta-BC, alpha-chlordane, endrin, endrin aldehyde, and heptachlor. Pesticides were detected in 59SB01-03, 59SB02-01D, 59SB03-04, 59SB04-01, 59SB04-05, 59SB05-01, 59SB06-01, 59SB08-05, 59SB10-01, 59SB13-01D, 59SB15-01, and 59SB18-01.

Seventeen metals were detected in the subsurface soil samples including:

- Antimony
- Arsenic
- Barium
- Beryllium
- Cadmium
- Chromium
- Cobalt
- Copper
- Lead
- Mercury
- Nickel
- Selenium
- Silver
- Thallium
- Tin
- Vanadium
- Zinc

Of these seventeen metals, twelve were detected in one or more samples at concentrations in excess of the NAPR Base background screening values, as shown on Table 6-3. Arsenic was detected in three subsurface samples, slightly above the basewide background screening value (1.59 mg/kg). Barium was detected above the basewide background screening value (220 mg/kg) in three samples ranging from 229 J mg/kg to 312 mg/kg in 59SB19-05. Beryllium was detected slightly above the basewide background screening value (0.596 mg/kg) in six samples and one duplicate sample. Cadmium was detected above the basewide background screening value (0.539 mg/kg) in nine samples; the highest detection was 5 mg/kg in sample 59SB08-05. Chromium was detected above the basewide background screening value (114 mg/kg) in sample 59SB16-05 at a concentration of 232 J mg/kg. Cobalt was detected above its basewide background screening value of 26.9 mg/kg in seventeen samples and three duplicates ranging in concentration from 28.5 J mg/kg to 83.9 J mg/kg in subsurface soil sample 59SB02-04. Copper and tin were detected above their basewide background screening values in a few samples as shown on Table 6-3. Lead was detected above its basewide background screening value in eleven samples and one duplicate sample ranging from 6.8 mg/kg to 37.4 mg/kg, in subsurface soil sample 59SB12-05. Mercury was detected above the basewide background screening value (0.108 mg/kg) in samples 59SB06-03 and 59SB16-05 with concentrations of 0.15 mg/kg and 0.13 mg/kg, respectively. Nickel was detected above its basewide background screening value in ten samples and one duplicate, as shown on Table 6-3. Zinc was detected above its basewide background screening value (88.1 mg/kg) in fifteen samples and two duplicate samples ranging from 88.1 mg/kg to 242 J mg/kg in sample 59SB04-01.

September 2012 CMS Investigation

As part of the September 2012 CMS investigation, eleven subsurface soil samples (59SB24-01 through 59SB33-01) and one duplicate sample (59SB24-01D) were collected from ten locations under the concrete/asphalt pads. All subsurface soil samples were collected from the 1 to 3 foot depth interval and were analyzed for Appendix IX VOCs, SVOCs (with LLPAHs), and metals. The detected results for the subsurface soil data set as compared to the applicable NAPR basewide background value are provided in Table 6-4.

Two VOCs, acetone and methylene chloride, were detected in the subsurface soil data set. Acetone was detected in three of eleven samples ranging from 14 J µg/kg to 40 J µg/kg. Methylene chloride was detected in one of eleven samples at a concentration of 7.2 µg/kg. As previously noted, acetone is a common laboratory contaminant.

Three SVOCs (2,4-dimethylphenol, bis[2-ethylhexyl]phthalate, and pentachlorobenzene) and one LLPAH (phenanthrene) were detected in the subsurface soil samples as shown on Table 6-4. 2,4-Dimethylphenol and pentachlorobenzene were each detected in only one sample. 2,4-Dimethylphenol was detected in 59SB25-01 at a concentration of 17 J µg/kg, and pentachlorobenzene was detected in 59SB24-01D at a concentration of 5.6 J µg/kg. Bis(2-ethylhexyl)phthalate was detected in nine of eleven samples at concentrations ranging from 8.3 J µg/kg to 59 J µg/kg. Phenanthrene was detected in one out of eleven samples at a concentration of 4.6 J µg/kg.

Fourteen metals were detected in the subsurface soil samples, as follows:

- Arsenic
- Barium
- Beryllium
- Cadmium
- Chromium

- Cobalt
- Copper
- Mercury
- Nickel
- Selenium
- Silver
- Thallium
- Vanadium
- Zinc

Of these fourteen metals, two were detected in one or more samples at concentrations in excess of the NAPR basewide background screening value, as shown on Table 6-4. Chromium was detected above the basewide background screening value (114.5 mg/kg) in only one of eleven samples at a concentration of 120 mg/kg. Nickel was detected above the basewide background screening value (24.7 mg/kg) in six of eleven samples at concentrations ranging from 25 mg/kg to 44 mg/kg.

6.3 Groundwater

April/May 2010 CMS Investigation

As part of the April/May 2010 CMS investigation, ten groundwater samples (59GW01 through 59GW10) and one duplicate sample (59GW02D) were collected and analyzed as part of the CMS at SWMU 59. The groundwater samples were analyzed for Appendix IX VOCs, SVOCs, pesticides, and total metals and dissolved metals. The detected results for the groundwater data set are provided in Table 6-5.

Two VOCs were detected in the groundwater samples, benzene (detected in four of ten samples), and carbon disulfide (detected in three of ten samples). All detections of VOCs in the groundwater samples are considered low (i.e., near detection limits).

Four SVOCs were detected in the groundwater samples including bis(2-ethylhexyl)phthalate, naphthalene, phenanthrene and pyrene. These SVOCs were detected in one or two samples at low concentrations (i.e., near the detection limit).

The pesticide, alpha-chlordane was detected in one groundwater sample (59GW04) at a concentration of 0.016 JN micrograms per liter (µg/l). The JN qualifier means the analyte was tentatively identified and has an estimated value.

Fourteen total metals were detected in the groundwater samples, including:

- Antimony
- Arsenic
- Barium
- Beryllium
- Cadmium
- Chromium
- Cobalt
- Copper
- Lead
- Nickel

- Selenium
- Silver
- Thallium
- Vanadium

None of these total metals were detected at concentrations in excess of the NAPR basewide background screening value for groundwater.

Thirteen dissolved metals were detected in the groundwater samples, including:

- Antimony
- Arsenic
- Barium
- Cadmium
- Chromium
- Cobalt
- Copper
- Nickel
- Selenium
- Silver
- Thallium
- Vanadium
- Zinc

Vanadium was detected at concentrations in excess of the NAPR basewide background screening value for groundwater (21 µg/L) in seven of the ten groundwater samples with concentrations exceeding background ranging from 22.8 µg/L to 179 µg/L.

6.4 Surface Water

April/May 2010 CMS Investigation

As part of the April/May 2010 CMS investigation, three surface water samples (59SW01 through 59SW03) were collected and analyzed during the CMS investigation at SWMU 59. The surface water samples were analyzed for Appendix IX VOCs, SVOCs, pesticides, total metals and dissolved metals. Please note that total calcium and total magnesium were requested and reported in 59SW01, these metals were also verbally requested for 59SW02 and 59SW03, but were not analyzed due to laboratory oversight. The detected results for the surface water data set as compared to the applicable NAPR background value non-airfield freshwater drainage ditch surface water data set are provided in Table 6-6.

Four VOCs were detected in the surface water samples as follows: bromodichloromethane, carbon disulfide, chloroform, and dibromochloromethane. The detected concentrations were low (near reporting limits). Two SVOCs (fluoranthene and pyrene) were detected in 59SW02 and 59SW03, at low concentrations. Pesticides 4,4'-DDE and 4,4- DDT were detected in sample 59SW01 at concentrations of 0.006 J ug/L and 0.0065 J ug/L, respectively.

Ten total metals were detected in the surface water samples including:

- Antimony
- Arsenic

- Barium
- Calcium
- Chromium
- Cobalt
- Copper
- Selenium
- Vanadium
- Zinc

None of these total metals were detected at concentrations in excess of the NAPR background screening value for non-airfield non-airfield freshwater drainage ditch surface water.

Nine dissolved metals were detected in the surface water. These include:

- Antimony
- Arsenic
- Barium
- Chromium
- Cobalt
- Copper
- Selenium
- Vanadium
- Zinc

None of these dissolved metals were detected at concentrations in excess of the NAPR background screening value for non-airfield freshwater drainage ditch surface water.

6.5 Sediment

April/May 2010 CMS Investigation

As part of the April/May 2010 CMS investigation, three sediment samples (59SD01 through 59SD03) were collected. The sediment samples were collected for analysis of Appendix IX VOCs, SVOCs (including LLPAHs), pesticides, metals, AVS/SEM, and TOC. AVS/SEM was not analyzed in sample 59SD01. The detected results for the sediment data set are provided in Table 6-7.

Four VOCs were detected in sediment samples including acetone (detected in two of the sediment samples), carbon disulfide (detected in one sample), and m,p-xylene and total xylenes detected in 59SD01.

Twelve SVOCs were detected in the sediment samples including 2-methylnaphthalene, acenaphthylene, anthracene, benzo(a)anthracene, bis(2-ethylhexyl)phthalate, butyl benzyl phthalate, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene. The detections were relatively low. All SVOCs listed above were detected in 59SD01. Bis(2-ethylhexyl)phthalate was detected in all three sediment samples. Fluoranthene and pyrene were also detected in both 59SD01 and 59SD03.

Nine pesticides were detected in the sediment soil data set as follows: 4,4'-DDD, 4,4'-DDE, 4.4'-DDT, aldrin, alpha-chlordane, gamma-chlordane, dieldrin, endrin aldehyde, and heptachlor. The pesticides detected were generally low in concentration. The highest detected concentrations were 4,4-DDE detected at 35 J µg/kg, 32 J µg/kg, and 160 µg/kg from 56SD01 though 59SD03,

respectively; and gamma-chlordane detected at 18 J µg/kg and 31 J µg/kg, in samples 59SD01 and 59SD02.

Sixteen total metals were detected in the sediment samples including:

- Antimony
- Arsenic
- Barium
- Beryllium
- Cadmium
- Chromium
- Cobalt
- Copper
- Lead
- Mercury
- Nickel
- Selenium
- Silver
- Thallium
- Vanadium
- Zinc

The sediment samples were compared to the non-airfield freshwater drainage ditch background screening values as shown on Table 6-7. Of the sixteen metals detected, six were detected at concentrations exceeding the background screening values. Beryllium, nickel, and zinc were detected above the basewide background screening value in all three samples. Copper and mercury were detected slightly above their basewide background screening values, as shown on Table 6-7. Lead was detected in sample 59SD01 at a concentration of 71.2 mg/kg, above the basewide background screening value of 26.8 mg/kg. The basewide background number for zinc is 105 mg/kg and the exceedances ranged in concentration from 122 J mg/kg in 59SD01 to 176 mg/kg in 59SD03.

A more detailed comparison to relevant criteria is given in Sections 7.0 and 8.0. The AVS/SEM data was incorporated into the ecological risk assessment as part of this document and is not presented in this Section; please refer to Section 7.9.1.5 and Table 7-50 for results and discussion.

Total organic carbon concentrations ranged from 21,000 mg/kg to 68,100 mg/kg.

September 2012 CMS Investigation

As part of the September 2012 CMS investigation, nine sediment samples (59SD04 through 59SD12) and one duplicate sediment sample (59SD04D) were collected from Freshwater Drainage Ditch No. 1. The sediment samples were analyzed for copper, lead, and zinc. The detected results for the sediment data set are provided in Table 6-8.

Copper was detected above the background screening value (131 mg/kg) in four of ten samples at concentrations ranging from 134 mg/kg to 187 mg/kg. Lead was detected above the background screening value (26.8 mg/kg) in four of ten samples at concentrations ranging from 30.1 mg/kg to 70 mg/kg. Zinc was detected above background (105 mg/kg) in nine of ten sediment samples at concentrations ranging from 108 J mg/kg to 357 J mg/kg.

6.6 Field QA/QC Blank Samples

Field QA/QC blank samples (e.g., trip blanks, field blanks, equipment rinsate blanks) were collected during the investigations to provide a measure of potential contamination that may have been introduced into the sample set during collection, transportation, preparation, and/or analysis of the samples (see Section 4.9). The blank samples collected and the associated analyses are presented in Table 4-2. The laboratory analytical results for detected constituents are presented in Tables 6-9 through 6-11. A complete set of analytical results is included in Appendix B.

April/May 2010 CMS Investigation

Six trip blanks (59TB01 through 59TB06) were analyzed for Appendix IX VOCs as shown in Table 4-2 and Table 6-9. Methylene chloride (0.18 J to 0.22 J µg/L) and toluene (0.041 J to 0.13 J µg/L) were detected at low, estimated concentrations in each of the trip blanks except for sample 59TB06. In addition, acetone (1.3 J µg/L) was detected at a low, estimated concentration in sample 59TB05. Acetone, methylene chloride, and toluene are common laboratory contaminants, and their presence likely is attributable to laboratory-type preparation/cleaning.

One field blank (59FB01) was collected from the laboratory-grade DI water used for decontamination purposes and as the source water for the equipment rinsate blanks. In addition, one field blank (59FB02) was collected from store-bought distilled water used for decontamination purposes. The samples were analyzed for parameters shown in Table 4-2; results are shown on Table 6-9. No SVOCs were detected in any of the samples. However, the following constituents were detected at low concentrations in one or both of the samples. The majority of these reported values were qualified as estimated (J) by the data validator to signify the analytes were positively identified, but the reported values are estimated.

- VOCs – acetone, 2-butanone, chloroform, methylene chloride, and toluene
- PAHs – naphthalene
- Pesticides – beta-BHC
- Metals – copper, lead, nickel, and zinc

Eleven equipment rinsate blanks (59ER01 through 59ER11) were collected from the disposable and non-disposable sampling equipment and analyzed for parameters shown in Table 4-2; results are summarized on Table 6-9. No SVOCs or pesticides were detected in any of the samples. However, the following constituents were detected at low concentrations in one or more of the samples. The majority of these reported values were qualified as estimated (J) by the data validator to signify the analytes were positively identified, but the reported values are estimated.

- VOCs – acetone, 2-butanone, carbon disulfide, chlorobenzene, chloroform, methylene chloride, toluene, and xylenes

- PAHs – naphthalene and 2-methylnaphthalene

- Metals – lead, nickel, and zinc

September 2012 CMS Investigation

One trip blank (59TB07) was analyzed for Appendix IX VOCs as shown in Table 4-2; results are presented on Table 6-10. No VOCs were detected in the sample.

One field blank (59FB03) was collected from laboratory-grade DI water and analyzed for parameters shown in Table 4-2. The results shown on Table 6-10 indicate that no VOCs or PAHs were detected in the sample. However, two SVOCs (acetophenone and diethylphthalate) and two metals (barium and thallium) were detected at low concentrations in the sample.

Two equipment rinsate blanks (59ER12 and 59ER14) were collected from the disposable sampling equipment and analyzed for parameters shown in Table 4-2. The results shown on Table 6-10 indicate that no VOCs or PAHs were detected in the samples. However, two SVOCs (acetophenone and diethylphthalate) and three metals (barium, thallium, and tin) were detected at low concentrations in one or both of the samples.

September/November 2012 Pre-Excavation Delineation Sampling

One field blank (59FB05) was collected from laboratory-grade DI water and analyzed for copper, lead, and zinc as shown in Table 4-2. The results shown on Table 6-11 indicate that no metals were detected in the sample.

Two equipment rinsate blanks (59ER13 and 59ER15) were collected from the disposable sampling equipment. 59ER13 was analyzed for Appendix IX metals while 59ER15 was only analyzed for copper, lead, and zinc. As shown on Table 6-11, copper, lead, and zinc were not detected in the samples.

Overall, the constituents and respective concentrations detected in the blank samples did not negatively impact the usability of the analytical data, and the associated results are considered usable as qualified by the validator. Data qualifications required based on validation/evaluation of the blank results are discussed in the data validation report summaries (Appendix C).

6.7 Data Validation/Usability Assessment

Independent, third-party data validation was conducted by DataQual Environmental Services of St. Louis, Missouri. Laboratory analytical data (except soil and liquid IDW data) were evaluated to assess the technical adequacy and usability of the data. The data were validated in accordance with the SW-846 methods used by the laboratory, specifications set forth in the USEPA Region 2 SOPs for validation of organic data acquired using SW-846 methods (USEPA, 2008a; USEPA 2008b; USEPA 2008c), and professional judgment. The DoD Quality Systems Manual for Environmental Laboratories (DoD, 2010) also was consulted. It should be noted that Region 2 has not developed validation checklist SOPs for the methods used to assess inorganics (SW-846 Methods 6010C/6020A/7470A/7471B for metals). Therefore, alternative worksheets were used. Non-compliant analytical results were qualified using Region 2 flagging conventions. The data validation report summaries for each SDG are included in Appendix C.

Some analytical results were "qualified" with an associated explanatory note based on the requirements set forth in the aforementioned guidelines. In general, these results represent minor quality control problems (e.g., typical analytical difficulties or the result of sample matrix issues) and do not affect data usability. Qualification of the results did not significantly compromise the data quality objectives, and the data generated are acceptable, as qualified by the validator, for its intended use except for the rejected results discussed below.

2010 CMS Investigation

CompuChem SDG 1004193 – The calibrations for acrolein, acrylonitrile, 2-butanone, propionitrile, and isobutyl alcohol exhibited non-compliant percent difference (%D) and relative response factor (RRF) values. Therefore, non-detect results for all of the samples were rejected. The calibrations for acetone and 1,4-dioxane also exhibited non-compliant %D and RRF values.

Therefore, non-detect results for the majority of samples were rejected. In addition, the laboratory control sample (LCS) and laboratory control sample duplicate (LCSD) for 1,4-phenylenediamine and endrin aldehyde exhibited recoveries below the QC limit. Therefore, non-detect results for all of the samples were rejected.

CompuChem SDG 1004194 **–** The calibrations for acrolein, propionitrile, isobutyl alcohol, 1,4-dioxane, and methylmethacrylate exhibited non-compliant %D and RRF values. Therefore, non-detect results for all of the samples were rejected. In addition, the LCS for 1,4-phenylenediamine and endrin aldehyde exhibited recoveries below the QC limit. Therefore, non-detect results for all of the samples were rejected. The MS/MSD associated with sample 59SB02-00 exhibited non-compliant recoveries for 1,4-phenylenediamine, 1-naphthylamine, 2-naphthylamine, 4-aminobiphenyl, methapyrilene, and 3,3'-dimethylbenzidine. Therefore, non-detect results for all of the samples were rejected. Beta-BHC also was rejected in sample 59SB04-00 due to non-compliant column quantitation %D values.

CompuChem SDG 1004195 **–** The calibrations for acrolein, propionitrile, isobutyl alcohol, 1,4-dioxane, methylmethacrylate, and 1,4-phenylenediamine exhibited non-compliant percent relative standard deviation (%RSD), %D, and/or RRF values. Therefore, non-detect results for all of the samples were rejected. Non-detect results for 1,4-phenylenediamine and kepone in all of the samples also were rejected because the LCS exhibited recoveries below the QC limit. The MS/MSD associated with sample 59SB02-01 exhibited non-compliant recoveries for 1,4-phenylenediamine and methapyrilene. Therefore, non-detect results for all of the samples were rejected. Barium in all of the samples also was rejected because the matrix duplicate analysis exhibited a non-compliant relative percent difference (RPD) value.

CompuChem SDG 1004208 **–** The calibrations for acetone, acrolein, acrylonitrile, propionitrile, isobutyl alcohol, and 1,4-dioxane exhibited non-compliant %D and RRF values. Therefore, non-detect results for these constituents were rejected. In addition, the LCS and LCSD for 1,4-phenylenediamine exhibited a recovery below the QC limit. Therefore, the non-detect result for this constituent was rejected.

CompuChem SDG 1005175 **–** The calibrations for acetone, acrolein, acrylonitrile, 2-butanone, propionitrile, isobutyl alcohol, and 1,4-dioxane exhibited non-compliant %D and RRF values. Therefore, non-detect results for all of the samples were rejected. The calibration for 4-nitroquinoline-1-oxide also exhibited non-compliant %RSD and %D values. Therefore, non-detect results for the majority of samples were rejected. In addition, non-detect results for 1,4-phenylenediamine in all of the samples were rejected because the LCS exhibited a recovery below the QC limit. The MS/MSD associated with samples 59GW02 and 59GW02D exhibited non-compliant recoveries for 1,4-phenylenediamine and pronamide. Therefore, non-detect results for these two samples were rejected. In addition, mercury and zinc in all of the samples were rejected due to non-compliant percent recovery (%R) and RPD values in the MS/MSD analysis. Zinc in samples 59GW02 and 59GW02D also was rejected due to non-compliant field duplicate reproducibility.

CompuChem SDG 1005176 **–** The calibrations for acrolein, propionitrile, isobutyl alcohol, 1,4-dioxane, and methylmethacrylate exhibited non-compliant %D and RRF values. Therefore, non-detect results for all of the samples were rejected. In addition, the LCS for 1,4-phenylenediamine and kepone exhibited recoveries below the QC limit. Therefore, non-detect results for all of the samples were rejected. The MS/MSD associated with samples 59SB11-01 and 59SB11-01D exhibited non-compliant recoveries for 1,4-phenylenediamine, methapyrilene, and kepone. Therefore, non-detect results for these two samples were rejected.

CompuChem SDG 1005177 **–** The calibrations for acrolein, propionitrile, isobutyl alcohol, 1,4-dioxane, and methylmethacrylate exhibited non-compliant %D and RRF values. Therefore, non-detect results for all of the samples were rejected. In addition, the LCS for 1,4-phenylenediamine exhibited a recovery below the QC limit. Therefore, non-detect result for all of the samples were rejected. The MS/MSD associated with samples 59SB13-00 exhibited non-compliant recoveries for 1,4-phenylenediamine and methapyrilene. Therefore, non-detect results for this sample were rejected.

CompuChem SDG 1005178 **–** The calibrations for acrolein, propionitrile, isobutyl alcohol, 1,4-dioxane, and methylmethacrylate exhibited non-compliant %D and RRF values. Therefore, non-detect results for all of the samples were rejected. In addition, the LCS for 1,4-phenylenediamine exhibited a recovery below the QC limit. Therefore, non-detect results for all of the samples were rejected. The MS/MSD associated with samples 59SB13-01 and 59SB13-01D exhibited non-compliant recoveries for 1,4-phenylenediamine and methapyrilene. Therefore, non-detect results for these two samples were rejected. In addition, lead in all of the samples was rejected due to a non-compliant %R value in the matrix spike analysis.

CompuChem SDG 1005179 **–** Mercury (dissolved fraction) in all of the samples was rejected due to a non-compliant %R value in the matrix spike analysis. In addition, zinc (dissolved fraction) in samples 59GW02 and 59GW02D was rejected due to non-compliant field duplicate reproducibility.

CompuChem SDG 1005188 **–** The calibrations for acetone, acrolein, acrylonitrile, 2-butanone, propionitrile, isobutyl alcohol, and 1,4-dioxane exhibited non-compliant %D and RRF values. Therefore, non-detect results for samples 59ER11 and 59TB06 were rejected.

2012 CMS Investigation

Test America SDG 680-82907-1 **–** The calibrations for isobutanol and 1,4-dioxane exhibited non-compliant %D and RRF values. Therefore, non-detect results for all of the samples were rejected. In addition, the MS/MSD associated with samples 59SB24-00 and 59SB33-00 exhibited non-compliant recoveries for 1,4-phenylenediamine, a,a-dimethylphenethylamine, 1-naphthylamine, hexachlorophene, and methylmethanesulfonate (59SB33-00 only). Therefore, non-detect results for these two samples were rejected. Lead in all of the soil samples associated with this SDG also was rejected due to a non-compliant %R value in the matrix spike analysis.

6.7.1 Data Completeness Summary

Data completeness is a measure of the number of valid sample results that are available relative to the number of sample results that were intended. The Final RCRA Facility Investigation Management Plans (Baker, 1995) establishes the project data completeness goal at 90 to 95 percent. Results for each method/analytical suite were within the project completeness criteria except for VOCs in surface water (87.7 percent data usability) and VOCs and total metals in groundwater (87.7 and 88.2 percent data usability, respectively) (see Table 6-12).

Non-detect results for acetone, acrolein, acrylonitrile, 2-butanone, isobutyl alcohol, propionitrile, and 1,4-dioxane were rejected in the water samples, which contributed to the lower percentage of usable data. It should be noted that these rejected VOC results were non-detect values. Any positive results likely would have been qualified as estimated (J) and considered usable in accordance with USEPA Region 2 guidance. Therefore, missing these rejected data points is not anticipated to significantly affect project decisions. In addition, total mercury and zinc were rejected in the groundwater samples, which contributed to the lower percentage of usable data.

It should be noted that CompuChem inadvertently did not analyze a number of samples (surface soil, subsurface soil, surface water, sediment, and QA/QC samples) for the SVOC dinoseb because the initial instrument calibration did not contain this analyte. However, a search was conducted in the tentatively identified compounds for all of the samples, and dinoseb was not present. Of the samples for which dinoseb was reported, there were no detected results.

Overall, 96.4 percent of the validated data was considered usable (see Table 6-12), and lack of data for the rejected constituents/missing data points (3.6 percent) is not anticipated to significantly affect project decisions. Therefore, project completeness goals have been achieved.

6.7.2 Comparison of LOD Values to Screening Values

Sample-specific LODs for non-detect results were compared to the risk-based, human health and ecological screening values to evaluate any impact on usability of the data and the decision making process. Due to limitations of best available analytical technology, the LODs for a number of non-detect constituents in soil, groundwater, surface water, and sediment were greater than the screening values (see Appendix B). In addition, sensitivity issues were identified for some other constituents for reasons that may include, but are not limited to, the following:

- Sample dilution in order to report analytes present at elevated concentrations within the instrument's linear calibration range
- Matrix effects that mask low concentrations and result in elevated quantitation limits to demonstrate low concentrations cannot be detected
- Strong matrix effects that result in analysis of the sample at a dilution in an attempt to minimize the matrix effects
- Soil or sediment samples with high percent moisture that result in elevated quantitation limits such that the concentrations and limits are reported on a dry-weight basis

These non-detect constituents reported at LODs greater than the screening values were further evaluated qualitatively during the ecological and human health risk assessments (see Sections 7.0 and 8.0, respectively). An assessment of the associated uncertainty and impact to the overall estimates of risk and hazard are provided, as appropriate, to determine if risk management decisions would be affected by the fact that the LOD exceeds the screening value(s) for a particular constituent(s).

6.8 References

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USEPA. 2008a. Validating Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry, SW-846 Method 8260B. SOP HW-24 Rev. 2. USEPA Region 2 Hazardous Waste Support Branch. August 2008.

USEPA. 2008b. Validating Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry, SW-846 Method 8270D. SOP HW-22 Rev. 4. USEPA Region 2 Hazardous Waste Support Branch. August 2008.

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7.0 SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT AND STEP 3A OF THE BASELINE ECOLOGICAL RISK ASSESSMENT

This section presents a screening level ecological risk assessment (SERA) and Step 3a of the baseline ecological risk assessment (BERA) for SWMU 59 – Former Vehicle Maintenance and Refueling Area, located at NAPR, Ceiba, Puerto Rico. The SERA and Step 3a of the BERA were performed in accordance with Navy policy for conducting ecological risk assessments (ERAs) (Chief of Naval Operations [CNO], 1999) and Navy guidance for conducting ERAs (available at http://web.ead.anl.gov/ecorisk/), as well as guidance provided by the USEPA (1997).

The Navy ERA process (see Figure 7-1) consists of eight steps organized into three tiers and represents a clarification and interpretation of the eight-step ERA process outlined in the USEPA ERA guidance for the Superfund program (USEPA, 1997). Tier 1 of the Navy ERA process represents the SERA:

- Screening level problem formulation and ecological effects evaluation (Step 1).
- Screening level exposure estimate and risk calculation (Step 2).

Under Navy policy (CNO, 1999), if the results of Steps 1 and 2 (Tier 1 SERA) indicate that, based on a set of conservative exposure assumptions, there are chemicals present in environmental media that may present a risk to receptor species/communities, the ERA process proceeds to the BERA. According to Superfund guidance (USEPA, 1997), Step 3 represents the problem formulation phase of the BERA. Under Navy policy, the BERA is defined as Tier 2, and the first activity under Tier 2 is Step 3a. In Step 3a, the conservative exposure assumptions applied in Tier 1 are refined and risk estimates are recalculated using the same conceptual site model. The evaluation of risks in Step 3a also may include consideration of available background data and chemical bioavailability. If the screening level ERA and re-evaluation of conservative exposure assumptions in Step 3a does not support an acceptable risk determination for all potential chemical-pathway-receptor combinations, CAOs will be established to address potential ecological risks at SWMU 59.

7.1 Environmental Setting

The sections that follow provide a description of the habitats occurring within and contiguous to SWMU 59, as well as the biota that may be present. The description of habitats and biota relies on literature-based information for Puerto Rico and NAPR, and is supplemented by observations made during the 2010 and 2012 CMS field investigations conducted at the SWMU.

7.1.1 Terrestrial Habitats

The upland habitat bounded by NAPR is classified as subtropical dry forest (Ewel and Witmore, 1973). Similar to other forested areas of Puerto Rico, this region was previously clear-cut in the early part of the century, primarily for pastureland (Geo-Marine, Inc., 1998). After acquisition by the Navy, a secondary growth of thick scrub, dominated by lead tree (*Leucaena* spp.), white indigoberry (*Randia aculeata*), sweet acacia (*Acacia farnesiana*), and Australian corkwood (*Sesbania grandiflora*) grew in the previously grazed sections (Geo-Marine, Inc., 1998). Secondary growth communities (upland coastal forest communities and coastal scrub forest communities) exist today throughout NAPR's undeveloped upland.

As evidenced by Figures 4-1 and 7-2, a coastal scrub forest community borders and extends into the northern, eastern, and southern fringes of the SWMU. This community, dominated by white lead tree (*Leucaena leucocephala*), is encroaching upon previously maintained grassy areas. A small coastal scrub community also has become established in the immediate vicinity of the abandoned fuel islands, east of Forrestal Drive (see Figure 4-1). This community also is dominated by white lead tree. Other vegetation recorded at the SWMU during the 2010 CMS field investigation includes white indigoberry (*Randia aculeata*), climbing day flower (*Commelina diffusa*), guinea grass (*Panicum maxima*), light-blue snakeweed (*Stachytarpheta jamaicensis*), gumbo-limo (*Bursera simaruba*), bretonica prieta (*Melochia nodiflora*), fringed windmill grass (*Chloris ciliata*), barrelier's woodsorrel (*Oxalis barrelieri*), tropical fimbry (*fimbristylis cymosa*), and oceanblue morning-glory (*Ipomoea indica*).

Cobana negra (*Stahlia monosperma*), a federally threatened tree species, is known to occur between the boundary of black mangrove communities and upland coastal forest communities. This species is also known to occur in coastal forests of southeastern Puerto Rico (Little and Wadsworth, 1964). A single individual was encountered at NAPR during recent surveys conducted by Geo-Marine, Inc. (NAVFAC, 2006). This individual is located within a coastal scrub forest community near the Capehart housing area, west of American Circle, approximately 3.0 miles southwest of SWMU 59. No other plant species listed under the provisions of the Endangered Species Act of 1973 are known to occur or have the potential to occur at NAPR (Geo-Marine, Inc., 2000 and NAVFAC, 2006).

7.1.2 Aquatic Habitats

Approximately 460 acres at NAPR are covered by palustrine habitat, which includes all freshwater wetlands. These wetlands include wet meadows and marshes, dominated by cattails (*Typha* spp.) and grasses (*Panicum* spp. and *Paspalum* spp.), as well as wet coastal scrub forests. The marine environment surrounding NAPR includes mudflats, mangroves, and seagrass beds. The total area of mudflats, mangroves, and seagrass beds in the offshore environment is approximately 161 acres, 2,700 acres, and 1,900 acres, respectively (Geo-Marine, Inc., 1998). Coral reefs are also located in the offshore marine environment). Coral reef types within the waters surrounding NAPR, as well as their associated acreage cover are listed below (Department of Navy [DoN], 2007):

Reef Habitat Type	Area (acres)
Colonized bedrock	266
Linear reef	84
Patch reef (aggregated)	146
Patch reef (individual)	175
Scattered coral-rock	5

Mangroves at NAPR mainly consist of red mangrove (*Rhizophora mangle*), black mangrove (*Avicennia germinans*), and white mangrove (*Laguncularia racemosa*) (Geo-Marine, Inc., 2000 and 2005). Red mangroves tolerate relatively deep water levels, grow in unstable, soft soil, and tolerate a salinity range of 10 to 55 parts per thousand (ppt). They develop large prop roots which usually extend above the water surface. Black and white mangroves generally grow in areas that are not inundated by water. Mangroves at NAPR are natural filters for upland runoff and protect the coastline from storm damage (Lewis, 1986). They also provide habitat for wildlife, fish, and benthic invertebrates. Lewis (1986) reported 112 species of birds that use the NAPR mangroves as habitat for feeding, nesting, and roosting. The red mangrove prop root habitat in Puerto Rico is also used by at least 13 species of fish (including the gray snapper [*Lutijanus griseus*], lane snapper [*Lutijanus synagris*], and gold and black tricolor [*Holocanthus tricolor*]), several

crustaceans (including the flat tree oyster [*Isognomon alatus*]), gastropods (including the coffee bean snail [*Melampus coffeus*] and mangrove periwinkle [*Littorina angulifera*]), echinoids (including the long-spined sea urchin [*Diadema antillarum*] and pencil sea urchin [*Eucidaris tribuloides*]), sponges (including the fire sponge [*Tedania ignis*]), ascidians (including the black tunicate [*Acsidia nigra*]), and hydroids (including the feathered hydroid [*Halocordyle disticha*]) (Geo-Marine, Inc., 2005).

The seagrass beds in eastern Puerto Rico are typical of well-developed climax meadows found throughout the tropical Atlantic and Caribbean basin, consisting primarily of a dense continuous coverage of turtle grass (*Thalassia testudinum*) with lesser amounts of manatee grass (*Syringodium filiforme*) and a wide diversity of calcareous algae (Reid et al., 2001). Patchy and sparse beds of mixed species, including shoal grass (*Halodule wrightii*), manatee grass, and paddle grass (*Halophila decipiens*), occur in localized areas affected and maintained by different wave regimes, substrate type, and turbidity than what is normally found in association with the climax turtle grass meadows.

The nearest open water marine habitat to SWMU 59 is the Ensenada Honda (an embayment located approximately 1,400 feet south of the SWMU). As evidenced by Figure 7-2, seagrass beds are prevalent throughout much of the Ensenada Honda, including the area immediately downgradient from SWMU 59. Seagrass meadows within the Ensenada Honda are dominated by a nearly continuous cover of turtle grass with a high abundance of calcareous green algae (*Avranvilla* spp., *Ventricaria ventricosa*, *Caulerpa* spp., *Valonia* spp., and *Udotea* spp.) (Reid et al., 2001). The turtle grass climax meadows of the Ensenada Honda represent grazing areas for the West Indian manatee, a federally endangered species in Puerto Rico, and the green sea turtle (*Chelonia mydas*), a federally threatened species in Puerto Rico (see Section 7.1.3.1 and 7.1.3.3, respectively).

A map showing the spatial relationship of SWMU 59 to wetland habitats is provided as Figure 7-3. The wetlands depicted on Figure 7-3, identified by the Cowardin Wetland Classification System (Cowardin et al., 1979 [see Figure 7-4]), were delineated by Geo-Marine, Inc. in December 1999 from 1993 color infrared and 1998 true color aerial photography. Twenty percent of the wetlands delineated by aerial photography were field checked to verify the accuracy of the delineations. Field verification was based on the 1987 Corps of Engineers wetland delineation manual (United States Army Corps of Engineers [USACE], 1987). As evidenced by Figure 7-3, there are no freshwater wetlands within or contiguous to SWMU 59. However, several estuarine wetland systems are depicted on this figure. The most significant wetland feature is the Los Machos mangrove forest, located approximately 900 feet north and 1,400 feet east of SWMU 59. Based on the Cowardin Wetland Classification System (Cowardin et al., 1979), the specific wetland types found within the Los Machos mangrove forest include the following:

- Estuarine, Intertidal, Scrub-Shrub, Broad-Leaved Evergreen (E2SS3)
- Estuarine, Intertidal, Unconsolidated, Shore, Sand (E2US2)
- Estuarine, Intertidal, Unconsolidated, Shore, Mud (E2US3)
- Estuarine, Intertidal, Unconsolidated Shore, Organic (E2US4)

E2SS3 wetlands also are located approximately 900 feet west and 1,000 feet southwest of SWMU 59 (see Figure 7-3). The coastal scrub forest community forming the northern, eastern, and southern boundary of SWMU 59 is topographically upgradient of the SWMU. Although

groundwater flow at SWMU 59 appears to be radial based on groundwater elevation measurements (see Section 5.2.2 and Figures 5-3 and 5-4), site topography indicates that groundwater flow off-site is in a west/southwest direction toward the E2SS3 wetlands depicted on Figure 7-3 and the Ensenada Honda. These estuarine/marine systems represent potential discharge points for SWMU 59 groundwater.

As discussed in Section 2.2, several drop inlets are located within paved areas of the SWMU. Storm water entering the drop inlets travels through a storm sewer system that conveys run-off to a 24-inch culvert extending under Forrestal Drive. Surface run-off originating North of SWMU 59 also enters the 24-inch culvert via a drainage ditch/swale running parallel to Forrestal Drive. Storm water exiting the culvert west of Forrestal Drive discharges to a small pool (likely formed by the scouring action of the discharge) prior to entering a drainage ditch (see Photograph No. 10 in Appendix A). During the 2010 CMS field investigation, water depth within the pool was approximately three feet. Although submergent and/or emergent vegetation were not growing within the pool (see Photograph No. 10 in Appendix A), hydrophytic vegetation (i.e., southern cattail [*Typha domingensis*]) was present along its banks (see Photograph No. 11 in Appendix A). Water was flowing within the drainage ditch during the 2010 CMS field investigation. However, no water was present during the 2012 CMS field investigation. Although water was absent during the 2012 CMS field investigation, hydrophytic vegetation was prevalent throughout the ditch channel.

Storm water within the drainage ditch travels approximately one mile before discharging through Outfall 002 to an estuarine wetland system adjacent to the Ensenada Honda. It is noted that in addition to SWMU 59, the drainage ditch receives run-off from AOC F, SWMU 13, JP-5 Hill, and a large portion of the airfield, including SWMUs 56 and 69 (see Figure 2-4). Storm water run-off from JP-5 Hill and the airfield, including SWMUs 56 and 69, as well as the portion of SWMU 13 west of Forrestal Drive of SWMU 13, enters the drainage ditch downstream from the SWMU 59 discharge point. However, as evidenced by Figure 2-4, storm water originating from SWMU 53 and a small portion of SWMU 13 east of Forrestal Drive combine with storm water originating from SWMU 59 prior to discharge to the drainage ditch, while storm water from AOC F enters the drainage ditch upstream from SWMU 59.

7.1.3 Fauna

A description of the fauna occurring in Puerto Rico and the landmass encompassed by NAPR is provided in the sections that follow. The description is supplemented by observations and information from the 2010 and 2012 CMS field investigations conducted at SWMU 59.

7.1.3.1 Mammals

A total of 22 terrestrial mammal species are known historically from Puerto Rico; however, all mammals except bats (13 species) have been extirpated (Mac et al., 1998). None of the bats found on Puerto Rico are exclusive to the island, nor are they listed under provisions of the Endangered Species Act of 1973. The specific bat species known to occur on Puerto Rico are listed below:

- Fruit-eating bats: Jamaican fruit bat (*Artibeus jamaicensis*), Antillean fruit bat (*Brachyphylla cavernarum*), and red fig-eating bat (*Stenoderma rufum*)

- Nectivorous bats: brown flower bat (*Erophylla sezekoni*) and greater Antillean long-tounged bat (*Monophyllus redmani*)

- Insectivorous bats: Antillean ghost-faced bat (*Mormoops blainvillii*), Parnell's mustached bat (*Pteronotus parnellii*), sooty mustached bat (*Pteronotus quadridens*), big brown bat (*Eptesicus fuscus*), red bat (*Lasiurus borealis*), velvety free-tailed bat (*Molossus molossus*), and Brazilian free-tailed bat (*Tadarida brasiliensis*)

- Piscivorous bats: Mexican bulldog bat (*Noctilio leporinus*)

As discussed in Section 7.1.1, vegetation growing within the coastal scrub forest communities at and immediately contiguous to SWMU 59 is dominated by white lead tree. The nectar/pollen of this flowering plant is used as a source of food by nectivorous bats in Puerto Rico (Gannon et al., 2005).

Of the endangered/threatened marine mammals that may occur in Puerto Rico, only the West Indian manatee is known to occur in the marine environment surrounding NAPR (DoN, 2007). Manatee populations in Puerto Rico's coastal waters have been documented during three aerial surveys conducted from 1978 to 1979, 1984 to 1985, and in 1993 (United Nations Environmental Program [UNEP], 1995), a radio tracking study of manatee distribution and abundance (Reid and Kruer, 1998), and a year-long study of manatee distribution and abundance (Woods et al., 1984). Historical manatee sightings at NAPR are summarized on Figure 7-5. The figure (reproduced from DoN, 2007) includes information from most of the studies identified above. Feeding manatees are most often recorded within Pelican Cove and the Ensenada Honda. Given that the Ensenada Honda represents a potential discharge point for SWMU 59 groundwater, this surface water body is a potential exposure point for West Indian manatee dietary exposures to chemicals in SWMU 59 groundwater.

Several mammals have been introduced into Puerto Rico, including the black rat (*Rattus rattus*), Norway rat (*Rattus norvegicus*), and small Indian mongoose (*Herpestes javanicus*). These nonindigenous mammals have been implicated in the decline of native bird and reptile populations (Mac et al., 1998 and United States Fish and Wildlife Service [USFWS], 1996a).

7.1.3.2 Birds

A total of 239 bird species are native to Puerto Rico (Raffaele, 1989). This total includes breeding permanent residents and non-breeding migrants. In addition, many nonindigenous bird species have been introduced to Puerto Rico, including the shiny cowbird (*Molothrus bonariensis*) and several parrot species, such as the budgerigar (*Melopsittacus undulates*), orange-fronted parrot (*Aratinga canicularis*), and monk parrot (*Myiopsitta monaqchus*). Of the 239 species native to Puerto Rico, 12 are endemic to the island (Raffaele, 1989).

Numerous native and migratory bird species have been reported at NAPR (Geo-Marine, Inc., 1998). A list of bird species reported at NAPR or having the potential to occur is provided in Table 7-1. The list, compiled from literature-based information pre-dating 1990, includes the great blue heron (*Ardea herodias*), snowy egret (*Egretta thula*), little blue heron (*Florida caerulea*), black-crowned night heron (*Nycticorax nycticorax*), belted kingfisher (*Ceryle alcyon*), spotted sandpiper (*Actitis macularia*), greater yellowlegs (*Tringa melanoleauca*), black-bellied plover (*Squatarola squatarola*), clapper rail (*Rallus longirostris*), Royal tern (*Thalasseus maximus*), sandwich tern (*Thalasseus sandvicensis*), least tern (*Stema albifrons*), yellow warbler (*Dendroica petechia*), palm warbler (*Dendroica palmarum*), prairie warbler (*Dendroica discolar*), magnolia warbler (*Dendrocia magnolia*), mourning dove (*Zenaida macroura*), red-legged thrush (*Mimocichla plumbea*), common nighthawk (*Chordeiles minor*), and red-tailed hawk (*Buteo jamaicensis*). Endemic species reported from NAPR include the Puerto Rican lizard cuckoo (*Saurothera vieilloti*), Puerto Rican flycatcher (*Myiarchus antillarum*), Puerto Rican

woodpecker (*Malanerpes portoricensis*), Puerto Rican emerald (*Chlorostilbon maugaeus*), and yellow-shouldered blackbird (*Agelaius xanthomus*).

The yellow-shouldered blackbird is a federally endangered species (USFWS, 2013). One of the principal reasons for the status of this species is attributed to nest parasitism by the nonindigenous shiny cowbird (USFWS, 1983). Other factors contributing to the status of this species include nest predation by the introduced black rat, Norway rat, and mongoose, as well as habitat modification and destruction (USFWS, 1996a). The entire land area of NAPR was declared critical habitat for the yellow-shouldered blackbird in 1976; however, a 1980 agreement between the Navy and the USFWS exempted certain areas from this categorization (Geo-Marine, Inc., 1998). A study conducted by the Naval Facilities Engineering Service Center (NFESC, 1996) reported that the mangrove forests surrounding NAPR should be considered the most important nesting habitat for the yellow-shouldered blackbird. A survey conducted in July 2002 by the Puerto Rico Department of Natural Resources (PRDNR, 2002) reported fifteen yellow-shouldered blackbirds (including five juveniles) at NAPR. At the time of the survey, the birds were using the structures at the NAPR airport for resting cover. Although nesting pairs were not observed (the survey was not conducted during the breeding season), the airport structures contained several inactive nests. The inactive nests and juvenile birds indicate that a small breeding population is present at NAPR.

SWMU 59 is not located within critical habitat established for the yellow-shouldered blackbird. However, based on the presence of coastal scrub communities within and adjacent to the SWMU, as well as the arboreal feeding behavior of yellow-shouldered blackbirds (USFWS, 1996a), the tree and shrub strata within the coastal scrub communities represent potential foraging habitat. However, arboreal insectivores, such as the yellow-shouldered blackbird, would not be expected to experience any significant exposures to chemicals in surface and subsurface soil that may be associated with activities at SWMU 59. This line of reasoning is consistent with USEPA's approach to ecological soil screening level (Eco-SSL) development. As discussed in Guidance for Developing Ecological Soil Screening Levels (USEPA, 2005a), aerial and arboreal insectivorous birds were excluded from Eco-SSL development because they are considered inappropriate (i.e., they do not have a clear or indirect exposure pathway link to soil [indirect exposure pathways involve ingestion of prey that have direct contact with soil]).

Other federally listed bird species that have the potential to occur at NAPR are the piping plover (*Charadrius melodus*) and roseate tern (*Sterna dougallii dougallii*) (Geo-Marine, Inc., 1998). The piping plover is a rare, non-breeding winter visitor in Puerto Rico (Raffaele, 1989). This species breeds only in North America in three geographic regions (Atlantic Coast population [threatened], Great Lakes population [endangered], and Northern Great Plains population [threatened]; USFWS, 1996b). No piping plover observations were reported at NAPR during the 1990s or during sea turtle nesting surveys conducted in 2002 and 2004 (Geo-Marine, Inc., 2005). No historic evidence is available to indicate whether the roseate tern (threatened in Puerto Rico) has ever nested at NAPR and no roseate tern observations have been noted in or over coastal waters adjacent to NAPR (DoN, 2007). The nearest active roseate tern colony likely occurs on the eastern end of Vieques Island (more than twenty miles east of NAPR) (DoN, 2007).

Foraging birds, such as herons, egrets, sandpipers, and plovers, were not observed within the small pool located at the discharge point of the culvert conveying storm water from SWMU 59 or within the drainage ditch segment immediately adjacent to this pool. However, vocalizations (songs and calls) were heard within the coastal scrub forest community surrounding these surface water features, as well as the coastal scrub forest community along the northern, eastern, and southern boundaries of SWMU 59, indicating that these habitats likely serve as resting, nesting, and/or foraging habitat for a variety of terrestrial bird species.

7.1.3.3 Reptiles and Amphibians

A total of twenty-three amphibians and forty-seven reptiles are known from Puerto Rico and the adjacent waters (Mac et al., 1998). Fifteen of the amphibians and twenty-nine of the reptiles are endemic, while four amphibian species and three reptilian species have been introduced (Mac et al. 1998). Puerto Rico's native amphibian species include sixteen species of tiny frogs commonly called coquis. On the coastal lowlands, almost all coqui species are arboreal. The only amphibians listed under provisions of the Endangered Species Act of 1973 are the Puerto Rican crested toad (*Peltophryene lemur*) and the golden coqui (*Eleutherodactylus jasperi*). Both species are listed as threatened (USFWS, 2013). Distribution of the golden coqui is restricted to areas of dense bromeliad growth. All specimens to date have been collected from a small semicircular area of a 6-mile radius south of Cayey (approximately 30 miles southwest of NAPR), generally at elevations above 700 meters (USFWS, 1984). The Puerto Rican crested toad occurs at low elevations (below 200 meters) where there is exposed limestone or porous, well-drained soil offering an abundance of fissures and cavities (USFWS, 1987). A single large population is known to exist from the southwest coast in Guánica Commonwealth Forest, and a small population is believed to survive on the north coast near Quebradillas, Arecibo, Barceloneta, Vega Baja, and Bayamón (USFWS, 1987). It also has been collected on the southeastern coastal plain near Coamo (USFWS, 1987). Given the habitat preferences and locations of known occurrences, these two amphibian species are not expected to occur at NAPR.

Puerto Rico's native reptilian species include thirty-one lizards, eight snakes, one freshwater turtle, and five sea turtles (Mac et al., 1998). Of the five sea turtles, only the green sea turtle, hawksbill sea turtle (*Eretmochelys imbricata*), and loggerhead sea turtle (*Dermochelys coriacea*) nest within Puerto Rico. These three sea turtles, as well as the leatherback sea turtle (*Caretta caretta)* are listed under the provisions of the Endangered Species Act of 1973 (hawksbill sea turtle and leatherback sea turtle are listed as endangered, while the green sea turtle [Caribbean population] and loggerhead sea turtle are listed as threatened; USFWS, 2013). Aerial surveys of turtles were performed from March 1984 through March 1995 along the Puerto Rican Coast. This information is summarized in the Draft NAPR Disposal Environmental Assessment (Geo-Marine, Inc., 2005). Figures 7-6 and 7-7, reproduced from Geo-Marine, Inc. (2005), present cumulative sea turtle sightings and potential turtle nesting sites, respectively, at NAPR. Significant turtle observations were made near the mouth of the Ensenada Honda, the northern shore of Piñeros Island, Pelican Bay, and the Medio Mundo Passage with the frequency of turtle observations listed as green > hawksbill > loggerhead > leatherback. Based on the life history information for each turtle species (summarized in Baker, 2006a and 2006b) and the availability of forage material (in the form of sea grass), the green sea turtle has the potential to forage within the Ensenada Honda.

The Puerto Rican boa (*Epicrates inornatus*) is a federally endangered species. Four Puerto Rican boa sightings were reported at NAPR prior to 1999 and an additional four occurrences were reported between 2001 and 2003 (Geo-Marine, Inc., 2005). However, no boas were observed during 211 man-hours of surveys conducted within potential boa habitat in 2004 (Tolson, 2004). The Puerto Rican boa uses a variety of habitats but is most commonly found in Karst forest habitat (forested limestone hills). Based on the absence of preferred habitat, there is low probability of occurrence of this species at SWMU 59 and adjacent habitats.

7.1.3.4 Fish and Aquatic Invertebrates

A diverse fish and invertebrate community can be found in the marine environment surrounding NAPR. This can be attributed to the varied habitats that include marine and estuarine open water habitat, mud flats, sea grass beds, and mangrove forests. The fish community is represented by

stingrays, herrings, groupers, needlefish, mullets, barracudas, jacks, snappers, grunts, snooks, lizardfishes, parrotfishes, gobies, filefishes, wrasses, damselfishes, and butterflyfish (Geo-Marine, Inc., 1998). The benthic invertebrate community includes sponges, corals, anemones, sea cucumbers, sea stars, urchins, and crabs.

As discussed in Section 7.1.2, the Ensenada Honda represents a potential discharge points for groundwater at SWMU 59. The composition of the aquatic community within the Ensenada Honda has not been document during previous field investigations conducted at NAPR. A marine reconnaissance survey was conducted within a small cove of Puerca Bay as part of an ERA at SWMU 45 in May 2000 [(Geo-Marine, Inc., 2000)]. Marine invertebrates observed within this embayment included sea urchins (*Echinometra lucunter* and *Echinometra viridis*), encrusting fire coral (*Millipora alcicormus*), common sea fan (*Gorgonia venalina*), starlet coral (*Siderastrea ammulatta*), pincushin starfish (*Oreaster reticulate*s), and corkscrew anemone (*Bartholomea annulatta*), as well as two species of sea cucumbers (*Actinopyga agassizii* and *Holothuria mexicana*). In addition to invertebrates, sixteen fish species were observed within the embayment. The specific species encountered included sergeant major (*Abudefduf saxatillis*), dusky damselfish (*Stegates fuscus*), tomtate (*Haemulon aurolineatum*), gray snapper (*Lutjanus griseus*), squirrelfish (*Holocentrus sp*.), yellow fin mojarra (*Gerres cinereus*), and silver jenny (*Eucinostomus gula*). Many of the species encountered during the marine reconnaissance survey are likely present within the Ensenada Honda.

Identical to the Ensenada Honda, the composition of the biological community within the drainage ditch receiving storm water run-off from the SWMU has not been documented. However, a qualitative benthic macroinvertebrate survey was conducted at three locations within a drainage ditch associated with SWMU 56 (Baker, 2010a). Only snails of unknown species composition were collected at each sampling point. The absence of aquatic insects, such as Ephemeroptera (mayflies), Plecoptera (stoneflies), Trichoptera (caddisflies), Odonta (dragonflies and damselflies), and Coleoptera (beetles) reflect the poor quality of available habitat within this drainage ditch. It is expected that a qualitative benthic macroinvertebrate survey within the drainage ditch associated with SWMU 59 would yield similar results. It is noted that a single fish (unknown species approximately 2.5 inches in length) was observed within the small pool during sampling activities conducted as part of the 2010 CMS field investigation, suggesting the presence of a fish population within the drainage ditch connected to the pool. However, water was not present within the drainage ditch during the 2012 CMS field investigation (see photographs in Appendix A). As such, the ditch is not considered capable of supporting a permanent fish population.

7.2 Sources of Available Analytical Data

Sampling activities at SWMU 59 have been conducted under three separate investigations: Phase II ECP, 2010 CMS field investigation, and 2012 CMS field investigation. The Phase II ECP field investigation was conducted in May 2004 and involved the collection of six surface soil samples (designated 5E-SS01 through 5E-SS06; collected from the 0.0 to 1.0-foot depth interval), ten subsurface soil samples (5E-SB05-01 and 5E-SB07-01 [collected from the 1.0 to 3.0-foot depth interval], 5E-SB02-02, 5E-SB03-02, 5E-SB04-02, 5E-SB06-02, and 5E-SB08-02 [collected from the 3.0 to 5.0-foot depth interval], 5E-SB01-03 [collected from the 5.0 to 7.0-foot depth interval], 5E-SB08-04 [collected from the 9.0 to 11.0-foot depth interval], and 5E-SB07-06 [collected from the 11.0 to 13.0-foot depth interval], and three groundwater samples (designated 13GW04, 5E-GW05, and 5E-GW08). Each surface and subsurface soil sample was analyzed for Appendix IX VOCs, SVOCs, organochlorine pesticides, organophosphorous pesticides, chlorinated herbicides, and metals. Sample locations are depicted on Figure 2-4. A description of the Phase II ECP field investigation and associated analytical results were previously presented in the Final Phase I/II Environmental Condition of Property (NAVFAC Atlantic, 2005). It is noted that the quality of

the analytical data obtained during the Phase II ECP field investigations is uncertain due to the lack of independent, third party data validation. Based on the lack of validation, the surface soil, subsurface soil, and groundwater data were deemed unacceptable for use in the SERA. However, the ECP analytical data were qualitatively evaluated in Step 3a of the BERA (Section 7.9) to ensure recommendations for soil and groundwater are supported by all available analytical data.

The 2010 CMS field investigation (see description in Section 4.0) was conducted in April and May 2010 and involved the collection of nineteen surface soil, forty-six subsurface soil, ten groundwater, three surface water, and three sediment samples. Surface soil was collected from the 0.0 to 1.0-foot depth interval, while subsurface soil was collected from the 1.0 to 3.0-foot, 3.0 to 5.0-foot, 5.0 to 7.0-foot, 7.0 to 9.0-foot, and 9.0 to 11.0-foot depth intervals (see Appendix B). Surface water and sediment was collected from the small pool that receives surface run-off from the SWMU (see last paragraph in Section 7.1.2). All samples (surface soil, subsurface soil, groundwater, surface water, and sediment) were analyzed for Appendix IX VOCs, SVOCs, organochlorine pesticides, and metals. In addition, each groundwater and surface water sample was analyzed for dissolved metals, while each sediment sample was analyzed for AVS, SEM, and TOC. It is noted that all surface soil samples and nineteen of twenty-three (19/23) subsurface soil samples (0.0 to 1.0-foot depth interval) were collected at locations established adjacent to concrete pads and paved surfaces.

The 2012 CMS field investigation (see description in Section 4.0) was conducted in September 2012 and involved the collected of ten surface soil samples (designated 59SB24-00 through 59SB33-00; collected from the 0.0 to 1.0-foot depth interval) and ten subsurface soil samples (designated 59SB24-01 through 59SB33-01; collected from the 1.0 to 3.0-foot depth interval). All surface and subsurface soil samples were collected at locations beneath concrete pads and paved surfaces. In addition to the surface and subsurface soil samples, a total of nine sediment samples were collected within the drainage ditch that receives storm water run-off from the SWMU (designated 59SD04 through 59SD12). All surface and subsurface soil samples were analyzed for Appendix IX VOCs, SVOCs, including LLPAHs, and metals, while the drainage ditch sediment samples were analyzed for copper, lead, and zinc.

Analytical data for soil samples collected from the 0.0 to 1.0-foot depth interval during the CMS field investigations were quantitatively evaluated as surface soil in the SERA. This depth interval is the most active biological zone (most soil heterotrophic activity occurs within the surface soil and soil invertebrates occur on the surface or within the oxidized root zone [Suter II, 1995]). As discussed above, subsurface soil samples were collected from five depth intervals during the CMS field investigation. Analytical data for soil samples collected from the 1.0 to 3.0-foot depth interval were quantitatively evaluated as subsurface soil in the SERA. Analytical data for subsurface samples collected from deeper depth intervals were not evaluated since this depth is not likely to represent a significant exposure point for ecological receptors. As discussed in the preceding paragraphs, surface soil from the 2010 CMS field investigation was collected at locations established adjacent to concrete pads and paved surfaces, while surface soil from the 2012 CMS field investigation was collected at locations established beneath concrete pads and paved surfaces. These two surface soil data sets were evaluated independently from each other in this ERA. In the case of subsurface soil, the majority of samples from the 2010 CMS field investigation were collected at locations established adjacent to concrete pads and paved surfaces (nineteen of twenty-three samples), while all subsurface soil from the 2012 CMS field investigation was collected at locations established beneath concrete pads and paved surfaces. Identical to surface soil, the two subsurface soil data sets were evaluated independently from each other in this ERA.

In addition to the surface and subsurface soil analytical data identified within the preceding paragraph, analytical data for the ten groundwater samples and three drainage ditch surface water samples collected during the 2010 CMS field investigation were quantitatively evaluated in the SERA, as was analytical data for a unified sediment data set.
The surface soil, subsurface soil, groundwater, surface water, and sediment analytical data sets quantitatively evaluated in the ERA are included as Appendix D, while sample locations are depicted on Figure 4-1. It is noted that the analytical laboratory reported non-detected results at the RL for samples collected during the 2010 CMS field investigation. However, non-detected results for samples collected during 2012 CMS field investigation were reported at the LOD.

7.3 Screening Level Problem Formulation

Problem formulation establishes the goals, scope, and focus of the ERA. The products of the screening level problem formulation are (1) the preliminary conceptual model and (2) the assessment and measurement endpoints. The purpose of the preliminary conceptual model is to describe how ecological receptors may be exposed to chemicals originating from the site. The preliminary conceptual model is developed using information regarding major habitats and ecological receptors, media of concern, and potential contaminant sources in conjunction with an understanding of potential transport pathways, exposure pathways, and exposure routes. The fate, transport, and toxicological properties of the chemicals present at the site are also considered during this process. Assessment and measurement endpoints define the ecological attributes to be protected. They are selected to evaluate those receptors for which complete and potentially significant exposure pathways are likely to exist.

7.3.1 Preliminary Conceptual Model

Figure 7-8 presents a preliminary conceptual model for SWMU 59. The conceptual model outlines potential sources of contaminants, transport pathways, exposure media, potential exposure routes, and receptor groups. Specific components of the preliminary conceptual model (i.e., source areas, transport pathways, and exposure pathways and routes) are discussed in the sections that follow.

7.3.1.1 Source Area

The former maintenance facilities and fueling islands represent historical source areas for the release of petroleum, POL (Petroleum, Oils and Lubricant), and HM (Hazardous Material) to paved surfaces at the SWMU. The paved surfaces represent historical source areas for the release of chemicals to surface soil, drainage ditch surface water, and drainage ditch sediment. Contaminated surface soil also represents a potential source for the release of chemicals to subsurface soil and downgradient surface soil. Finally, subsurface soil represents a potential source for the release of chemicals to groundwater.

7.3.1.2 Transport Pathways

A transport pathway describes the mechanisms whereby chemicals may be transported from a source of contamination to ecologically relevant media. As depicted on Figure 7-8, potential mechanisms for contaminant transport from potential source areas at SWMU 59 are believed to include the following:

- Transport of chemicals associated with historical petroleum, POL, and HM spills to paved surfaces with storm water to downgradient surface soil.

- Transport of chemicals associated with historical petroleum, POL, and HM spills to paved surfaces and subsequent infiltration to underlying surface soil through joints and cracks.

- Transport of chemicals associated with historical petroleum, POL, and HM spills to paved surfaces with storm water to storm sewers and subsequent discharge to drainage ditch surface water and sediment.

- Overland transport of chemicals with surface soil via surface run-off to downgradient surface soil.

- Leaching of chemicals from surface soil and/or subsurface soil by infiltrating precipitation and transport with groundwater to estuarine wetland and/or Ensenada Honda surface water and sediment.

- Uptake by biota from surface soil, subsurface soil, drainage ditch surface water, and drainage ditch sediment and trophic transfer to upper trophic level receptors.

7.3.1.3 Exposure Pathways and Routes

An exposure pathway links a source of contamination with one or more receptors via exposure to one or more media. Requirements for a complete exposure pathway are listed below.

- A source of contamination must be present

- Release and transport mechanisms must be available to move contaminants from the source to an exposure point

- An exposure point must exist where ecological receptors could contact affected media

- An exposure route must exist whereby the contaminants can be taken up by ecological receptors

As depicted on Figure 7-8, potentially complete and significant exposure pathways exist at SWMU 59. Exposure pathways and routes applicable to the SWMU and qualitatively or quantitatively evaluated by the SERA are discussed in the paragraphs that follow.

Terrestrial plants may be exposed to chemicals present in soil directly through their root surfaces during water and nutrient uptake. Unrooted, floating aquatic plants, rooted submerged aquatic plants, and algae may be exposed to chemicals directly from the water or (for rooted plants) from sediments. Terrestrial and aquatic invertebrates may be exposed to chemicals in soil, surface water, and/or sediment through dermal adsorption and ingestion. Much of the toxicological data available for terrestrial and aquatic invertebrates are based upon *in situ* studies that represent both pathways. Therefore, both pathways are typically considered together in ERAs. Invertebrates also represent a link between soil, surface water, and/or sediment and upper trophic level receptors through food web transfer. As such, they are often included as prey items for upper trophic level dietary exposures.

Birds and mammals may be exposed to chemicals through: (1) the inhalation of gaseous chemicals or chemicals adhered to particulate matter; (2) the incidental ingestion of contaminated abiotic media (e.g., soil) during feeding or cleaning activities; (3) the ingestion of contaminated water; (4) the ingestion of contaminated plant and/or animal tissues for chemicals that have

entered food webs; and/or (5) dermal contact with contaminated abiotic media. These exposure routes, where applicable, are depicted on Figure 7-8. Their relative importance depends in part on the chemical being evaluated. For chemicals having the potential to bioaccumulate (e.g., PCBs), the greatest exposure to wildlife is likely to be from the ingestion of prey. For chemicals having a limited potential to bioaccumulate (e.g., aluminum), the exposure of wildlife to chemicals is likely to be greatest through the direct ingestion of abiotic media, such as surface soil.

Direct ingestion of drinking water is only considered if the salinity of a potential drinking water source is less than 15 ppt, the approximate toxic threshold for wildlife receptors (Humphreys, 1988). The drainage ditch west of Forrestal Drive represents a potential drinking water source linked to SWMU 59. As any surface water within the pool is freshwater (i.e., surface run-off) and surface water samples were collected from the drainage ditch pool during the 2010 CMS field investigation, ingestion of surface water was considered in risk calculations for upper trophic level receptors.

Certain potential exposure pathways and/or routes depicted on Figure 7-8 are considered insignificant relative to other pathways due to low potential for exposure and low levels of relevant contaminants. For example, dermal exposures are not considered significant relative to ingestion exposures for upper trophic level receptors. This is supported by evidence outlined in Suter II et al. (2000) and the USEPA (2003a), including the general fate properties of the majority of compounds detected in soil (e.g., low affinity for dermal uptake), the low potential exposure frequency and duration, and the protection offered by feathers, fur, and scales to avian, mammalian, and reptilian receptors. In addition, literature reviews indicate that dermal exposures to wildlife from classes of chemicals known or suspected to be of concern via dermal adsorption (e.g., VOCs, organophosphorous pesticides, and petroleum compounds) are often overestimated in laboratory studies (where feathers/fur are removed) and do not represent realistic exposure scenarios (USEPA, 2003a). Furthermore, though burrowing reptiles (which would be expected to experience the most significant exposure) may inhabit the vegetative units within and immediately contiguous to the SWMU, chemicals known or suspected to be of concern via dermal adsorption are not known to be associated with historical activities at the site (e.g., organophosphorous pesticides) or were detected at a low frequency and concentration (e.g., VOCs). Moreover, USEPA (2003a) calculated that the contribution of dermal exposures to the total dose received by terrestrial receptors to be 0.5 percent or less and therefore omitted the dermal pathway from consideration during Eco-SSL development. Incidental ingestion of soil and sediment during feeding and preening activities by upper trophic level receptors, as well as direct contact exposures by lower trophic level receptors (e.g., terrestrial and aquatic invertebrates) are considered significant exposure routes (see Figure 7-8).

Inhalation of gaseous chemicals and chemicals adhered to particulate matter (e.g., soil) is also considered insignificant relative to ingestion pathways. As described above for dermal exposures, this approach is consistent with Suter II et al. (2000) and USEPA (1997 and 2003a), which recognize the relatively small contribution the inhalation pathway contributes to exposure estimates. For example, USEPA (2003a) estimates that the expected contribution to the total dose associated with the inhalation pathway is less than 0.01 percent for particulates and less than 1.0 percent for volatiles. Site conditions further reduce the importance of this exposure route relative to ingestion. The vegetative groundcover at the SWMU (see photographs in Appendix B) will minimize the suspension of dust and the potential for exposure via inhalation of chemicals adhered to soil particles. Furthermore, inhalation of gaseous chemicals that have volatilized from surface soil is likely to be insignificant given that VOCs were generally detected at a low frequency and/or concentration during the 2010 CMS field investigation.

7.3.2 Endpoints and Risk Questions

The conclusion of the screening level problem formulation includes the selection of ecological endpoints, which are based on the preliminary conceptual model. Two types of endpoints, assessment endpoints and measurement endpoints, are defined as part of the ERA process, as are risk hypotheses or risk questions (USEPA, 1997 and 1998). An assessment endpoint is an explicit expression of the environmental component or value that is to be protected. A measurement endpoint is a measurable ecological characteristic that is related to the component or value chosen as the assessment endpoint. The considerations for selecting assessment and measurement endpoints are summarized in USEPA (1992 and 1997) and discussed in detail by Suter II (1989, 1990, and 1993). Risk questions ask how the assessment endpoints could be affected by site-related constituents.

Endpoints in the SERA define ecological attributes that are to be protected (assessment endpoints) and a measurable characteristic of those attributes (measurement endpoints) that can be used to gauge the degree of impact that has or may occur. Assessment endpoints most often relate to attributes of biological populations or communities, and are intended to focus the risk assessment on particular components of the ecosystem that could be adversely affected by chemicals attributable to the site (USEPA, 1997). Assessment endpoints contain an entity (e.g., red-tailed hawk) and an attribute of that entity (e.g., survival rate). Individual assessment endpoints usually encompass a group of species or populations (the receptor) with some common characteristic, such as a specific exposure route or sensitivity to a specific contaminant, with the receptor then used to represent the assessment endpoint in the risk evaluation.

Assessment and measurement endpoints may involve ecological components from any level of biological organization, from individual organisms to the ecosystem itself (USEPA, 1992). Effects on individuals are important for some receptors, such as rare and endangered species; however, population- and community-level effects are typically more relevant to ecosystems. Population- and community-level effects are usually difficult to evaluate directly without long-term and extensive study. However, measurement endpoint evaluations at the individual level, such as an evaluation of the effects of chemical exposure on reproduction, can be used to predict effects on an assessment endpoint at the population or community level. In addition, use of criteria values designed to protect the vast majority (e.g., 95 percent) of the components of a community (e.g., National Recommended Water Quality Criteria [NRWQC]) can be useful in evaluating potential community and/or population-level effects.

Table 7-2 summarizes the assessment endpoints, risk questions, and measurement endpoints selected for the SERA. As evidenced by Table 7-2, the assessment endpoints selected for the upland habitat at SWMU 59 are based on the survival, growth, and reproduction of lower trophic level terrestrial receptor groups (terrestrial plants and invertebrates), terrestrial reptiles and amphibians, upper trophic level terrestrial birds (herbivores, omnivores, and carnivores), and upper trophic level terrestrial mammals (i.e., nectivorous bats), while assessment endpoints for the drainage ditch are based on the survival, growth, and reproduction of lower trophic level aquatic receptor groups (aquatic plants, invertebrates, fish, and amphibians) and upper trophic level birds (piscivores). The population traits of interest for each of the assessment endpoints listed in Table 7-2 represent components of a healthy population. Failure or impairment of survival, growth, or reproduction will adversely affect the ability of the population to be healthy and viable and fill its appropriate role in an ecosystem.

7.3.3 Selection of Receptors

Because of the complexity of natural systems, it is generally not possible to directly assess the potential impacts to all ecological receptors present within an area. Therefore, specific receptor species (e.g., mourning dove) are often selected as surrogates to evaluate potential risks to larger components of the ecological community (e.g., avian herbivores) used to represent the assessment endpoints (e.g., survival, growth, and reproduction of avian herbivores). Selection criteria typically include those species that:

- Are known to occur, or are likely to occur, at the site
- Have a particular ecological, economic, or aesthetic value
- Are representative of taxonomic groups, life history traits, and/or trophic levels in the habitats present at the site for which complete exposure pathways are likely to exist
- Can, because of toxicological sensitivity or potential exposure magnitude, be expected to represent potentially sensitive populations at the site
- Have sufficient ecotoxicological information available on which to base an evaluation

Lower trophic level receptor species were evaluated based on those taxonomic groupings (e.g., terrestrial plants and invertebrates, aquatic plants and invertebrates, and fish) for which screening values have been developed. These groupings and screening values are used in most ERAs. As such, specific receptor species of lower trophic level terrestrial and aquatic biota were not chosen because of the limited species-specific information available. These receptors were instead dealt with on a community level via a comparison to soil, groundwater, surface water, and sediment screening values.

The upper trophic level receptor species listed below were chosen for dietary exposure modeling to chemicals in SWMU 59 surface soil, subsurface soil, and/or drainage ditch sediment based on the criteria listed above, the general guidelines presented in USEPA (1991), the description of habitats and biota presented in Section 7.1, and the assessment endpoints (see Table 7-2).

<u>Terrestrial Habitat</u>

- Mourning dove (*Zenaida macroura*) (avian herbivore)
- American robin (*Turdus migratorius*) (avian omnivore)
- Red-tailed hawk (*Buteo jamaicensis*) (avian carnivore)
- Brown flower bat (*Erophylla sezekorni*) (mammalian nectivore)

<u>Drainage Ditch Habitat</u>

- Green heron (*Butorides virescens*) (avian piscivore)

The mourning dove, red-tailed hawk, and green heron are known to occur in Puerto Rico (Raffaele, 1989). These three species also have been reported at NAPR (see Table 7-1). The green heron was selected as a representative avian piscivore based on the indication that the drainage ditch can support fish. The American robin was selected as a surrogate species to represent birds reported from NAPR with similar feeding habits and dietary preferences (e.g., red-legged thrush). SWMU 59 is not located within the critical habitat designation for the yellow-shouldered blackbird. However, based on their arboreal feeding habits, the yellow-shouldered

blackbird could potentially forage within the coastal scrub forest communities at the SWMU. As discussed in Section 7.1.3.2, arboreal insectivores, such as the yellow-shouldered blackbird, would not be expected to experience any significant exposures. Regardless, aspects of the feeding ecology of the American robin and yellow-shouldered blackbird indicate that the American robin can be protectively used as a surrogate receptor:

- The American robin forages on the ground for soft-bodied invertebrates, whereas the yellow-shouldered black bird is an arboreal feeder that forages within the canopy and sub-canopy of trees (USFWS, 1996a). The invertebrate prey item consumed by the American robin is assumed to be earthworms for the SERA. Because earthworms are in direct contact with soil, they will bioaccumulate soil contaminants at higher concentrations than the arboreal invertebrates consumed by the yellow-shouldered blackbird. Therefore, modeled dietary intakes that include earthworm ingestion will result in a conservative estimate of food web exposures for the yellow-shouldered blackbird.

- The diet of the American robin is assumed to include 10.5 percent soil, whereas soil consumption by the yellow-shouldered blackbird is likely to be negligible based on their arboreal feeding behavior. Modeled dietary intakes that include soil ingestion also will result in a conservative estimate of food web exposures for the yellow-shouldered blackbird.

Although potentially complete and significant exposure pathways exist at SWMU 59 for terrestrial ground mammals (i.e., incidental ingestion of surface soil, ingestion of surface water, and ingestion of contaminated plant and/or animal tissues for chemicals that have entered food webs), a terrestrial ground mammal was not selected as an ecological receptor for the following reasons.

- All native terrestrial ground mammals have been extirpated from Puerto Rico (Mac et al., 1998).

- The terrestrial ground mammals represented by potentially complete exposure pathways are limited to nonindigenous, nuisance species (i.e., Norway rat, black rat, and mongoose) that have been implicated in the decline of native reptilian and bird populations (Mac et al., 1998 and USFWS, 1996a).

As discussed in Section 7.1.3.1, vegetation within the coastal scrub forest communities at SWMU 59 includes plants known to be used as a source of food by nectivorous bats in Puerto Rico (white lead tree). Therefore, a nectivorous bat (i.e., brown flower bat) was selected as an ecological receptor for upland habitat at the SWMU. This species is common and found throughout Puerto Rico (Gannon et al., 2005). As discussed in Section 7.1.3.2, the USEPA has excluded aerial and arboreal insectivorous birds from Eco-SSL development because they are considered inappropriate (i.e., they do not have a clear or indirect exposure pathway link to soil [indirect exposure pathways involve ingestion of prey that have direct contact with soil]). For this same reason, the USEPA also has excluded aerial insectivorous mammals (i.e., bats) from Eco-SSL development. As such, an aerial insectivorous bat (i.e., Antillean ghost-faced bat, Parnell's mustached bat, sooty mustached bat, big brown bat, red bat, velvety free-tailed bat, or Brazilian free-tailed bat) was not selected as an ecological receptor. A frugivorous bat (i.e., Jamaican fruit bat, Antillean fruit bat, or red fig-eating bat) was also excluded from evaluation based on the absence of fruit-bearing vegetation known to be used as a source of food on Puerto Rico. Finally, a piscivorous bat (i.e., Mexican bulldog bat) was excluded from evaluation since the dense vegetation surrounding and within the drainage ditch (see Photograph in Appendix A) is not

conducive to foraging methods (use of echolocation while patrolling just above the water or trolling). The absence of surface water during the 2012 CMS field investigation also indicates that the drainage ditch is incapable of supporting a permanent fish population

While exposure pathways to terrestrial reptiles and amphibians are likely to be complete, specific reptilian and amphibian species were not selected as receptors in the SERA since the life history and toxicological database concerning the effects of chemicals on herpetofauna is severely limited, rendering a quantitative evaluation problematic (USEPA, 2000a and 2005a). It is assumed that reptiles and amphibians potentially present at the site are not exposed to significantly higher concentrations of chemicals and are not more sensitive to chemicals than the other upper trophic level receptor species evaluated in the risk assessment. Although this assumption is a source of uncertainty in the SERA, this approach is consistent with USEPA Region III guidance (USEPA, 2013a; available at http://www.epa.gov/reg3hwmd/risk/eco/index.htm), which states that "*As a general rule in Region 3, impacts to reptiles do not have to be considered as an assessment endpoint in the screening level ERA. However, the screening ERA would need to state that impacts to reptiles are being assessed qualitatively through the use of surrogate receptors. An exception to this rule is when a threatened or endangered reptile has been identified as a potential receptor on the site. In this situation, it may be appropriate to consider impact on reptiles when identifying assessment endpoints*."

Based on the presence of surface water during the 2010 CMS field investigation, the drainage ditch west of Forrestal Drive may provide appropriate habitat for amphibian reproduction. Identical to terrestrial and aquatic plants and invertebrates, aquatic amphibians were dealt with on a community level via a comparison of surface water and sediment analytical data to media-specific screening values. This approach is also consistent with USEPA Region III guidance (USEPA, 2013a), which states that "*Amphibians can and should be included as receptors in the screening level risk assessment as appropriate (based on the potential presence of habitat necessary to support these receptors). The assessment should consider AWQCs and any appropriate contaminant specific benchmark available in the literature*."

7.3.4 Fate and Transport Mechanisms

In the absence of measured values of chemicals within biotic media, the transport and partitioning of constituents into particular environmental compartments, and their ultimate fate in those compartments, can be predicted from key physical-chemical characteristics. The physical-chemical characteristics that are most relevant for exposure modeling in this assessment include water solubility, adsorption to solids, octanol-water partitioning, and degradability. These characteristics are defined below.

The water solubility of a compound influences its partitioning to aqueous media. Highly water-soluble chemicals, such as most VOCs, have a tendency to remain dissolved in the water column rather than partitioning to sediment (Howard, 1991). Compounds with high water solubility also generally exhibit a lower tendency to bioconcentrate in aquatic organisms and a greater likelihood of biodegradation, at least over the short term (Howard, 1991).

Adsorption is a measure of a compound's affinity for binding to solids, such as soil or sediment particles. Adsorption is expressed in terms of partitioning, either as the adsorption coefficient (K_d), a unitless expression of the equilibrium concentration in the solid phase versus the water phase, or the organic carbon partition coefficient (K_{oc}, K_d normalized to the organic carbon content of the solid phase; again unitless) (Howard, 1991). For a given organic chemical, the higher the K_{oc} or K_d, the greater the tendency for that chemical to adhere strongly to soil or sediment particles. K_{oc} values can be measured directly or can be estimated from either water

solubility or the octanol-water partition coefficient using one of several available regression equations (Howard, 1991).

Octanol-water partitioning indicates whether a compound is hydrophilic or hydrophobic. The octanol-water partition coefficient (K_{ow}) expresses the relative partitioning of a compound between octanol (lipids) and water. A high affinity for lipids equates to a high K_{ow} and vice versa. K_{ow} has been shown to correlate well with adsorption to soil or sediment particles and the potential to bioaccumulate in the food chain (Howard, 1991). Typically expressed as log K_{ow}, a value of 3.0 or less generally indicates that the chemical will not bioconcentrate to a significant degree (Maki and Duthie, 1978). Log K_{ow} values and K_{oc} values for organic chemicals analyzed for in environmental media collected at SWMU 59 during the 2010 and 2012 CMS field investigations (i.e., Appendix IX VOCs, SVOCs, and/or organochlorine pesticides) are presented in Table 7-3. The Log K_{ow} values listed in Table 7-3 were obtained from USEPA sources (USEPA, 1995 and 2011a), while K_{oc} values were estimated using the following regression equation (USEPA 1993a and 1996):

$$Log\ K_{oc} = 0.00028 + (0.983)(Log\ K_{ow})$$

Degradability is an important factor in determining whether there will be significant loss of mass or change in the form of a chemical over time in the environment. The half-life of a compound is typically used to describe losses from either degradation (biological or abiotic) or from transfer from one compartment to another (e.g., volatilization from soil to air). The half-life is the time required for one-half of the mass of a compound to undergo the loss or degradation process.

7.4 Screening Level Effects Evaluation

The purpose of the screening level effects evaluation is the establishment of chemical exposure levels (screening values) that represent conservative thresholds for adverse ecological effects. One set of screening values is typically developed for each selected assessment endpoint. For the SERA at SWMU 59, two types of screening values were developed (media-specific screening values and toxicity reference values [TRVs]). Media-specific screening values were developed for soil (surface and subsurface soil), groundwater, surface water, and sediment, while TRVs were developed for the evaluation of potential risks to upper trophic level receptors (i.e., birds and mammals) from dietary exposures (i.e., ingested chemical doses).

7.4.1 Media-Specific Screening Values for Soil, Groundwater, Surface Water, and Sediment

The sections that follow describe the various criteria and toxicological benchmarks that were used as media-specific screening values for chemicals in soil (surface and subsurface soil), groundwater, drainage ditch surface water, and drainage ditch sediment. The media-specific screening values, listed in Tables 7-4 and 7-5 (soil), 7-6 (groundwater), 7-7 (surface water), and 7-8 (sediment), represent conservative exposure thresholds above which adverse ecological effects may occur.

7.4.1.1 Soil Screening Values for Terrestrial Plants and Invertebrates

The toxicological benchmarks that were used as screening values for chemicals in surface soil (0.0 to 1.0-feet bgs) and subsurface soil (1.0 to 3.0-feet bgs) are summarized in Table 7-4. USEPA Eco-SSLs for terrestrial plants and invertebrates (documentation is available at http://www.epa.gov/ecotox/ecossl/) were preferentially selected as soil screening values. For a given chemical, if an Eco-SSL was available for both receptor groups, the lowest value was

selected as the soil screening value. In the case of chromium and vanadium, insufficient data are available from the literature for derivation of plant- and invertebrate-based Eco-SSLs (USEPA, 2008 and 2005b). However, both Eco-SSL documents list toxicological data from studies eligible for Eco-SSL derivation. The chromium Eco-SSL document cites two studies (Van Gestel et al., 1992 and 1993) that investigated the effect of chromium on earthworm (*Eisenia andrei*) reproduction, while the vanadium Eco-SSL document cites two studies (Kaplan et al., 1990) that investigated the effect of vanadium on broccoli (*Brassica oleracea*) growth. The chromium studies using earthworms reported Maximum Acceptable Toxicant Concentration (MATC) values of 57 mg/kg, while the vanadium studies using broccoli reported either a Lowest Observed Adverse Effect Concentration (LOAEC) of 100 mg/kg or a No Observed Adverse Effect Concentration (NOAEC) of 100 mg/kg. For this ERA, the MATC value of 57 mg/kg based on earthworm reproduction was used as the soil screening value for chromium, while the LOAEC value based on broccoli growth (with a safety factor of 5; Wentsel et al., 1996) was used as the soil screening value for vanadium.

For those chemicals lacking terrestrial plant and invertebrate Eco-SSLs or toxicological data eligible for Eco-SSL derivation, the toxicological benchmarks listed below were selected as soil screening values.

- USEPA Region 5 (2003b) ecological screening levels (ESLs) for soil based on exposures to plants or invertebrates (http://epa.gov/region5/waste/cars/pdfs/ecological-screening-levels-200308.pdf)

- Toxicological thresholds for earthworms and microorganisms (Efroymson et al., 1997a)

- Toxicological thresholds for plants (Efroymson et al., 1997b)

Identical to the Eco-SSLs, when more than one screening value was available for a given chemical from USEPA (2003b) and Efroymson et al. (1997a and 1997b), the lowest value was selected as the soil screening value. For those chemicals lacking an Eco-SSL, toxicological data eligible for Eco-SSL derivation, as well as a toxicological threshold from Efroymson et al. (1997a and 1997b), the following values, listed in their order of decreasing preference, were used as soil screening values:

- Toxicity reference values for plants and invertebrates listed in USEPA (1999a)

- Soil standards developed by the Dutch Ministry of Housing, Spatial Planning and Environment (MHSPE, 2000)

- Canadian soil quality guidelines (agricultural land use) developed by the Canadian Council of Ministers of the Environment (CCME, 2001 and 2007)

- Ecological soil screening values compiled by Friday (1998)

Soil quality guidelines developed by CCME (2001 and 2007), as well as ecological soil screening values compiled by Friday (1998) were given the lowest preference since many are based on background concentrations or detection limits, not effect-based concentrations

The Dutch soil standards are expressed as target values and intervention values. The target and intervention values published by the MHSPE are based on a standard soil with 10 percent organic carbon. Target and intervention values for organic chemicals can be adjusted to account for the organic carbon content of soil (the organic carbon adjustment range is 2 to 30 percent). As a measure of conservatism, target and intervention values used in the derivation of soil screening

values were adjusted to reflect an assumed organic carbon content of 2 percent (minimum value within the adjustment range) using the following correction formula (MHSPE, 2000):

$$(Target_{59}/Intervention_{59}) = (Target_{ss}/Intervention_{ss}) \times (\%\ organic\ matter/10)$$

where:

$Target_{59}/Intervention_{59}$ = Adjusted target value or intervention value for SWMU 59 soil
$Target_{ss}/Intervention_{ss}$ = Target value or intervention value for standard soil

The soil screening values listed in Table 7-4 were derived by taking the average of the adjusted target and intervention values. A summary of the target and intervention values (standard soil and SWMU 59 soil) for organic chemicals with soil screening values based on Dutch MHSPE soil standards is provided in Table 7-5.

7.4.1.2 Groundwater Screening Values

The toxicological benchmarks selected as screening values for chemicals in groundwater are listed in Table 7-6. As discussed in Section 7.1.2 groundwater flow at SWMU 59 is in a southwest direction, toward an E2SS3 wetland unit and the Ensenada Honda. As such, Puerto Rico Water Quality Standards (PRWQS) for Class SB coastal and estuarine waters listed in the Puerto Rico Water Quality Standards Regulation (PRWQSR) dated March 31, 2010 (Puerto Rico Environmental Quality Board [PREQB], 2010) were preferentially used as groundwater screening values. PRWQS for Class SB coastal and estuarine waters were selected based on the classifications contained within Rule 1302.1 of the PRWQSR. For those chemicals lacking PRWQS for Class SB coastal and estuarine waters, groundwater screening values were identified from the following information listed in their order of decreasing preference:

- Chronic saltwater NRWQC (USEPA, 2013b)
- Final Chronic Values (FCVs) for saltwater contained in ECO Update Volume 3, Number 2 (USEPA, 1996)
- USEPA Region 4 chronic screening values for saltwater contained in Ecological Risk Assessment Bulletins – Supplement to Risk Assessment Guidance for Superfund (RAGS) (USEPA 2001a)
- Minimum chronic toxicity test endpoints (No Observed Effect Concentration [NOEC], No Observed Effect Level [NOEL], and MATC values based on reproduction, growth, or survival) for marine species reported in the ECOTOXicology (ECOTOX) Release 4.0 Database System (USEPA, 2007a) and, in the case of organochlorine pesticides, the Office of Pesticide Programs (OPP) Pesticide Ecotoxicology database (USEPA, 2005c)
- Chronic Lowest Observable Effect Levels (LOELs) for saltwater contained in National Oceanic and Atmospheric Administration (NOAA) Screening Quick Reference Tables (SQUIRTs) (Buchman, 2008) with a safety factor of 5 (Wentsel et al., 1996)

The order of preference was selected based on their level of protection. For example, NRWQC and FCVs would be expected to offer a greater degree of protection than a single species NOEC, MATC, or LOEL since their derivation considers a larger toxicological database. It is noted that chronic toxicity test endpoints reported in the ECOTOX and Pesticide Ecotoxicology databases

were given equal preference. If a chronic saltwater value was available from both sources, the minimum value was selected as the surface water screening value.

In the absence of the above-mentioned National Ambient Water Quality Criteria (NAWQC), FCVs, USEPA Region 4 chronic screening values, chronic test endpoints, and chronic LOELs, screening values were derived from the acute saltwater values listed below:

- Acute LOELs for saltwater contained in NOAA SQUIRTs (Buchman, 2008)

- Acute toxicity test endpoints (NOEC, NOEL, LOEL, Lowest Observed Effect Concentration [LOEC], median lethal concentration [LC_{50}], and median effective concentration [EC_{50}] values) for marine species contained in the ECOTOX Release 4.0 Database System (USEPA, 2007a) and, in the case of organochlorine pesticides, the OPP Pesticide Ecotoxicology database (USEPA, 2005c)

- LC_{50} values for marine species contained in Superfund Chemical Matrix (USEPA, 2004)

Chronic-based screening values were extrapolated from acute NOEC, NOEL, LOEC, LOEL, LC_{50}, and EC_{50} values as follows:

- A safety factor of 30 was used to convert an acute NOEC or NOEL to a chronic-based screening value (Wentsel et al., 1996)

- A safety factor of 50 was used to convert an acute LOEC or LOEL to a chronic-based screening value (Wentsel et al., 1996)

- A safety factor of 100 was used to convert an EC_{50} or LC_{50} to a chronic-based screening value (Wentsel et al., 1996)

When acute toxicity data were used to extrapolate a chronic screening value, NOECs/NOELs were given preference over LOECs/LOELs, LOECs/LOELs were given preference over LC_{50} and EC_{50} values, and EC_{50} values were given preference over LC_{50} values. When more than one value was available for a given test endpoint (e.g., NOEC), the minimum value was conservatively used to extrapolate a chronic screening value.

For those chemicals lacking saltwater toxicological thresholds, surface water screening values were identified or developed from freshwater values using the sources and procedures discussed in Section 7.4.1.3. In some cases, acute and/or chronic saltwater LOELs for chemical classes (e.g., PAHs) were available (Buchman, 2008). For a given chemical, a saltwater LOEL based on a chemical class was used as the groundwater screening value only if that chemical lacks freshwater and saltwater benchmarks and/or toxicity test endpoints.

As evidenced by Table 7-6, the screening value selected for mercury is USEPA saltwater NRWQC (i.e., criteria continuous concentration [CCC]). The saltwater CCC value for this metal is identified in National Recommended Water Quality Criteria (USEPA, 2013b) as a dissolved concentration. A total recoverable CCC value for mercury was derived for use as a groundwater screening value in the Step 2 screening level risk calculation by dividing the dissolved CCC value (0.94 µg/L) by 0.85 (saltwater conversion factor for mercury listed in Appendix A of National Recommended Water Quality Criteria [USEPA, 2013b]).

7.4.1.3 Surface Water Screening Values

The drainage ditch surface water data were screened against the freshwater toxicological thresholds listed in Table 7-7. PRWQS for Class SD surface waters listed in the PRWQSR dated March 31, 2010 (PREQB, 2010) were preferentially used as freshwater screening values. PRWQS for Class SD surface waters were selected based on the classifications contained within Rule 1302.2 of the PRWQSR. For those chemicals lacking PRWQS for Class SD surface waters, screening values were identified from the following information listed in their order of decreasing preference:

- Chronic freshwater NRWQC (USEPA, 2013b)
- FCVs for freshwater contained in ECO Update Volume 3, Number 2 (USEPA, 1996)
- USEPA Region 4 chronic screening values for freshwater contained in Ecological Risk Assessment Bulletins – Supplement to RAGS (USEPA 2001a) and USEPA Region 5 freshwater ESLs (http://epa.gov/region5/waste/cars/pdfs/ecological-screening-levels-200308.pdf) (USEPA, 2003b)
- Minimum chronic toxicity test endpoints (NOEC, NOEL, and MATC values based on reproduction, growth, or survival) for freshwater species reported in the ECOTOX Release 4.0 Database System (USEPA, 2007a) and, in the case of organochlorine pesticides, the OPP Pesticide Ecotoxicology database (USEPA, 2005c)
- Great Lakes basin Tier II Secondary Chronic Values (SCVs) listed in the Great Lakes Initiative (GLI) Toxicity Data Clearinghouse (http://www.epa.gov/gliclearinghouse/) (USEPA, 2011b)
- Chronic LOELs for freshwater contained in NOAA SQUIRTs (Buchman, 2008) with a safety factor of 5 (Wentsel et al., 1996)

Identical to the marine/estuarine-based groundwater screening values presented in Section 7.4.1.2, the order of preference was selected based on their level of protection. It is noted that USEPA Region 4 and Region 5 screening values were given equal preference. When a value was available from both sources, the minimum value was selected as the surface water screening value. Chronic toxicity test endpoints reported in the ECOTOX and Pesticide Ecotoxicology databases were also given equal preference. Identical to the USEPA Region 4 and Region 5 screening values, if a chronic freshwater value was available from both sources, the minimum value was selected as the surface water screening value.

In the absence of the above-mentioned freshwater NRWQC, freshwater FCVs, freshwater USEPA Region 4 and Region 5 screening values, freshwater chronic test endpoints, and freshwater chronic LOELs, screening values were derived from the acute freshwater values listed below:

- Acute LOELs for freshwater contained in NOAA SQUIRTs (Buchman, 2008)
- Acute toxicity test endpoints (NOEC, NOEL, LOEL, LOEC, LC_{50}, EC_{50} values) for freshwater species contained in the ECOTOX Release 4.0 Database System (USEPA, 2007a) and, in the case of organochlorine pesticides, the OPP Pesticide Ecotoxicology database (USEPA, 2005c)

- LC_{50} values for freshwater species contained in Superfund Chemical Matrix (USEPA, 2004)

Chronic-based screening values were extrapolated from acute NOEC, NOEL, LOEC, LOEL, LC_{50}, and EC_{50} values using the safety factors previously identified in Section 7.4.1.2 (i.e., safety factors recommended by Wentsel et al., 1996).

When acute toxicity data were used to extrapolate a chronic screening value, NOECs/NOELs were given preference over LOECs/LOELs, LOECs/LOELs were given preference over LC_{50} and EC_{50} values, and EC_{50} values were given preference over LC_{50} values. When more than one value was available for a given test endpoint (e.g., NOEC), the minimum value was conservatively used to extrapolate a chronic screening value. For those chemicals lacking freshwater toxicological thresholds, surface water screening values were identified or developed from saltwater values using the sources and procedures discussed in Section 7.4.1.2.

As evidenced by Table 7-7, the screening values selected for cadmium, chromium, copper, lead, nickel, silver, and zinc are PRWQS for Class SD surface waters. In addition, the screening value selected for beryllium is a Great Lakes basin Tier II chronic criterion (i.e., SCV) developed by the Ohio Environmental Protection Agency (OEPA). The screening values listed in Table 7-7 for these eight metals are expressed as total recoverable concentrations. PRWQS for cadmium, chromium, copper, lead, nickel, silver, and zinc, as well as the OEPA SCV for beryllium are further expressed as a function of water hardness (PREQB, 2010, USEPA, 2011b, and USEPA, 2013b). A hardness-dependent, total recoverable SCV for beryllium and hardness-dependent, total recoverable PRWQS for cadmium, chromium, copper, lead, nickel, silver, and zinc were derived for use as surface water screening values using the following regression equations (PREQB, 2010, USEPA, 2011b, and USEPA, 2013b):

- Beryllium: exp[2.528(*ln* hardness)-10.77]
- Cadmium: exp[0.7409(*ln* hardness)-4.719]
- Chromium: exp[0.8190(*ln* hardness)+0.6848]
- Copper: exp[0.8545(*ln* hardness)-1.702]
- Lead: exp[1.273(*ln* hardness)-4.705]
- Nickel: exp[0.8460(*ln* hardness)+0.0584]
- Silver: exp[1.72(*In* hardness)-6.59]
- Zinc: exp[0.8473(*ln* hardness)+0.884]

In these equations, hardness concentrations are expressed in units of mg/L as calcium carbonate ($CaCO_3$).

Of the three surface water samples collected from the drainage ditch pool during the 2010 CMS field investigation, only one sample (59SW01) was analyzed for total recoverable calcium and magnesium. The total recoverable calcium and magnesium data can be used to calculate the hardness concentration of the 59SW01 surface water sample using the following equation from Franson (1985):

$$Hardness\ (mg\ CaCO_3/L) = 2.497[Ca] + 4.118\ [Mg]$$

where:

[Ca] = Total recoverable calcium concentration (mg/L)
[Mg] = Total recoverable magnesium concentration (mg/L)

However, as evidenced by Appendix B, total recoverable magnesium was not detected in this surface water sample. Therefore, site-specific hardness data were not used to adjust the PREQB PRWQS for cadmium, chromium, copper, lead, nickel, silver, and zinc or the OEPA Great Lakes basin Tier II chronic criterion for beryllium.

The Water Resources Division of the USGS, in cooperation with local and Federal agencies, obtains data pertaining to the water resources of Puerto Rico each year. Data are available in the National Water Information System water quality database available at http://waterdata.usgs.gov/nwis. A USGS monitoring station (i.e., 50071000) was identified within a stream located approximately 4 miles northwest of NAPR. From February 21, 1961 to August 10, 2004, a total of 231 hardness measurements were taken at this station. Hardness concentrations ranged from 4 mg/L to 61 mg/L as $CaCO_3$, with an arithmetic mean concentration of 32.2 mg/L as $CaCO_3$, a 95 percent lower confidence limit (LEL) of the mean concentration of 31.35 mg/L (derived using Scout Version 1.00.01 software [USEPA, 2009), and a 95 percent upper confidence limit (UCL) of the mean concentration of 32.86 mg/L as $CaCO_3$ (derived using USEPA ProUCL Version 4.00.02 software [USEPA, 2007b]). Because NAPR and USGS monitoring station 50071000 are located within the same hydrologic unit (21010005), hardness data for the USGS monitoring station represent reasonable estimates of surface water hardness within the drainage ditch system downgradient from SWMU 59. Therefore, the 95 percent LEL concentration (i.e., 31.35 mg/L as $CaCO_3$) was used to derive the surface water screening values listed in Table 7-7 for beryllium, cadmium, chromium, copper, lead, nickel, silver, and zinc.

The screening values selected for arsenic and mercury are USEPA freshwater NAWQC (i.e., CCCs). Identical to the saltwater CCC value for mercury discussed in Section 7.4.1.2, the freshwater arsenic and mercury CCC values are expressed in National Recommended Water Quality Criteria (USEPA, 2013b) as dissolved concentrations. Total recoverable CCC values for arsenic and mercury were derived for use as surface water screening values in the Step 2 screening level risk calculation by dividing the dissolved CCC values (150 µg/L and 0.77 µg/L, respectively) by the following freshwater conversion factors listed in Appendix A of National Recommended Water Quality Criteria (USEPA, 2013b):

- Arsenic: 1.000
- Mercury: 0.850

7.4.1.4 Sediment Screening Values

MacDonald et al. (2000) developed consensus-based sediment quality guidelines (SQGs) for freshwater using existing SQGs established for the protection of sediment-dwelling organisms. The consensus-based SQGs (Threshold Effect Concentrations [TECs] and Probable Effect Concentrations [PECs]) were derived by calculating the geometric mean of existing SQGs. TECs are intended to identify contaminant concentrations below which harmful effects on sediment-dwelling organisms are not expected, while PECs are intended to identify contaminant concentrations above which harmful effects are expected to occur frequently. The TECs developed by MacDonald et al. (2000) were preferentially selected for use as sediment screening values (see Table 7-8). For those chemicals lacking a consensus-based TEC from MacDonald et al. (2000), sediment screening values were identified from the freshwater toxicological benchmarks listed and described below:

- **Sediment quality assessment guidelines (SQAGs) for Florida inland waters.** The consensus-based SQGs (i.e., TECs and PECs) derived by MacDonald et al. (2000) were adopted for use as SQAGs for Florida inland waters (MacDonald et al., 2003). SQAGs also were identified for twenty additional chemicals using effects-based guidelines

promulgated in other jurisdictions. Identical to the consensus-based SQGs developed by MacDonald et al. (2000), only TEC-based SQAGs guidelines were used as sediment screening values.

- **Ontario Ministry of the Environment Lowest Effect Level (LEL) Provincial sediment quality guidelines (PSQGs).** The Ontario Ministry of the Environment (Persaud et al., 1993) developed PSQGs expressed as LELs and Severe Effect Levels (SELs). The LEL and SEL PSQGs are based on matched sediment chemistry and biological effects measures (co-occurrence analysis) from a wide range of geographical areas within the province. The LEL represents the chemical concentration at which actual ecotoxicological effects become apparent (e.g., species absence), while the SELs represent chemical concentrations that could potentially eliminate most benthic organisms. Only LELs were selected as sediment screening values.

- **Canadian interim freshwater sediment quality guidelines (ISQGs).** The CCME (2002) developed ISQGs using data from models (i.e., equilibrium partitioning [EqP]) spiked sediment toxicity tests, and field studies (co-occurrence data consisting of matching sediment chemistry and biological effect data). This information was used to establish associations between concentrations of chemicals in sediments and adverse biological effects.

For a given chemical, when more than one toxicological threshold was available from the sources listed above (i.e., MacDonald et al., 2003, Persaud et al., 1993, and CCME, 2002), the minimum value was conservatively selected as the sediment screening value. For those chemicals lacking a consensus-based SQG, SQAG, PSQG, and ISQG, the marine and estuarine toxicological benchmarks listed and described below were used as sediment screening values:

- **Effects Range-Low (ER-L) marine and estuarine SQGs**. Long and Morgan (1991) developed effects-based SQGs using data from EqP modeling, spiked-sediment toxicity tests, and matched sediment chemistry and biological effects measures. For a given chemical, the data were arranged in ascending order of concentration with each data entry assigned an "effects" or "no effects" descriptor, and the 10th percentile and 50th percentile concentrations of the “effects” data were calculated. The 10th and 50th percentiles of the “effects” data represent the ER-L and Effects Range-Median (ER-M), respectively. The ER-L and the ER-M delineate three concentration ranges for a given chemical. The concentration range below the ER-L value represents a minimal effects range (i.e., the concentration range in which effects would be rarely observed). Concentrations equal to or greater than the ER-L but less than the ER-M represent a possible effects range within which effects would occasionally occur, while concentrations greater than the ER-M represent a probable-effects range within which effects would frequently occur. The ER-L and ER-M values were recalculated by Long et al. (1995) after omitting a small amount of freshwater data included in the original calculations (Long and Morgan, 1991) and incorporating more recent marine and estuarine data. Only ER-Ls were selected as sediment screening values in this screening level ERA.

- **Threshold Effect Level (TEL) SQAGs for Florida coastal waters.** The updated and revised data set used by Long et al. (1995) also was used by MacDonald (1994) to calculate SQAGs for Florida coastal waters (TELs and Probable Effect Levels [PELs]). Unlike the methodology used by Long et al. (1995) to derive ER-L and ER-M values, the derivation of TELs and PELs took into consideration the "no effects" data set. Specifically, TELs were derived by calculating the geometric mean of the 15th percentile

in the "effects" data set and the 50th percentile in the "no effects" data set, while PELs were derived by calculating the geometric mean of the 50th percentile in the "effects" data set and the 85th percentile in the "no effects" data set.

Identical to ER-Ls and ER-Ms, TELs and PELs delineate three concentration ranges for a given chemical. The TEL represents the upper limit of the range of sediment concentrations dominated by "no effects" data. Within this range, concentrations are not considered to represent significant hazards to sediment-associated biota. The PEL represents the lower limit of the range of sediment concentrations that are usually or always associated with adverse biological effects. The range of concentrations that could be associated with biological effects is delineated by the TEL and PEL. Within this range of concentrations, adverse biological effects are possible.

- **Apparent Effects Threshold (AET) marine SQGs.** The AET method, developed by Tetra Tech, Inc. (1986), associates chemical concentrations in sediments with adverse biological effects (lethal and sub-lethal toxicity as measured using sediment toxicity tests or changes in benthic macroinvertebrate abundance and community structure as measured by *in situ* biological surveys). For a given chemical and measurement of biological effect (biological indicator), the AET value represents the sediment concentration above which statistically significant biological effects are always observed. The AET values shown in Table 7-8 represent the lowest AET value from a suite of seven biological indicators (amphipod mortality, oyster larval abnormality, Microtox® luminescence, benthic macroinvertebrate abundance, bivalve larvae mortality/abnormality, Echinoderm larvae mortality/abnormality, and juvenile polychaete growth). It is noted that the AET values included within Table 7-8 are interim values subject to change (Buchman, 2008).

  Minimum, chemical-specific AET values are used by the Washington State Department of Ecology (1995) as sediment management standards for Puget Sound. Minimum AET values also are used by the USACE (USEPA/USACE, 1998) as "reason to believe" guidance for screening levels for the Dredged Material Management Program (DMMP). The DMMP screening levels are implemented for use in Puget Sound and Grays Harbor/Willapa Bay in the State of Washington. Current Washington State Department of Ecology sediment management standards and USACE DMMP screening levels do not reflect the interim AET values reported by Buchman (2008).

Identical to the freshwater toxicological benchmarks, when more than one marine and estuarine toxicological benchmark was available from the sources listed above, the minimum value was conservatively selected as the sediment screening value. For those organic chemicals lacking bulk sediment freshwater and marine/estuarine toxicological benchmarks, EqP-based screening values were either developed using the USEPA EqP approach (USEPA, 1993a and 1996 [see Appendix E]) or identified from the literature (Di Toro and McGrath, 2000). For a given chemical, when an EqP-based value was derived in accordance with USEPA (1993a and 1996) methodology and also was available from Di Toro and McGrath (2000), the minimum value was selected as the sediment screening value. As discussed in Appendix E, EqP-based screening values developed in accordance with USEPA (1993a and 1996) methodology are based, in part, on the fraction of organic carbon (f_{oc}) measured in SWMU 59 drainage ditch sediment. Specifically, a f_{oc} of 0.021 was used in their derivation (minimum measured value for sediment collected during the 2010 CMS field investigation). This f_{oc} value also was used to adjust the Di Toro and McGrath (2000) EqP-based toxicological benchmarks selected as sediment screening values (published values are based on a default f_{oc} of 0.01).

7.4.2 Toxicity Reference Values for Avian and Mammalian Dietary Exposures

TRVs for avian and mammalian dietary exposures to chemicals in surface soil, subsurface soil, and surface water, as well as avian dietary exposures to chemicals in drainage ditch surface water and sediment were identified from various literature sources and USEPA compilations for each receptor species and chemical evaluated for dietary exposures. If available, TRVs identified and used by the USEPA in the derivation of avian and mammalian Eco-SSLs were preferentially used to evaluate risks from ingested dietary doses.

For chemicals lacking an avian/mammalian Eco-SSL, toxicological information for wildlife species most closely related to the receptor species was used if available. This information was supplemented by laboratory studies of non-wildlife species when necessary. Chronic No Observed Adverse Effects Levels (NOAELs) based on growth or reproduction endpoints were preferentially used as TRVs for upper trophic level receptors. NOAELs represent the highest dose of a chemical at which an effect being measured in a toxicity test does not occur. If several chronic toxicity studies were available from the literature, the most appropriate study was selected for each receptor species based on study design, study methodology, study duration, study endpoint, and test species. When chronic NOAEL values were unavailable, estimates were derived or extrapolated from chronic Lowest Observed Adverse Effects Levels (LOAELs) or median lethal dose (LD_{50}) acute values. LOAELs represent the lowest dose of a chemical at which an effect being measured in a toxicity test occurs, while an LD_{50} represents the dose of a chemical at which half of the organisms being tested die. An uncertainty factor of 5 was used to convert a reported chronic LOAEL to a chronic NOAEL (Wentsel et al., 1996), while an uncertainty factor of 100 was used to convert the acute LD_{50} to a chronic NOAEL (i.e., the LD_{50} was multiplied by 0.01 to obtain the chronic NOAEL [Wentsel et al., 1996 and USEPA, 1997]).

TRVs for the avian species selected as ecological receptors (i.e., American robin, mourning dove, red-tailed hawk, and green heron), expressed as milligrams of the chemical per kilogram body weight of the receptor per day (mg/kg-BW/day) are provided in Table 7-9. Sample et al. (1996) consider a scaling factor of 1.0 most appropriate for interspecies extrapolation between birds. Therefore, the NOAEL and LOAEL values listed in Table 7-9 were not adjusted to reflect differences in body weights between avian test receptor species and test species. TRVs for the mammalian species selected as an ecological receptor (i.e., brown flower bat) are provided in Table 7-10. Identical to the avian TRVs, the NOAEL and LOAEL values listed in Table 7-10 were not adjusted to account for differences in body weights between the brown flower bat and mammalian test species (Allard et al., 2010).

Not all chemicals analyzed for in surface soil, subsurface soil, surface water, and sediment were evaluated for avian and mammalian dietary exposures. The organic chemicals evaluated for dietary exposures are limited to those listed in Table 7-3 with the potential to bioaccumulate to a significant extent. Bioaccumulative organic chemicals are defined as those with a maximum reported log K_{ow} greater than or equal to 3.0. Rational for using a log K_{ow} of 3.0 to define an organic chemical with the potential to bioaccumulate is included as Appendix F. For conservatism, all inorganic chemicals (i.e., metals) also were evaluated for dietary exposures. The list of selected for evaluation contains many chemicals that are not identified as "important bioaccumulative compounds" by the USEPA (2000b). It is noted that upper trophic level receptors may be exposed to non-bioaccumulative chemicals in surface soil, subsurface soil, and sediment through incidental ingestion. As such, their exclusion from consideration in the ERA represents an uncertainty that is addressed in Section 7.7.

7.5 Screening Level Exposure Estimation

This section presents the analytical data, exposure assumptions, and the exposure models and input parameters that were used to estimate the potential exposure of ecological receptors to chemicals in soil, groundwater, drainage ditch surface water, and drainage ditch sediment.

7.5.1 Selection Criteria for Analytical Data

The analytical data used in the SERA (described in Section 7.2 and presented in Appendix D) were reviewed against a set of selection criteria to identify specific data that would be used to estimate potential exposures to ecological receptors. The criteria used to select these analytical data are listed below.

- Data must have been validated by a qualified data validator using acceptable data validation methodology. Rejected ("R") values were not used in the SERA. Unqualified data and data qualified as estimated, "J" or "NJ" were treated as detected, while data qualified as "U "or estimated, "UJ" were treated as non-detected.

- The available soil analytical data were divided into surface soil data (i.e., analytical data for soil samples collected from the 0 to 1.0-foot depth interval) and subsurface soil data (analytical data for soil samples collected from the 1.0 to 3.0-foot depth interval). The evaluation of available soil analytical data was limited to these depth ranges since most soil heterotrophic activity and soil invertebrates occur on the surface or within the oxidized root zone (Suter II, 1995).

- For surface water and groundwater, only total (unfiltered) analytical data were used in the Step 2 screening level risk calculation. Total recoverable metals data also were used in the estimation of upper trophic level dietary exposures.

- Maximum Reporting Limits (RLs)/LODs were conservatively used to estimate exposure for non-detected chemicals.

- In some instances, duplicate samples were collected in the field (see Section 4.9.1). The maximum detected concentration of each chemical (or the maximum non-detected value for chemicals that were not detected) in the original or duplicate sample was used as a conservative estimate of contaminant concentrations at a particular sampling point. In cases where one result was a detection and the other a non-detect, the detected value was used in the assessment. Results from duplicate samples were not evaluated individually.

7.5.2 Exposure Estimation

Maximum detected concentrations in soil (surface and subsurface soil), groundwater, surface water, and sediment were used to conservatively estimate potential chemical exposures for the ecological receptors selected to represent the assessment endpoints. For conservatism, maximum RLs/LODs for chemicals that were analyzed for but not detected also were compared to media-specific screening values and (where appropriate) used for food web exposure modeling. This was done to ensure that RLs/LODs are similar to, or less than, chemical concentrations at which potential adverse effects to ecological receptors may occur.

7.5.2.1 Terrestrial and Aquatic Receptor Groups

Maximum measured chemical concentrations in soil, groundwater, surface water, and sediment were compared to the media-specific screening values discussed in Section 7.4.1 and summarized in Tables 7-4 through 7-8 to conservatively evaluate the potential for adverse ecological effects to the lower trophic level receptor groups selected as assessment endpoints (e.g., terrestrial and aquatic plants and invertebrates).

7.5.2.2 Upper Trophic Level Receptors

Exposures for upper trophic level terrestrial receptor species via the food web were determined by estimating chemical-specific concentrations in each dietary component using uptake and food web models. Incidental ingestion of soil and sediment, as well as ingestion of surface water were also included when calculating the total level of exposure. As indicated previously, maximum measured soil, surface water, and sediment were used in all calculations to provide a conservative assessment.

For the screening level exposure estimation, tissue concentrations were modeled for terrestrial plants (food item for the mourning dove and brown flower bat), soil invertebrates (food item assumed for the American robin), small mammals (food item for the red-tailed hawk), and fish (food item for the green heron). The omnivorous Norway rat was selected as the small mammal food item for the red-tailed hawk. A small mammal herbivore and/or insectivore were excluded as potential food items for the red-tailed hawk because they are not part of the Puerto Rican mammalian fauna (see Section 7.1.3.1).

7.5.2.2.1 Exposure Point Concentrations

The uptake of chemicals from abiotic media into terrestrial food items is based (where available) on chemical-specific uptake equations (i.e., regressions based on measured soil and tissue concentrations) or conservative (e.g., maximum or 90th percentile) bioaccumulation factors (BAFs) from the literature. Generic models based on Log K_{ow} values (presented in USEPA [2007c]) or default factors of 1.0 were used for chemicals only when uptake equations and/or BAF data were unavailable from the literature. The methodology and models used to derive these estimates are described below.

Terrestrial plants. Tissue concentrations in the aboveground vegetative portion of terrestrial plants were estimated by chemical-specific uptake equations (i.e. regressions developed from measured soil and tissue data) or by multiplying maximum measured soil concentrations by conservative, chemical-specific BAFs (e.g., maximum or 90th percentile values) either obtained directly from the literature or derived from literature data sets (see Table 7-11). The chemical-specific BAF values listed in Table 7-11 are based on root uptake from soil and on the ratio between dry-weight soil and dry-weight plant tissue. Literature values based on the ratio between dry-weight soil and wet-weight plant tissue were converted to a dry-weight basis by dividing the wet-weight BAF by the estimated solids content of terrestrial plants (15 percent [0.15]; Sample et al., 1997). Chemical-specific regressions developed by Bechtel Jacobs (1998a) or USEPA (2007c) were given preference over high-end BAF values (e.g., maximum and 90th percentile values) if the regressions were significant ($p < 0.05$).

For bioaccumulative organic chemicals lacking significant regressions and chemical-specific BAFs, soil-to-plant BAFs were estimated from their Log K_{ow} values using the rinsed foliage regression equation provided in Figure 5, Panel B of USEPA (2007c):

$$Log\ BAF = (-0.4057)\ (Log\ K_{ow}) + 1.781$$

where:

Log BAF = Log soil-to-plant BAF (unitless; dry-weight basis)
Log K_{ow} = Log octanol-water partitioning coefficient (unitless)

The Log K_{ow} values used in this equation are those listed in Table 7-3.

Earthworms. Tissue concentrations in soil invertebrates (earthworms) were estimated by chemical-specific uptake equations (i.e. regressions developed from measured soil and tissue data) or by multiplying maximum measured soil concentrations for each chemical by conservative, chemical-specific soil-to-invertebrate BAFs (90th percentile values) obtained directly from the literature or derived from literature data sets (see Table 7-11). The chemical-specific BAF values listed in Table 7-11 are based on the ratio between dry-weight soil and dry-weight earthworm tissue. Literature values based on the ratio between dry-weight soil and wet-weight earthworm tissue were converted to a dry-weight basis by dividing the wet-weight BAF by the estimated solids content of earthworms (16 percent [0.16]; USEPA, 1993b). BAFs based on depurated analyses (soil was purged from the gut of the earthworm prior to analysis) were given preference over undepurated analyses since direct ingestion of surface soil is accounted for separately in the food web model. Chemical-specific regressions developed by Sample et al. (1998a) were given preference over high-end BAF values (i.e., 90th percentile values) if the regressions were significant ($p < 0.05$).

For inorganic chemicals without available chemical-specific uptake equations or high-end BAFs, an earthworm BAF of 1.0 was assumed. For organic chemicals lacking chemical-specific uptake equations or high-end BAFs, earthworm BAF values were estimated using the model presented in Section 3.2.2 and Table 5 of USEPA (2007c). In this model, the soil-to-earthworm BAF value is estimated using the following equation:

$$BAF = K_{ww}/K_d$$

K_{ww} is the biota to soil water partitioning coefficient (liter [L] soil pore water/kilogram [kg] worm tissue - dry weight), while K_d represents the soil to water partitioning coefficient (liter [L] soil pore water/kg soil - dry weight). For a given organic chemical, K_{ww} is a function of the K_{ow} value and lipid content of the organism. The following regression equation for K_{ww} (wet weight basis) was derived by Jager (1998) for earthworms based on data for sixty-nine organic chemicals with Log K_{ow} values ranging from 2.0 to 8.0:

$$Log\ K_{ww} = (0.87)(Log\ K_{ow}) - 2.0$$

K_{ww} can be converted to a dry weight basis by dividing the wet weight value by the estimated solids content of earthworms (16 percent [0.16]; USEPA, 1993b). K_d can be estimated by the following equation (USEPA 2007c):

$$K_d = (f_{oc})(K_{oc})$$

In this equation, f_{oc} is the fraction of organic carbon in soil (kg organic carbon/kg soil; assumed to be 0.01 [1.0 percent]) and K_{oc} is the organic carbon partition coefficient. For a given chemical, the Log K_{ow} and K_{oc} value used to estimate K_{ww} and K_d, respectively are those listed in Table 7-3.

Small mammals. Whole-body tissue concentrations in small mammals (omnivores) were estimated using one of two methodologies. When available, chemical-specific uptake equations (i.e., regressions developed from measured soil and tissue data) or conservative, chemical-

specific soil-to-small mammal BAFs (90th percentile values) obtained directly from the literature or derived from literature data sets were used to estimate whole-body tissue concentrations (see Table 7-12). The chemical-specific BAFs listed in Table 7-12 are based on the ratio between dry-weight soil and dry-weight tissue. Literature values based on the ratio between dry-weight soil and wet-weight tissue were converted to a dry-weight basis by dividing the wet-weight BAF by the estimated solids content of small mammals (32 percent [0.32]; USEPA, 1993b). Chemical-specific regressions developed by Sample et al. (1998b) for general small mammals were given preference over high-end BAF values (i.e., 90th percentile values) if the regressions were significant ($p < 0.05$).

For those chemicals lacking chemical-specific uptake equations or literature-based BAF values, an alternate approach was used to estimate whole-body tissue concentrations. Because most chemical exposure for small mammal species is via the diet, it was assumed that the concentration of each chemical in a small mammal's tissues is equal to the chemical concentration in its diet multiplied by a diet to whole-body BAF (wet-weight basis) derived from the literature. For chemicals lacking literature-based diet to whole-body BAF values, a diet to whole-body BAF value of 1.0 was assumed. Resulting tissue concentrations (wet-weight) were converted to dry weight using an estimated solids content of 32 percent (see above). The use of a diet to whole-body BAF of 1.0 is likely to result in a conservative estimate of chemical concentrations for chemicals that are not known to biomagnify in terrestrial food chains (e.g., aluminum). For chemicals that are known to biomagnify, a diet to whole-body BAF value of one will likely result in a realistic estimate of tissue concentrations based on reported literature values. For example, a maximum BAF (wet weight) of 1.0 was reported by Simmons and McKee (1992) for PCBs based on laboratory studies with white-footed mice. Menzie et al. (1992) reported BAF values (wet-weight) for dichlorodiphenyltrichloroethane (DDT) of 0.3 for voles and 0.2 for short-tailed shrews. Reported BAF (wet-weight) values for dioxin are only slightly above one (1.4) for the deer mouse (USEPA, 1990).

Fish. Tissue concentrations in fish were estimated by multiplying maximum measured sediment concentrations for each chemical by conservative, chemical-specific sediment-to-fish BAFs (maximum or 95th percentile values) obtained directly from the literature (see Table 7-13). The chemical-specific BAFs listed in Table 7-13 are based on the ratio between dry-weight sediment and dry-weight tissue. Literature values based on the ratio between dry-weight sediment and wet-weight tissue were converted to a dry-weight basis by dividing the wet-weight BAF by the estimated solids content for fish (25 percent [0.25]; USEPA, 1993b).

For those chemicals lacking literature-based values, BAFs were estimated from the available Biota-Sediment Accumulation Factors (BSAFs) listed in Table 7-14. The conservative (90th percentile) BSAF values listed in Table 7-14 were converted to BAF values (dry weight basis) for use in the food web models using a lipid content of 5.90 percent (mean value for the lipid data listed in Table 7-15), a percent solids content of 25 percent (see above), and a sediment organic carbon content of 2.1 percent (minimum TOC measured in sediment samples collected from the drainage ditch pool during the 2010 CMS field investigation). For those inorganic chemicals and bioaccumulative organic chemicals lacking literature-based BAF and BSAF values, a BAF of 1.0 was assumed.

7.5.2.2.2 Dietary Intakes

Dietary intakes for each upper trophic level receptor species were calculated using the following formula modified from USEPA (1993b).

$$DI_{xj} = \frac{[[\sum_i[(FIR_j)(FC_{xi})(PDF_i)]] + [(FIR_j)(SC_x)(PDS)] + [(WIR_j(WC_x)]][AUF_j]}{BW_j}$$

where:

DI_{xj}	=	Dietary intake of chemical x by receptor j (mg chemical/kg body weight/day)
FIR_j	=	Food ingestion rate for receptor j (kilograms per day [kg/day]; dry-weight)
FC_{xi}	=	Maximum concentration of chemical x in food item i (mg/kg; dry weight)
PDF_i	=	Proportion of diet composed of food item i (unitless; dry weight basis)
SC_x	=	Maximum concentration of chemical x in soil/sediment (mg/kg; dry weight)
PDS	=	Proportion of diet composed of soil/sediment (unitless; dry weight basis)
WIR_j	=	Water ingestion rate for receptor j (liters per day [L/day])
WC_x	=	Maximum concentration of chemical x in surface water (mg/L)
BW_j	=	Body weight of receptor j (kg; wet weight basis)
AUF_j	=	Area use factor for receptor j (unitless)

Conservative, receptor-specific exposure parameters (maximum food ingestion rates, maximum water ingestion rates, and minimum body weights) for the American robin, mourning dove, red-tailed hawk, green heron, and brown flower bat are provided in Table 7-16. The food items selected for each receptor species are provided in Table 7-17. Although American robins are omnivores, an exclusive diet of earthworms was assumed for the SERA, allowing for the most conservative estimation of exposure. Table 7-16 contains exposure parameters and Table 7-17 contains a dietary composition for the Norway rat (assumed diet of the red-tailed hawk). This assumption is based on likely small mammal prey species present in Puerto Rico (rats). Identification of exposure parameters and food items was necessary when estimating small mammal whole body tissue concentrations for those chemicals that lack a literature-based soil-to-small mammal BAF (i.e., exposure doses were used to estimate tissue concentrations [see Section 7.5.2.2.1 and Table 7-12]). Identical to the American robin, an exclusive diet of earthworms was assumed.

For the SERA, an Area Use Factor (AUF) of 1.0 was assumed (i.e., each receptor is assumed to spend 100 percent of its time on the site). As such, receptor-specific home ranges were not considered in the estimation of dietary intakes.

7.6 Screening Level Risk Calculation

The screening level risk calculation represents the final step in the SERA. In this step, maximum chemical concentrations in abiotic media or maximum exposure doses for upper trophic level receptor species are compared with the corresponding screening values to derive screening level risk estimates. The outcome of this step is a list of ecological chemicals of potential concern (COPCs) for each media-pathway-receptor combination evaluated or a conclusion of negligible risk.

7.6.1 Selection of Ecological Chemicals of Potential Concern

Ecological COPCs were selected using the hazard quotient (HQ) method. For a given chemical, an HQ was calculated by dividing the maximum chemical concentration in the medium being evaluated by the corresponding medium-specific screening value or, in the case of upper trophic level receptors, by dividing the maximum exposure dose (derived by the equation presented in Section 7.5.2.2.2) by the corresponding TRV.

The following conservative methodology was used to identify ecological COPCs for lower trophic level receptor exposures to chemicals in soil (surface and subsurface soil), groundwater (assuming discharge to surface water without dilution), surface water, and sediment.

- The maximum detected concentrations in surface soil, subsurface soil, groundwater, surface water, and sediment were used to calculate media-specific HQs. For a given medium, chemicals with HQs greater than 1.0 based on maximum detected concentrations were identified as ecological COPCs.

- For non-detected chemicals, maximum RLs/LODs were used to calculate media-specific HQ values. For a given medium, non-detected chemicals with HQs greater than 1.0 based on maximum RLs/LODs were identified as ecological COPCs.

- Detected and non-detected chemicals without media-specific screening values were identified as ecological COPCs.

To select ecological COPCs for dietary exposures, maximum chemical concentrations in soil (surface and subsurface soil), sediment, and surface water were used to estimate dietary doses for each receptor. HQs were calculated with NOAEL-, LOAEL-, and MATC-based TRVs. The MATC is derived by taking the geometric mean of the NOAEL and LOAEL. Calculations with NOAELs provide the most conservative risk estimate, while calculations with LOAELs provide the least conservative risk estimate. Calculations with MATCs provide realistic risk estimates since the MATC represents an estimation of the threshold concentration (i.e., the concentration above which a toxic effect on the test endpoint is produced). For the SERA, chemicals (detected and non-detected) with NOAEL-based HQs greater than 1.0 were identified as ecological COPCs. Identical to the media-specific screening evaluation, detected and non-detected chemicals without literature-based TRVs were also identified as ecological COPCs for upper trophic level receptor exposures.

HQs greater than 1.0 indicate the potential for risk since the chemical concentration or dose (exposure) exceeds the screening value (effect). However, risk estimates are derived using intentionally conservative assumptions (e.g., maximum media concentrations, maximum ingestion rates, and minimum body weights) such that HQs greater than 1.0 do not necessarily indicate that risks are present or impacts are occurring. Rather, they identify chemical-pathway-receptor combinations requiring further evaluation. Following the same reasoning, HQs less than 1.0 indicate that risks are very unlikely, enabling a conclusion of no unacceptable risk to be reached with high confidence.

In most cases, the SERA considered independent effects of chemicals. However, the potential does exist for multiple chemicals in environmental media to interact. Much uncertainty is involved with the interpretation of chemical interactions due to the complexity of potential effects (e.g., synergistic, antagonistic, or additive), and due to varying toxicities of compounds in different species. For these reasons, cumulative effects were not addressed for most chemicals in the SERA. Chemical interactions can be addressed by site-specific studies conducted in Step 6 of the Navy ERA process (i.e., site investigation and data analysis [see Figure 7-1]).

7.6.2 Screening Level Risk Calculation for Surface Soil, Subsurface Soil, Groundwater, Surface Water, and Sediment: Lower Trophic Level Receptor Groups

Screening level risk estimates (i.e., HQ values) for surface soil, subsurface soil (1.0 to 3.0 foot depth interval), groundwater, surface water, and sediment are presented in Tables 7-18 through 7-24. These calculations apply only to lower trophic level community direct contact exposures (i.e., HQ calculations for terrestrial plant and invertebrate exposures to chemicals in soil, pelagic and benthic biota exposures to chemicals in groundwater discharging to the downgradient marine

habitats [E2SS3 wetlands and Ensenada Honda], and pelagic and benthic biota exposures to chemicals in drainage ditch surface water and sediment). Ecological COPCs were identified in Step 2 of the ERA using the procedures outlined in Section 7.6.1.

7.6.2.1 Surface Soil

The results of the screening level risk calculation for the 2010 and 2012 surface soil data sets are presented and discussed within Sections 7.6.2.1.1 and 7.6.1.1.2, respectively. As discussed in Section 7.2, surface soil sampled during the 2010 CMS field investigation were collected at locations adjacent to concrete pads and paved surfaces, while surface soil sampled during the 2012 CMS field investigation were collected at locations beneath concrete pads and paved surfaces.

7.6.2.1.1 Surface Soil: 2010 CMS Field Investigation

Table 7-18 presents the results of the screening level risk calculation for plant and invertebrate exposures to chemicals in surface soil collected during the 2010 CMS field investigation. Twelve VOCs (2-hexanone, acetone, acrylonitrile, benzene, bromomethane, carbon disulfide, chloromethane, methyl acrylonitrile, methyl iodide, propionitrile, m,p-xylene and total xylenes) were each detected in one or more of the surface soil samples. Acrylonitrile, benzene, m,p-xylene, and total xylenes are not identified as ecological COPCs because maximum detected concentrations are less than soil screening values. However, 2-hexanone, acetone, bromomethane, carbon disulfide, chloromethane, methyl acrylonitrile, methyl iodide, and propionitrile are identified as ecological COPCs based on the lack of soil screening values. An additional seventeen non-detected VOCs are also identified as ecological COPCs based on the lack of soil screening values (see Table 7-18). All surface soil analytical data for 1,4-dioxane, acrolein, isobutyl alcohol, and methyl methacrylate were rejected during data validation activities (see Appendix D). These four VOCs are also identified as ecological COPCs based on the lack of any usable data with which to evaluate potential risks.

Three SVOCs (bis[2-ethylhexyl]phthalate, butyl benzyl phthalate, and dibenzofuran) were detected in surface soil collected during the 2010 CMS field investigation. Bis(2-ethylhexyl)phthalate and butyl benzyl phthalate are not identified as ecological COPCs because maximum detected concentrations are less than soil screening values (HQs = 0.10 and 0.03, respectively). However, dibenzofuran is identified as an ecological COPC based on the lack of a soil screening value. Six non-detected SVOCs (1,2,4,5-tetrachlorobenzene, 2,4-dimethylphenol, 2-methylphenol, 3-methylphenol, 4-methylphenol, and pronamide) are identified as ecological COPCs because maximum RLs exceed soil screening values. An additional fifty-three non-detected SVOCs are identified as ecological COPCs due to the lack of soil screening values. All surface soil analytical data for 1,4-phenylenediamine were rejected during data validation activities (see Appendix D). This SVOC is also identified as an ecological COPC based on the lack of any usable data with which to evaluate potential risks.

Seventeen PAHs were detected in surface soil collected during the 2010 CMS field investigation. Available information available indicates that PAH toxicities in waters, tissues, and sediments are additive or nearly additive (USEPA 2003c). Assuming that PAH toxicities in soils also are additive or nearly additive, the combined toxicological contributions of the PAH mixture in SWMU 59 soils was considered. The USEPA (2007d) has developed Eco-SSLs for low molecular weight (LMW) and high molecular weight (HMW) PAHs (29,000 µg/kg and 18,000 µg/kg, respectively [soil invertebrate-based values]). LMW PAHs are defined as PAH compounds composed of fewer than four rings, while HMW PAHs are defined as PAH compounds composed of four or more rings (USEPA, 2007d). A total of eight LMW PAH compounds (i.e., 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, fluoranthene,

fluorene, naphthalene, and phenanthrene) and nine HMW PAH compounds (i.e., benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[g,h,i]perylene, benzo[k]fluoranthene, dibenz[a,h]anthracene, chrysene, indeno[1,2,3-cd]pyrene, and pyrene) were analyzed for in SWMU 59 surface soil collected during the 2010 CMS field investigation. The sum of maximum LMW PAH concentrations across the SWMU for the 2010 data set (13,410 µg/kg; maximum RLs used for non-detected LMW PAHs) is less than the LMW PAH Eco-SSL value (29,000 µg/kg). The sum of maximum HMW PAH concentrations across the SWMU for the 2010 data set (6,706 µg/kg; maximum RLs used for non-detected HMW PAHs) is also less than the HMW PAH Eco-SSL. Based on the comparison of the sum of maximum LMW and HMW PAH concentrations across the site to the invertebrate-based Eco-SSLs, PAHs are not identified as ecological COPCs.

Nine organochlorine pesticides (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, beta-BHC, alpha-chlordane, gamma-chlordane, endosulfan sulfate, endrin aldehyde, and methoxychlor) were detected in surface soil collected during the 2010 CMS field investigation. Of these nine pesticides, beta-BHC is identified as an ecological COPC because the maximum detected concentration exceeds the soil screening value (HQ = 2.31). Although not detected, gamma-BHC, isodrin, kepone, and toxaphene are identified as an ecological COPC because maximum RLs exceed soil screening values.

Seventeen metals were detected in surface soil collected during the 2010 CMS field investigation. Of these seventeen metals, cobalt, copper, lead, selenium, vanadium, and zinc are identified as ecological COPCs because maximum detected concentrations exceed soil screening values (see Table 7-18). HQ values for these six metals range from 3.48 for cobalt to 13.00 for vanadium.

In summary, cobalt, copper, lead, selenium, vanadium, zinc, and beta-BHC were detected and identified as ecological COPCs for surface soil collected during the 2010 CMS field investigation because maximum detected concentrations exceed soil screening values. Eight VOCs (2-hexanone, acetone, bromomethane, carbon disulfide, chloromethane, methyl acrylonitrile, methyl iodide, and propionitrile) and one SVOC (dibenzofuran) were also detected and identified as ecological COPCs based on the lack of soil screening values. Six non-detected SVOCs (1,2,4,5-tetrachlorobenzene, 2,4-dimethylphenol, 2-methylphenol, 3-methylphenol, 4-methylphenol, and pronamide) and four non-detected pesticides (gamma-BHC, isodrin, kepone, and toxaphene) were identified as ecological COPCs because maximum RLs exceed soil screening values. An additional seventeen non-detected VOCs and fifty-three non-detected SVOCs were identified as ecological COPCs based on the lack of soil screening values. Finally, 1,4-dioxane, acrolein, isobutyl alcohol, methyl methacrylate, and 1,4-phenylenediamine were identified as ecological COPCs based on the lack of any usable data with which to evaluate potential risks (all surface soil analytical data for these five organic chemicals were rejected during data validation activities).

7.6.2.1.2 Surface Soil: 2012 CMS Field investigation

Table 7-19 presents the results of the screening level risk calculation for plant and invertebrate exposures to chemicals in surface soil collected during the 2012 CMS field investigation. Acetone was detected in four surface soil samples. This VOC is identified as an ecological COPC based on the lack of a soil screening value. Twenty-seven non-detected VOCs are also identified as ecological COPCs based on the lack of soil screening values. All surface soil analytical data for isobutanol (isobutyl alcohol) were rejected during data validation activities (see Appendix D). This VOC is also identified as an ecological COPC based on the lack of any usable data with which to evaluate potential risks.

Bis(2-ethylhexyl)phthalate was detected in five surface soil samples collected during the 2012 CMS field investigation. However, this SVOC is not identified as an ecological COPC because the maximum detected concentration is less than the soil screening value (HQ = 0.01). Although not detected, 2,4-dimethylphenol and pronamide are identified as ecological COPCs based on maximum LODs greater than soil screening values (HQs = 11.0 and 4.34, respectively). An additional fifty-four non-detected SVOCs are identified as ecological COPCs based on the lack of soil screening values.

As discussed in Section 7.6.2.1.1, PAH toxicities in soil are assumed to be additive or nearly additive. The USEPA (2007d) has developed Eco-SSLs for LMW and HMW PAHs (29,000 µg/kg and 18,000 µg/kg, respectively [soil invertebrate-based values]). The sum of maximum LMW PAH concentrations across the SWMU for the 2012 data set (288 µg/kg; maximum LODs used for non-detected LMW PAHs) is less than the LMW PAH Eco-SSL value (29,000 µg/kg). The sum of maximum HMW PAH concentrations across the SWMU for the 2012 data set (461 µg/kg; maximum LODs used for non-detected HMW PAHs) is also less than the HMW PAH Eco-SSL (18,000 µg/kg). Based on the comparison of the sum of maximum LMW and HMW PAH concentrations to the invertebrate-based Eco-SSLs, PAHs are not identified as ecological COPCs.

Sixteen metals were detected in surface soil collected during the 2012 CMS field investigation. Of these sixteen metals, chromium, cobalt, copper, nickel, selenium, and vanadium are identified as ecological COPCs because maximum detected concentrations for these six metals exceed soil screening. HQ values for these six metals range from 1.24 for nickel to 16.50 for vanadium. All surface soil analytical data for lead were rejected during data validation activities (see Appendix D). Based on the lack of any usable data with which to evaluate potential risks, this metal is also identified as an ecological COPC.

In summary, chromium, cobalt, copper, nickel, selenium, and vanadium were detected and identified as ecological COPCs for surface soil collected during the 2012 CMS field investigation because maximum detected concentrations exceed soil screening values. Acetone was also detected and identified as an ecological COPC based on the lack of a soil screening value. Two non-detected SVOCs (2,4-dimethylphenol and pronamide) were identified as ecological COPCs because maximum LODs exceed soil screening values. An additional twenty-seven non-detected VOCs and fifty-four non-detected SVOCs were identified as ecological COPCs based on the lack of soil screening values. Finally, isobutanol and lead were identified as ecological COPCs based on the lack of any usable data with which to evaluate potential risks (all surface soil analytical data for these five organic chemicals were rejected during data validation activities).

7.6.2.2 Subsurface Soil

The results of the screening level risk calculation for the 2010 and 2012 subsurface soil data sets are presented in Sections 7.6.2.2.1 and 7.6.2.2.2, respectively. As discussed in Section 7.2, subsurface soil sampled during the 2010 CMS field investigation were collected primarily at locations adjacent to concrete pads and paved surfaces, while all of the subsurface soil samples during the 2012 CMS field investigation were collected at locations beneath concrete pads and paved surfaces.

7.6.2.2.1 Subsurface Soil: 2010 CMS Field Investigation

Table 7-20 presents the results of the screening level risk calculation for plant and invertebrate exposures to chemicals in subsurface soil (1.0 to 3.0 foot depth interval) collected during the 2010 CMS field investigation. Eight VOCs (acetone, benzene, bromomethane, carbon disulfide,

chloromethane, methyl iodide, m,p-xylene, and total xylenes) were each detected in one or more of the subsurface soil samples. Acetone, bromomethane, carbon disulfide, chloromethane, and methyl iodide are identified as ecological COPCs based on the lack of soil screening values. Nineteen non-detected VOCs are also identified as ecological COPCs based on the lack of soil screening values. All subsurface soil analytical data for 1,4-dioxane, acrolein, isobutyl alcohol, methyl methacrylate, and propionitrile were rejected during data validation activities (see Appendix D). These five VOCs are also identified as ecological COPCs based on the lack of any usable data with which to evaluate potential risks.

Bis(2-ethylhexyl)phthalate and di-n-octylphthalate were detected in subsurface soil collected during the 2010 CMS field investigation. However, these two SVOCs are not identified as ecological COPCs because maximum detected concentrations are less than soil screening values (HQs = 0.01 and <0.01, respectively). Although not detected, 1,2,4,5-tetrachlorobenzene, 2,4-dimethylphenol, 2-methylphenol, 3-methylphenol, 4-methylphenol, and pronamide are identified as ecological COPCs because maximum RLs exceed soil screening values. An additional fifty-three non-detected SVOCs are identified as ecological COPCs based on the lack of soil screening values. All surface soil analytical data for 1,4-phenylenediamine were rejected during data validation activities (see Appendix D). This SVOC is also identified as an ecological COPC based on the lack of any usable data with which to evaluate potential risks.

As discussed in Section 7.6.2.1.1, PAH toxicities in soil are assumed to be additive or nearly additive. The USEPA (2007d) has developed Eco-SSLs for LMW and HMW PAHs (29,000 µg/kg and 18,000 µg/kg, respectively [soil invertebrate-based values]). The sum of maximum LMW PAH concentrations across the SWMU for the 2010 data set (67.45 µg/kg; maximum RLs used for non-detected LMW PAHs) is less than the LMW PAH Eco-SSL value (29,000 µg/kg). The sum of maximum HMW PAH concentrations across the SWMU for the 2010 data set (65.99 µg/kg; maximum RLs used for non-detected HMW PAHs) is also less than the HMW PAH Eco-SSL (18,000 µg/kg). Based on the comparison of the sum of maximum LMW and HMW PAH concentrations to the invertebrate-based Eco-SSLs, PAHs are not identified as ecological COPCs.

Seven organochlorine pesticides (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, beta-BHC, endrin, endrin aldehyde, and heptachlor) were detected in subsurface soil collected during the 2010 CMS field investigation. Of these seven pesticides, beta-BHC is identified as an ecological COPC because the maximum detected concentration exceeds the soil screening value (HQ = 2.24). Although not detected, isodrin, kepone, and toxaphene are also identified as ecological COPCs because maximum RLs for these three organochlorine pesticides exceed soil screening values.

Seventeen metals were detected in SWMU 59 subsurface soil collected during the 2010 CMS field investigation. Of these seventeen metals, chromium, cobalt, copper, nickel, selenium, vanadium, and zinc are identified as ecological COPCs because maximum detected concentrations exceed soil screening values. HQ values for these seven metals range from 1.24 for nickel to 14.10 for vanadium.

In summary, chromium, cobalt, copper, nickel, selenium, vanadium, zinc, and beta-BHC were detected in SWMU 59 subsurface soil collected during the 2010 CMS field investigation and identified as ecological COPCs because maximum detected concentrations exceed soil screening values. Five detected VOCs (acetone, bromomethane, carbon disulfide, chloromethane, and methyl iodide) were also identified as ecological COPCs based on the lack of soil screening values. Six non-detected SVOCs (1,2,4,5-tetrachlorobenzene, 2,4-dimethylphenol, 2-methylphenol, 3-methylphenol, 4-methylphenol, and pronamide) and three non-detected pesticides (isodrin, kepone, toxaphene) were identified as ecological COPCs because maximum RLs exceed soil screening values. An additional nineteen non-detected VOCs and fifty-three

non-detected SVOCs were identified as ecological COPCs based on the lack of soil screening values. Finally, 1,4-dioxane, acrolein, isobutyl alcohol, methyl methacrylate, propionitrile, and 1,4-phenylenediamine were identified as ecological COPCs for SWMU 59 subsurface soil based on the lack of any usable data with which to evaluate potential risks (all subsurface soil analytical data for these six organic chemicals were rejected during data validation activities).

7.6.2.2.2 Subsurface Soil: 2012 CMS Field Investigation

Table 7-21 presents the results of the screening level risk calculation for plant and invertebrate exposures to chemicals in subsurface soil (1.0 to 3.0 foot depth interval) collected during the 2012 CMS field investigation. Two VOCs (acetone and methylene chloride) were detected in subsurface soil. Acetone is identified as an ecological COPC based on the lack of a soil screening value. Twenty-seven non-detected VOCs are also identified as ecological COPCs based on the lack of soil screening values. All surface soil analytical data for isobutanol (isobutyl alcohol) were rejected during data validation activities (see Appendix D). This VOC is also identified as an ecological COPC based on the lack of any usable data with which to evaluate potential risks.

Bis(2-ethylhexyl)phthalate, 2,4-dimethylphenol, and pentachlorobenzene were each detected in one or more of the subsurface soil collected during the 2012 CMS field investigation. Of these three SVOCs, 2,4-dimethylphenol is identified as an ecological COPC because the maximum detected concentration exceeds the soil screening value (HQ = 1.7). Fifty-four non-detected SVOCs are also identified as ecological COPCs based on the lack of soil screening values.

As discussed in Section 7.6.2.1.1, PAH toxicities in soil are assumed to be additive or nearly additive. The USEPA (2007d) has developed Eco-SSLs for LMW and HMW PAHs (29,000 µg/kg and 18,000 µg/kg, respectively [soil invertebrate-based values]). The sum of maximum LMW PAH concentrations across the SWMU for the 2012 data set (37.5 µg/kg; maximum LODs used for non-detected LMW PAHs) is less than the LMW PAH Eco-SSL value (29,000 µg/kg). The sum of maximum HMW PAH concentrations across the SWMU for the 2012 data set (47.1 µg/kg; maximum LODs used for non-detected HMW PAHs) is also less than the HMW PAH Eco-SSL (18,000 µg/kg). Based on the comparison of the sum of maximum LMW and HMW PAH concentrations to the invertebrate-based Eco-SSLs, PAHs are not identified as ecological COPCs.

Fourteen metals were detected in subsurface soil collected during the 2012 CMS field investigation. Of these fourteen metals, chromium, cobalt, copper, nickel, selenium, and vanadium are identified as ecological COPCs because maximum detected concentrations exceed soil screening. HQ values for these six metals range from 1.16 for nickel to 20.00 for vanadium. All surface soil analytical data for lead were rejected during data validation activities (see Appendix D). Based on the lack of any usable data with which to evaluate potential risks, this metal is also identified as an ecological COPC.

In summary, chromium, cobalt, copper, nickel, selenium, vanadium, and 2,4-dimethylphenol were detected and identified as ecological COPCs for SWMU 59 subsurface soil collected during the 2012 CMS field investigation because maximum detected concentrations exceed soil screening values. Acetone was detected and identified as an ecological COPC based on the lack of a soil screening value. Twenty-seven non-detected VOCs and fifty-four non-detected SVOCs were identified as ecological COPCs based on the lack of soil screening values. Finally, isobutanol and lead were identified as ecological COPCs based on the lack of any usable data with which to evaluate potential risks (all surface soil analytical data for isobutanol and lead were rejected during data validation activities).

7.6.2.3 Groundwater

Table 7-22 presents the results of the screening level risk calculation for groundwater. Two VOCs (benzene and carbon disulfide) were detected in groundwater but are not identified as ecological COPCs because maximum detected concentrations are less than groundwater screening values (HQs = <0.01 and 0.01, respectively). However, five non-detected VOCs (1,4-dichloro-2-butene, 2-chloro-1,3-butadiene, chloroethane, methyl acrylonitrile, and methyl iodide) are identified as ecological COPCs based on the lack of groundwater screening values. All groundwater analytical data for 1,4-dioxane, 2-butanone, acetone, acrolein, acrylonitrile, isobutyl alcohol, and propionitrile were rejected during data validations activities (see Appendix D). Based on the lack of any usable data with which to evaluate potential risks, these seven VOCs are also identified as ecological COPCs for SWMU 59 groundwater.

Bis(2-ethylhexyl)phthalate, naphthalene, phenanthrene, and pyrene were detected in groundwater. However, these four SVOCs are not identified as ecological COPCs because maximum detected concentrations are less than surface water screening values. Seventeen SVOCs are identified as ecological COPCs because maximum RLs exceed groundwater screening values. An additional eighteen non-detected SVOCs are identified as ecological COPCs based on the lack of screening values. All groundwater analytical data for 1,4-phenylenediamine were rejected during data validation activities (see Appendix D). Based on the lack of any usable data with which to evaluate potential risks, this SVOC is also identified as an ecological COPC for groundwater.

One organochlorine pesticide (alpha-chlordane) was detected in groundwater and is identified as an ecological COPC because the maximum detected concentration exceeds the groundwater screening value (HQ = 4.00). Sixteen non-detected pesticides are also identified as ecological COPCs because maximum RLs exceed groundwater screening values.

Antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, nickel, selenium, silver, thallium, and vanadium were detected within the total recoverable fraction of groundwater. Maximum detected copper and vanadium concentrations exceed surface water screening values (maximum HQs = 5.71 for copper and 14.25 for vanadium). As such, these two metals are identified as ecological COPCs. All total recoverable groundwater analytical data for mercury and zinc were rejected during data validation activities (see Appendix D). These two metals are also identified as ecological COPCs based on the lack of any usable data with which to evaluate potential risks.

In summary, copper, vanadium, and alpha-chlordane were detected and identified as ecological COPCs for groundwater because maximum detected concentrations exceed groundwater screening values. Sixteen non-detected pesticides and seventeen non-detected SVOCs were also identified as ecological COPCs because maximum RLs exceed screening values. An additional five non-detected VOCs (1,4-dichloro-2-butene, 2-chloro-1,3-butadiene, chloroethane, methyl acrylonitrile, and methyl iodide) and eighteen non-detected SVOCs were identified as ecological COPCs based on the lack of groundwater screening values. Finally, 1,4-dioxane, 2-butanone, acetone, acrolein, acrylonitrile, isobutyl alcohol, propionitrile, 1,4-phenylenediamine, mercury, and zinc were identified as ecological COPCs for SWMU 59 groundwater based on the lack of any usable data with which to evaluate potential risks (all groundwater analytical data for these ten chemicals were rejected during data validation activities).

7.6.2.4 Drainage Ditch Surface Water

Table 7-23 presents the results of the screening level risk calculation for drainage ditch surface water. Four VOCs were each detected in one or more of the surface water samples i.e.,

bromodichloromethane, carbon disulfide, chloroform, and dibromochloromethane). However, because maximum detected concentrations are less than surface water screening values, these four VOCs are not identified as ecological COPCs. Five non-detected VOCs (1,4-dichloro-2-butene, 2-chloro-1,3-butadiene, chloroethane, methyl acrylonitrile, and methyl iodide) are identified as ecological COPCs based on the lack of surface water screening values. All surface water analytical data for 1,4-dioxane, 2-butanone, acetone, acrolein, acrylonitrile, isobutyl alcohol, and propionitrile were rejected during data validation activities (see Appendix D). These seven VOCs are also identified as ecological COPCs based on the lack of any usable data with which to evaluate potential risks.

Fluoranthene and pyrene were each detected in two surface water samples. However, as evidenced by Table 7-23, maximum detected concentrations are less than surface water screening values (HQs = <0.01 and 0.07, respectively). Twenty-two non-detected SVOCs are identified as ecological COPCs because maximum RLs exceed surface water screening values. An additional seventeen non-detected SVOCs are identified as ecological COPCs based on the lack of screening values. All surface water analytical data for 1,4-pheylenediamine were rejected during data validation activities (see Appendix D). Based on the lack of any usable data with which to evaluate potential risks, this SVOC is also identified as an ecological COPC for drainage ditch surface water.

Two organochlorine pesticides (4,4'-DDE and 4,4'-DDT) were each detected in a single surface water sample and are identified as ecological COPCs because maximum detected concentrations exceed surface water screening values (HQs = 6.00 and 6.50, respectively). Although not detected, 4,4'-DDD, aldrin, gamma-BHC, alpha-chlordane, gamma-chlordane, dieldrin, endosulfan II, endrin, endrin aldehyde, heptachlor, heptachlor epoxide, isodrin, methoxychlor, and toxaphene are also identified as ecological COPCs because maximum RLs exceed surface water screening values.

Antimony, arsenic, barium, chromium, cobalt, copper, selenium, vanadium, and zinc were detected within the total recoverable fraction of surface water (see Table 7-23). Of these nine metals, copper is identified as an ecological COPC because the maximum detected concentration exceeds the surface water screening value (HQ = 1.16). Although not detected, cadmium, lead, and silver are also identified as ecological COPCs because maximum RLs exceed surface water screening values.

In summary, 4,4'-DDE, 4,4'-DDT, and copper were detected and identified as ecological COPCs for drainage ditch surface water because maximum detected concentrations exceed surface water screening values. Twenty-two non-detected SVOCs, fourteen non-detected pesticides, and three non-detected metals (cadmium, lead, and silver) were identified as ecological COPCs because maximum RLs exceed screening values. An additional five non-detected VOCs (1,4-dichloro-2-butene, 2-chloro-1,3-butadiene, chloroethane, methyl acrylonitrile, and methyl iodide) and seventeen non-detected SVOCs were identified as ecological COPCs based on the lack of surface water screening values. Finally, 1,4-dioxane, 2-butanone, acetone, acrolein, acrylonitrile, isobutyl alcohol, propionitrile, and 1,4-phenylenediamine were identified as ecological COPCs for SWMU 59 surface water based on the lack of any usable data with which to evaluate potential risks (all surface water analytical data for these eight organic chemicals were rejected during data validation activities).

7.6.2.5 Drainage Ditch Sediment

Table 7-24 presents the results of the screening level risk calculation for drainage ditch sediment. Acetone, carbon disulfide, m,p-xylene, and total xylenes were each detected in one or more of the

drainage ditch sediment samples. Of these four VOCs, acetone is identified as an ecological COPC because the maximum detected concentration exceeds the sediment screening value (maximum HQ = 7.23). Although not detected, 3-chloropropene, acrylonitrile, bromomethane, ethylbenzene, and o-xylene are identified as ecological COPCs because maximum RLs exceed sediment screening values. An additional four non-detected VOCs (1,4-dichloro-2-butene, 2-chloro-1,3-butadiene, methyl acrylonitrile, and methyl iodide) are identified as ecological COPCs based on the lack of sediment screening values. All sediment analytical data for 1,4-dioxane, acrolein, isobutyl alcohol, and propionitrile were rejected during data validations activities (see Appendix D). These four VOCs are also identified as ecological COPCs based on the lack of any usable data with which to evaluate potential risks.

Twelve SVOCs were detected in sediment (see Table 7-24). Of these twelve SVOCs, only bis(2-ethylhexyl)phthalate is identified as an ecological COPC because the maximum detected concentration exceeds the sediment screening value (maximum HQ = 4.06). Although not detected, sixty-two SVOCs are identified as ecological COPCs because maximum RLs exceed sediment screening values. An additional seventeen non-detected SVOCs are identified as ecological COPCs based on the lack of sediment screening values. All sediment analytical data for 1,4-phenylenediamine were rejected during data validations activities (see Appendix D). Based on the lack of any usable data with which to evaluate potential risks, this SVOC is also identified as ecological COPCs for sediment.

Nine pesticides (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, aldrin, alpha-chlordane, gamma-chlordane, dieldrin, endrin aldehyde, and heptachlor) were detected in sediment. Of these nine organochlorine pesticides, 4,4'-DDD, 4,4'-DDE, alpha-chlordane, gamma-chlordane, and heptachlor are identified as ecological COPCs because maximum detected concentrations exceed sediment screening values. HQ values range from 1.21 for 4,4'-DDD to 50.63 for 4,4'-DDE). Four non-detected pesticides (gamma-BHC, endrin, heptachlor epoxide, and toxaphene) are also identified as ecological COPCs because maximum RLs exceed sediment screening values.

Sixteen metals were detected in sediment. Of these, barium, copper, lead, mercury, nickel, vanadium, and zinc are identified as ecological COPCs because maximum detected concentrations exceed sediment screening values. Maximum HQ values range from 1.06 for mercury to 8.20 for barium. Beryllium and thallium were also detected and are identified as ecological COPCs based on the lack of sediment screening values. Although not detected, tin is identified as an ecological COPC because the maximum RL for this metal exceeds the sediment screening value (HQ = 3.09).

In summary, acetone, bis(2-ethylhexyl)phthalate, 4,4'-DDD, 4,4'-DDE, alpha-chlordane, gamma-chlordane, heptachlor, barium, copper, lead, mercury, nickel, vanadium, and zinc were detected and identified as ecological COPCs for drainage ditch sediment because maximum detected concentrations exceed sediment screening values. Beryllium and thallium were also detected and identified as ecological COPCs based on the lack of sediment screening values. Although not detected, five VOCs (3-chloropropene, acrylonitrile, bromomethane, ethylbenzene, and o-xylene), sixty-two SVOCs, four pesticides (gamma-BHC, endrin, heptachlor epoxide, and toxaphene), and one metal (tin) were identified as ecological COPCs because maximum RLs exceed sediment screening values. Four non-detected VOCs (1,4-dichloro-2-butene, 2-chloro-1,3-butadiene, methyl acrylonitrile, and methyl iodide) and seventeen non-detected SVOCs were also identified as ecological COPCs based on the lack of sediment screening values. Finally, 1,4-dioxane, acrolein, isobutyl alcohol, propionitrile, and 1,4-phenylenediamine were identified as ecological COPCs for drainage ditch sediment based on the lack of any usable data with which to evaluate potential risks (all sediment analytical data for these five organic chemicals were rejected during data validation activities).

7.6.3 Screening Level Risk Calculation for Avian and Mammalian Dietary Exposures

Results of the screening level risk calculation for avian and mammalian dietary exposures to chemicals in surface soil and subsurface soil, as well as avian dietary exposures to chemicals in sediment are presented in Tables 7-25 through 7-29. Prey item tissue concentrations and dietary doses for each chemical-receptor combination evaluated for avian and mammalian dietary exposures are also provided in Appendix G. Ecological COPCs for avian and mammalian dietary exposures were identified in Step 2 of the ERA using the procedures outlined in Section 7.6.1.

7.6.3.1 Surface Soil

The results of the screening level risk calculation for avian and mammalian dietary exposures to chemicals in surface soil collected during the 2010 and 2012 CMS field investigations are presented within Sections 7.6.3.1.1 and 7.6.3.1.2, respectively. Identical to the screening level risk calculation for terrestrial plant and invertebrate direct contact exposures, the two surface soil data sets were evaluated independently from each other.

7.6.3.1.1 Surface Soil: 2010 CMS Field Investigation

Results of the screening level risk calculation for avian dietary exposures to chemicals in surface soil collected during the 2010 CMS field investigation are presented in Table 7-25. 4,4'-DDE, 4,4'-DDT, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, tin, vanadium, and zinc were detected and are identified as ecological COPCs because maximum dietary exposure doses for one or more of the avian receptors exceed NOAEL-based TRVs. The highest HQ values were calculated for the American robin, including an HQ of 37.29 for vanadium, 18.22 for mercury, 16.11 for chromium, and 14.43 for lead. Two detected SVOCs (butyl benzyl phthalate and dibenzofuran) and one detected metal (beryllium) are identified as ecological COPCs based on the lack of avian TRVs. One non-detected SVOC (pentachlorophenol) and one non-detected pesticide (endrin) are identified as ecological COPCs because American robin dietary exposure doses, calculated using maximum RLs, exceed NOAEL-based TRVs (HQs = 1.45 and 1.57, respectively). In addition, nine non-detected VOCs, twenty-six non-detected SVOCs, and one non-detected pesticide (isodrin) are identified as ecological COPCs based on the lack of avian TRVs.

Results of the screening level risk calculation for brown flower bat dietary exposures to chemicals in surface soil collected during the 2010 CMS field investigation are also included within Table 7-25. Selenium and pyrene were detected and are identified as ecological COPCs because maximum brown flower bat dietary exposure doses exceed NOAEL-based TRVs (HQs = 1.62 and 3.12, respectively). Dibenzofuran was detected and is also identified as an ecological COPC based on the lack of a mammalian TRV. In addition, two non-detected VOCs (1,1,1,2-tetrachloroethane and pentachloroethane), twenty-one non-detected SVOCs, and one non-detected pesticide (isodrin) are identified as ecological COPCs based on the lack of mammalian TRVs.

7.6.3.1.2 Surface Soil: 2012 CMS Field Investigation

Results of the screening level risk calculation for avian dietary exposures to chemicals in surface soil collected during the 2012 CMS field investigation are presented in Table 7-26. Chromium, copper, mercury, nickel, tin, vanadium, and zinc were detected and are identified as ecological COPCs because maximum dietary exposure doses for one or more of the avian receptors exceed NOAEL-based TRVs. The highest HQ values were calculated for the American robin, including an HQ of 47.33 for vanadium, 44.43 for chromium, and 13.23 for mercury. One detected metal

(beryllium), nine non-detected VOCs, and twenty-seven non-detected SVOCs are also identified as ecological COPCs based on the lack of avian TRVs.

Results of the screening level risk calculation for brown flower bat dietary exposures to chemicals in surface soil collected during the 2012 CMS field investigation are also included within Table 7-26. Based on the comparison of maximum brown flower bat dietary exposure doses to NOAEL-based TRVs, no detected chemical has an HQ value greater than 1.0. However, two non-detected VOCs (1,1,1,2-tetrachloroethane and pentachloroethane) and twenty-one non-detected SVOCs are identified as ecological COPCs based on the lack of mammalian TRVs.

As evidenced by Appendix D, all analytical data for lead were rejected during data validation activities. Based on the lack of any usable data with which to evaluate potential risks, this metal is identified as an ecological COPC for avian and mammalian dietary exposures.

7.6.3.2 Subsurface Soil

The screening level risk calculation for avian and mammalian dietary exposures to chemicals in subsurface soil (1.0 to 3.0 foot depth interval) collected during the 2010 and 2012 CMS field investigations is presented within the subsections that follow. Identical to the screening level risk calculation for terrestrial plant and invertebrate direct contact exposures, the two subsurface soil data sets were evaluated independently from each other.

7.6.3.2.1 Subsurface Soil: 2010 CMS Field Investigation

Results of the screening level risk calculation for avian dietary exposures to chemicals in subsurface soil collected during the 2010 CMS field investigation are presented in Table 7-27. Cadmium, chromium, copper, mercury, nickel, selenium, silver, tin, vanadium, and zinc were detected and are identified as ecological COPCs because maximum dietary exposure doses for one or more of the avian receptors exceed NOAEL-based TRVs. Identical to surface soil adjacent to and beneath paved surfaces, the highest HQ values were calculated for the American robin, including an HQ of 40.45 for vanadium, 23.49 for chromium, and 19.18 for mercury. Beryllium was detected and is also identified as an ecological COPC based on the lack of an avian TRV. One non-detected SVOC (pentachlorophenol) is identified as an ecological COPC because the American robin dietary exposure dose, calculated using the maximum RL, exceeds the NOAEL-based TRV. In addition, nine non-detected VOCs, twenty-eight non-detected SVOCs, and one non-detected pesticide (isodrin) are identified as ecological COPCs based on the lack of TRVs.

Results of the screening level risk calculation for brown flower bat dietary exposures to chemicals in subsurface soil collected during the 2010 CMS field investigation are also included within Table 7-27. Selenium was detected and is identified as an ecological COPC because the maximum brown flower bat dietary exposure dose for this metal exceeds the NOAEL-based TRV (HQ = 1.77). Two non-detected VOCs, twenty-two non-detected SVOCs, and one non-detected pesticide (isodrin) are also identified as ecological COPCs based on the lack of mammalian TRVs.

7.6.3.2.2 Subsurface Soil: 2012 CMS Field Investigation

Results of the screening level risk calculation for avian dietary exposures to chemicals in subsurface soil collected during the 2012 CMS field investigation are presented in Table 7-28. Chromium, copper, mercury, nickel, vanadium, and zinc were detected and are identified as ecological COPCs because maximum dietary exposure doses for one or more of the avian

receptors exceed NOAEL-based TRVs. The highest HQ values were calculated for the American robin, including an HQ of 57.37 for vanadium, 35.55 for chromium, and 15.92 for mercury. Pentachlorobenzene and beryllium were detected and are identified as ecological COPCs based on the lack of avian TRVs. Nine non-detected VOCs and twenty-six non-detected SVOCs are also identified as ecological COPCs based on the lack of avian TRVs.

Results of the screening level risk calculation for brown flower bat dietary exposures to chemicals in subsurface soil collected during the 2012 CMS field investigation are also included within Table 7-28. Based on the comparison of maximum brown flower bat dietary exposure doses to NOAEL-based TRVs, no detected chemical has an HQ value greater than 1.0. However, two non-detected VOCs (1,1,1,2-tetrachloroethane and pentachloroethane) and twenty-one non-detected SVOCs are identified as ecological COPCs based on the lack of mammalian TRVs.

Identical to surface soil collected during the 2012 CMS field investigation, all analytical data for lead were rejected during data validation activities. Based on the lack of any usable data with which to evaluate potential risks, this metal is identified as an ecological COPC for avian and mammalian dietary exposures.

7.6.3.3 Drainage Ditch Sediment

Results of the screening level risk calculation for avian dietary exposures to chemicals in drainage ditch sediment are presented in Table 7-29. Barium, chromium, copper, lead, mercury, vanadium, zinc, bis(2-ethylhexyl)phthalate), and 4,4'-DDE were detected and are identified as ecological COPCs because maximum green heron dietary exposure doses exceed NOAEL-based TRVs (HQs = 1.47 for barium, 2.94 for chromium, 8.59 for copper, 3.17 for lead, 6.23 for mercury, 125.44 for vanadium, 4.84 for zinc, 4.24 for bis[2-ethylhexyl]phthalate, and 30.06 for 4,4'-DDE). Butyl benzyl phthalate and beryllium were detected and are also identified as ecological COPCs based on the lack of avian TRVs. Although not detected, endrin is identified as an ecological COPC because the green heron dietary exposure dose, calculated using the maximum RL, exceeds the NOAEL-based TRV (HQ = 1.25). An additional nine non-detected VOCs, twenty-seven non-detected SVOCs, and one non-detected pesticide (isodrin) are identified as ecological COPCs based on the lack of avian TRVs.

7.7 Uncertainties Associated with the SERA

The procedures used in this evaluation to assess risks to ecological receptors, as in all such assessments, are subject to uncertainties because of the limitations of the available data and the need to make certain assumptions and extrapolations based on incomplete information. Reliance on results from a risk assessment can be misleading without a consideration of the uncertainties, limitations, and assumptions inherent in the process. The major uncertainties associated with the SERA for SWMU 59 are identified and discussed below.

Analytical Data

- Analytical data for many chemicals were qualified as estimated, "J" because the results fall between the method detection limit (MDL) and RL/LOD. Although concentrations that fall between the MDL and RL/LOD are considered detected and were evaluated as such in the SERA, the confidence in the quantified values is low.

- A second source of uncertainty related to the analytical data applies to chemicals with no usable analytical data with which to evaluate potential risks. In the case of surface and subsurface soil collected during the 2010 CMS field investigation, all analytical data for

four VOCs (1,4-dioxane, acrolein, isobutyl alcohol, and methyl methacrylate) and one SVOC (1,4-phenylenediamine) were rejected during data validation activities. All subsurface soil data for propionitrile were also rejected. In the case of surface and subsurface soil collected during the 2012 CMS field investigation, all analytical data for one VOC (isobutyl alcohol) and one metal (lead) were rejected. In the case of groundwater and surface water, all analytical data for seven VOCs (1,4-dioxane, 2-butanone, acetone, acrolein, acrylonitrile, isobutyl alcohol, and propionitrile) and one SVOC (1,4-phenylenediamine) were rejected during data validation activities. All groundwater analytical data for total recoverable mercury and zinc also were rejected. Finally, in the case of sediment, all analytical data for four VOCs (1,4-dioxane, acrolein, isobutyl alcohol, and propionitrile) and one SVOC (1,4-phenylenediamine) were rejected during data validation activities. Without any usable data, an evaluation of potential risks in Step 2 of the ERA could not be performed. As such, the chemicals identified above were identified as ecological COPCs in Step 2 of the ERA. The uncertainty associated with the rejected data is addressed in Step 3a of the BERA.

- A third uncertainty related to the analytical data applies to the lack of surface water and sediment analytical data for downgradient marine habitats (i.e., E2SS3 wetlands and Ensenada Honda). To address the transport of chemicals with groundwater to downgradient aquatic habitats, the SERA included a comparison of groundwater analytical data to the estuarine/marine screening values listed in Table 7-6 (see the Step 2 screening level risk calculation for groundwater presented in Section 7.6.2.4 and summarized in Table 7-22).

  It is acknowledged that the groundwater screening values listed in Table 7-6 are toxicological thresholds based on lower trophic level aquatic receptor groups (i.e., plants, invertebrates, and fish). As such, the comparisons presented in Table 7-22 do not address potential exposures by upper trophic level receptors that may occupy or forage within the downgradient marine habitats. A review of the groundwater analytical data for SWMU 59 shows that four organics with the potential to bioaccumulate were detected in SWMU 59 groundwater (naphthalene, phenanthrene, pyrene, and bis[2-ethylhexyl]phthalate). Naphthalene was detected in 59GW06 at 1.3J µg/L, phenanthrene was detected in 59GW10 at 0.05J µg/L, pyrene was detected in 59GW01 and 59GW02 at 0.01J µg/L, and bis(2-ethyl)phthalate was detected in 59GW05 at 2.4J µg/L. Naphthalene, phenanthrene, and pyrene are considered to be bioaccumulative chemicals based on their identification as "important bioaccumulative compounds" by the USEPA (2000b), while bis(2-ethylhexyl)phthalate is considered to be a bioaccumulative chemical based on the discussion presented in Appendix E, Although detected in groundwater, the low magnitude of the detected concentrations indicates that these organics are not likely to be migrating with groundwater at concentrations that would adversely impact upper trophic level receptors occupying or feeding within the downgradient marine habitats.
  In addition to the organics discussed above, seven metals identified by the USEPA (2000b) as "important bioaccumulative compounds" were detected within the total recoverable fraction of one or more of the SWMU 59 groundwater samples (arsenic, cadmium, chromium, copper, lead, nickel, and selenium; see Appendix D). As evidenced by the table below, maximum detected concentrations are less than ULM background concentrations for groundwater contained in the Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds for NAPR (Baker, 2010b), indicating that these metals are not likely migrating with groundwater to downgradient marine habitats at concentrations greater than what would be expected under background conditions.

Metal	Maximum Groundwater Concentration (µg/L)	ULM Background Concentration (µg/L)
Arsenic	6.2	18.89
Cadmium	0.71J	16.62
Chromium	5.5	162.41
Copper	21.3	324
Lead	5	26.25
Nickel	8	95.74
Selenium	24.2	29.88

Identification of Ecological COPCs

- Chemicals without available screening values and/or TRVs were identified as ecological COPCs in Step 2 of the SERA even if they were not detected. Non-detected chemicals with maximum RLs/LODs greater than screening values and/or maximum exposure doses greater than NOAEL-based TRVs were also identified as ecological COPCs in the SERA. This approach likely overstates the number of actual COPCs.

- A second source of uncertainty related to the selection of ecological COPCs applies to the use of NOAEL-based TRVs in risk calculations for upper trophic level receptors. The use of NOAEL-based TRVs is extremely conservative since they give no indication as to how much higher a dose must be before adverse effects are observed. This uncertainty does not apply to avian TRVs obtained from Eco-SSL documents for arsenic, cadmium, chromium, cobalt, copper, lead, nickel, selenium, silver, vanadium, and zinc or mammalian TRVs obtained from Eco-SSL documents for HMW PAHs, LMW PAHs, antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, nickel, selenium, silver, vanadium, and zinc since these values are based on a compilation of NOAEL and LOAEL values.

- Direct comparison of groundwater concentrations to surface water screening values is considered extremely conservative since dilution upon migration and discharge to surface water, as well as natural attenuation, defined as the reduction in the concentration of a chemical in groundwater over time or distance from the source due to naturally occurring physical, chemical, and biological processes, such as; biodegradation, dispersion, dilution, adsorption, and volatilization (American Society for Testing and Materials [ASTM], 2003]), was not considered. As such, the number of ecological COPCs for groundwater was likely overstated.

Exposure Point Concentrations

- The maximum measured concentration provides a conservative estimate for immobile biota or those with a limited home range. The most realistic exposure estimates for mobile species with relatively large home ranges and for species populations (even those that are immobile or have limited home ranges) are those based on arithmetic mean concentrations or 95 percent UCL of the mean concentrations in each medium to which these receptors are exposed. This is reflected in the wildlife dietary exposure models contained in the Wildlife Exposure Factors Handbook (USEPA, 1993b), which specify the use of average media concentrations. Given the mobility of the upper trophic level receptor species used in the SERA, the use of maximum chemical concentrations to estimate the exposure via food webs is very conservative. For a given medium, this uncertainty was reduced in Step 3a of the BERA by deriving exposure estimates based on 95 percent UCL of the mean concentrations for those ecological COPCs with a minimum

of eight detected concentrations and less than 70 percent non-detected values (see Section 7.9).

Media-Specific Screening Values

- Media-specific toxicological thresholds were not available for many of the VOCs and SVOCs evaluated in the SERA. Furthermore, many of the soil screening values used in the comparison to surface and subsurface soil analytical data are based on background concentrations or detection limits (e.g., Canadian soil quality guidelines; see Section 7.4.1 and Table 7-4). Because screening values based on background concentrations or detection limits do not represent effect concentrations, their use in the SERA likely resulted in an overstatement of the actual number of ecological COPCs.

- When a toxicological threshold was available for both terrestrial plants and invertebrates, the minimum value was selected as the soil screening value. For several chemicals, only a plant or earthworm toxicological threshold was available from the literature. It was assumed in the SERA that the screening values selected for these chemicals are protective of both receptor communities. If a given chemical does not have an available screening value for both terrestrial plants and invertebrates, this approach will result in an underestimation of potential risks if the screening value is not based on the most sensitive receptor community.

- A third source of uncertainty related to media-specific screening values applies to surface water. PRWQS or USEPA NAWQC expressed as total recoverable concentrations were used as surface water screening values for arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc. Because the filtered fraction more closely approximates the bioavailable fraction of these nine metals in the water column (USEPA, 1999b, 2002a, and 2006), use of screening values expressed in terms of the total recoverable concentration in the water column likely resulted in an overstatement of the actual number of ecological COPCs. The uncertainty associated with the comparison of total recoverable metal concentrations to PRWQS or NAWQC expressed as total recoverable concentrations was addressed in Step 3a of the BERA by comparing dissolved metals concentrations to screening values expressed as dissolved concentrations. It is noted that this uncertainty does not apply to filter feeding organisms, which may receive exposure from total metals in surface water.

- A fourth source of uncertainty related to media-specific screening values applies to sediment. The bulk sediment toxicological thresholds used as screening values in the SERA (e.g., AET, LEL, and TEC values) do not take into consideration site-specific conditions that can influence chemical bioavailability and toxicity. These conditions include TOC and AVS, which can influence the bioavailability of organic chemicals and metals, respectively. As exposure does not necessarily equate to risk, the use of bulk sediment screening values may overstate risks to benthic macroinvertebrates.

- A fifth source of uncertainty related to media-specific screening values also applies to sediment. Measurement endpoints for aquatic plants, amphibians, and fish included a comparison of chemical concentrations in sediment with sediment screening values. However, as discussed in Section 7.4.1.4, the AET, TEC, TEL, and LEL values selected as sediment screening values for drainage ditch sediment were developed from data specific to invertebrates. Therefore, they may not be protective of plants, amphibians and fish.

Toxicity Reference Values

- Data on the toxicity of many chemicals to the receptor species were sparse or lacking, requiring the extrapolation of data from other wildlife species or from laboratory studies with non-wildlife species. This is a typical limitation for ERAs because so few wildlife species have been tested directly for most chemicals. The uncertainties associated with toxicity extrapolation were minimized through the selection of the most appropriate test species for which suitable toxicity data were available. The factors that were considered in selecting a test species to represent a receptor species included taxonomic relatedness, trophic level, foraging method, and similarity of diet. Regardless, the use of NOAEL and LOAEL values derived from laboratory studies with non-wildlife species may have resulted in an overstatement or understatement of potential risks if the sensitivities of the receptor and test species differ appreciably.

- A second source of uncertainty related to TRVs applies to metals. Most of TRVs selected for metals are based on forms (such as salts [see Tables 7-9 and 7-10]) that have high water solubility and high bioavailability to receptors. Since the analytical samples on which site-specific exposure estimates were based measured total metal concentrations, regardless of form, and these highly bioavailable forms are expected to compose only a fraction of the total metal concentration, the use of TRVs based on highly bioaccumulative forms is likely to result in an overestimation of potential risks for these chemicals.

- A third source of uncertainty related to the derivation of TRVs applies to mercury. The NOAEL-based mercury TRVs used in the Step 2 screening-level risk calculation for birds and mammals (0.026 mg/kg-BW/day and 0.032 mg/kg-BW/day, respectively) are based on organometallic (methylated) forms (methyl mercury dicyandiamide for birds and methyl mercury chloride for mammals). Avian and mammalian TRVs for inorganic forms of mercury are at least an order of magnitude higher (NOAEL-based avian TRV of 0.45 mg/kg-BW/day and NOAEL-based mammalian TRV of 1.0 mg/kg-BW/day for mercuric chloride [Sample et al., 1996]). The USEPA (2001b) reports that between 0.5 to 5.3 percent of the total mercury in soil and between 0.1 and 1.0 percent of the total mercury in sediment is present as methylmercury. These data indicate that methylmercury represents a fraction of the total mercury in soil and sediment. As such, the use of TRVs based on methylated forms, which assume that 100 percent of the detected mercury is present as methyl mercury, likely resulted in an overestimation of potential risks to avian and mammalian receptors.

Ecological Receptors

- Although exposure pathways to terrestrial reptiles and amphibians are likely to be complete, there is a paucity of data concerning the toxicological effects of chemicals for reptiles and amphibians, rendering a quantitative evaluation problematic (USEPA, 2000a and 2005a). Therefore, for a given ecological COPC, a conclusion of acceptable or unacceptable risk to the other terrestrial receptor species evaluated in the ERA was also applied to terrestrial reptiles and amphibians. It was assumed that terrestrial reptiles and amphibians at the SWMU are not exposed to significantly higher concentrations of ecological COPCs and are not more sensitive to ecological COPCs than the avian and mammalian terrestrial receptors evaluated by the ERA. If terrestrial reptiles and amphibians are exposed to significantly higher concentrations of ecological COPCs and/or are more sensitive to ecological COPCs than the avian and mammalian receptors, this approach resulted in an underestimation of potential risks. However, reptiles and

amphibians are poikilotherms (body temperature varies with environmental temperature), while birds and mammals are homeotherms (temperature is regulated, constant, and largely independent of environmental temperatures). Therefore, reptiles and amphibians tend to have much lower metabolic rates and lower caloric intake requirements than birds and mammals. As a consequence, birds and mammals are likely to consume more food than reptiles and amphibians on a daily dietary intake basis, assuming similar caloric content of the food items. Therefore, potential risks to terrestrial reptiles and amphibians are likely overstated when risk estimates for avian and mammalian receptors are applied to herpetofauna.

Exposure Routes

- Although inhalation and/or dermal adsorption represent potential exposure routes for upper trophic level receptors, they were not evaluated in the SERA because they were considered insignificant relative to ingestion exposures (see Section 7.3.1.3). While this is a reasonable assumption for the terrestrial birds and mammals selected as ecological receptors, the exclusion of inhalation and dermal adsorption represents a source of uncertainty that may have resulted in an underestimation of potential risks.

Dietary Exposure Modeling

- Chemical concentrations in avian food items (terrestrial plants and invertebrates, fish, and small mammal omnivores) and mammalian food items (plants) were modeled from measured media concentrations and were not directly measured. The use of generic, literature-derived up-take equations and BAFs introduces some uncertainty into the risk estimates and may have resulted in an overstatement or understatement of potential risks. The values selected and the methodologies employed were intended to provide a reasonable estimate of potential food web exposure concentrations.

- A second source of uncertainty related to the dietary exposure models is the use of default assumptions for exposure parameters such as BAFs. Although chemical-specific uptake equations and BAFs for many chemicals were readily available from the literature and were used in the ERA, the use of a default factor of 1.0 to estimate the concentration of some chemicals in receptor prey items is a source of uncertainty. The assumption that the chemical body burden in the prey item is at the same concentration as in soil is conservative for chemicals that are not known not to accumulate to any significant degree. However, if a chemical does accumulate in receptor prey items, the use of a default factor of 1.0 may have resulted in an underestimation of potential risks to the upper trophic level receptors evaluated by this ERA.

- A third source of uncertainty related to dietary exposure modeling applies to the assumed diet of the red-tailed hawk. In the SERA, it was assumed that the diet of the red-tailed hawk consisted solely of rodents (i.e., Norway rat). However, red-tailed hawks are opportunistic feeders and prey will vary with regional and seasonal availability. In Puerto Rico's El Yunque rainforest, the following food items were delivered to nestlings: rats (black rat and Norway rat), birds (such as the zenaida dove), lizards (*Anolis* spp.), snakes (such as the Puerto Rican racer [*Alsophis portoricensis*]), and coquis (*Eleutherodactylus* spp.) (Global Raptor Information Network, 2010). Santana and Temple (1988) reported the diet of red-tailed hawks in mountain rain and cloud forests of Puerto Rico consisted primarily of birds, reptiles, and amphibians captured from the tree canopy, while the diet of lowland hawks was comprised mostly of mammals. The diet of lowland hawks reported by Santana and Temple (1988) support the diet assumption used

in the SERA. However, if red-tailed hawks at NAPR consume a mixed diet of rats, birds, and reptiles, and bioaccumulation of chemicals in birds and reptiles differ from their bioaccumulation in rats, an assumed diet of 100 percent rats may have resulted in an overestimation or underestimation of potential risks.

- A fourth source of uncertainty related to the food web models is the use of unrealistically conservative exposure parameters. The use of maximum food ingestion rates, maximum water ingestion rates, and minimum body weights resulted in a conservative estimate of exposure. In addition, AUFs were assumed to equal one. This is a conservative assumption since a significant percentage of each upper trophic level receptor species' time could be spent foraging off-site in areas not impacted by site-related chemicals or areas where chemical concentrations are expected to be significantly lower. The uncertainty associated with the use of maximum food ingestion rates and minimum body weights in Step 2 of the SERA was reduced in Step 3a of the BERA by using values based on central tendency estimates (see Section 7.9).

- As discussed in Section 7.4.2, not all chemicals analyzed for in surface soil, subsurface soil, surface water, and sediment were evaluated for avian and mammalian dietary exposures. The organic chemicals evaluated for dietary exposures were limited to those listed in Table 7-3 with the potential to bioaccumulate to a significant extent. Bioaccumulative organic chemicals are defined as those with a maximum reported log K_{ow} greater than or equal to 3.0. Rational for using a log K_{ow} of 3.0 to define an organic chemical with the potential to bioaccumulate is included as Appendix F. The exclusion on non-bioaccumulative chemicals from dietary exposure modeling represents an uncertainty since ecological receptors may be exposed to non-bioaccumulative chemicals in soil and sediment through incidental ingestion.

  The diet of the upper trophic level receptor species selected for dietary exposure modeling to chemicals in drainage ditch sediment (i.e., green heron) does not include sediment (see Table 7-17). However, the diet of American robin and mourning dove includes soil. Eleven non-bioaccumulative VOCs (2-hexanone, acetone, acrylonitrile, benzene, bromomethane, carbon disulfide, chloromethane, methyl acrylonitrile, methylene chloride, methyl iodide, and propionitrile) and one non-bioaccumulative SVOC (2,4-dimethylphenol) were detected in surface and/or subsurface soil collected during the 2010 or 2012 CMS field investigations (see Tables 7-18 through 7-21 for the frequency and range of detected concentrations). Avian TRVs for the detected organics are not available from the literature or government compilations. As such, a comparison of dietary doses from incidental ingestion to avian TRVs could not be conducted. However, given their low magnitude and/or frequency of detection, it is unlikely that the non-bioaccumulative chemicals excluded from dietary exposure modeling based on Log K_{ow} values would impact avian receptor populations at SWMU 59.

<u>Chemical Mixtures</u>

- The cumulative impacts of ecological COPCs in a given medium cannot be directly addressed by a SERA, which is specifically designed to compare individual chemical concentrations to individual chemical threshold values established by regulatory agencies or the scientific literature. Approaches exist to conservatively sum Step 2 risk estimates (i.e., hazard index (HI) values); however, they can vastly overestimate the potential for risk and have been identified as "*a conservative estimator of risk that may have little ecological relevance*" (Dyer et al., 2000).

Although cumulative effects may be indirectly examined via detailed literature reviews and toxicity testing of site media, this level of investigation is reserved for a BERA (i.e., Steps 3b through 7 of the Navy ERA process; see Figure 7-1), which has a goal of collecting and interpreting site-specific information. It is important to note that Norwood et al. (2003) performed a review of the impacts of mixtures of inorganic constituents on aquatic biota and found that additive, synergistic, and antagonistic responses were found with equal frequency. This finding indicates that generalizations cannot be made in Step 2.

7.8 SERA Decision Point and Recommendations

The results of the SERA for SWMU 59 indicated that, based on a set of conservative exposure assumptions, there are one or more chemicals in surface soil (2010 and 2012 data set), subsurface soil (2010 and 2012 data sets), groundwater, surface water, and sediment that may present risks to one or more of the receptors species/receptor groups evaluated (see Section 7.6.2 and Tables 7-18 through 7-29). Under Navy policy, if the results of the Steps 1 and 2 (Tier 1 SERA) indicate that there are chemicals present in environmental media that may present risks to receptor species/receptor groups, the ERA process proceeds to the BERA (i.e., Step 3a).

7.9 Step 3a of the BERA

The results of the screening level risk calculation indicated that, based on a set of conservative assumptions, there are one or more chemicals in each medium evaluated that may present risks to ecological receptor groups and/or receptor species. As such, the ERA process at SWMU 59 proceeded to the BERA. According to Superfund guidance (USEPA, 1997), Step 3 initiates the problem formulation phase of the BERA. Under Navy guidance (CNO, 1999), the BERA is defined as Tier 2, and the first activity under Tier 2 is Step 3a (see Figure 7-1). In Step 3a, the conservative assumptions employed in the SERA (Tier 1) are refined and risk estimates are recalculated using the same conceptual model. Step 3a may also include consideration of background data and chemical bioavailability.

The specific assumptions, parameters, and methods that were modified for the recalculation of media-specific and dietary HQ values are identified below, along with justification for each modification. These refinements and methods were used in Step 3a of the BERA to weigh the evidence of potential risk for each ecological COPC identified for each medium and receptor to determine whether the ecological COPCs should be identified as ecological COCs.

- Chemicals that were not identified as ecological COPCs because maximum detected concentrations (or, in the case of non-detected chemicals, maximum RLs/LODs) are less then media-specific screening values were not evaluated in Step 3a of the BERA since a conclusion of no unacceptable risk can be made with high confidence. Detected and non-detected chemicals with maximum dietary intakes less than NOAEL-based TRVs also were excluded from further evaluation in Step 3a of the BERA.

- Non-detected chemicals lacking media-specific screening values (or, in the case of food web exposures, TRVs) were excluded from further evaluation in Step 3a of the BERA. It is not possible to quantitatively address the potential for risk from chemicals that are not detected and that do not have established screening values with which to compare them. Even considerations of the most conservative measurement (the maximum non-detected result) are not informative when no threshold value has been established. Because of these limitations, the approach follows that outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 Code of Federal Regulations [CFR]

300, Appendix A), which does not establish a release when the sample measurement is less than the contract required detection limit as determined by a USEPA certified laboratory. As all samples were analyzed by a certified laboratory, and were validated by an independent third party, the exclusion of non-detected chemicals lacking screening values/TRVs is considered reasonable and appropriate. Although eliminated from further evaluation, they remain ecological COPCs but are not considered ecological COCs. It is additionally noted that any site-specific studies, which may be conducted during a BERA (Steps 3a through 7 of the Navy ERA process; see Figure 7-1), would indirectly evaluate the impacts of non-detected chemicals.

- Risk estimates for ecological COPCs identified in the Step 2 screening level risk calculation were refined in Step 3a of the BERA using 95 percent UCL of the mean chemical concentrations rather than maximum concentrations (Parker et al., 2003). 95 percent UCL of the mean concentrations were calculated using USEPA ProUCL Version 4.1.01 software (available at http://www.epa.gov/osp/hstl/tsc/software). For individual upper trophic-level receptor species, 95 percent UCL of the mean concentrations provide a better estimate of the likely level of chemical exposure because each receptor would be expected to forage in several different areas of the site, and, in many cases, off-site. 95 percent UCL of the mean concentrations are also appropriate for evaluating impacts *to populations* of lower trophic level receptors (e.g., terrestrial and aquatic invertebrates). Because some of these receptors are relatively immobile, *individuals* are likely to be impacted by locations of maximum concentrations. However, an evaluation of exposure based on 95 percent UCL of the mean concentrations is more indicative of the level of impact that might be expected at the *population* level. The magnitude of detections above soil screening values was considered when evaluating refined risk estimates based on 95 percent UCL of the mean concentrations (Parker et al., 2003). This consideration ensures that potential effects of "hot spots" are not diluted by calculating 95 percent UCL of the mean concentrations.

  Refined risk estimates using 95 percent UCL of the mean concentrations were derived only for those ecological COPCs with data sets that have a minimum of eight detected concentrations and less than 70 percent non-detected results (USEPA, 2010a). The 95 percent UCL of the mean value is considered unreliable for data sets that do not meet both of these conditions. Based on the limited size of the surface water data set (n = 3; see Appendix D), Step 3a of the BERA did not include a refinement of risk estimates for this medium using 95 percent UCL of the mean concentrations. In the case of sediment, the use of 95 percent UCL of the mean concentrations in Step 3a of the BERA was restricted to three ecological COPCs (i.e., copper, lead, and zinc) since the sediment data set for all other COPCs does not meet the conditions identified above.

- Central tendency estimates (e.g., mean, median, midpoint) for body weights, food ingestion rates, and water ingestion rates (see Table 7-30) were used to develop exposure estimates for upper trophic level receptors rather than the minimum body weights and maximum food ingestion rates used in the SERA. The use of central tendency estimates is more relevant because they represent the characteristics of a greater proportion of the individuals in the population. For conservatism, the evaluation of food web exposures still assumed an AUF of 1.0.

- The diets of the American robin and Norway rat (food item for the red-tailed hawk) were adjusted to reflect their omnivorous feeding behavior. Wheelwright (1986), as cited in USEPA (1993b), reported seasonal dietary compositions for American robins in the western United States. Martin et al. (1951) also reported seasonal dietary compositions

for the American robin throughout North America. The highest percentage of invertebrates in the diet of the American robin was reported during the spring: 83.0 percent by Wheelwright (1986) and 78.9 percent by Martin et al. (1951). For conservatism, the contribution that earthworms have to the total diet of the American robin in the BERA was assumed to be 83.0 percent (highest seasonal contribution reported by Wheelwright (1986) and Martin et al. (1951). Using the relationship presented in Sample and Sutter II (1994), a diet of 83.0 percent earthworms extrapolates to a soil contribution of 8.7 percent to the total diet. The remainder of the diet was assumed to be plants (8.3 percent). The diet of the Norway rat was assumed to be 49.0 percent terrestrial invertebrates, 49.0 percent terrestrial plants, and 2.0 percent soil. In addition to the diet adjustments discussed above for the American robin and Norway rat, the diet of the green heron was modified to include aquatic invertebrates (29 percent aquatic invertebrates and 71 percent fish [Sample et al., 1997]). The specific diets used in Step 3a of the BERA for each ecological receptor are summarized in Table 7-31.

- The chemical-specific uptake equations used in the SERA to estimate tissue concentrations in terrestrial plants and invertebrates were also used in Step 3a of the BERA. However, soil concentrations used in the estimation were 95 percent UCL of mean values (in place of maximum concentrations) for those ecological COPCs with data sets that meet the criteria specified within the first bullet item above (i.e., a minimum of eight detected concentrations and less than 70 percent non-detected values). The uptake equations used for small mammals (general uptake equations for all small mammals developed by Sample et al. [1998b]) were replaced by uptake equations developed specifically for small mammal omnivores. Identical to uptake equations for terrestrial plants and invertebrates, 95 percent UCL of the mean concentrations were used to estimate small mammal tissue concentrations for those ecological COPCs with data sets having a minimum of eight detected concentrations and less than 70 percent non-detected values. When chemical-specific BAFs were used to estimate prey item tissue concentrations, BAFs based on central tendency estimates (e.g., mean, median, midpoint) were used in place of maximum or high-end (e.g., 90th percentile) values. The chemical-specific uptake equations and BAFs that were used in Step 3a for those chemicals identified as ecological COPCs for American robin and/or mourning dove dietary exposures are summarized in Tables 7-32 (plant and earthworm uptake equations/BAFs), while chemical-specific uptake equations and BAFs that were used in Step 3a for those chemicals identified as ecological COPCs for red-tailed hawk dietary exposures are summarized in Table 7-33 (small mammal omnivore uptake equations/BAFs).

  As discussed in the second bullet item above, the diet of the green heron was adjusted in Step 3a of the BERA to include aquatic invertebrates (29 percent invertebrates and 71 percent fish). Tissue concentrations in aquatic invertebrates were estimated by chemical-specific uptake equations (i.e. regressions developed from measured sediment and tissue data) or by multiplying ecological COPC concentrations in sediment by chemical-specific BAFs either obtained directly from the literature or derived from literature data sets (see Table 7-34). The BAFs listed in Table 7-34 are based on central tendency estimates (e.g., mean, median, midpoint) obtained directly from the literature or derived from literature-based data sets. BAFs based on depurated analyses (sediment was purged from the gut of the organism prior to analysis) were given preference over undepurated analyses since direct ingestion of sediment is accounted for separately within the food web model. The chemical-specific BAFs used in the estimation of aquatic invertebrate tissue concentrations are based on the ratio between dry-weight sediment and dry-weight tissue. Literature values based on the ratio between dry-weight sediment and wet-weight tissue were converted to a dry-weight basis by dividing the wet-weight BAF by the estimated

solids content for aquatic invertebrates (21 percent [0.21]; USEPA, 1993b). Chemical-specific regressions developed by Bechtel Jacobs (1998b) or USEPA (2007c) were given preference over literature-based BAF values if the regressions were significant ($p < 0.05$).

For those ecological COPCs lacking a chemical-specific uptake equation or a literature-based BAF value, BAFs were estimated from the median BSAF values listed in Table 7-35. Median BSAF values were converted to BAFs (dry weight basis) for use in the food web models using a lipid content of 3.44 percent (mean value for aquatic invertebrate percent lipid data listed in Table 7-36), a percent solids content of 21 percent for aquatic invertebrates (see above), and a sediment organic carbon content of 2.1 percent for drainage ditch sediment (minimum TOC measured in sediment samples collected from the drainage ditch during the 2010 CMS field investigation). In the case of fish, BAFs estimated using 90th percentile BSAF values were replaced by BAFs estimated using the median BSAF values listed in Table 7-14. BAFs based on central tendency estimates (e.g., mean, median, midpoint) were also used in place of maximum or high-end (95th percentile) values. With the exception of copper, lead, and zinc, maximum sediment concentrations were still used in the estimation of invertebrate and fish tissue concentrations. In the case of copper, lead, and zinc, 95 percent UCL of the mean sediment concentrations were used since the data set for each metals has at least eight detected concentrations and less than 70 percent non-detected values.

It is noted that a BAF of 1.0 was still used to estimate terrestrial and aquatic prey item tissue concentrations for those inorganic chemicals and bioaccumulative organic chemicals lacking BAF and BSAF values.

- For detected ecological COPCs in soil lacking screening values (e.g., 2-hexanone, acetone, bromomethane, carbon disulfide, chloromethane, methyl acrylonitrile, and methyl iodide in surface soil adjacent to paved surfaces), the USEPA (2012a and 2012b) Ecological Structure Activity Relationships (ECOSAR) Class Program (Version 1.11), available at http://www.epa.gov/opptintr/newchems/tools/21ecosar.htm), was used to estimate their toxicity to earthworms based on structural similarities to chemicals for which toxicity data are available (i.e., structure activity relationships [SARs]).

- For inorganic ecological COPCs (i.e., metals) in SWMU 59 surface soil, subsurface soil, and groundwater, consideration was given to available background data. This was accomplished by statistically comparing SWMU-specific media concentrations to background concentrations in accordance with Navy guidance (NFESC, 2002, 2003, and 2004). Statistical comparisons included descriptive summaries of each data set (e.g., maximum, arithmetic mean, and 95 percent UCL of the mean concentrations), statistical tests on the mean/median of the distributions (i.e., two sample t-test, Satterthwaite t-test, Wilcoxon rank sum test, Gehan test, or Satterthwaite t-test), and statistical tests on the right-tail of the distributions (i.e., quantile test and slippage test). The significance level (i.e., the probability criteria for rejecting the null hypothesis that the SWMU 59 and background data sets were sampled from the same population) was set at 0.05 for all statistical tests (NFESC, 2002, 2003, and 2004). The background surface soil, subsurface soil, and groundwater data sets used in Step 3a of the BERA were the basewide (non-airfield) background data sets presented within the Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds (Baker, 2010b). This document includes three unique data sets for subsurface soil (i.e., data sets for soil classified as (1) clay; (2) fine sand/silt; and (3) weathered bedrock). Based on soil characteristics at SWMU 59, the background subsurface soil data set used in the statistical comparison was the data set classified as "clay".

Analytical data for the inorganic chemicals identified as ecological COPCs for drainage ditch surface water and sediment were also statistically compared to background concentrations. The background surface water and sediment data sets used in Step 3a of the BERA are the non-airfield, freshwater drainage ditch background data sets presented within the Revised Addendum C and Addendum D to the Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds (Baker 2013). However, in the case of surface water, the statistical evaluations were limited to a descriptive comparison based on the small size of the SWMU and background data sets (n = 3 and n = 7, respectively). With the exception of copper, lead, and zinc, statistical evaluations performed on the SWMU and background sediment data sets were also limited to a descriptive comparison due to the small size of the SWMU data set (n = 3). In the case of copper, lead, and zinc, the SWMU 59 data set was sufficiently large enough to allow for statistical tests evaluating the mean/median and right-tail of the SWMU and background data set (n = 10 for lead and n = 12 for copper and zinc).

In addition to the statistical comparisons described above, graphical representations of the SWMU data sets (i.e., box plots and probability plots) were prepared for those chemicals in a given medium with a discernible distribution (normal or lognormal distribution for box plots; normal, lognormal, or gamma distribution for probability plots). Box plots and probability plots can be useful for identifying potential outliers. For example, in the case of probability plots, data points that are near a straight line and form a continuous distribution are likely to represent natural conditions, whereas data points that are not near the line or do not fit a continuous distribution (i.e., outliers) may represent contamination (NFESC, 2002, 2003, and 2004).

- As exposure does not necessarily equate to risk, consideration was given to site-specific factors that can affect the bioavailability of chemicals in surface water and sediment to aquatic receptor groups. Literature sources indicate that the filtered fraction of metals more closely approximates the bioavailable fraction in the water column (USEPA, 1999b, 2002a, and 2006). One reason is that a primary mechanism for water column toxicity is adsorption at the gill surface, which requires metals to be in the dissolved form. Therefore, a comparison of dissolved ecological COPC concentrations in SWMU 59 surface water to screening values expressed in terms of the dissolved metal in the water column is more appropriate.

  Copper was identified as an ecological COPC in Step 2 of the ERA for drainage ditch surface water because the maximum detected total recoverable concentration exceeds the surface water screening value expressed as a total recoverable concentration. Although not detected, cadmium, lead, and silver were also identified as ecological COPCs because maximum RLs exceed screening values expressed as total recoverable concentrations. As discussed in Section 7.4.1.3, PRWQS for Class SD surface waters were selected as the surface water screening values for these four metals. The PRWQSR (PREQB, 2010) has adopted USEPA total recoverable NAWQC as PRWQS for copper, cadmium, lead, and silver (the PRWQSR regression equations listed in Section 7.4.1.3 are identical to the regression equations listed in National Recommended Water Quality Criteria [USEPA, 2013b]). Therefore, copper, cadmium, lead, and silver NAWQC (i.e., CCC values or, in the case of silver, criteria maximum concentration [CMC]) expressed in terms of the dissolved metal in the water column were derived for use as a dissolved screening values in Step 3a of the BERA by multiplying the total recoverable screening value listed in Table 7-7 by the fresh water conversion factors listed below (USEPA, 2013b).

- Cadmium: 1.101672-[(*ln* hardness)(0.041838)]
- Copper: 0.960
- Lead: 1.46203-[(*In* hardness)(0.145712]
- Silver: 0.850

Two of the three sediment samples collected during the 2010 CMS field investigation (59SD02 and 59SD03) were analyzed for AVS and SEM. AVS is a reactive pool of solid-phase sulfide that represents an important partitioning phase controlling the bioavailability and toxicity of cadmium, copper, lead, nickel, silver, and zinc to sediment-associated biota (Ankley et al, 1996 and Berry et al., 1999). Cadmium, copper, lead, nickel, silver, and zinc, collectively termed SEM, represent those metals that form a more stable complex with sulfide than does iron. The model states that if the SEM concentration is less than the concentration of AVS, toxicity will not be observed. That is, if the SEM-to-AVS ratio is less than 1.0 or the SEM-to-AVS difference is less than zero (i.e., negative value), sufficient AVS is available to bind all the SEM and sediment-associated biota will not be exposed to toxic concentrations of these metals in the sediment pore water.

For organic chemicals, TOC represents the primary sediment characteristic affecting bioavailability (USEPA 1993a, Di Toro and McGrath, 2000, and Fuchsman, 2003). However, based on the low sample size of the drainage ditch sediment data set (n = 3), sediment screening values for ecological COPCs derived using USEPA (1993a and 1996) methodology or EqP-based toxicological thresholds developed by Di Toro and McGrath (2000) were not recalculated in Step 3a using 95 percent UCL of the mean f_{oc} values.

7.9.1 Refined Risk Evaluation for Surface Soil, Subsurface Soil, Groundwater, Surface Water, and Sediment: Lower Trophic Level Receptor Groups

Detected chemicals with maximum concentrations greater than screening values, as well as detected chemicals lacking screening values were identified as ecological COPCs in Step 2 of the ERA. Non-detected chemicals with maximum Method Reporting Limits (MRLs)/LODs greater than screening values, as well as non-detected chemicals lacking screening values were also identified as ecological COPCs in the Step 2 risk calculations. Only those detected and non-detected chemicals with maximum concentrations greater than screening values, and those detected chemicals lacking screening values are addressed in Step 3a of the BERA. Although non-detected chemicals lacking screening values were eliminated from further evaluation, they remain ecological COPCs, but are not considered ecological COCs.

7.9.1.1 Step 3a Risk Evaluation for Surface Soil

Refined risk evaluations for surface and subsurface collected during the 2010 and 2012 CMS field investigations are presented and discussed within Sections 7.9.1.1.1 and 7.9.1.1.2, respectively. As discussed in Section 7.2, all of the surface soil samples associated with the 2010 CMS field investigation were collected at locations adjacent to concrete pads and paved surfaces, while all surface soil samples associated with the 2012 CMS field investigation were collected at locations beneath concrete pads and paved surfaces.

7.9.1.1.1 Surface Soil: 2010 CMS Field Investigation

Section 7.6.2.1.1 presented the results of the Step 2 screening level risk calculation for surface soil collected during the 2010 CMS field investigation. Screening level risk estimates (i.e., HQ values) were also provided in Table 7-18. Cobalt, copper, lead, selenium, vanadium, zinc, and beta-BHC were identified as ecological COPCs because maximum detected concentrations exceed soil screening values. The spatial extent of detected ecological COPC concentrations greater than soil screening values is depicted on Figure 7-9. Eight detected VOCs, (2-hexanone,

acetone, bromomethane, carbon disulfide, chloromethane, methyl acrylonitrile, methyl iodide, and propionitrile) and one detected SVOC (dibenzofuran) were identified as ecological COPCs based on the lack of soil screening values. Six non-detected SVOCs (1,2,4,5-tetrachlorobenzene, 2,4-dimethylphenol, 2-methylphenol, 3-methylphenol, 4-methylphenol, and pronamide) and four non-detected pesticide (gamma-BHC, isodrin, kepone, and toxaphene) were also identified as ecological COPCs because maximum RLs exceed soil screening values. Finally, four VOCs (1,4-dioxane, acrolein, isobutyl alcohol, and methyl methacrylate) and one SVOC (1,4-phenylenediamine) were identified as ecological COCs based on the lack of any usable data (all surface soil data were rejected during data validation activities).

The refined risk calculation for surface soil collected during the 2010 CMS field investigation is presented in Table 7-37. As discussed in Section 7.9, risk estimates for surface soil were re-calculated using 95 percent UCL of the mean concentrations for those ecological COPCs having a minimum of eight detected values and less than 70 percent non-detected results (acetone, cobalt, copper, lead, selenium, vanadium, and zinc). Additional refinements that were applied in Step 3a of the BERA are presented and discussed within Section 7.9.

All surface soil analytical data for four VOCs (1,4-dioxane, acrolein, isobutyl alcohol, and methyl methacrylate) and one SVOC (1,4-phenylenediamine) were rejected during data validation activities. Based on the lack of any usable analytical data with which to evaluate potential risks, these five organic chemicals were identified as ecological COPCs in Step 2 of the ERA. Although there are no usable data for 1,4-dioxane, acrolein, isobutyl alcohol, methyl methacrylate, and 1,4-phenylenediamine, industrial uses for these five organics indicate that they are not likely to be site-related chemicals, nor are they likely to be present in abiotic media at SWMU 59:

- 1,4-Dioxane: This SVOC is used as a solvent for chemical processing (e.g., adhesives, cleaning and detergent preparations, cosmetics, deodorant fumigants, emulsions and polishing compositions, lacquers, pulping of wood, varnishes, and waxes) (Agency for Toxic Substances and Disease Registry [ATSDR, 2007a]. 1,4-Dioxane is also used as a laboratory reagent, chemical intermediate, polymerization catalyst, as well as an extraction medium for animal and vegetable oils (ATSDR, 2007a). Minor uses are in the manufacture of membrane filters, measurement of optical activity, and cryoscopic determination (ATSDR, 2007a).

- Acrolein: The largest industrial use for acrolein is as an intermediate in the manufacture of acrylic acid (ATSDR, 2007b). Acrolein is also used as a biocide in the control of algae and mollusks in recirculating process water systems, as a slimacide in the paper industry, in the cross-linking of protein collagen in leather tanning, as a tissue fixative in histological samples, in the manufacture of colloidal forms of metals, and in the production of perfumes (ATSDR, 2007b).

- Isobutyl Alcohol: Isobutyl alcohol is used as a solvent for surface coatings and adhesives and in the manufacture of pharmaceuticals and pesticides, as well as a co-solvent in tertiary oil recovery (Hazardous Substances Data Bank [HSDB, 2011]. Isobutyl alcohol is also used in the organic synthesis of isobutylacetate, zinc diisobutyldithiophosphate, isobutylamines, acrylate, and methacrylate and in the manufacture of perfume, fruit essences, amino acids, acetaldehyde, nitrocellulose, plasticizers, lacquers, paint removers, hydraulic fluids, and industrial cleaners (HSDB, 2011).

- Methyl Methacrylate: Methyl Methacrylate is primarily used in the production of resins and plastics. Most often it is polymerized to polymethyl methacrylate and used to make acrylic moldings, acrylic sheets, and extrusion powders (USEPA, 2010b). Other acrylates are also copolymerized with methyl methacrylate and used to make lacquers, surface coating resins, and emulsion polymers (USEPA, 2010b). Methyl methacrylate

also has uses in the dental and medical field to make ceramic filler or cement and prosthetic devices (USEPA, 2010b).

- 1,4-Phenylenediamine: 1,4-Phenylenediamine is primarily used as a dye intermediate and as a dye (e.g., hair dyes and dyes used for dyeing furs), as well as a photographic developing agent and a chemical intermediate in the manufacture of diisocyanates for polyurethane (USEPA, 2010b). 1,4-Phenylenediamine is also used as a vulcanization accelerator and as an antioxidant in rubber compounds (USEPA, 2010b).

The lack of detections in surface and subsurface soil collected during the 2004 Phase II ECP field investigation and, in the case of 1,4-dioxane, acrolein, methyl methacrylate, and 1,4-phenylenediamine, the 2012 CMS field investigation also show that these five organics are not likely to be site-related chemicals (see Appendix B). Based on their industrial uses, as well as the lack of any detections in surface and subsurface soil collected during the Phase II ECP field investigation and/or 2012 CMS field investigation, 1,4-dioxane, acrolein, isobutyl alcohol, methyl methacrylate, and 1,4-phenylenediamine are not identified as ecological COCs for surfaces soil collected during the 2010 CMS field investigation. Therefore, no additional evaluation of these five organics in surface soil adjacent to concrete pads and paved surfaces is recommended.
2-Hexanone, acetone, bromomethane, carbon disulfide, chloromethane, methyl acrylonitrile, methyl iodide, and propionitrile were detected and identified as ecological COPCs in Step 2 of the ERA based on the lack of soil screening values. Acetone was detected in thirteen of nineteen (13/19) surface soil samples at concentrations ranging from 24J µg/kg (59SB03-00) to 190 µg/kg (59SB21-00). A search of the literature did not identify any studies that investigated the effects of acetone in soil on terrestrial plants and invertebrates. However, Gorsuch et al. (1990), as cited in Organization for Economic Co-operation and Development (OECD, 1999), investigated the effect of acetone on emergence and growth of radish (*Raphanus sativus*), lettuce (*Lactuca sativa*), and rye grass (*Lolium perenne*) in solution. A 7-day NOEC of 100 mg/L was reported for each species. Although solution exposure studies cannot be used to predict effects from soil exposures, the results of the study conducted by Gorsuch et al. (1990) illustrate the low toxicity of acetone to terrestrial plants. The USEPA (2012a and 2012b) ECOSAR Class Program (Version 1.11) also indicates that acetone is relatively non-toxic to earthworms. As discussed in Section 7.9, ECOSAR is a program that is used to estimate the toxicity of chemicals lacking data based on their structural similarity to chemicals for which toxicity data are available (i.e., SARs). The SARs analysis predicts a 14-day earthworm LC_{50} of 172 mg/L. Again, although solution exposures cannot be used to predict effects from soil exposures, the LC_{50} value estimated using SARs analysis illustrates the low toxicity of acetone to earthworms. Based on the low toxicity in solution to terrestrial plants and low predicted toxicity in solution to earthworms, acetone is not identified as an ecological COC for SWMU 59 surface soil collected during the 2010 CMS field investigation. Therefore, no additional evaluation of this VOC in surface soil adjacent to concrete pads and paved surfaces is recommended.

2-Hexanone was detected in one of nineteen (1/19) surface soil samples at a concentration of 4.8J µg/kg (59SB12-00), bromomethane was detected in three of nineteen (3/19) surface soil samples at concentrations ranging from 2.4J µg/kg (59SB12-00) to 6.3 µg/kg (59SB11-00), carbon disulfide was detected in two of nineteen (2/19) surface soil samples at 0.52J µg/kg (59SB12-00) and 1J µg/kg (59SB17-00), methyl acrylonitrile was detected in one of nineteen (1/19) surface soil samples at a concentration of 3.3J µg/kg (59SB12-00), methyl iodide was detected in four of nineteen (4/19) surface soil samples at concentrations ranging from 0.97J µg/kg (59SB02-00) to 12 µg/kg (59SB11-00), while propionitrile was detected in one of one (1/1) surface soil samples at a concentration of 8.1J µg/kg (59SB08-00). With the exception of the maximum detected methyl iodide concentration (12 µg/kg), detected concentrations are less than the minimum soil screening value developed for other VOCs (11 µg/kg for vinyl chloride; Table 7-4]). Identical to acetone, the USEPA (2012a and 2012b) ECOSAR Class Program (Version 1.11) indicates that in

solution, 2-hexanone, bromomethane, carbon disulfide, chloromethane, methyl iodide, and propionitrile are relatively non-toxic to earthworms. Specifically, the SARs analysis predicts 14-day earthworm LC_{50} values of 209 mg/kg for 2-hexanone, 201 mg/L for bromomethane, 134 mg/kg for carbon disulfide, 109 mg/L for chloromethane, 272 mg/kg for methyl iodide, and 142 mg/kg for propionitrile. Predicted LC_{50} values were not available for methyl acrylonitrile. Based on the low magnitude and/or frequency of detection, comparison of maximum detected concentrations to the minimum soil screening value developed for other VOCs, and/or their predicted toxicity in solution to earthworms, 2-hexanone, bromomethane, carbon disulfide, chloromethane, methyl acrylonitrile, methyl iodide, and propionitrile are not identified as ecological COCs for SWMU 59 surface soil collected during the 2010 CMS field investigation. Therefore, no additional evaluation of these seven VOCs in surface soil adjacent to concrete pads and paved surfaces is recommended.

Dibenzofuran was detected and identified as an ecological COPC in Step 2 of the ERA based on the lack of a soil screening value. This SVOC was detected in a single surface soil sample (750 µg/kg in 59SB04-00). A search of the literature on the toxicological effects of dibenzofuran to soil flora and fauna identified several studies. Sverdrup et al. (2003) investigated the effect of dibenzofuran on the seed emergence and early life-stage growth (fresh weight and dry weight) of three terrestrial plants: red clover (*Trifolium pratense*), ryegrass, and mustard (*Sinapsis alba*). After 21-days of exposure, dibenzofuran concentrations causing a 20 percent reduction in seedling wet weight ranged from 43 mg/kg (red clover) to 82 mg/kg (mustard), while concentrations causing a 20 percent reduction in seedling dry weight ranged from 45 mg/kg (red clover) to 78 mg/kg (ryegrass). 21-Day seed emergence LC_{50} values ranged from 510 mg/kg (red clover) to 1,000 mg/kg (mustard).

Sverdrup et al. (2002a) investigated the effect of dibenzofuran on the survival and reproduction of the enchytraeid worm *Enchytraeus crypticus*. A 21-day LC_{50} value of 400 mg/kg and a 21-day NOEC value of 130 mg/kg were reported by the authors. Invertebrate toxicity data were also identified from the literature for an earthworm and springtail species. Sverdrup et al. (2002b) investigated the acute and chronic toxicity of dibenzofuran to the earthworm *Eisenia veneta*. The 28-day LC_{50} value based on earthworm survival was 78 mg/kg, while the 28-day NOEC value based on *earthworm* growth was 36 mg/kg. Sverdrup et al. (2001) investigated the effect of dibenzofuran on the survival and reproduction of the springtail *Folsomia fimetaria* (Order Collembola). A 21-day LC_{50} of 50 mg/kg based on springtail survival and a 21-day NOEC of 14 mg/kg based on springtail reproduction was reported by the authors. The last study identified from the literature (Sverdrup et al., 2002c) investigated the toxic effect of dibenzofuran on soil microorganisms and heterotrophic processes (i.e., total number of protozoa [total population and subpopulation of heterotrophic flagellates] and soil nitrification). The 28-day NOEC value for effects on soil nitrification was 75 mg/kg. The 28-day EC_5 value for protozoan abundance and heterotrophic flagellate abundance was 1,300 mg/kg and 600 mg/kg, respectively. To summarize, literature-based dibenzofuran toxicity data were available for terrestrial plants, invertebrates, and microorganisms. Given that the maximum detected concentration of dibenzofuran (750 µg/kg) is approximately two orders of magnitude lower than the minimum chronic effect concentration reported from the literature (21-day NOEC of 14 mg/kg for springtail reproduction), it is unlikely that this SVOC is impacting terrestrial plant, invertebrate and microorganism populations at SWMU 59. As such, dibenzofuran is not identified as an ecological COC for surface soil collected during the 2010 CMS field investigation. Therefore, no additional evaluation of this SVOC in surface soil adjacent to concrete pads and paved surfaces is recommended.

Six non-detected SVOCs (1,2,4,5-tetrachlorobenzene, 2,4-dimethylphenol, 2-methylphenol, 3-methylphenol, 4-methylphenol, and pronamide) were identified as ecological COPCs in Step 2 of the ERA because maximum RLs exceed soil screening values. The soil screening values used for

1,2,4,5-tetrachlorobenzene, 2-methylphenol, 3-methylphenol, and 4-methylphenol in Step 2 of the ERA are background-based concentrations or detection limits (CCME, 2001 and 2007). Because the screening values for these chemicals are not based on toxicological data (background concentrations and detection limits do not represent threshold effect concentrations), there is uncertainty in their identification as ecological COPCs. A search of the literature did not identify any studies that investigated the effects of 1,2,4,5-tetrachlorobenzene, 2-methylphenol, 3-methylphenol, and 4-methylphenol in soil on terrestrial plants and invertebrates. However, the USEPA (2003b) has developed soil ESLs based on exposures to the masked shrew:

- 1,2,4,5-tetrachlorobenzene: 2,020 µg/kg
- 2-methylphenol: 40,400 µg/kg
- 3-methylphenol: 3,490 µg/kg
- 4-methylphenol: 163,000 µg/kg

Although maximum non-detected results for 1,2,4,5-tetrachlorobenzene (240 µg/kg), 2-methylphenol (460 µg/kg), 3-methylphenol (350 µg/kg), and 4-methylphenol (350 µg/kg) are less than the ESLs listed above, the applicability of the ESLs to terrestrial plants and invertebrates is uncertain. The USEPA (2012a and 2012b) ECOSAR Class Program (Version 1.00a) indicates that in solution, these four SVOCs are relatively non-toxic to earthworms. ECOSAR estimates the toxicity of chemicals lacking data based on their structural similarity to chemicals for which toxicity data are available (i.e., SARs). The SARs analysis predicts 14-day earthworm LC_{50} values of 203 mg/L for 1,2,4,5-tetrachlorobenzene and 94.9 mg/L for 2-methylphenol, 3-methylphenol, and 4-methylphenol. Although solution exposures cannot be used to predict effects from soil exposures, LC_{50} values estimated using SARs analysis illustrate the low toxicity of 1,2,4,5-tetrachlorobenzene, 2-methylphenol, 3-methylphenol, and 4-methylphenol to earthworms. In addition, the lack of detections in abiotic media collected at SWMU 59 during the 2010 and 2012 CMS field investigations, as well as the 2004 Phase II ECP field investigation (Appendix B) indicates that these four SVOCs are not likely to be site-related chemicals. Based on their low predicted toxicity in solution to earthworms and the lack of detections in abiotic media collected at SWMU 59, 1,2,4,5-tetrachlorobenzene, 2-methylphenol, 3-methylphenol, and 4-methylphenol are not identified as ecological COCs for SWMU 59 surface soil collected during the 2010 CMS field investigation. Therefore, no additional evaluation of these four SVOCs in surface soil adjacent to concrete pads and paved surfaces is recommended.

The soil screening values used in the screening level risk calculation for 2,4-dimethylphenol and pronamide are based on toxicological data (i.e., plant-based ESLs [USEPA, 2003b]). Pronamide was not detected in abiotic media collected at SWMU 59 during the 2010 and 2012 CMS field investigations or the 2004 Phase II ECP field investigation, while 2,4-dimethylphenol was detected in a single subsurface soil sample collected during the 2012 CMS field investigation at a low, estimated concentration (17J µg/kg in 59SB25-01) (see Appendices B). These data indicate that these two SVOCs are not likely to be site-related chemicals. Industrial uses for pronamide (systemic herbicide used for the selective control of annual and perennial grasses and broad-leaved weeds in food and feed crops [HSDB, 2011]) and 2,4-dimethylphenol (manufacture of pharmaceuticals, plastics, insecticides, fungicides, and dyestuffs [HSDB, 2011]) also indicate that these two SVOCs are not likely to be associated with historical activities at the SWMU. Based on these considerations, pronamide and 2,4-dimethylphenol are not identified as ecological COPCs for surface soil collected during the 2010 CMS field investigation. Therefore, no additional evaluation of these two SVOCs in surface soil adjacent to concrete pads and paved surface sis recommended.

Identical to the SVOCs discussed within the preceding paragraphs, gamma-BHC, isodrin, kepone, and toxaphene were identified as ecological COPCs in Step 2 of the ERA because maximum RLs

exceed soil screening values. As evidenced by Table 7-4, the soil screening values used for kepone and toxaphene in the Step 2 screening level risk calculation are background-based concentrations or detection limits (Friday 1998). A search of the literature did not identify any studies that investigated the effects of kepone and toxaphene in soil on terrestrial plants and invertebrates. The USEPA (2012a and 2012b) ECOSAR Class Program (Version 1.11) indicates that kepone and toxaphene in solution are relatively non-toxic to earthworms. Specifically, the SARs analysis predicts a 14-day earthworm LC_{50} of 426 mg/L for kepone and 229 mg/L for toxaphene. Again, although solution exposures cannot be used to predict effects from soil exposures, the LC_{50} value estimated using SARs analysis illustrates the low toxicity of these two pesticides to earthworms. Based on their low predicted toxicity in solution to earthworms, kepone and toxaphene are not identified as ecological COCs for surface soil collected during the 2010 CMS field investigation. Therefore, no additional evaluation of these two organochlorine pesticides in surface soil adjacent to concrete pads and paved surfaces is recommended.

The soil screening values used for isodrin and gamma-BHC in Step 2 of the ERA are plant-based ESLs (USEPA, 2003b). These two organochlorine pesticides were not detected in abiotic media collected at SWMU 59 during the 2010 and 2012 CMS field investigations, nor where they detected in abiotic media collected during the 2004 Phase II ECP field investigation (see Appendices B). These data indicate that isodrin and gamma-BHC are not likely to be site-related chemicals, nor are they likely to be present in abiotic media at the SWMU. Based on the lack of detections in abiotic media at the SWMU 59, isodrin and gamma-BHC are not identified as ecological COCs for surface soil collected during the 2010 CMS field investigation.

The organochlorine pesticide beta-BHC was identified as an ecological COPC in Step 2 of the ERA because the maximum detected concentration exceeds the soil screening value. This organochlorine pesticides was detected in five of eighteen (5/18) surface soil samples at concentrations ranging from 0.47J µg/kg in 59SB03-00 to 9.2NJ µg/kg in 59SB17-00. In addition to the maximum detected concentration, the detected concentration in 59SB15-00 (8.6NJ µg/kg) also exceeds the soil screening value of 3.98 µg/kg (USEPA, 2003b). Both detections greater than the soil screening value were qualified as "NJ". This qualifier is defined in Guidance on Environmental Data Verification and Data Validation (USEPA, 2002b) as: "*The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration"*. As such, the presence or identity of beta-BHC in 59SB15-00 and 59SB17-00 is in doubt and the reported concentrations are estimated (the estimation is both qualitative and quantitative in nature). Based on the uncertainty associated with detected concentrations greater than the soil screening value, beta-BHC is not identified as an ecological COC for surface soil collected during the 2010 CMS field investigation. Therefore, no additional evaluation of this organochlorine pesticide in surface soil adjacent to concrete pads and paved surfaces is recommended. It is noted that two detected concentrations were reported between the MDL and RL without the N qualifier (0.47J µg/kg in 59SB03-00 and 0.57J µg/kg in 59SB07-00). Both of these detections are approximately one order of magnitude less than the soil screening value.

Cobalt, copper, lead, selenium, vanadium, and zinc were identified as ecological COPCs in the Step 2 screening level risk calculation because maximum detected concentrations exceed soil screening values (see Table 7-18). To further evaluate the significance of potential risks presented by these six metals, risk estimates were re-calculated using 95 percent UCL of the mean concentrations (see Table 7-37). It is acknowledged that terrestrial plants are immobile and many terrestrial invertebrates are relatively immobile; therefore, individuals are likely to be impacted by locations of maximum concentrations. However, as discussed in Section 7.9, evaluation of the 95 percent UCL of the mean exposure case is more indicative of the level of impact that might be expected at the population level. In addition to the re-calculation of risk estimates using 95% UCL of the mean concentrations, the surface soil data were statistically

compared to the NAPR basewide background surface soil data set contained within the Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds (Baker, 2010b) in accordance with Navy guidance (NFESC, 2002). Supporting statistics for the SWMU and background surface soil data sets, including 95 percent UCL of mean calculations, are provided in Appendix H. Finally, the refined risk evaluation also took into consideration the magnitude and spatial distribution of detected concentrations above soil screening values and/or background concentrations. The refined risk evaluation for cobalt, copper, lead, selenium, vanadium, and zinc is presented below.

Cobalt

Cobalt was detected in nineteen of nineteen (19/19) surface soil samples at concentrations ranging from 10.4J mg/kg (59SB01-00) to 45.2 mg/kg (59SB14-00). Eighteen of the detected concentrations exceed the soil screening value of 13 mg/kg (USEPA 2005d; see Figure 7-9). The Step 2 screening level risk estimate (HQ = 3.48; see Table 7-18), derived using the maximum detected concentration, indicates that cobalt may be presenting unacceptable risk to terrestrial plants and invertebrates. The refined risk estimate (HQ = 1.99; see Table 7-37), derived using the 95 percent UCL of the mean concentration (25.8 mg/kg), also indicates that this metal may be presenting unacceptable risk to terrestrial plant and invertebrate populations.

The descriptive statistics presented in Table 7-38 for the SWMU 59 and background surface soil data sets show that cobalt concentrations in SWMU 59 surface soil collected during the 2010 CMS field investigation are not elevated relative to background concentrations. Maximum, arithmetic mean, and 95 percent UCL of the mean cobalt concentrations for the SWMU 59 data set (45.2 mg/kg, 22.8 mg/kg, and 25.8 mg/kg, respectively) are less than or equal to maximum, arithmetic mean, and 95 percent UCL of the mean background concentrations (50.2J mg/kg, 22.8 mg/kg, and 28.0 mg/kg, respectively). The statistical tests that were used to evaluate the median and right-tail of the SWMU and background data set distributions (i.e., Wilcoxon rank sum test, quantile test, and slippage test) also concluded that cobalt concentrations in SWMU 59 surface soil are not elevated relative to background concentrations.

Distribution tests indicate that the SWMU 59 data set follows both a normal and lognormal distribution. The normal and lognormal probability plots included within Appendix H show that the data set best fits a lognormal distribution. A box plot of log-transformed cobalt concentrations in SWMU 59 surface soil (see Appendix H) supports the descriptive and distributional statistics. As evidenced by the box plot, there are no potential outliers within the SWMU data set at the upper end of the range.

In summary, based on the descriptive and distributional statistics presented in Table 7-38, as well as the box plot depicting log-transformed concentrations, which indicates that there are no potential outliers within the SWMU data set at the upper end of the range, cobalt is not identified as an ecological COC for surface soil collected during the 2010 CMS field investigation. Therefore, no additional evaluation of this metal in surface soil adjacent to concrete pads and paved surfaces is recommended.

Copper

Copper was detected in nineteen of nineteen (19/19) surface soil samples at concentrations ranging from 24.8J mg/kg (59SB04-00) to 291 mg/kg (59SB14-00). Sixteen of the detected concentrations exceed the soil screening value of 70 mg/kg (USEPA, 2007e; see Figure 7-9). The Step 2 screening level risk estimate (HQ = 4.16; see Table 7-18), derived using the maximum detected concentration, indicates that copper may be presenting unacceptable risk to terrestrial

plants and invertebrates. The refined risk estimate (HQ = 1.94; see Table 7-37), derived using the 95 percent UCL of the mean concentration (136 mg/kg), also indicates that this metal may be presenting unacceptable risk to terrestrial plant and invertebrate populations.

The descriptive statistics presented in Table 7-38 for the SWMU 59 and background surface soil data sets show that copper concentrations in SWMU 59 surface soil adjacent to paved surfaces are elevated relative to background concentrations. Maximum, arithmetic mean, and 95 percent UCL of the mean copper concentrations for the SWMU 59 data set (291 mg/kg, 105 mg/kg, and 136 mg/kg, respectively) exceed maximum, arithmetic mean, and 95 percent UCL of the mean background concentrations (180 mg/kg, 77.1 mg/kg, and 96.3 mg/kg, respectively). The statistical tests that were used to evaluate the median and right-tail of the SWMU and background data set distributions (Wilcoxon rank sum test, quantile test, and slippage test) were contradictory. The statistical tests evaluating the right tail of the distributions (i.e., quantile test and slippage test) concluded that copper concentrations in SWMU 59 surface soil are not elevated relative to background concentrations, while the statistic test evaluating the median of the distributions (i.e., Wilcoxon rank sum test) concluded that copper concentrations in SWMU 59 surface soil are elevated relative to background concentrations.

Distribution tests indicate that the SWMU 59 data set follows a lognormal distribution. Box and probability plots depicting log-transformed copper concentrations in SWMU 59 surface soil (see Appendix H) support the descriptive statistics, as well as the conclusion of the Wilcoxon rank sum test. As evidenced by the box plot, two detections at the upper end of the range (237J mg/kg in 59SB09-00 and 291 mg/kg in 59SB14-00) are elevated relative to other concentrations at the SWMU and may represent potential outliers. The lognormal probability plot also shows that these two detections do not fit a continuous distribution, further supporting their identification as potential outliers.

In summary, based on the 95 percent UCL of the mean HQ value (1.94), which indicates unacceptable risk to terrestrial plants and invertebrate populations, the descriptive and distributional statistics presented in Table 7-38, as well as the box and probability plots depicting log-transformed data, which indicate that detected concentrations at soil boring locations 59SB09 and 59SB14 are elevated relative to other detected concentrations at the SWMU, copper is identified as an ecological COC for SWMU 59 surface soil collected during the 2010 CMS field investigation. Therefore, additional evaluation in the form of corrective measures is recommended for this metal in surface soil adjacent to concrete pads and paved surfaces. It is noted that that an elevated copper concentration (relative to the soil screening value and maximum background concentration) was detected in a surface soil collected during the 2004 Phase II ECP field investigation (250N mg/kg in 5E-03; see Appendix B), further supporting the identification of copper as an ecological COC for SWMU 59 surface soil collected during the 2010 CMS field investigation.

<u>Lead</u>

Lead was detected in nineteen of nineteen (19/19) surface soil samples at concentrations ranging from 2.6J mg/kg (59SB08-00) to 654J mg/kg (59SB09-00). Two of the detected concentrations (638 mg/kg in 59SB15-00 and 654J mg/kg in 59SB09-00) exceed the soil screening value of 120 mg/kg (USEPA, 2005e; see Figure 7-9). The Step 2 screening level risk estimate (HQ = 5.45; see Table 7-18), derived using the maximum detected concentration, indicates that lead may be presenting unacceptable risk to terrestrial plants and invertebrates. The refined risk estimate (HQ = 4.48; see Table 7-37), derived using the 95 percent UCL of the mean concentration (537 mg/kg), also indicates that this metal may be presenting unacceptable risk to terrestrial plant and invertebrate populations.

The descriptive statistics presented in Table 7-38 for the SWMU 59 and background surface soil data sets show that lead concentrations in SWMU 59 surface soil collected during the 2010 CMS field investigation are elevated relative to background concentrations. Maximum, arithmetic mean, and 95 percent UCL of the mean lead concentrations for the SWMU 59 data (654J mg/kg, 83.0 mg/kg, and 537 mg/kg, respectively) exceed maximum, arithmetic mean, and 95 percent UCL of the mean background concentrations (21J mg/kg, 8.68 mg/kg, and 12.4 mg/kg, respectively). The statistical tests that were used to evaluate the median and right-tail of the SWMU and background data set distributions (i.e., Wilcoxon rank sum test, quantile test, and slippage test) also concluded that lead concentrations in SWMU 59 surface soil are elevated relative to background concentrations.

Distribution tests indicate that the SWMU 59 data set does not follow a discernible distribution. However, the normal, lognormal, and gamma probability plots included within Appendix H show that the data set best fits a lognormal distribution. A box plot of log-transformed lead concentrations in SWMU 59 surface soil (see Appendix H) shows that two detections at the upper end of the range (638 mg/kg in 59SB15-00 and 654J mg/kg in 59SB09-00) are elevated relative to other concentrations at the SWMU and may represent potential outliers. The lognormal probability plot also shows that these two detections do not fit a continuous distribution, further supporting their identification as potential outliers.

In summary, based on the 95 percent UCL of the mean HQ value (4.48), which indicates unacceptable risk to terrestrial plant and invertebrate populations, the descriptive and distributional statistics presented in Table 7-38, as well as the box and probability plots depicting log-transformed data, which indicate that detected concentrations at soil boring locations 59SB09 and 59SB15 are elevated relative to other detected concentrations at the SWMU, lead is identified as an ecological COC for surface soil collected during the 2010 CMS field investigation. Therefore, additional evaluation in the form of corrective measures is recommended for this metal in surface soil adjacent to concrete pads and paved surfaces. It is noted that that elevated lead concentrations (relative to the soil screening value and maximum background concentration) were detected in a surface soil collected during the 2004 Phase II ECP field investigation (280 mg/kg in 5E-03 and 1,100 mg/kg in 5E-06; see Appendix B), supporting the identification of lead as an ecological COC for surface soil collected during the 2010 CMS field investigation.

<u>Selenium</u>

Selenium was detected in fifteen of nineteen (15/19) surface soil samples at concentrations ranging from 0.21J mg/kg (59SB03-00) to 2.4J mg/kg (59SB20-00). Six of these detections exceed the soil screening value of 0.52 mg/kg (USEPA, 2007f; see Figure 7-9). The Step 2 screening level risk estimate (HQ = 4.62; see Table 7-18), derived using the maximum concentration, indicates that selenium may be presenting unacceptable risk to terrestrial plants and invertebrates. The refined risk estimate (HQ = 1.81; see Table 7-37), derived using the 95 percent UCL of the mean concentration (0.94 mg/kg), also indicates that this metal may be presenting unacceptable risk to terrestrial plant and invertebrate populations.

The descriptive statistics presented in Table 7-38 for the SWMU 59 and background surface soil data sets show that selenium concentrations in SWMU 59 surface soil collected during the 2010 CMS field investigation are slightly elevated relative to background concentrations. Maximum and arithmetic mean concentrations in SWMU 59 surface soil (2.4J mg/kg and 3.52 mg/kg, respectively) exceed maximum and arithmetic mean background concentrations (1.2J mg/kg and 0.84 mg/kg, respectively).

A statistical evaluation of the mean/median and right tail of the SWMU and background data set distributions could not be performed due to the low frequency of detection within the background data set (25 percent). Although, the refined risk estimate (HQ = 1.81) indicates that selenium is presenting unacceptable risk to terrestrial plant and invertebrate populations, the magnitude of the HQ value above one is low. The magnitude of the maximum selenium concentration in SWMU 59 surface soil (2.4J mg/kg) above the maximum background concentration (1.2J mg/kg) is also low. Furthermore, of the six detected concentrations that exceed the soil screening value, only the maximum detection also exceeds the maximum background concentration. The single detected concentration greater than the maximum background concentration is not considered to be indicative of a release of hazardous wastes or hazardous constituents. Rather, this detection is likely representative of naturally occurring concentrations that are not reflected by the background surface soil data set due to its small size.

For the reasons discussed within the preceding paragraph, selenium is not identified as an ecological COC for surface soil collected during the 2010 CMS field investigation. Therefore, no additional evaluation of this metal in surface soil adjacent to concrete pads and paved surfaces is recommended. This recommendation is supported by the Phase II ECP analytical data included within Appendix B. As evidenced by these data, selenium was not detected in surface soil collected during the 2004 Phase II ECP field investigation. It is further noted that selenium was not detected in surface soil collected during the 2012 CMS field investigation at a concentration greater than the maximum detected background concentration (see Table 7-38).

Vanadium

Vanadium was detected in nineteen of nineteen (19/19) surface soil samples at concentrations ranging from 72.8J mg/kg (59SB08-00) to 260J mg/kg (59SB01-00). Each of the detected concentrations exceeds the soil screening value of 20 mg/kg (USEPA, 2005b; see Figure 7-9). The Step 2 screening level risk estimate (HQ = 13.00; see Table 7-18), derived using the maximum detected concentration, indicates that vanadium may be presenting unacceptable risk to terrestrial plants and invertebrates. The refined risk estimate (HQ = 8.35; see Table 7-37), derived using the 95 percent UCL of the mean concentration (167 mg/kg), also indicates that this metal may be presenting unacceptable risk to terrestrial plant and invertebrate populations.

The descriptive statistics presented in Table 7-38 for the SWMU 59 and background surface soil data sets show that vanadium concentrations in SWMU 59 surface soil collected during the 2010 CMS field investigation are not elevated relative to background concentrations. Maximum, arithmetic mean, and 95 percent UCL of the mean vanadium concentrations in SMWU 59 surface soil (260J mg/kg, 143 mg/kg, and 167 mg/kg, respectively) are comparable to maximum, arithmetic mean, and 95 percent UCL of the mean background concentrations (230 mg/kg, 142 mg/kg, and 166 mg/kg, respectively). The statistical tests that were used to evaluate the median and right-tail of the SWMU and background data set distributions (Wilcoxon rank sum test, quantile test, and slippage test) also concluded that vanadium concentrations in SWMU 59 surface soil are not elevated relative to background concentrations (see Table 7-38).

Distribution tests indicate that the SWMU 59 data set follows both a lognormal and gamma distribution. The lognormal and gamma probability plots included within Appendix H show that the data set best fits a lognormal distribution. A box plot of log-transformed cobalt concentrations in SWMU 59 surface soil (see Appendix H) supports the descriptive and distributional statistics. As evidenced by the box plot, there are no potential outliers within the SWMU data set at the upper end of the range. The probability plot depicting lognormal concentrations also shows that individual data points within the SWMU data set, including data points at the upper end of the range, fall along or near a straight line and form a continuous

distribution. Data points that exhibit these characteristics are likely to represent natural conditions (NFESC, 2002, 2003, and 2004).

In summary, based on the descriptive and distributional statistics presented in Table 7-38, as well as the box and probability plots depicting log-transformed data, which indicate that there are no potential outliers within the SWMU data set at the upper end of the range, vanadium is not identified as an ecological COC for SWMU 59 surface soil collected during the 2010 CMS field investigation. Therefore, no additional evaluation of this metal in surface soil adjacent to paved surfaces is recommended.

Zinc

Zinc was detected in nineteen of nineteen (19/19) surface soil samples at concentrations ranging from 34.1J mg/kg (59SB01-00) to 747 mg/kg (59SB15-00). Five of the detected concentrations exceed the soil screening value of 120 mg/kg (USEPA, 2007g; see Figure 7-9). The Step 2 screening level risk estimate (HQ = 6.23; see Table 7-18), derived using the maximum detected concentration, indicates that zinc may be presenting unacceptable risk to terrestrial plants and invertebrates. The refined risk estimate (HQ = 2.64; see Table 7-37, derived using the 95 percent UCL of the mean concentration (317 mg/kg), also indicates that this metal may be presenting unacceptable risk to terrestrial plant and invertebrate populations.

The descriptive statistics presented in Table 7-38 show that zinc concentrations in SWMU 59 surface soil collected during the 2010 CMS field investigation are elevated relative to background concentrations. Maximum, arithmetic mean, and 95 percent UCL of the mean zinc concentrations in SWMU 59 surface soil (747 mg/kg, 141 mg/kg, and 317 mg/kg, respectively) exceed maximum, arithmetic mean, and 95 percent UCL of mean background concentrations (120E mg/kg, 52.5 mg/kg,, and 65.7 mg/kg, respectively). The statistical tests that were used to evaluate the median and right-tail of the SWMU and background data set distributions (i.e., Wilcoxon rank sum test, quantile test, and slippage test) also concluded that zinc concentrations in SWMU 59 surface soil are elevated relative to background concentrations.

Distribution tests indicate that the SWMU data set does not follow a discernible distribution. However, based on the normal, lognormal, and gamma probability plots included within Appendix H, the SWMU 59 data set best follows a lognormal distribution. A box plot of log-transformed zinc concentrations in SWMU 59 surface soil (see Appendix H) shows that two detections at the upper end of the range (468J mg/kg in 59SB09-00 and 747 mg/kg in 59SB15) are elevated relative to other concentrations at the SWMU and may represent potential outliers. The lognormal probability plot also shows that these two detections do not fit a continuous distribution, further supporting their identification as potential outliers.

Based on the 95 percent UCL of the mean HQ value (2.64), which indicates unacceptable risk to terrestrial plant and invertebrate populations, the descriptive and distributional statistics presented in Table 7-38, as well as the box and probability plots depicting log-transformed data, which indicate that detected concentrations at soil boring locations 59SB09 and 59SB15 are elevated relative to other detected concentrations at the SWMU, zinc is identified as an ecological COC for SWMU 59 surface soil collected during the 2010 CMS field investigation. Therefore, additional evaluation in the form of corrective measures is recommended for surface soil adjacent to concrete pads and paved surfaces. It is noted that elevated zinc concentrations (relative to the soil screening value and maximum background concentration) were detected in four surface soil collected during the 2004 Phase II ECP Phase field investigation (160 mg/kg in 5E-06, 210 mg/kg in 5E-02, 290 mg/kg in 5E-04, and 930 mg/kg in 5E-03). These data support the identification of zinc as an ecological COC for surface soil collected during the 2010 CMS field investigation.

In summary copper, lead, and zinc were detected and identified as ecological COCs for SWMU 59 surface soil collected during the 2010 CMS field investigation. Although 2-hexanone, acetone, bromomethane, carbon disulfide, chloromethane, methyl acrylonitrile, methyl iodide, propionitrile, beta-BHC, dibenzofuran, cobalt, selenium, and vanadium, were detected in SWMU 59 surface soil and identified as ecological COPCs in Step 2 of the ERA, they are not identified as ecological COCs based on the discussion presented within the preceding paragraphs, and no additional evaluation is recommended. No additional evaluation is also recommended for the non-detected SVOCs and organochlorine pesticides identified as ecological COPCs in Step 2 of the ERA because maximum RLs exceed soil screening values.

7.9.1.1.2 Surface Soil: 2012 CMS field investigation

Section 7.6.2.1.2 presented the results of the Step 2 screening level risk calculation for surface soil collected during the 2012 CMS field investigation. Screening level risk estimates (i.e., HQ values) were also provided in Table 7-19. Chromium, cobalt, copper, nickel, selenium, and vanadium were detected and identified as ecological COPCs because maximum detected concentrations exceed soil screening values. The spatial extent of detected ecological COPC concentrations greater than soil screening values is depicted on Figure 7-11. Acetone was detected and identified as an ecological COPC based on the lack of a soil screening value. Two non-detected SVOCs (2,4-dimethylphenol and pronamide) were identified as ecological COPCs because maximum LODs exceed soil screening values. Finally, isobutanol and lead were identified as ecological COPCs based on the lack of any usable data with which to evaluate potential risks (all surface soil analytical data for isobutanol and lead were rejected during data validation activities).

The refined risk calculation for surface soil collected during the 2012 CMS field investigation is presented in Table 7-39. As discussed in Section 7.9, risk estimates for surface soil were re-calculated using 95 percent UCL of the mean concentrations for those ecological COPCs having a minimum of eight detected values and less than 70 percent non-detected results (chromium, cobalt, copper, nickel, and vanadium). Additional refinements that were applied in Step 3a of the BERA are presented and discussed within Section 7.9.

All surface soil analytical data for isobutyl alcohol and lead were rejected during data validation activities. As such, these two chemicals were identified as ecological COPCs in Step 2 of the ERA based on the lack of any usable analytical data with which to evaluate potential risks. Given the industrial uses for isobutyl alcohol (see Section 7.9.1.1.1), this VOC is not likely to represent a site-related chemical and, therefore not likely to be present in abiotic media at the SWMU. In the case of lead, all surface soil analytical results were rejected because the MS/MSD pair exhibited percent recoveries that exceeded 200 percent. The high percent recoveries indicate that the matrix may be providing an additive effect and the reported values could be higher than what is actually present in the samples (Type I Error). Given that samples results were rejected due to unacceptable high bias and all rejected data are less than the soil screening value, it is unlikely that lead is present at concentrations that would impact terrestrial plant and invertebrate populations. Based on the discussion presented above, isobutyl alcohol and lead are not identified as ecological COCs for surface soil collected during the 2012 CMS field investigation.

Two non-detected SVOCs (2,4-dimethylphenol and pronamide) were identified as ecological COPCs in Step 2 of the ERA because maximum RLs exceed soil screening values (USEPA Region 5 plant-based ESLs). However, the lines of evidence applied to 2,4-dimethylphenol and pronamide in Section 7.9.1.1.1 indicate that these two SVOCs do not warrant identification as ecological COCs for surface collected during the 2012 CMS field investigation.

Acetone was detected in four of ten surface soils samples collected during the 2012 CMS field investigation (15J µg/kg in 59SB30-00, 27J µg/kg in 59SB25-00, 30J µg/kg in 59SB31-00, and 45J µg/kg in 59SB32-00). As discussed in Section 7.9.1.1.1, This VOC is relatively non-toxic to terrestrial plants in solution. The USEPA (2012a and 2012b) ECOSAR Class Program (Version 1.11) also indicates that acetone is relatively non-toxic to earthworms. Based on the low toxicity in solution to terrestrial plants and low predicted toxicity in solution to earthworms, acetone is not identified as an ecological COC for SWMU 59 surface soil collected during the 2012 CMS field investigation. Therefore, no additional evaluation of this VOC in surface soil adjacent to concrete pads and paved surfaces is recommended.

Chromium, cobalt, copper, nickel, selenium, and vanadium were identified as ecological COPCs in the Step 2 screening level risk calculation because maximum detected concentrations exceed soil screening values (see Table 7-19). To further evaluate the significance of potential risks presented by chromium, cobalt, copper, nickel, and vanadium, risk estimates were re-calculated using 95 percent UCL of the mean concentrations (see Table 7-39). It is acknowledged that terrestrial plants are immobile and many terrestrial invertebrates are relatively immobile; therefore, individuals are likely to be impacted by locations of maximum concentrations. However, as discussed in Section 7.9, evaluation of the 95 percent UCL of the mean exposure case is more indicative of the level of impact that might be expected at the population level. In addition to the re-calculation of risk estimates using 95% UCL of the mean concentrations, the SWMU 59 surface soil data were statistically compared to the NAPR basewide background surface soil data set contained within the Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds (Baker, 2010b) in accordance with Navy guidance (NFESC, 2002). Supporting statistics for the SWMU and background surface soil data sets, including 95 percent UCL of the mean calculations, are provided in Appendix I. Finally, the refined risk evaluation also took into consideration the magnitude and spatial distribution of detected concentrations above soil screening values and/or background concentrations. The refined risk evaluation for chromium, cobalt, copper, nickel, selenium, and vanadium is presented below.

Chromium

Chromium was detected in ten of ten (10/10) surface soil samples at concentrations ranging from 32 mg/kg (59SB30-00) to 150 mg/kg (59SB33-00). Five of the detected concentrations exceed the soil screening value of 57 mg/kg (USEPA, 2008; see Figure 7-10). The Step 2 screening level risk estimate (HQ = 2.63; see Table 7-19), derived using the maximum detected concentration, indicates that chromium may be presenting unacceptable risk to terrestrial plants and invertebrates. The refined risk estimate (HQ = 1.55; see Table 7-39, derived using the 95 percent UCL of the mean concentration (88.5 mg/kg), also indicates that this metal may be presenting unacceptable risk to terrestrial plant and invertebrate populations.

The descriptive statistics presented in Table 7-40 show that chromium concentrations in SWMU 59 surface soil collected during the 2012 CMS field investigation are elevated relative to background concentrations. Maximum, arithmetic mean, and 95 percent UCL of the mean chromium concentrations in SWMU 59 surface soil (150 mg/kg, 64.5 mg/kg, and 88.5 mg/kg, respectively) exceed maximum, arithmetic mean, and 95 percent UCL of mean background concentrations (47 mg/kg, 25.7 mg/kg,, and 30.4 mg/kg, respectively). The statistical tests that were used to evaluate the median and right-tail of the SWMU and background data set distributions (i.e., Wilcoxon rank sum test, quantile test, and slippage test) also concluded that chromium concentrations in SWMU 59 surface soil are elevated relative to background concentrations.

Distribution tests indicate that the SWMU 59 data set follows both a lognormal and gamma distribution. The lognormal and gamma probability plots included within Appendix I show that the data set best fits a lognormal distribution. A box plot of log-transformed chromium concentrations in SWMU 59 surface soil (see Appendix I) indicates that there are no potential outliers within the SWMU data set at the upper end of the range. The probability plot depicting lognormal concentrations also shows that individual data points within the SWMU data set, including data points at the upper end of the range, fall along or near a straight line and form a continuous distribution. Data points that exhibit these characteristics are likely to represent natural conditions (NFESC, 2002, 2003, and 2004).

In summary, based on the graphical depictions of the SWMU 59 analytical data (i.e., box and probability plots using log-transformed concentrations), chromium concentrations in surface soil collected during the 2012 CMS field investigation are not considered to be indicative of a release of hazardous wastes or hazardous constituents. Rather, they likely represent naturally occurring concentrations that are not reflected by the background surface soil data set due to its small size. As such, chromium is not identified as an ecological COC for surface soil collected during the 2012 CMS field investigation. Therefore, no additional evaluation of this metal in surface soil beneath concrete pads and paved surfaces is recommended. It is noted that chromium was not detected in surface soil collected during the 2010 CMS field investigation at concentrations greater than the soil screening value. Statistical tests used to evaluate the mean and right-tail of the SWMU and background data set distributions (see Table 7-38) also concluded that chromium concentrations in surface soil collected during the 2010 CMS field investigation are not elevated relative to background concentrations. These considerations support the conclusion that chromium concentrations in surface soil collected during the 2012 CMS field investigation are not likely to be indicative of a release.

Cobalt

Cobalt was detected in ten of ten (10/10) surface soil samples at concentrations ranging from 6J mg/kg (59SB32-00) to 36J mg/kg (59SB26-00). Nine of the detected concentrations exceed the soil screening value of 13 mg/kg (USEPA, 2005d; see Figure 7-10). The Step 2 screening level risk estimate (HQ = 2.77; see Table 7-19), derived using the maximum detected concentration, indicates that cobalt may be presenting unacceptable risk to terrestrial plants and invertebrates. The refined risk estimate (HQ = 1.91; see Table 7-39, derived using the 95 percent UCL of the mean concentration (24.8 mg/kg), also indicates that this metal may be presenting unacceptable risk to terrestrial plant and invertebrate populations.

The descriptive statistics presented in Table 7-40 for the SWMU 59 and background surface soil data sets show that cobalt concentrations in surface soil collected during the 2012 CMS field investigation are not elevated relative to background concentrations. Maximum, arithmetic mean, and 95 percent UCL of the mean cobalt concentrations in SMWU 59 surface soil (36J mg/kg, 20.1 mg/kg, and 24.8 mg/kg, respectively) are less than maximum, arithmetic mean, and 95 percent UCL of the mean background concentrations (50.2J mg/kg, 22.8 mg/kg, and 28.0 mg/kg, respectively). The statistical tests that were used to evaluate the median and right-tail of the SWMU and background data set distributions (Wilcoxon rank sum test, quantile test, and slippage test) also concluded that cobalt concentrations in SWMU 59 surface soil are not elevated relative to background concentrations (see Table 7-40).

Distribution tests indicate that the SWMU 59 data set follows a normal, lognormal, and gamma distribution. However, the normal, lognormal, and gamma probability plots included within Appendix I show that the data set best fits a normal distribution. A box plot of non-transformed cobalt concentrations in SWMU 59 surface soil (see Appendix I) supports the descriptive and

distributional statistics. As evidenced by the plot, there are no potential outliers within the SWMU data set at the upper end of the range.

In summary, based on the descriptive and distributional statistics presented in Table 7-40, as well as the box plot depicting non-transformed data, which indicates that there are no potential outliers within the SWMU data set at the upper end of the range, cobalt is not identified as an ecological COC for SWMU 59 surface soil collected during the 2012 CMS field investigation. Therefore, no additional evaluation of this metal in surface soil beneath concrete pads and paved surfaces is recommended.

Copper

Copper was detected in ten of ten (10/10) surface soil samples at concentrations ranging from 50 mg/kg (59SB27-00) to 260J mg/kg (59SB24-00). Eight of the detected concentrations exceed the soil screening value of 70 mg/kg (USEPA, 2007e; see Figure 7-10). The Step 2 screening level risk estimate (HQ = 3.71; see Table 7-19), derived using the maximum detected concentration, indicates that copper may be presenting unacceptable risk to terrestrial plants and invertebrates. The refined risk estimate (HQ = 2.09; see Table 7-39, derived using the 95 percent UCL of the mean concentration (146 mg/kg), also indicates that this metal may be presenting unacceptable risk to terrestrial plant and invertebrate populations.

The descriptive statistics presented in Table 7-40 show that copper concentrations in SWMU 59 surface soil collected during the 2012 CMS field investigation are elevated relative to background concentrations. Maximum, arithmetic mean, and 95 percent UCL of the mean copper concentrations in SWMU 59 surface soil (260J mg/kg, 109 mg/kg, and 146 mg/kg, respectively) exceed maximum, arithmetic mean, and 95 percent UCL of mean background concentrations (180 mg/kg, 77.1 mg/kg, and 96.3 mg/kg, respectively). The statistical tests that were used to evaluate the median and right-tail of the SWMU and background data set distributions (Wilcoxon rank sum test, quantile test, and slippage test) were contradictory. The statistical tests evaluating the right tail of the distributions (i.e., quantile test and slippage test) concluded that copper concentrations in SWMU 59 surface soil are not elevated relative to background concentrations, while the statistic test evaluating the median of the distributions (i.e., Wilcoxon rank sum test) concluded that copper concentrations in SWMU 59 surface soil are elevated relative to background concentrations.

Distribution tests indicate that the SWMU 59 data set follows both a lognormal and gamma distribution. The lognormal and gamma probability plots included within Appendix I, show that the data set best fits a lognormal distribution. A box plot of log-transformed chromium concentrations in SWMU 59 surface soil (see Appendix I) indicates that there is a single data point at the upper end of the range that is elevated relative to other concentrations at the SWMU. This data point corresponds to the maximum detected concentration (260J mg/kg in 59SB24-00).

In summary, based on the 95 percent UCL of the mean HQ value (2.09), which indicates unacceptable risk to terrestrial plant and invertebrate populations, the descriptive statistics and the statistical test evaluating the median of the SWMU and background data set distributions (see Table 7-40), as well as the box plot depicting log-transformed data, which indicates that the detected concentration at soil boring location 59SB24 is elevated relative to other concentrations at the SWMU, copper is identified as an ecological COC for SWMU 59 surface soil collected during the 2012 CMS field investigation. Therefore, additional evaluation in the form of corrective measures is recommended for this metal in surface soil beneath concrete pads and paved surfaces. It is noted that copper was also identified as an ecological COC for surface soil collected during the 2010 CMS field investigation (see Section 7.9.1.1.1)

Nickel

Nickel was detected in ten of ten (10/10) surface soil samples at concentrations ranging from 15 mg/kg (59SB32-00) to 47 mg/kg (59SB33-00). Only the maximum detected concentration exceeds the soil screening value of 38 mg/kg (USEPA, 2007h; see Figure 7-10). The Step 2 screening level risk estimate (HQ = 1.24; see Table 7-19), derived using the maximum detected concentration, indicates that nickel may be presenting unacceptable risk to terrestrial plants and invertebrates. However, the refined risk estimate (HQ = 0.84; see Table 7-39, derived using the 95 percent UCL of the mean concentration (32.1 mg/kg), indicates that this metal is not presenting unacceptable risk to terrestrial plant and invertebrate populations.

The descriptive statistics presented in Table 7-40 for the SWMU 59 and background surface soil data sets show that nickel concentrations in SWMU 59 surface soil collected during the 2012 CMS field investigation are elevated relative to background concentrations. Maximum, arithmetic mean, and 95 percent UCL of the mean nickel concentrations in SMWU 59 surface soil (47 mg/kg, 26.1 mg/kg, and 32.1 mg/kg, respectively) exceed maximum, arithmetic mean, and 95 percent UCL of the mean background concentrations (19 mg/kg, 10.5 mg/kg, and 13.1 mg/kg, respectively). The statistical tests that were used to evaluate the median and right-tail of the SWMU and background data set distributions (Wilcoxon rank sum test, quantile test, and slippage test) also concluded that nickel concentrations in SWMU 59 surface soil are elevated relative to background concentrations (see Table 7-40).

Distribution tests indicate that the SWMU 59 data set follows a normal, lognormal, and gamma distribution. The normal, lognormal, and gamma probability plots included within Appendix I, show that the data set best fits either a normal or lognormal distribution. Box plots depicting non-transformed and log-transformed nickel concentrations in SWMU 59 surface soil (see Appendix I) indicate that there are no potential outliers within the SWMU data set at the upper end of the range. It is noted that the normal and lognormal probability plots suggest that two distinct populations are present within the data set (an obvious inflection point is evident). However, based on the absence of potential outliers, both populations are considered to be representative of natural conditions.

In summary, based on the 95 percent UCL of the mean HQ value (0.84), which indicates no unacceptable risk to terrestrial plant and invertebrate populations, as well as the box plots depicting non-transformed and log-transformed data, which show that there are no potential outliers within the SWMU data set at the upper end of the range, nickel is not identified as an ecological COC for surface soil collected during the 2012 CMS field investigation. Therefore, no additional evaluation of this metal in surface soil beneath concrete pads and paved surfaces is recommended.

Selenium

Selenium was detected in three of ten (10/10) surface soil samples at concentrations ranging from 0.47J mg/kg (59SB30-00) to 1.2 mg/kg (59SB32-00). Two of the detected concentrations (0.74 mg/kg in 59SB25-00 and 1.2 mg/kg in 59SB32-00) exceed the soil screening value of 0.52 mg/kg (USEPA, 2007f; see Figure 7-10). The Step 2 screening level risk estimate (HQ = 2.31; see Table 7-19, derived using the maximum detected concentration, indicates that selenium may be presenting unacceptable risk to terrestrial plants and invertebrates. It is noted that a refined risk estimate was not derived for selenium because there are less than eight detected values within the data set.

The descriptive statistics presented in Table 7-40 for the SWMU 59 and background surface soil data sets show that selenium concentrations in SWMU 59 surface soil collected during the 2012 CMS field investigation are not elevated relative to background concentrations. Maximum and arithmetic mean concentrations in SWMU 59 surface soil (1.2 mg/kg and 0.46 mg/kg, respectively) are less than or equal to maximum and arithmetic mean background concentrations (1.2J mg/kg and 0.84 mg/kg, respectively). A statistical evaluation of the mean/median and right tail of the SWMU and background data set distributions could not be performed due to the low frequency of detection within the SWMU 59 and background data sets (30 percent and 25 percent, respectively). Although a refined risk estimate could not be calculated and distributional statistics could not be performed on the SWMU and background data sets, the descriptive statistics indicate that selenium concentrations in SWMU 59 surface soil are not elevated relative to background concentrations. For this reason, selenium is not identified as an ecological COC for surface soil collected during the 2012 CMS field investigation. Therefore, no additional evaluation of this metal in surface soil beneath concrete pads and paved surfaces is recommended.

Vanadium

Vanadium was detected in ten of ten (10/10) surface soil samples at concentrations ranging from 110 mg/kg (59SB28-00) to 330 mg/kg (59SB33-00). Each of the detected concentrations exceeds the soil screening value of 20 mg/kg (USEPA, 2005b; see Figure 7-10). The Step 2 screening level risk estimate (HQ = 16.50; see Table 7-19), derived using the maximum detected concentration, indicates that vanadium may be presenting unacceptable risk to terrestrial plants and invertebrates. The refined risk estimate (HQ = 12.32; see Table 7-39, derived using the 95 percent UCL of the mean concentration (246 mg/kg), also indicates that this metal may be presenting unacceptable risk to terrestrial plant and invertebrate populations.

The descriptive statistics presented in Table 7-40 for the SWMU 59 and background surface soil data sets show that vanadium concentrations in SWMU 59 surface soil collected during the 2010 CMS field investigation are elevated relative to background concentrations. Maximum, arithmetic mean, and 95 percent UCL of the mean cobalt concentrations in SMWU 59 surface soil (330 mg/kg, 206 mg/kg, and 246 mg/kg, respectively) exceed maximum, arithmetic mean, and 95 percent UCL of the mean background concentrations (230 mg/kg, 142 mg/kg, and 166 mg/kg, respectively). The statistical tests that were used to evaluate the mean and right-tail of the SWMU and background data set distributions (two sample t-test, quantile test, and slippage test) also concluded that vanadium concentrations in SWMU 59 surface soil are elevated relative to background concentrations (see Table 7-40).

Distribution tests indicate that the SWMU 59 data set follows a normal, lognormal, and gamma distribution. The normal, lognormal, and gamma probability plots included within Appendix I show that the data set best fits a lognormal distribution. A box plot of log-transformed vanadium concentrations in SWMU 59 surface soil (see Appendix I) shows that there are no potential outliers within the SWMU data set at the upper end of the range. The log-normal probability plot also shows that all data points fall on or near a straight line and follow a continuous distribution. Data points that exhibit these characteristics are likely to represent natural conditions (NFESC, 2002, 2003, and 2004).

Based on the box and probability plots depicting log-transformed data, which indicates that there are no potential outliers within the SWMU data set at the upper end of the range, vanadium is not identified as an ecological COC for SWMU 59 surface soil collected during the 2012 CMS field investigation. Therefore, no additional evaluation of this metal in surface soil beneath paved surfaces is recommended.

In summary, copper was detected and identified as an ecological COC for SWMU 59 surface soil collected during the 2012 CMS field investigation. Although chromium, cobalt, nickel, selenium,

vanadium, and acetone were detected and identified as ecological COPCs in Step 2 of the ERA, they are not identified as an ecological COCs based on the discussion presented within the preceding paragraphs, and no additional evaluation is recommended. No additional evaluation is also recommended for chemicals lacking usable data, as well as the non-detected chemicals identified as ecological COPCs in Step 2 of the ERA because maximum RLs exceed surface soil screening values (i.e., 2,4-dimethylphenol and pronamide).

7.9.1.2 Step 3a Risk Evaluation for Subsurface Soil

Refined risk evaluations for SWMU 59 subsurface soil collected during the 2010 and 2012 CMS field investigations are presented in Sections 7.9.1.2.1 and 7.9.1.2.2, respectively. As discussed in Section 7.2, subsurface soil samples associated with the 2010 CMS field investigation were primarily collected at locations adjacent to concrete pads and paved surfaces, while all of the subsurface soil samples associated with the 2012 CMS field investigation were collected at locations beneath concrete pads and paved surfaces.

7.9.1.2.1 Subsurface Soil: 2010 CMS Field Investigation

Section 7.6.2.2.1 presented the results of the Step 2 screening level risk calculation for SWMU 59 subsurface soil collected during the 2010 CMS field investigation. Screening level risk estimates were also provided in Table 7-20. One organochlorine pesticide (beta-BHC) and seven metals (chromium, cobalt, copper, nickel, selenium, vanadium, and zinc) were detected and identified as ecological COPCs in Step 2 of the ERA because maximum detected concentrations exceed soil screening values. The spatial extent of detected ecological COPC concentrations greater than soil screening values is depicted on Figure 7-11. Five detected VOCs (acetone, bromomethane, carbon disulfide, chloromethane, and methyl iodide) were identified as ecological COPCs based on the lack of soil screening values. Six non-detected SVOCs (1,2,4,5-tetrachlorobenzene, 2,4-dimethylphenol, 2-methylphenol, 3-methylphenol, 4-methylphenol, and pronamide) and three non-detected pesticide (isodrin, kepone, and toxaphene) were also identified as ecological COPCs because maximum RLs exceeding soil screening values. Finally, five VOCs (1,4-dioxane, acrolein, isobutyl alcohol, methyl methacrylate, and propionitrile) and one SVOC (1,4-phenylenediamine) were identified as ecological COPCs based on the lack of any usable data (all subsurface soil data were rejected during data validation activities).

The refined risk calculation for SWMU 59 subsurface soil collected during the 2010 CMS field investigation is presented in Table 7-41. As discussed in Section 7.9, risk estimates were re-calculated using 95 percent UCL of the mean concentrations for those ecological COPCs having a minimum of eight detected values and less than 70 percent non-detected results (chromium, cobalt, copper, nickel, selenium, vanadium, and zinc). Additional refinements that were applied in Step 3a of the BERA are presented and discussed within Section 7.9.

All subsurface soil analytical data for five VOCs (1,4-dioxane, acrolein, isobutyl alcohol, methyl methacrylate, and propionitrile) and one SVOC (1,4-phenylenediamine) were rejected during data validation activities. Based on the lack of any usable analytical data with which to evaluate potential risks, these five organic chemicals were identified as ecological COPCs in Step 2 of the ERA. Based on the discussion presented in Section 7.9.1.1.1, 1,4-dioxane, acrolein, isobutyl alcohol, methyl methacrylate, and 1,4-phenylenediamine are not likely to be present in abiotic media at SWMU 59 and, therefore are not identified as ecological COCs for subsurface soil collected during the 2010 CMS field investigation. Propionitrile was detected in a single surface soil sample collected during the 2010 CMS field investigation (8.1J µg/kg in 59SB08-00). As such, this VOC has the potential to be present in subsurface soil. However, as discussed in Section 7.9.1.1.1, the predicted toxicity of propionitrile to earthworms is low (SARs analysis

predicts a 14-day earthworm LC_{50} value of 142 mg/kg). Industrial uses for propionitrile (curing agent for synthesizing epoxy resin, chemical intermediate in the manufacture of di-n-propylamine and cyanoacetates, and selective solvent for separating hydroxide and refining petroleum fraction by the petro-chemical industry [HSDB, 2011]) also indicate that this VOC is not likely to be site-related. For these reasons, propionitrile is also not identified as an ecological COC for subsurface soil collected during the 2010 CMS field investigation.

Six non-detected SVOCs (1,2,4,5-tetrachlorobenzene, 2,4-dimethylphenol, 2-methylphenol, 3-methylphenol, 4-methylphenol, and pronamide) and three non-detected pesticides (isodrin, kepone, and toxaphene) were identified as ecological COPCs in Step 2 of the ERA for SWMU 59 subsurface soil collected during the 2010 CMS field investigation because maximum RLs (250 µg/kg for 1,2,4,5-tetrachlorobenzene, 480 µg/kg for 2,4-dimethylphenol and 2-methylphenol, 370 µg/kg for 3-methylphenol and 4-methylphenol, 480 µg/kg for pronamide, 250 µg/kg for isodrin, 230 µg/kg for kepone, and 120 µg/kg for toxaphene), exceed soil screening values. As discussed in Section 7.9.1.1.1, the soil screening values used for 1,2,4,5-tetrachlorobenzene, 2-methylphenol, 3-methylphenol, 4-methylphenol, kepone, and toxaphene in Step 2 of the ERA are based on background concentrations or detection limits (CCME, 2001 and 2007 and Friday, 1998). Because the screening values for these chemicals are not based on toxicological data (background concentrations and detection limits do not represent threshold effect concentrations), there is uncertainty in their identification as ecological COPCs. If the same lines of evidence used in Section 7.9.1.1.1 for surface soil collected during the 2010 CMS field investigation are applied to 1,2,4,5-tetrachlorobenzene, 2-methylphenol, 3-methylphenol, 4-methylphenol, kepone, and toxaphene in subsurface soil collected during the 2010 CMS field investigation (i.e., comparison of maximum RLs to available USEPA Region 5 [2003b]) soil ESLs, low predicted toxicity in solution to earthworms using SARs, and/or the lack of detections in abiotic media collected at SWMU 59), these four SVOCs and two organochlorine pesticides do not warrant identification as ecological COCs. The lines of evidence applied to 2,4-dimethylphenol, pronamide, and isodrin in Section 7.9.1.1.1 also indicate that these organics do not warrant identification as ecological COCs for subsurface collected during the 2010 CMS field investigation.

Five detected VOCs (acetone, bromomethane, carbon disulfide, chloromethane, and methyl iodide) were identified as ecological COPCs for subsurface soil collected during the 2010 CMS field investigation based on the lack of soil screening values. Acetone was detected in four of twenty-three (4/23) subsurface soil samples at concentrations ranging from 26 µg/kg (59SB09-01) to 150 µg/kg (59SB02-01), bromomethane was detected in three of twenty-three (3/23) subsurface soil samples at concentrations ranging from 1.2J µg/kg (59SB11-01) to 1.6J µg/kg (59SB17-01), carbon disulfide was detected in two of twenty-three (2/23) subsurface soil samples at concentrations ranging from 0.54J µg/kg (59SB22-01) to 0.76J µg/kg (59SB13-01), chloromethane was detected in four of twenty-three (4/23) subsurface soil samples at concentrations ranging from 0.37J µg/kg (59SB12-01) to 1.1J µg/kg (59SB02-01), and methyl iodide was detected in three of twenty-three (3/23) subsurface soil samples at concentrations ranging from 1.3J µg/kg (59SB09-01) to 30J µg/kg (59SB02-01). These five VOCs also were detected and identified as ecological COPCs for SWMU 59 surface soil collected during the 2010 CMS field investigation based on the lack of soil screening values. If the same lines of evidence used in Section 7.9.1.1.1 for surface soil are applied to acetone, bromomethane, carbon disulfide, chloromethane, and methyl iodide in subsurface soil (i.e., low magnitude and/or frequency of detection, comparison of maximum detected concentrations to the minimum soil screening value developed for other VOCs [11µg/kg for vinyl chloride], and/or their measured/predicted toxicity in solution to earthworms using SARs), these five VOCs do not warrant identification as ecological COCs for SMWU 59 subsurface soil collected during the 2010 CMS field investigation.

Chromium, cobalt, copper, nickel, selenium, vanadium, and zinc were identified as ecological COPCs in Step 2 of the ERA because maximum detected concentrations exceed soil screening values (see Table 7-20). To further evaluate the significance of potential risks presented by these metals, risk estimates were re-calculated using 95 percent UCL of the mean concentrations (see Table 7-41). It is acknowledged that terrestrial plants are immobile and many terrestrial invertebrates are relatively immobile; therefore, individuals are likely to be impacted by locations of maximum concentrations. However, as discussed in Section 7.9, evaluation of the 95 percent UCL of the mean exposure case is more indicative of the level of impact that might be expected at the population level. In addition to the re-calculation of risk estimates using 95 percent UCL of the mean concentrations, the subsurface soil data were statistically compared to the NAPR basewide background subsurface soil data set ("clay" data set) contained within the Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Chemicals (Baker, 2010b) in accordance with Navy guidance (NFESC, 2002). Supporting statistics for the SWMU and background subsurface soil data sets, including 95 percent UCL of the mean calculations, are provided in Appendix J. The risk evaluation also took into consideration the magnitude and spatial distribution of detected concentrations above soil screening values and/or background concentrations. The refined risk evaluation for chromium, cobalt, copper, nickel, selenium, vanadium, and zinc is presented below.

Chromium

Chromium was detected in twenty-three of twenty-three (23/23) subsurface soil samples at concentrations ranging from 8 mg/kg (59SB13-01) to 79.3J mg/kg (59SB12-01). Five of the detected concentrations exceed the soil screening value of 57 mg/kg (USEPA, 2008; see Figure 7-11). The Step 2 screening level risk estimate (HQ = 1.39; see Table 7-20), derived using the maximum detected concentration, indicates that this metal may be presenting unacceptable risk to terrestrial plants and invertebrates. However, the refined risk estimate (HQ = 0.74; see Table 7-41), derived using the 95 percent UCL of the mean concentration (42.3 mg/kg), indicates that this metal is not presenting unacceptable risk to terrestrial plant and invertebrate populations.

The descriptive statistics presented in Table 7-42 for the SWMU 59 and background subsurface soil data sets show that chromium concentrations in subsurface soil collected during the 2010 CMS field investigation are elevated relative to background concentrations. Maximum, arithmetic mean, and 95 percent UCL of the mean chromium concentrations in the SWMU 59 data set (79.3J mg/kg, 35.4 mg/kg, and 42.3 mg/kg, respectively) are less than maximum, arithmetic mean, and 95 percent UCL of the mean background concentrations (148J mg/kg, 37.3 mg/kg, and 56.5 mg/kg, respectively). The statistical tests that were used to evaluate the median and right-tail of the SWMU 59 and background data set distributions (Wilcoxon rank sum test, quantile test, and slippage test) also concluded that chromium concentrations in SWMU 59 subsurface soil are not elevated above background concentrations (see Table 7-42).

Distribution tests indicate that the SWMU 59 data set follows a normal, lognormal, and gamma distribution. However, the probability plots included within Appendix J show that the data set best fits a lognormal distribution. A box plot of log-transformed chromium concentrations in SWMU 59 subsurface soil (see Appendix J) supports the descriptive and distributional statistics. As evidenced by the box plot, there are no potential outliers within the SWMU data set at the upper end of the range.

In summary, based on the 95 percent UCL of the mean HQ value (0.74), which indicates no unacceptable risk to terrestrial plant and invertebrate populations, the descriptive and distributional statistics presented in Table 7-42, as well as the box plot depicting log-transformed data, which indicates that there are no potential outliers within the SWMU data set at the upper

end of the range, chromium is not identified as an ecological COC for SWMU 59 subsurface soil collected during the 2010 CMS field investigation. Therefore, no additional evaluation of this metal in subsurface soil adjacent to concrete pads and paved surfaces is recommended.

Cobalt

Cobalt was detected in twenty-three of twenty-three (23/23) subsurface soil samples at concentrations ranging from 9.6J mg/kg (59SB01-01) to 72.1J mg/kg (59SB02-01). Twenty of the detected concentrations exceed the soil screening value of 13 mg/kg (USEPA, 2005d; see Figure 7-10). The Step 2 screening level risk estimate (HQ = 5.55; see Table 7-20), derived using the maximum detected concentration, indicates that this metal may be presenting unacceptable risk to terrestrial plant and invertebrates. The refined risk estimate (HQ = 2.71; see Table 7-41), derived using the 95 percent UCL of the mean concentration (35.2 mg/kg), also indicates that cobalt may be presenting unacceptable risk to terrestrial plant and invertebrate populations.

The descriptive statistics presented in Table 7-42 for the SWMU 59 and background subsurface soil data sets show that cobalt concentrations in SWMU 59 subsurface soil collected during the 2010 CMS field investigation are elevated relative to background concentrations. Maximum, arithmetic mean, and 95 percent UCL of the mean cobalt concentrations for the SWMU 59 data set (72.1J mg/kg, 28.9 mg/kg, and 35.2 mg/kg, respectively) exceed maximum, arithmetic mean, and 95 percent UCL of the mean background concentrations (33.8 mg/kg, 9.2 mg/kg, and 18.3 mg/kg, respectively). The statistical tests that were used to evaluate the median and right-tail of the SWMU and background data set distributions (Wilcoxon rank sum test, quantile test, and slippage test) were contradictory. The statistical tests evaluating the right tail of the distributions (i.e., quantile test and slippage test) concluded that cobalt concentrations in SWMU 59 subsurface soil are not elevated relative to background concentrations, while the statistic test evaluating the median of the distributions (i.e., Wilcoxon rank sum test) concluded that cobalt concentrations in SWMU 59 subsurface soil are elevated relative to background concentrations.

Distribution tests indicate that the SWMU 59 data set follows a lognormal and gamma distribution. The lognormal and gamma probability plots included within Appendix J show that the data set best fits a lognormal distribution. A box plot of log-transformed cobalt concentrations in SWMU 59 subsurface soil (see Appendix J) shows that the maximum detected concentration (72.1J mg/kg in 59SB02-01) is slightly elevated relative to other detected concentrations at the SWMU (i.e., value slightly elevated above the upper whisker of the plot) and may represent a potential outlier.

Although the Wilcoxon rank sum test concluded that cobalt concentrations in SMWU 59 subsurface soil adjacent to paved surfaces are elevated above background concentrations and the box plot depicting log-transformed cobalt concentrations indicate that a potential outlier is present within the SWMU data set at the upper end of the range, cobalt is not identified as an ecological COC for subsurface soil collected during the 2010 CMS field investigation. Therefore, no additional evaluation of this metal in subsurface soil adjacent to concrete pads and paved surfaces is recommended. This decision is based on in part on the low magnitude of the refined risk estimate (HQ = 2.71) above 1.0. In addition, cobalt was not detected in SWMU 59 surface soil collected during the 2010 and 2012 CMS field investigations at concentrations elevated relative to background concentrations (see Tables 7-38 and 7-40). This is relevant since any releases at the SWMU would be to surface soil or paved surfaces. Finally, the maximum cobalt concentration is not co-located with other metal concentrations that are elevated relative to maximum background concentrations in surface or subsurface soil collected at boring location 59SB02.

Copper

Copper was detected in twenty-three of twenty-three (23/23) subsurface soil samples at concentrations ranging from 5.1J mg/kg (59SB08-01) to 270 mg/kg (59SB14-01). Sixteen of the detected concentrations exceed the soil screening value of 70 mg/kg (USEPA, 2007e; see Figure 7-11). The Step 2 screening level risk estimate (HQ = 3.86; see Table 7-20), derived using the maximum detected concentration, indicates that copper may be presenting unacceptable risk to terrestrial plants and invertebrates. The refined risk estimate (HQ = 1.60; see Table 7-41), derived using the 95 percent UCL of the mean concentration (112 mg/kg), also indicates that copper may be presenting unacceptable risk to terrestrial plant and invertebrate populations.

The descriptive statistics presented in Table 7-42 show that copper concentrations in SWMU 59 subsurface soil collected during the 2010 CMS field investigation are not elevated relative to background concentrations. Although the maximum copper concentration in SWMU 59 subsurface soil (270 mg/kg) is slightly elevated above the maximum background concentration (260J mg/kg), arithmetic mean and 95 percent UCL of the mean copper concentration in SWMU 59 subsurface soil (88.3 mg/kg and 112 mg/kg, respectively) are less than arithmetic mean and 95 percent UCL of the mean background concentrations (105 mg/kg and 135 mg/kg, respectively). The statistical tests that were used to evaluate the median and right-tail of the SWMU 59 and background data set distributions (Wilcoxon rank sum test, quantile test, and slippage test) also concluded that copper concentrations in SWMU 59 subsurface soil are not elevated above background concentrations (see Table 7-42).

Distribution tests indicate that the SWMU 59 data set follows a gamma distribution. Therefore, a box plot depicting non-transformed or log-transformed copper concentrations was not prepared. Regardless, based on the descriptive and distributional statistics presented in Table 7-42, as well as the low magnitude of the refined risk estimate above 1.0 (HQ = 1.60), copper is not identified as an ecological COC for subsurface soil collected during the 2010 CMS field investigation. Therefore, no additional evaluation of this metal in subsurface soil adjacent to concrete pads and paved surfaces is recommended.

Nickel

Nickel was detected in twenty-three of twenty-three (23/23) subsurface soil samples at concentrations ranging from 6.3 mg/kg (59SB13-01) to 47.3 mg/kg (59SB17-01). Only the maximum detected concentration exceeds the soil screening value of 38 mg/kg (USEPA, 2007h; see Figure 7-11). The Step 2 screening level risk estimate (HQ = 1.24; see Table 7-20), derived using the maximum detected concentration, indicates that nickel may be presenting unacceptable risk to terrestrial plants and invertebrates. However, the refined risk estimate (HQ = 0.55; see Table 7-41), derived using the 95 percent UCL of the mean concentration (20.9 mg/kg), indicates that nickel is not presenting unacceptable risk to terrestrial plant and invertebrate populations.

The descriptive statistics presented in Table 7-42 show that nickel concentrations in SWMU 59 subsurface soil collected during the 2010 CMS field investigation are slightly elevated relative to background concentrations. Maximum, arithmetic mean, and 95 percent UCL of the mean nickel concentrations in SWMU 59 subsurface soil (47.3 mg/kg, 17.4 mg/kg, and 20.1 mg/kg, respectively) exceed maximum, arithmetic mean, and 95 percent UCL of the mean background concentrations (35.6 mg/kg, 7.89 mg/kg, and 11.8 mg/kg, respectively). However, the statistical tests that were used to evaluate the median and right-tail of the SWMU 59 and background data set distributions (Wilcoxon rank sum test, quantile test, and slippage test) concluded that nickel concentrations in SWMU 59 subsurface soil are not elevated relative to background concentrations (see Table 7-42).

Distribution tests indicate that the SWMU 59 data set follows a lognormal and gamma distribution. A box plot of log-transformed nickel concentrations in SWMU 59 subsurface soil (see Appendix J) shows that there are no potential outliers within the SWMU data set at the upper end of the range. The probability plot depicting lognormal concentrations also shows that individual data points within the SWMU data set, including data points at the upper end of the range, fall along or near a straight line and form a continuous distribution. Data points that exhibit these characteristics are likely to represent natural conditions (NFESC, 2002, 2003, and 2004).

In summary, based on the 95 percent UCL of the mean HQ value (0.55), which indicates no unacceptable risk to terrestrial plant and invertebrate populations, the box plot depicting log-transformed data, which indicates that there are no potential outliers within the SWMU data set at the upper end of the range, as well as the lognormal probability plot, which indicates that detected concentrations likely represent natural conditions, nickel is not identified as an ecological COC for SWMU 59 subsurface soil collected during the 2010 CMS field investigation. Therefore, no additional evaluation of this metal in subsurface soil adjacent to concrete pads and paved surfaces is recommended.

Selenium

Selenium was detected in thirteen of twenty-three (13/23) subsurface soil samples at concentrations ranging from 0.2J mg/kg (59SB20-01) to 2.6J mg/kg (59SB02-01). Seven of the detected concentrations exceed the soil screening value of 0.52 mg/kg (USEPA, 2007f; see Figure 7-11). The Step 2 screening level risk estimate (HQ = 5.00; see Table 7-20), derived using the maximum detected concentration, indicates that selenium may be presenting unacceptable risk to terrestrial plants and invertebrates. The refined risk estimate (HQ = 2.59; see Table 7-41), derived using the 95 percent UCL of the mean concentration (1.35 mg/kg), also indicates that selenium may be presenting unacceptable risk to terrestrial plant and invertebrate populations.

The descriptive statistics presented in Table 7-42 show that selenium concentrations in SWMU 59 subsurface soil collected during the 2010 CMS field investigation are not elevated relative to background concentrations. Although arithmetic mean and 95 percent UCL of the mean concentrations in SWMU 59 subsurface soil (7.04 mg/kg and 1.35 mg/kg, respectively) are elevated above arithmetic mean and 95 percent UCL of the mean background concentrations (0.90 mg/kg and 0.91 mg/kg, respectively), the maximum SWMU 59 subsurface soil concentration (2.6J mg/kg) is less than the maximum background concentration (3.8J mg/kg). It is noted that the elevated arithmetic mean concentration for the SWMU 59 subsurface soil can be attributed to elevated RLs reported for non-detected results, which ranged from 13.2 mg/kg to 17.7 mg/kg.

A statistical evaluation of the mean/median and right-tail of the SWMU and background data set distributions could not be performed due to the low frequency of detection within the background data set (30 percent). Regardless, based on the comparison of the maximum detected concentration in the SWMU data set to the maximum detected concentration in the background data set, selenium is not identified as an ecological COC for SWMU 59 subsurface soil collected during the 2010 CMS field investigation. Therefore, no additional evaluation of this metal in subsurface soil adjacent to concrete pads and paved surfaces is recommended.

Vanadium

Vanadium was detected in twenty-three of twenty-three (23/23) subsurface soil samples at concentrations ranging from 43.5J mg/kg (59SB20-00) to 282J mg/kg (59SB02-01). Each of the

detected concentrations exceeds the soil screening value of 10 mg/kg (USEPA, 2005b; see Figure 7-11). The Step 2 screening level risk estimate (HQ = 14.10; see Table 7-20), derived using the maximum detected concentrations, indicates that this metal may be presenting unacceptable risk to terrestrial plants and invertebrates. The refined risk estimate, (HQ = 7.80; see Table 7-41), derived using the 95 percent UCL of the mean concentration (156 mg/kg), also indicates that vanadium may be presenting unacceptable risk to terrestrial plant and invertebrate populations.

The descriptive statistics presented in Table 7-42 for the SWMU 59 and background subsurface soil data sets show that vanadium concentrations in SWMU 59 subsurface soil collected during the 2010 CMS field investigation are not elevated relative to background concentrations. Maximum, arithmetic mean, and 95 percent UCL of the mean vanadium concentrations in SMWU 59 subsurface soil (282J mg/kg, 134 mg/kg, and 156 mg/kg, respectively) are less than maximum, arithmetic mean, and 95 percent UCL of the mean background concentrations (410 mg/kg, 209 mg/kg, and 253 mg/kg, respectively). The statistical tests that were used to evaluate the mean and right-tail of the SWMU and background data set distributions (Satterthwaite t-test, quantile test, and slippage test) also concluded that vanadium concentrations in SWMU 59 subsurface soil are not elevated relative to background concentrations (see Table 7-42).

Distribution tests indicate that the SWMU 59 data set follows a normal, lognormal, and gamma distribution. However, the normal, lognormal, and gamma probability plots included within Appendix J show that the data set best fit either a lognormal or gamma distribution. The log-normal and gamma probability plot shows that all data points fall on or near a straight line and follow a continuous distribution. Data points that exhibit these characteristics are likely to represent natural conditions (NFESC, 2002, 2003, and 2004). A box plot of log-transformed vanadium concentrations in SWMU 59 subsurface soil (see Appendix J) also indicates that there are no potential outliers within the SWMU data set at the upper end of the range.

In summary, based on the descriptive and distributional statistics presented in Table 7-42, the box plot depicting log-transformed data, which indicates that there are no potential outliers within the SWMU data set at the upper end of the range, as well as the lognormal and gamma probability plots, which indicate that detected concentrations likely represent natural conditions, vanadium is not identified as an ecological COC for SWMU 59 subsurface soil collected during the 2010 CMS field investigation. Therefore, no additional evaluation of this metal in subsurface soil adjacent to concrete pads and paved surfaces is recommended.

Zinc

Zinc was detected in twenty-three of twenty-three (23/23) subsurface soil samples at concentrations of 39.3 mg/kg (59SB20-01) to 242J mg/kg (59SB04-01). Four of the detections exceed the soil screening value of 120 mg/kg (USEPA, 2007g; see Figure 7-11). The Step 2 screening level risk estimate (HQ = 2.02; see Table 7-20), derived using the maximum detected concentration, indicates that zinc may be presenting unacceptable risk to terrestrial plants and invertebrates. However, the refined risk estimate (HQ = 0.88; see Table 7-41), derived using the 95 percent UCL of the mean concentration (105 mg/kg), indicates that zinc is not presenting unacceptable risk to terrestrial plant and invertebrate populations.

The descriptive statistics presented in Table 7-42 for the SWMU 59 and background subsurface soil data sets show that zinc concentrations in SWMU 59 subsurface soil collected during the 2010 CMS field investigation are elevated relative to background concentrations. Maximum, arithmetic mean, and 95 percent UCL of the mean zinc concentrations in SMWU 59 subsurface soil (242J mg/kg, 87.8 mg/kg, and 105 mg/kg, respectively) exceed maximum, arithmetic mean, and 95 percent UCL of the mean background concentrations (98J mg/kg, 38.1 mg/kg, and 47.6 mg/kg, respectively). The statistical tests that were used to evaluate the median and right-tail of

the SWMU and background data set distributions (i.e., Wilcoxon rank sum test, quantile test, and slippage test) also concluded that zinc concentrations in SWMU 59 subsurface soil are elevated relative to background concentrations.

Distribution tests indicate that the SWMU 59 data set follows a lognormal distribution. A box plot depicting log-transformed zinc concentrations (see Appendix J) shows that the maximum detected concentration (242J mg/kg in 59SB13-01) is elevated relative to other concentrations at the SWMU and may represent a potential outlier. The lognormal probability plot also indicates this data point may represent a potential outlier. However, the refined risk estimate indicates that zinc is not presenting unacceptable risk to terrestrial plant and invertebrate populations at the SWMU (HQ = 0.88). In addition, this metal was not detected in the co-located surface soil sample collected at soil boring location 59SB13 at a concentration greater than the ecological soil screening value or maximum background concentration, indicating that the elevated subsurface soil concentration at this boring location is not related to a release at the SWMU. Based on these considerations, zinc is not identified as an ecological COPC for SWMU 59 subsurface soil collected during the 2010 CMS field investigation. Therefore, no additional evaluation of this metal in subsurface soil adjacent to concrete pads and paved surfaces is recommended.

In summary, no chemicals were identified as ecological COCs for SWMU 59 subsurface soil collected during the 2010 CMS field investigation. Although acetone, bromomethane, carbon disulfide, chloromethane, methyl iodide, chromium, cobalt, copper, nickel, selenium, vanadium, and zinc were detected in SWMU 59 subsurface soil and identified as ecological COPCs in Step 2 of the ERA, they are not identified as ecological COCs based on the discussion presented in the preceding paragraphs, and no additional evaluation is recommended. No additional evaluation also is recommended for chemicals lacking usable data, as well as the non-detected SVOCs and organochlorine pesticides identified as ecological COPCs in Step 2 of the ERA because maximum RLs exceed soil screening values.

7.9.1.2.2 Subsurface Soil: 2012 CMS Field Investigation

Section 7.6.2.2.2 presented the results of the Step 2 screening level risk calculation for SWMU 59 subsurface soil collected during the 2012 CMS field investigation. Screening level risk estimates were also provided in Table 7-21. Chromium, cobalt, copper, nickel, selenium, vanadium, and 2,4-dimethylphenol were detected and identified as ecological COPCs for SWMU 59 subsurface soil collected during the 2012 CMS field investigation because maximum detected concentrations exceed soil screening values. The spatial extent of detected ecological COPC concentrations greater than soil screening values is depicted on Figure 7-12. Acetone was detected and identified as an ecological COPC based on the lack of a soil screening value. Finally, isobutanol and lead were identified as ecological COPCs based on the lack of any usable data with which to evaluate potential risks (all subsurface soil analytical data for isobutanol and lead were rejected during data validation activities).

Identical to surface soil collected during the 2012 CMS field investigation, all subsurface soil analytical data for isobutyl alcohol and lead were rejected during data validation activities. As such, these two chemicals were identified as ecological COPCs in Step 2 of the ERA based on the lack of any usable analytical data with which to evaluate potential risks. Given the industrial uses for isobutyl alcohol (see Section 7.9.1.1.1), this VOC is not likely to represent a site-related chemical and, therefore not likely to be present in abiotic media at the SWMU. In the case of lead, all subsurface soil analytical results were rejected because the MS/MSD pair exhibited percent recoveries that exceeded 200 percent. As discussed in Section 7.9.1.1.2, the high percent recoveries indicate that the matrix may be providing an additive effect and the reported values could be higher than what is actually present in the samples (Type I Error). Given that samples

results were rejected due to unacceptable high bias and all rejected data are less than the soil screening value, it is unlikely that lead is present at concentrations that would impact terrestrial plant and invertebrate populations. Based on the discussion presented above, isobutyl alcohol and lead are not identified as ecological COCs for subsurface soil collected during the 2012 CMS field investigation. Therefore, no additional evaluation of these two chemicals in subsurface soil beneath concrete pads and paved surfaces is recommended.

Acetone was detected in three of ten (3/10) subsurface soils samples collected during the 2012 CMS field investigation (14J µg/kg in 59SB30-01, 16J µg/kg in 59SB25-01, and 40J µg/kg in 59SB29-01). As discussed in Section 7.9.1.1.1, This VOC is relatively non-toxic to terrestrial plants in solution. The USEPA (2012a and 2012b) ECOSAR Class Program (Version 1.11) also indicates that acetone is relatively non-toxic to earthworms. Based on the low toxicity in solution to terrestrial plants and low predicted toxicity in solution to earthworms, acetone is not identified as an ecological COC for SWMU 59 subsurface soil collected during the 2012 CMS field investigation. Therefore, no additional evaluation of this VOC in subsurface soil adjacent to concrete pads and paved surfaces is recommended.

2.4-Dimethylphenol was detected and identified as an ecological COPC in Step 2 of the ERA because the single detected concentration (17J mg/kg in 59SB25-01) exceeds the soil screening value of 10 µg/kg (CCME, 2007). This SVOC was not detected in surface and subsurface soil collected during the 2010 CMS field investigation, nor was this SVOC detected in surface soil collected during the 2012 CMS field investigation, including the surface soil sample collected at boring location 59SB25. Based on the low magnitude of the single detected concentration above the soil screening value, as well as the low frequency of detection in soil at SWMU 59, 2,4-dimethylphenol is not identified as an ecological COC for subsurface soil collected during the 2012 CMS field investigation.

Chromium, cobalt, copper, nickel, selenium, and vanadium were identified as ecological COPCs in Step 2 of the ERA because maximum detected concentrations exceed soil screening values (see Table 7-21). To further evaluate the significance of potential risks presented by these metals, risk estimates were re-calculated using 95 percent UCL of the mean concentrations (see Table 7-43). It is acknowledged that terrestrial plants are immobile and many terrestrial invertebrates are relatively immobile; therefore, individuals are likely to be impacted by locations of maximum concentrations. However, as discussed in Section 7.9, evaluation of the 95 percent UCL of the mean exposure case is more indicative of the level of impact that might be expected at the population level. In addition to the re-calculation of risk estimates using 95 percent UCL of the mean concentrations, the subsurface soil data were statistically compared to the NAPR basewide background subsurface soil data set ("clay" data set) contained within the Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Chemicals (Baker, 2010b) in accordance with Navy guidance (NFESC, 2002). Supporting statistics for the SWMU and background subsurface soil data sets, including 95 percent UCL of the mean calculations, are provided in Appendix K. The risk evaluation also took into consideration the magnitude and spatial distribution of detected concentrations above soil screening values and/or background concentrations. The refined risk evaluation for chromium, cobalt, copper, nickel, selenium, and vanadium is presented below.

Chromium

Chromium was detected in ten of ten (10/10) subsurface soil samples at concentrations ranging from of 16 mg/kg (59SB32-01) to 120 mg/kg (59SB33-01). Six of the detected concentrations exceed the soil screening value of 57 mg/kg (USEPA, 2008; see Figure 7-12). The Step 2 screening level risk estimate (HQ = 2.11; see Table 7-21), derived using the maximum detected concentration, indicates that zinc may be presenting unacceptable risk to terrestrial plants and

invertebrates. The refined risk estimate (HQ = 1.40; see Table 7-43), derived using the 95 percent UCL of the mean concentration (79.9 mg/kg), also indicates that chromium may be presenting unacceptable risk to terrestrial plant and invertebrate populations.

The descriptive statistics presented in Table 7-44 for the SWMU 59 and background subsurface soil data sets show that chromium concentrations in SWMU 59 subsurface soil collected during the 2012 CMS field investigation are not elevated relative to background concentrations. Although arithmetic mean and 95 percent UCL of the mean chromium concentrations in SWMU 59 subsurface soil (59.6 mg/kg and 79.9 mg/kg, respectively) exceed arithmetic mean and 95 percent UCL of the mean background concentrations (37.3 mg/kg and 56.5 mg/kg, respectively), the maximum SWMU concentration (120 mg/kg) is less than the maximum background concentration (148J mg/kg). The statistical tests that were used to evaluate the median and right-tail of the SWMU and background data set distributions (i.e., Wilcoxon rank sum test, quantile test, and slippage test) were contradictory. Statistical tests evaluating the right-tail of the distributions (quantile test and slippage test) concluded that chromium concentrations in SWMU 59 subsurface soil are not elevated relative to background concentrations. However, the statistical test evaluating the median of the distributions (Wilcoxon rank sum test) concluded that chromium concentrations in SWMU 59 subsurface soil are elevated relative to background concentrations.

Distribution tests indicate that the SWMU 59 data set follows a normal, lognormal, and gamma distribution. However, the normal, lognormal, and gamma probability plots included within Appendix K show that the data set best fit a lognormal distribution. The log-normal probability plot shows that all data points fall on or near a straight line and generally follow a continuous distribution. Data points that exhibit these characteristics are likely to represent natural conditions (NFESC, 2002, 2003, and 2004). A box plot of log-transformed chromium concentrations in SWMU 59 subsurface soil (see Appendix K) also indicates that there are no potential outliers within the SWMU data set at the upper end of the range.

In summary, based on the descriptive statistics and statistical tests evaluating the right-tail of the distributions (see Table 7-44), the box plot depicting log-transformed data, which indicates that there are no potential outliers within the SWMU data set at the upper end of the range, as well as the lognormal probability plot, which indicates that detected concentrations likely represent natural conditions, chromium is not identified as an ecological COC for SWMU 59 subsurface soil collected during the 2012 CMS field investigation. Therefore, no additional evaluation of this metal in subsurface soil beneath concrete pads and paved surfaces is recommended.

<u>Cobalt</u>

Cobalt was detected in ten of ten (10/10) subsurface soil samples at concentrations ranging from of 3.5J mg/kg (59SB32-01) to 24J mg/kg (59SB25-01). Nine of the detected concentrations exceed the soil screening value of 13 mg/kg (USEPA, 2005d; see Figure 7-12). The Step 2 screening level risk estimate (HQ = 1.85; see Table 7-21), derived using the maximum detected concentration, indicates that cobalt may be presenting unacceptable risk to terrestrial plants and invertebrates. The refined risk estimate (HQ = 1.34; see Table 7-43), derived using the 95 percent UCL of the mean concentration (17.5 mg/kg), also indicates that this metal may be presenting unacceptable risk to terrestrial plant and invertebrate populations.

The descriptive statistics presented in Table 7-44 for the SWMU 59 and background subsurface soil data sets show that cobalt concentrations in SWMU 59 subsurface soil collected during the 2012 CMS field investigation are not elevated relative to background concentrations. Maximum, arithmetic mean, and 95 percent UCL of the mean cobalt concentrations in SMWU 59 subsurface

soil (24J mg/kg, 14.0 mg/kg, and 17.5 mg/kg, respectively) are less than or slightly elevated above maximum, arithmetic mean, and 95 percent UCL of the mean background concentrations (33.8 mg/kg, 9.15 mg/kg, and 18.3 mg/kg, respectively). The statistical tests that were used to evaluate the median and right-tail of the SWMU and background data set distributions (Wilcoxon rank sum test, quantile test, and slippage test) were contradictory. The statistical tests evaluating the right-tail of the distributions (quantile test and slippage test) both concluded that cobalt concentrations in SWMU 59 subsurface are not elevated relative to background concentrations. However, the statistical test evaluating the median of the SWMU and background data set distributions (Wilcoxon rank sum test) concluded that copper concentrations at the SWMU are elevated relative to background concentrations.

Distribution tests indicate that the SWMU 59 data set follows a normal distribution. A box plot of non-transformed cobalt concentrations in SWMU 59 subsurface soil (see Appendix K) indicates that the maximum detected concentration (24J mg/kg in 59SB25-01) is elevated relative to other detected concentrations at the SWMU, and may represent a potential outlier. It is noted that the normal probability plot included within Appendix K shows that the SWMU data set contains several populations (obvious inflection points are reflected by the data), supporting the identification of the maximum detected concentration as a potential outlier.

Although the SWMU data set contains a potential outlier, cobalt is not identified as an ecological COC for subsurface soil collected during the 2012 CMS field investigation based on the descriptive statistics summarized in Table 7-44, as well as the statistical tests evaluating the right-tail of the SWMU and background data set distributions. Therefore, no additional evaluation of this metal in subsurface soil beneath concrete pads and paved surfaces is recommended.

Copper

Copper was detected in ten of ten (10/10) subsurface soil samples at concentrations ranging from of 48 mg/kg (59SB31-01) to 210 mg/kg (59SB24-01). Seven of the detected concentrations exceed the soil screening value of 70 mg/kg (USEPA, 2007e; see Figure 7-12). The Step 2 screening level risk estimate (HQ = 3.00; see Table 7-21), derived using the maximum detected concentration, indicates that copper may be presenting unacceptable risk to terrestrial plants and invertebrates. The refined risk estimate (HQ = 1.87; see Table 7-43), derived using the 95 percent UCL of the mean concentration (131 mg/kg), also indicates that this metal may be presenting unacceptable risk to terrestrial plant and invertebrate populations.

The descriptive statistics presented in Table 7-44 for the SWMU 59 and background subsurface soil data sets show that copper concentrations in SWMU 59 subsurface soil collected during the 2012 CMS field investigation are not elevated relative to background concentrations. Maximum, arithmetic mean, and 95 percent UCL of the mean cobalt concentrations in SMWU 59 subsurface soil (210 mg/kg, 103 mg/kg, and 131 mg/kg, respectively) are less than maximum, arithmetic mean, and 95 percent UCL of the mean background concentrations (260J mg/kg, 105 mg/kg, and 135 mg/kg, respectively). The statistical tests that were used to evaluate the mean and right-tail of the SWMU and background data set distributions (two sample t-test, quantile test, and slippage test) also concluded that copper concentrations in SWMU 59 subsurface soil are not elevated relative to background concentrations (see Table 7-44).

Distribution tests indicate that the SWMU 59 data set follows a normal, lognormal, and gamma distribution. However, the normal, lognormal, and gamma probability plots included within Appendix K show that the data set best fits either a normal or gamma distribution. The normal probability plot shows that all data points fall on or near a straight line and generally follow a continuous distribution. Data points that exhibit these characteristics are likely to represent

natural conditions (NFESC, 2002, 2003, and 2004). A box plot of non-transformed copper concentrations in SWMU 59 subsurface soil (see Appendix K) also indicates that there are no potential outliers within the SWMU data set at the upper end of the range.

In summary, based on the descriptive statistics and statistical tests evaluating the right-tail of the distributions (see Table 7-44), the box plot depicting log-transformed data, which indicates that there are no potential outliers within the SWMU data set at the upper end of the range, as well as the lognormal probability plot, which indicates that detected concentrations likely represent natural conditions, copper is not identified as an ecological COC for SWMU 59 subsurface soil collected during the 2012 CMS field investigation. Therefore, no additional evaluation of this metal in subsurface soil beneath concrete pads and paved surfaces is recommended.

Nickel

Nickel was detected in ten of ten (10/10) subsurface soil samples at concentrations ranging from of 5.7 mg/kg (59SB32-01) to 44 mg/kg (59SB33-01). Two of the detected concentration exceed the soil screening value of 38 mg/kg (USEPA, 2007h; see Figure 7-12). The Step 2 screening level risk estimate (HQ = 1.16; see Table 7-21), derived using the maximum detected concentration, indicates that nickel may be presenting unacceptable risk to terrestrial plants and invertebrates. However, the refined risk estimate (HQ = 0.86; see Table 7-43), derived using the 95 percent UCL of the mean concentration (32.5 mg/kg) indicates that this metal is not presenting unacceptable risk to terrestrial plant and invertebrate populations.

The descriptive statistics presented in Table 7-44 for the SWMU 59 and background subsurface soil data sets show that nickel concentrations in SWMU 59 collected during the 2012 CMS field investigation are elevated relative to background concentrations. Maximum, arithmetic mean, and 95 percent UCL of the mean nickel concentrations in SMWU 59 subsurface soil (44 mg/kg, 25.4 mg/kg, and 32.5 mg/kg, respectively) exceed maximum, arithmetic mean, and 95 percent UCL of the mean background concentrations (35.6 mg/kg, 7.99 mg/kg, and 11.8 mg/kg, respectively). The statistical tests that were used to evaluate the mean and right-tail of the SWMU and background data set distributions (Wilcoxon rank sum test, quantile test, and slippage test) were contradictory. The slippage test concluded that nickel concentrations in SWMU 59 subsurface soil are not elevated relative to background concentrations. However, the Wilcoxon rank sum test and quantile test both concluded that nickel concentrations in SWMU 59 subsurface soil are elevated relative to background concentrations.

Distribution tests indicate that the SWMU 59 data set follows a normal, lognormal, and gamma distribution. However, the normal, lognormal, and gamma probability plots included within Appendix K show that the data set best fit a normal distribution. The normal probability plot shows that all data points fall on or near a straight line and generally follow a continuous distribution. Data points that exhibit these characteristics are likely to represent natural conditions (NFESC, 2002, 2003, and 2004). A box plot of non-transformed nickel concentrations in SWMU 59 subsurface soil (see Appendix K) also indicates that there are no potential outliers within the SWMU data set at the upper end of the range.

In summary, based on the refined risk estimate (HQ = 0.86), which does not indicate unacceptable risk to terrestrial plant and invertebrate populations, the box plot depicting non-transformed data, which indicates that there are no potential outliers within the SWMU data set at the upper end of the range, as well as the normal probability plot, which indicates that detected concentrations likely represent natural conditions, nickel is not identified as an ecological COC for SWMU 59 subsurface soil collected during the 2012 CMS field investigation. Therefore, no

additional evaluation of this metal in subsurface soil beneath concrete pads and paved surfaces is recommended.

Selenium

Selenium was detected in four of ten (10/10) subsurface soil samples at concentrations ranging from of 0.49J mg/kg (59SB30-01) to 0.69 mg/kg (59SB25-01). Three of the detected concentrations exceed the soil screening value of 0.52 mg/kg (USEPA, 2007f; see Figure 7-12). The Step 2 screening level risk estimate (HQ = 1.33; see Table 7-21), derived using the maximum detected concentration, indicates that selenium may be presenting unacceptable risk to terrestrial plants and invertebrates. A refined risk estimate was not derived for selenium because there are less than eight detected values within the data set.

The descriptive statistics presented in Table 7-44 show that selenium concentrations in SWMU 59 subsurface soil collected during the 2012 CMS field investigation are not elevated relative to background concentrations. Maximum and arithmetic mean selenium concentrations in SMWU 59 subsurface soil (0.69 mg/kg and 0.43 mg/kg, respectively) are less than maximum and arithmetic mean background concentrations (3.8J mg/kg and 0.90 mg/kg, respectively).

A statistical evaluation of the mean/median and right-tail of the of the SWMU and background data set distributions was not be performed due to the low frequency of detection within the SWMU and background data sets (40 percent and 30 percent respectively). Regardless, based on the comparison of the maximum detected concentration in the SWMU data set to the maximum detected concentration in the background data set, selenium is not identified as an ecological COC for SWMU 59 subsurface soil collected during the 2012 CMS field investigation. Therefore, no additional evaluation of this metal in subsurface soil beneath concrete pads and paved surfaces is recommended.

Vanadium

Vanadium was detected in ten of ten (10/10) subsurface soil samples at concentrations ranging from of 110 mg/kg (59SB28-01) to 400 mg/kg (59SB33-01). Each of the detections exceeds the soil screening value of 20 mg/kg (USEPA, 2005b; see Figure 7-12). The Step 2 screening level risk estimate (HQ = 20.00; see Table 7-21), derived using the maximum detected concentration, indicates that vanadium may be presenting unacceptable risk to terrestrial plants and invertebrates. The refined risk estimate (HQ = 13.82; see Table 7-43), derived using the 95 percent UCL of the mean concentration (276 mg/kg) also indicates that this metal may be presenting unacceptable risk to terrestrial plant and invertebrate populations.

The descriptive statistics presented in Table 7-44 for the SWMU 59 and background subsurface soil data sets show that vanadium concentrations in SWMU 59 subsurface soil collected during the 2012 CMS field investigation are not elevated relative to background concentrations. Maximum, arithmetic mean, and 95 percent UCL of the mean nickel concentrations in SMWU 59 subsurface soil (400 mg/kg, 223 mg/kg, and 276 mg/kg, respectively) are less than or slightly elevated above maximum, arithmetic mean, and 95 percent UCL of the mean background concentrations (410 mg/kg, 209 mg/kg, and 253 mg/kg, respectively). The statistical tests that were used to evaluate the mean and right-tail of the SWMU and background data set distributions (two sample t-test, quantile test, and slippage test) also concluded that vanadium concentrations in SWMU 59 subsurface soil are not elevated relative to background concentrations.

Distribution tests indicate that the SWMU 59 data set follows a normal, lognormal, and gamma distribution. The normal, lognormal, and gamma probability plots included within Appendix K

show that the data set best fit a lognormal distribution. The lognormal probability plot shows that all data points fall on or near a straight line and generally follow a continuous distribution. Data points that exhibit these characteristics are likely to represent natural conditions (NFESC, 2002, 2003, and 2004). Box plots depicting non-transformed and log-transformed vanadium concentrations in SWMU 59 subsurface soil (see Appendix K) also indicate that there are no potential outliers within the SWMU data set at the upper end of the range.

Based on the descriptive and distributional statistics summarized in Table 7-44, Box plots depicting non-transformed and log-transformed data, which indicate that there are no potential outliers within the SWMU data set at the upper end of the range, as well as the lognormal probability plot, which indicates that detected concentrations likely represent natural conditions, vanadium is not identified as an ecological COC for SWMU 59 subsurface soil collected during the 2012 CMS field investigation. Therefore, no additional evaluation of this metal in subsurface soil beneath concrete pads and paved surfaces is recommended.

In summary, no chemicals are identified as ecological COCs for SWMU 59 subsurface soil collected during the 2012 CMS field investigation. Although acetone, 2,4-dimethylphenol, chromium, cobalt, copper, nickel, selenium, and vanadium were detected in SWMU 59 subsurface soil and identified as ecological COPCs in Step 2 of the ERA, they are not identified as ecological COCs based on the discussion presented in the preceding paragraphs, and no additional evaluation is recommended. No additional evaluation also is recommended for chemicals lacking usable data.

7.9.1.3 Step 3a Risk Evaluation for Groundwater

Section 7.6.2.3 presented the results of the Step 2 screening level risk calculation for SWMU 59 groundwater. Screening level risk estimates (i.e., HQ values) were also provided in Table 7-22. Alpha-chlordane, copper, and vanadium were detected and identified as ecological COPCs for SWMU 59 groundwater because maximum detected concentrations exceed groundwater screening values. The spatial extent of detected ecological COPC concentrations greater than groundwater screening values is depicted on Figure 7-13. Seventeen non-detected SVOCs and sixteen non-detected organochlorine pesticides were identified as ecological COPCs because maximum RLs exceed groundwater screening values. All groundwater analytical data for seven VOCs (1,4-dioxane, 2-butanone, acetone, acrolein, acrylonitrile, isobutyl alcohol, and propionitrile), one SVOC (1,4-phenylenediamine), and two metals (mercury and zinc) were rejected during data validations activities (see Appendix D). Based on the lack of any usable data with which to evaluate potential risks, these seven VOCs and two metals were also identified as ecological COPCs for SWMU 59 groundwater.

The refined risk calculation for SWMU 59 groundwater is presented in Table 7-45. As discussed in Section 7.9, risk estimates for groundwater were re-calculated using 95 percent UCL of the mean concentrations for those ecological COPCs having a minimum of eight detected values and less than 70 percent non-detected results (copper and vanadium). Additional refinements that were applied in Step 3a of the BERA are presented and discussed within Section 7.9.

As indicated above, all groundwater analytical data for seven VOCs (1,4-dioxane, 2-butanone, acetone, acrolein, acrylonitrile, isobutyl alcohol, and propionitrile) and one SVOC (1,4-phenylenediamine) were rejected during data validation activities. Based on the industrial uses of 1,4-dioxane, acrolein, isobutyl alcohol, propionitrile, and 1,4-phenylenediamine (see Section 7.9.1.1.1), as well as propionitrile (see Section 7.9.1.2.1), these six organic chemicals are not likely to be present in groundwater. 2-Butanone and acrylonitrile were not detected in surface or subsurface soil collected during the 2004 Phase II ECP field investigation, nor were these VOCs

detected in surface or subsurface soil collected during the 2010 and 2012 CMS field investigations (see Appendix B). Based on the lack of detections in surface and subsurface soil, these two VOCs are not likely to be present in groundwater.

Acetone was detected in thirteen of nineteen (13/19) surface soil samples, four of forty-six (4/46) subsurface soil samples (all depth intervals), and three of three (3/3) sediment samples collected during the 2010 CMS field investigation. The high frequency of detection in soil/sediment can be attributed to the method of preservation used for VOCs (SW-846 method 5035). This method of VOC preservation includes the use of sodium bisulfate. Acetone production due to sodium bisulfate preservation is documented in the literature (Clausen et al., 2004), and is formed from the interaction of sodium bisulfate with naturally occurring organic matter. Acetone was also detected in four of ten (4/10) surface soil samples and three of ten (3/10) subsurface soil samples collected during the 2012 CMS field investigation. Detections in these soil samples cannot be attributed to sodium bisulfate since this compound was not used as a VOC preservative. However, given the low magnitude of these detections (concentrations range from 15J µg/kg to 45J µg/kg in surface soil and 14J µg/kg to 40J µg/kg in subsurface soil), acetone is not likely to be migrating with infiltrating precipitation to groundwater at concentrations that would impact aquatic receptor groups within the downgradient marine habitats.

Mercury and zinc were identified as ecological COPCs for SWMU 59 groundwater data because all total recoverable groundwater data for these two metals were rejected during data validation activities. As evidenced by Appendix B, all dissolved mercury analytical data also were rejected during data validation activities. Although there are no usable analytical data for mercury (total recoverable or dissolved fractions), the descriptive statistics presented in Tables 7-38 and 7-39 for SWMU 59 surface soil, as well as the descriptive statistics presented in Tables 7-41 and 7-43 for SWMU 59 subsurface soil indicate that mercury is not migrating with infiltrating precipitation to SWMU 59 groundwater at concentrations greater than what would be expected under background conditions. As evidenced by the tables, maximum mercury concentrations in each SWMU 59 soil data set (surface soil collected from the 0.0 to 1.0-foot depth interval and subsurface soil collected from the 1.0 to 3.0-foot depth interval during the 2010 and 2012 CMS field investigations) are less than maximum background concentrations. The maximum detected mercury concentration in subsurface soil collected at depths deeper than 3.0-feet bgs (0.15 mg/kg in 56SB06-03) is also less than the maximum detected concentration within the background subsurface soil data set (0.17J mg/kg). Given that mercury was not detected in SWMU 59 surface and subsurface soil at concentrations elevated above background concentrations, this metal is not identified as an ecological COC for SWMU 59 groundwater, and no additional evaluation is recommended. The 2004 Phase II ECP groundwater analytical data support this recommendation. As evidenced by Appendix B, total recoverable mercury was not detected in SWMU 59 groundwater collected during this investigation.

Zinc was detected within the dissolved fraction of seven groundwater samples at concentrations ranging from 2.6J µg/L (59GW03) to 13.4J µg/L (59GW01). The maximum detected concentration is less than the chronic saltwater NAWQC (CCC value) for this metal expressed as a dissolved concentration (81 µg/L; USEPA 2013b), indicating that zinc is not presenting unacceptable risk to aquatic receptor group populations residing within estuarine and open water marine habitats downgradient from SWMU 59. The descriptive statistics presented in Table 7-46 also show that dissolved zinc concentrations in SWMU 59 groundwater are not elevated relative to background concentrations. Specifically maximum and arithmetic mean zinc concentrations within the dissolved fraction of SWMU 59 groundwater (13.4J µg/L and 4.89 µg/L, respectively) are less than maximum and arithmetic mean zinc concentrations within the dissolved fraction of background groundwater (492 µg/L and 62.6 µg/L, respectively). Based on a comparison of the maximum detected zinc concentration within the dissolved fraction of SWMU 59 groundwater to

the USEPA CCC value expressed as a dissolved concentration, as well as the descriptive statistics presented in Table 7-46, zinc is not identified as an ecological COC for SWMU 59 groundwater, and no additional evaluation of this metal is recommended.

Seventeen non-detected SVOCs (1,2,4-trichlorobenzene, 2,3,4,6-tetrachlorophenol, 2,4-dichlorophenol, 2-chloronaphthalene, 3,3'-dichlorobenzidine, 4-bromophenyl-phenylether, 4-chloro-3-methylphenol, aramite, benzo[a]anthracene, di-n-butylphthalate, dinoseb, hexachlorobenzene, hexachloro-1,3-butadiene, hexachlorocyclopentadiene, o-toluidine, pentachloronitrobenzene, and pentachlorophenol) were identified as ecological COPCs because maximum RLs exceed groundwater screening values. With the exception of benzo(a)anthracene, none of these SVOCs were detected in soil collected from all depth intervals during the 2010 and 2012 CMS field investigations, nor were they detected in soil collected during the 2004 Phase II ECP field investigation (see Appendix B). The absence of detected concentrations in surface and subsurface soil indicates that these non-detected SVOCs are not likely to represent site-related chemicals, nor are they likely to be present in groundwater. For this reason, they are not identified as ecological COCs for SWMU 59 groundwater, and no additional evaluation is recommended

Benzo(a)anthracene was identified as an ecological COPC in Step 2 of the ERA because the maximum RL in groundwater (0.21 µg/L) exceeds the groundwater screening value (0.025 µg/L). Benzo(a)anthracene was detected in twelve of nineteen (12/18) surface soil samples and eight of forty-six (8/46) subsurface soil samples (all depth intervals) collected during the 2010 CMS field investigation (see Appendix B). This PAH was not detected in surface or subsurface soil collected during the 2012 CMS field investigation. The screening value used in the Step 2 screening level risk calculation represents a SCV reported by Suter II, G.W. and Tsao (1996) and selected by the USEPA Region 5 (2003b) as a surface water ESL. A more recent Tier II value is available from the GLI Toxicity Data Clearinghouse (USEPA, 2011b). This chronic Tier II value (4.7 µg/L), derived by the OEPA, is over and order of magnitude greater than the maximum RL (0.21 µg/L). As such, benzo(a)anthracene is not likely to be present in SWMU 59 groundwater at concentrations that would be expected to impact aquatic receptors within the downgradient marine habitats.

Sixteen non-detected pesticides (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, gamma-BHC, gamma-chlordane, dieldrin, endosulfan I, endosulfan II, endrin, endrin aldehyde, heptachlor, heptachlor epoxide, isodrin, kepone, methoxychlor, and toxaphene) were identified as ecological COPCs because maximum RLs exceed groundwater screening values. Gamma-BHC, endosulfan I, endosulfan II, heptachlor epoxide, isodrin, kepone, and toxaphene were not detected in surface soil or subsurface soil (all depth intervals) collected during the 2010 CMS field investigation at SWMU 59, nor were they detected in surface and subsurface soil collected during the 2004 Phase II ECP field investigation (see Appendix B). The absence of detected concentrations in surface and subsurface soil indicates that these non-detected pesticides are not likely to be present in SWMU 59 groundwater. 4.4'-DDD, 4,4'-DDE, 4,4'-DDT, gamma-chlordane, dieldrin, endrin, endrin aldehyde, heptachlor, and methoxychlor were detected in one or more of the surface and/or subsurface soil samples collected at SWMU 59 during the 2010 CMS field investigation. However, log K_{ow} values for these pesticides (see Table 7-3) indicate that they have a high affinity for adsorption to soil particles and are not likely to migrate with infiltrating precipitation to groundwater at ecologically important concentrations. This can be illustrated by analytical data for soil collected at soil boring location 59SB15. 4,4'-DDD, was detected at 8.1J µg/kg and 4,4'-DDE and 4,4'-DDT were each detected at 160 µg/kg in the surface soil sample collected from the 0.0 to 1.0-foot depth interval (59SB15-00). These detections in 59SB15-00 represent maximum detected surface soil concentrations at the SWMU. However, 4,4'-DDD and 4,4'-DDT were not detected in the subsurface soil sample collected from the 1.0 to 3.0-foot depth interval

(59SB15-01), while 4,4'-DDE was detected at a concentration over two orders of magnitude lower than that detected in the surface soil sample (0.66J µg/kg). None were detected in the subsurface soil sample collected from the 9.0 to 11.0-foot depth interval (59SN15-05). Based on the absence of detections in SWMU 59 surface and subsurface soil (in the case of gamma-BHC, endosulfan I, endosulfan II, heptachlor epoxide, isodrin, kepone, and toxaphene) and their physical properties, the non-detected organochlorine pesticides are not identified as ecological COCs for SWMU 59 groundwater, and no additional evaluation is recommended.

Alpha-chlordane was detected in one of ten (1/10) groundwater samples at a concentration of 0.016NJ µg/L (59GW04). This single detection exceeds the groundwater screening value of 0.004 µg/L (PREQB, 2010; see Figure 7-13). The PRWQS for alpha-chlordane represents a NRWQC (USEPA, 2013b) derived using the Final Residual Value (FRV) procedure. NRWQC derived using the FRV procedures are based on the protection of piscivorous organisms (e.g., birds) rather than the protection of aquatic organisms (e.g., fish and invertebrates). A search of the literature did not identify any toxicological thresholds that are based on the protection of aquatic invertebrates, amphibians, or fish. However, limited toxicological data for a single fish species (bluegill [*Lepomis macrochirus*]) are identified from the ECOTOX Release 4.0 Database System (USEPA, 2007a). Specifically, two 96-hour LC_{50} values (7.09 µg/L and 7.4 µg/L). Estimated chronic values (0.0709 µg/L and 0.074 µg/L), derived by applying a safety factor of 100 to the bluegill LC_{50} values (USEPA, 1997 and Wentsel et al., 1996), exceed the single detection in SWMU 59 groundwater (0.016NJ µg/L). This comparison indicates that alpha-chlordane in groundwater discharging to surface water within the downgradient marine habitats undiluted would not impact aquatic receptor groups. Based on the comparison of the single detected concentration to chronic values estimated from the bluegill LC_{50} values identified from the ECOTOX Release 4.0 Database System (USEPA, 2007a), alpha-chlordane is not identified as an ecological COC for SWMU 59 groundwater, and no additional evaluation is recommended. It is noted that the "NJ" qualifier indicates that the presence or identity of alpha-chlordane in groundwater sample 59GW04 is in doubt. As such, there is significant uncertainty associated with the reported concentration.

Copper and vanadium were identified as ecological COPCs in Step 2 of the ERA because maximum detected total recoverable concentrations exceed soil screening values (see Table 7-22). To further evaluate the significance of potential risks presented by these metals, risk estimates were re-calculated using 95 percent UCL of the mean concentrations (see Table 7-45). In addition to the re-calculation of risk estimates using 95 percent UCL of the mean concentrations, the total recoverable groundwater data were statistically compared to the NAPR basewide background groundwater data set contained within the Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Chemicals (Baker, 2010b) in accordance with Navy guidance (NFESC, 2004). Supporting statistics for the SWMU and background groundwater data sets, including 95 percent UCL of the mean calculations, are provided in Appendix L. The refined risk evaluation for copper and vanadium is presented below.

Copper

Total recoverable copper was detected in ten of ten (10/10) SWMU 59 groundwater samples at concentrations ranging from 3.9 µg/L (59GW08) to 21.3 µg/L (59GW01). Each of the detected concentrations exceeds the groundwater screening value of 3.73 µg/L (PREQB, 2010; see Figure 7-13). The Step 2 screening level risk estimate (HQ = 5.71; see Table 7-22), derived using the maximum detected concentration, indicates that copper may be presenting unacceptable risk to aquatic receptor groups within downgradient marine habitats. The refined risk estimate (HQ = 3.77; see Table 7-45), derived using the 95 percent UCL of the mean concentration (14.1 µg/L)

also indicates that this metal may be presenting unacceptable risk to aquatic receptor group populations within downgradient marine habitats.

The descriptive statistics presented in Table 7-46 for the SWMU 59 and background groundwater data sets show that total recoverable and dissolved copper concentrations in SWMU 59 groundwater are not elevated relative to background concentrations. Maximum, arithmetic mean, and 95 percent UCL of the mean total recoverable copper concentrations in SMWU 59 groundwater (21.3 µg/L, 9.51 µg/L, and 14.1 µg/L, respectively) are less than maximum, arithmetic mean, and 95 percent UCL of the mean background concentrations (352 µg/L, 114 µg/L, and 172 µg/L, respectively). Maximum and arithmetic mean dissolved copper concentrations in SWMU 59 groundwater (19 µg/L and 7.33 µg/L, respectively) are also less than maximum and arithmetic mean background concentrations (496J µg/L and 53.3 µg/L, respectively). The statistical tests that were used to evaluate the median and right-tail of the total recoverable SWMU and background data set distributions (Wilcoxon rank sum test, quantile test, and slippage test) also concluded that total recoverable copper concentrations in SWMU 59 groundwater are not elevated relative to total recoverable background concentrations. Statistical tests evaluating the mean/median and right-tail of the dissolved SWMU and background data set distributions were not performed due to the low frequency of detection within the background data set (41.7 percent). Based on the descriptive and distributional statistics presented within Table 7-46, copper is not identified an ecological COC for SWMU 59 groundwater, and no additional evaluation of this metal is recommended.

Vanadium

Total recoverable vanadium was detected in ten of ten (10/10) SWMU 59 groundwater samples at concentrations ranging from 9.2 µg/L (59GW02) to 171 µg/L (59GW10). Nine of the detected concentrations exceed the groundwater screening value of 12 µg/L (USEPA, 2003b; see Figure 7-13). The Step 2 screening level risk estimate (HQ = 14.25; see Table 7-22), derived using the maximum detected concentration, indicates that vanadium may be presenting unacceptable risk to aquatic receptor groups within downgradient marine habitats. The refined risk estimate (HQ = 7.83; see Table 7-45), derived using the 95 percent UCL of the mean concentration (93.3 µg/L) also indicates that this metal may be presenting unacceptable risk to aquatic receptor group populations within downgradient marine habitats.

The descriptive statistics presented in Table 7-46 for the SWMU 59 and background groundwater data sets show that total recoverable and dissolved vanadium concentrations in SWMU 59 groundwater are not elevated relative to background concentrations. Maximum, arithmetic mean, and 95 percent UCL of the mean total recoverable vanadium concentrations in SMWU 59 groundwater (171 µg/L, 63.3 µg/L, and 93.3 µg/L, respectively) are less than maximum, arithmetic mean, and 95 percent UCL of the mean background concentrations (549 µg/L, 161 µg/L, and 249 µg/L, respectively). Although the arithmetic mean dissolved vanadium concentration in SWMU 59 groundwater (65.6 µg/L) exceeds the arithmetic mean background concentration (39.0 µg/L), the maximum dissolved concentration (179 µg/L) is less than the maximum background concentration (265 µg/L). The statistical tests that were used to evaluate the median and right-tail of the total recoverable SWMU and background data set distributions (Wilcoxon rank sum test, quantile test, and slippage test) also concluded that total recoverable vanadium concentrations in SWMU 59 groundwater are not elevated relative to total recoverable background concentrations. Identical to copper, statistical tests evaluating the mean/median and right-tail of the dissolved SWMU and background data set distributions were not performed due to the low frequency of detection within the background data set (50 percent). Based on the descriptive and distributional statistics presented within Table 7-46, vanadium is not identified an

ecological COC for SWMU 59 groundwater, and no additional evaluation of this metal is recommended.

In summary, no chemicals were identified as ecological COCs for SWMU 59 groundwater. Although alpha-chlordane, copper, and vanadium were detected and identified as ecological COPCs in Step 2 of the ERA, they are not considered ecological COCs based on the discussion presented in the preceding paragraphs, and no additional evaluation is recommended. No additional evaluation is also recommended for chemicals lacking usable data, as well as the non-detected SVOCs and organochlorine pesticides identified as ecological COPCs in Step 2 of the ERA because maximum RLs exceed groundwater screening values.

7.9.1.4 Drainage Ditch Surface Water

Section 7.6.2.4 presented the results of the Step 2 screening level risk calculation for drainage ditch surface water. Screening level risk estimates were also provided in Table 7-23. 4,4'-DDE, 4,4'-DDT, and copper were detected and identified as ecological COPCs because maximum detected concentrations exceed screening values. The spatial extent of detected ecological COPC concentrations greater than groundwater screening values is depicted on Figure 7-14. Twenty-two non-detected SVOCs, fourteen non-detected pesticides, and three non-detected metals (cadmium, lead, and silver) were identified as ecological COPCs because maximum RLs exceed surface water screening values. Finally, 1,4-dioxane, 2-butanone, acetone, acrolein, acrylonitrile, isobutyl alcohol, propionitrile, and 1,4-phenylenediamine were identified as ecological COPCs based on the lack of any usable data with which to evaluate potential risks (all surface water analytical data for these eight organic chemicals were rejected during data validation activities).

As indicated above, seven VOCs (1,4-dioxane, 2-butanone, acetone, acrolein, acrylonitrile, isobutyl alcohol, and propionitrile) and one SVOC (1,4-phenylenediamine) were identified as ecological COPCs for drainage ditch surface water in Step 2 of the ERA because all analytical data were rejected during data validation activities. However, for the reasons discussed in Sections 7.9.1.1.1, 7.9.1.2.1 and/or 7.9.1.3, these eight organic chemicals are not likely to represent site-related chemicals, nor are they likely to be present in abiotic media due to a release at the SWMU. As such, 1,4-dioxane, 2-butanone, acetone, acrolein, acrylonitrile, isobutyl alcohol, propionitrile, and 1,4-phenylenediamine are not identified as ecological COCs for drainage ditch surface water, and no additional evaluation is recommended.

Twenty-two non-detected SVOCs (1,2,4,5-tetrachlorobenzene, 1,4-naphthoquinone, 2,3,4,6-tetrachlorophenol, 2,4,6-trichlorophenol, 2,4-dinitrophenol, 3,3'-dichlorobenzidine, 4-bromophenyl-phenylether, 4-chloro-3-methylphenol, aniline, anthracene, aramite, benzo[a]anthracene, benzo[a]pyrene, bis[2-ethylhexyl]phthalate, dibenzofuran, dinoseb, hexachloro-1,3-butadiene, hexachlorobenzene, hexachlorocyclopentadiene, pentachlorobenzene, pentachloronitrobenzene, and pronamide) were identified as ecological COPCs because maximum RLs exceed surface water screening values. With the exception of anthracene, benzo(a)anthracene, benzo(a)pyrene, bis(2-ethylhexyl)phthalate, dibenzofuran, and pentachlorobenzene, none of these SVOCs were detected in surface soil, subsurface soil (all depth intervals), or groundwater collected during the 2010 and 2012 CMS field investigations, nor were they detected in surface soil, subsurface soil (all depth intervals), or groundwater collected during the 2004 Phase II ECP field investigation (see Appendix B). The absence of detected concentrations in SWMU 59 surface soil, subsurface soil, and groundwater indicates that these SVOCs are not likely to represent site-related chemicals, nor are they likely to be present in abiotic media at the SWMU. Based on the absence of detections in SWMU 59 surface soil, subsurface soil, and groundwater, 1,2,4,5-tetrachlorobenzene, 1,4-naphthoquinone, 2,3,4,6-tetrachlorophenol, 2,4,6-trichlorophenol, 2,4-dinitrophenol, 3,3'-dichlorobenzidine, 4-bromophenyl-phenylether, 4-chloro-3-methylphenol, aniline, aramite, dinoseb, hexachloro-1,3-

butadiene, hexachlorobenzene, hexachlorocyclopentadiene, pentachloronitrobenzene, and pronamide are not identified as ecological COCs for drainage ditch surface water, and no additional evaluation is recommended.

Anthracene, benzo(a)anthracene, benzo(a)pyrene, bis(2-ethylhexyl)phthalate, and dibenzofuran were detected in SWMU 59 surface soil collected during the 2010 CMS field investigation, 2012 CMS field investigation, and/or 2004 Phase II ECP investigation (see Appendix B), indicating that these organic chemicals have the potential to migrate with storm water to drainage ditch surface water. The surface water screening values used in the screening level risk calculation for anthracene, benzo(a)anthracene, benzo(a)pyrene, and dibenzofuran are Tier II SCVs adopted for use as ESLs by USEPA Region 5 (2003b). The anthracene SCV represents a Minnesota water quality standard published in 2003, the benzo(a)anthracene SCV represents an Indiana Department of Environmental Management (IDEM) Great Lakes basin Tier II value published in 2002, the benzo(a)pyrene SCV was developed by Suter II, G.W. and Tsao (1996), while the dibenzofuran and pentachlorobenzene SCVs represents a Michigan water quality standards published in 2003. The screening value used in screening level risk calculation for bis(2-ethylhexyl)phthalate (0.3 µg/L) also represents a USEPA Region 5 (2003b) ESL. The ESL is based on a chronic value (3.0 µg/L) reported in USEPA (1986) with a safety factor of ten. More recent Tier II values (chronic aquatic values [CAVs]) developed by the OEPA are available from the GLI Toxicity Data Clearinghouse (USEPA, 2011b) for anthracene, benzo(a)pyrene, benzo(a)anthracene, and dibenzofuran: 0.03 µg/L, 0.06 µg/L, 4.7 µg/L, and 4.0 µg/L, respectively. A Tier I chronic aquatic criterion (CAC) developed by the OEPA is also available from the GLI Toxicity Data Clearinghouse for bis(2-ethylhexyl)phthalate (8.4 µg/L). A comparison of these more recent toxicological thresholds to maximum RLs is provided in the table below:

Chemical	Maximum Reporting Limit (µg/L)	OEPA Value/Criterion (µg/L)	Description
Anthracene	0.21	0.03	Tier II CAV
Benzo(a)anthracene	0.21	4.7	Tier II CAV
Benzo(a)pyrene	0.21	0.06	Tier II CAV
Bis(2-ethylhexyl)phthalate	5.1	8.4	Tier I CAC
Dibenzofuran	5.1	4.0	Tier II CAV

As evidenced by the table above, maximum reporting limits for benzo(a)anthracene and bis(2-ethylhexyl)phthalate are less than their respective OEPA criterion. For this reason, these two SVOCs are not identified as ecological COCs for drainage ditch surface water, and no additional evaluation is recommended.

Although maximum RLs for anthracene, benzo(a)pyrene, and dibenzofuran exceed their respective OEPA Tier II CAVs, these three SVOCs also are not identified as ecological COCs. This determination is based, in part, on the conservative procedure used in the derivation of OEPA Tier II CAVs (see Chapter 3745-1-35 of the Ohio Administrative Code [OAC]). No chronic toxicity data were available for the derivation of the anthracene, benzo(a)pyrene, and dibenzofuran Tier II CAVs. Therefore, the OEPA derived Tier II CAVS from available acute toxicity data (LC_{50} and/or EC_{50} values). In the case of anthracene and dibenzofuran, acute values were available for two species (anthracene: cladoceran [*Daphnia magna*] and bluegill [*Lepomis macrochirus*]; dibenzofuran: *Daphnia magna* and fathead minnow [*Pimephales promelas*]). For benzo(a)pyrene, acute values were available for three species (*Daphnia magna*, amphipod [*Gammarus pulex*], and midge [*Chironomus thummi*]). For each chemical, a secondary acute value (SAV) was estimated by dividing the minimum genus mean acute value (GMAV) by a

factor of thirteen. A Tier II CAV for each species was then estimated by dividing the SAVs by a factor of 18 (an assumed secondary acute-to-chronic ratio [SACR]). The physical properties of these three SVOCs also indicate that they are not likely to be dissolved within the water column at ecologically important concentrations. Specifically, log K_{ow} and K_{oc} values for anthracene, benzo(a)pyrene, and dibenzofuran (see Table 7-3) indicate that these three SVOCs have a high affinity for adsorption to sediment particles. Based on the lack of detections in drainage ditch surface water, the comparison of maximum RLs to the OEPA criterion identified above, the conservatism of the OEPA CAVs, which likely overstate their toxicity to aquatic life, and/or their physical properties, anthracene, benzo(a)pyrene, and dibenzofuran are not identified as ecological COCs for drainage ditch surface water, and no additional evaluation is recommended.

Pentachlorobenzene was detected in a single subsurface soil sample collected during the 2012 CMS field investigation (5.6J mg/kg in 59SB24-01). This SVOC was not detected in surface soil collected during the 2010 and 2012 CMS field investigations. Based on the location of the single detected concentration (subsurface soil beneath concrete pads and paved surfaces), as well as the lack of detections in surface soil, it is unlikely that pentachlorobenzene is migrating with storm water to drainage ditch surface water. For this reason, pentachlorobenzene is not identified as an ecological COC for drainage ditch surface water.

Fourteen non-detected pesticides (4,4'-DDD, aldrin, gamma-BHC, alpha-chlordane, dieldrin, gamma-chlordane, endosulfan II, endrin, endrin aldehyde, heptachlor, heptachlor epoxide, isodrin, methoxychlor, and toxaphene) were identified as ecological COPCs in Step 2 of the ERA because maximum TLs exceed screening values. Aldrin, gamma-BHC, dieldrin, endosulfan II, heptachlor epoxide, isodrin, and toxaphene were not detected in SWMU 59 surface soil, subsurface soil (all depth intervals), or groundwater collected during the 2010 CMS field investigation (see Appendix B). In addition, these seven pesticides were not detected in surface soil, subsurface soil, or groundwater collected during the 2004 Phase II ECP field investigation.

Endrin and heptachlor were not detected in SWMU 59 surface soil or groundwater collected during the 2010 CMS field investigation. Although detected in subsurface soil (see Appendix B), detections were of a low magnitude and frequency (both were detected in one of forty-six [1/46] subsurface soil samples: endrin was detected in 59SB04-01 at 0.56J µg/kg, while heptachlor was detected in 59SB13-01 at 0.22J µg/kg). Gamma-chlordane, endrin aldehyde, and methoxychlor also were detected in SWMU 59 soil collected during the 2010 CMS field investigation at a low frequency and magnitude. Gamma-chlordane was detected in two of nineteen [2/19] surface soil sample (0.56J µg/kg in 59SB04-01 and 0.22J µg/kg in 59SB13-01, endrin aldehyde was detected in one of twelve surface soil samples (1.8J µg/kg in 59SB09-00) and three of forty-four [3/44] subsurface soil samples (0.46J µg/kg in 59SB05-01, 0.54J µg/kg in 59SB10-01) and 0.53J µg/kg in 59SB18-01), while methoxychlor was detected in one of nineteen [1/19] surface soil samples (26NJ µg/kg in 59SB11-00). These five organochlorine pesticides were not detected in SWMU 59 groundwater collected during the 2010 CMS field investigation, nor were they detected in SWMU 59 surface soil, subsurface soil, and groundwater collected during the 2004 Phase II ECP field investigation. The analytical data for these five pesticides indicate that are not likely to be site-related chemicals, nor are they likely to be present in drainage ditch surface water at ecologically important concentrations. It is noted that log K_{ow} and K_{oc} values for all of the non-detected pesticides (see Table 7-3) indicate that they have a high affinity for adsorption to sediment particles and are not likely to be found within the dissolved fraction of drainage ditch surface water.

Of the fourteen non-detected pesticides, 4,4'-DDD and alpha-chlordane had the highest frequency of detection in SWMU 59 soil. 4,4'-DDD was detected in four surface soil samples at concentrations ranging from 0.6J µg/kg (59SB02-00) to 8.1J µg/kg (59SB15-00) and one

subsurface soil sample at 0.39J µg/kg (59SB18-01), while alpha-chlordane was detected in seven surface soil samples at concentrations ranging from 0.25J µg/kg (59SB12-00) to 1.9 µg/kg (59SB22-00) and one subsurface soil sample at 8.4 µg/kg (59SB03-04). Given that historical site activities at SWMU 59 were limited to vehicle maintenance and refueling operations, the presence of these two pesticides in SWMU 59 soil, as well as all detected pesticides, is likely attributable to anthropogenic usage for pest control, not a release. Based on historical site activities, which indicate that pesticides are not site-related, the absence of detections in site media (in the case of aldrin, gamma-BHC, dieldrin, endosulfan II, heptachlor epoxide, isodrin, and toxaphene), the low magnitude and frequency of detection in site media (in the case of endrin, endrin aldehyde, gamma-chlordane, heptachlor, and methoxychlor), and their physical properties (all pesticides), the non-detected pesticides discussed above and within the preceding paragraphs are not identified as ecological COCs for drainage ditch surface water, and no additional evaluation is recommended.

Three non-detected metals (cadmium, lead, and silver) were identified as ecological COPCs in Step 2 of the ERA because maximum reporting limits within the total recoverable fraction of drainage ditch surface water (1.0 µg/L for each metal) exceed their respective surface water screening values (0.11 for cadmium, 0.73 µg/L for lead, and 0.51 µg/L for silver). HQ values range from 1.38 for lead to 8.73 for cadmium (see Table 7-23). As discussed in Section 7.4.1.3, surface water screening values used in the screening level risk calculation for these three metals are expressed as a function of water hardness. The surface water hardness used in their derivation was a 95 percent LCL of the mean concentration (31.35 mg/L as $CACO_3$) for a USGS data set taken from a National Water Information System water quality database (see Section 7.4.1.3). Maximum total recoverable cadmium, copper, and silver RLs also exceed total recoverable screening values (0.12 µg/L, 0.77 µg/L, and 0.56 µg/L, respectively) derived using the regression equations listed in Section 7.4.1.3 and a 95 percent UCL of the mean hardness concentration for the USGS data set (32.86 mg/L as $CaCO_3$).

Literature sources indicate that the filtered fraction of metals more closely approximates their bioavailable fraction in the water column (USEPA, 1999b, 2002a, and 2006). One reason is that a primary mechanism for water column toxicity is adsorption at the gill surface, which requires metals to be in the dissolved form. Therefore, a comparison of maximum RLs within the dissolved fraction of drainage ditch surface water to screening values expressed in terms of the dissolved metal in the water column is more appropriate. The surface water screening values used in the Step 2 screening level risk calculation for cadmium, lead, and silver were PRWQS for Class SD surface waters. As discussed in Section 7.9, The PRWQSR (PREQB, 2010) has adopted USEPA total recoverable NAWQC as PRWQS for cadmium, lead, and silver (the PRWQSR regression equations listed in Section 7.4.1.3 are identical to the regression equations listed in National Recommended Water Quality Criteria [USEPA, 2013b]). Therefore, cadmium, lead, and silver NAWQC (i.e., CCC values or, in the case of silver, a CMC value) expressed in terms of the dissolved metal in the water column were derived for use as a dissolved screening values by multiplying the total recoverable screening values listed in Table 7-7 by the freshwater conversion factors listed below (USEPA, 2013b):

- Cadmium: 1.101672-[(*ln* hardness)(0.041838)]
- Lead: 1.46203-[(*In* hardness)(0.145712]
- Silver: 0.850

Based on a surface water hardness of 32.86 mg/L as $CaCO_3$ (95 percent UCL of the mean hardness concentration for the USGS data set taken from a National Water Information System water quality database), the freshwater conversion factors for cadmium and lead are 0.956 and 0.953, respectively. Use of the freshwater conversion factors listed above gives a dissolved CCC value of 0.11 µg/L for cadmium, a dissolved CCC value of 0.74 µg/L for lead, and a dissolved

CMC value of 0.47 µg/l for silver. As evidenced by the table below, maximum cadmium, lead, and silver RLs for the dissolved fraction of drainage ditch surface water exceed screening values expressed in terms of the dissolved metal in the water column.

Metal	Maximum Reporting Limit (µg/L)	Dissolved Screening Value (µg/L)
Cadmium	1.0	0.11
Lead	1.0	0.74
Silver	1.0	0.47

Although RLs for the total recoverable and dissolved fractions exceed screening values, these non-detected metals are not identified as ecological COCs. This decision is based on the relatively low magnitude that RLs exceed screening values. It is noted that in the case of lead and silver, one-half of the RLs for the total recoverable fraction (0.5 µg/L for both metals) are less than total recoverable screening values (0.77 µg/L and 0.56 µg/L, respectively). One half the RL for lead in the dissolved fraction of surface water (0.5 µg/L) is also less than the dissolved screening value for this metal (0.74 µg/L).

4,4'-DDE and 4,4'-DDT were each detected in surface water sample 59SW01 at 0.006J µg/L and 0.0065J µg/L, respectively. Both detections exceed surface water screening values. The screening values used for 4,4'-DDT and 4,4'-DDE in Step 2 of the ERA are PRWQS (PREQB, 2010). The PRWQS for these two pesticides represent a NRWQC (USEPA, 2013b) derived for 4,4'-DDT using FRV procedures. As discussed in Section 7.9.1.3, NRWQC derived using FRV procedures are based on the protection of piscivorous organisms (e.g., birds) rather than the protection of aquatic organisms (e.g., fish and invertebrates). A Tier I chronic value for 4,4'-DDT is available from the GLI Toxicity Data Clearinghouse USEPA (2011b). This Tier I value (0.032 µg/L), derived by IDEM using GLI methodology, is greater than the single detected concentration of 4,4'-DDT and 4,4'- DDE in surface water sample 59SW01 (0.006J and 0.0065J µg/L, respectively). Based on the comparison of maximum detected concentrations to the Tier I IDEM chronic value, 4,4'-DDE and 4,4'-DDT are not identified as ecological COCs for drainage ditch surface water, and no additional evaluation is recommended. It is noted that historical activities at SWMU 59 were limited to vehicle maintenance and refueling activities. Therefore, the presence of 4,4'-DDE and 4,4'-DDT in drainage ditch surface water is likely attributable to anthropogenic usage for pest control.

Copper was detected within the total recoverable fraction of each drainage ditch surface water sample (3.8 µg/L in 59SW01 and 4.0 µg/L in 59SW02 and 59SW03) at concentrations slightly elevated above the total recoverable screening value of 3.46 µg/L (PREQB, 2010; see Figure 7-14). As previously discussed, the filtered fraction of metals more closely approximates their bioavailable fraction in the water column (USEPA, 1999c, 2002a, and 2006). Therefore, a comparison of copper concentrations within the dissolved fraction of drainage ditch surface water to a screening value expressed in terms of dissolved copper in the water column is more appropriate. The total recoverable screening value used in Step 2 of the SERA for copper is a hardness-dependent PRWQS adopted from the USEPA (the hardness-dependent regression equation in the PRWQS regulation is identical to the hardness-dependent regression equation presented in National Recommended Water Quality Criteria [USEPA, 2013b]). The screening value was derived using a water hardness of 31.35 mg/l as $CaCO_3$. A hardness-dependent screening value expressed in terms of the dissolved metal in the water column can be derived by multiplying the total recoverable screening by a freshwater conversion factor of 0.960 (USEPA, 2013b). Based on a water hardness of 32.86 mg/L as $CaCO_3$ (95 percent UCL of the mean hardness concentration for the USGS data set taken from a National Water Information System

water quality database) and a total recoverable-to-dissolved conversion factor of 0.960, a dissolved screening value of 3.46 µg/L is derived. Copper concentrations within the dissolved fraction of drainage ditch surface water (3.1 µg/L in 59SW01, 3.0 µg/L in 59SW02, and 2.9 µg/L in 59SW03) are less than the dissolved screening value of 3.46 µg/L. The descriptive statistics presented in Table 7-47 also show that maximum copper concentrations within the total recoverable and dissolved fractions of SWMU 59 groundwater (4 µg/L and 3.1 µg/L, respectively) are less than maximum total recoverable and dissolved background concentrations (19 µg/L and 7.3 µg/L, respectively). Based on the comparison of the maximum detected dissolved concentration to the NRWQC expressed as a dissolved concentration, as well as the descriptive statistics presented in Table 7-47, copper is not identified as an ecological COC for drainage ditch surface water, and no additional evaluation is recommended.

In summary, no chemicals are identified as ecological COCs for drainage ditch surface water. Although 4,4'-DDE, 4,4'-DDT, and copper were detected and identified as ecological COPCs for drainage ditch surface water in Step 2 of the ERA, they are not identified as ecological based on the discussion presented within the preceding paragraphs. No additional evaluation is also recommended for chemicals lacking usable data, as well as the non-detected SVOCs, organochlorine pesticides, and metals identified as ecological COPCs in Step 2 of the ERA because maximum RLs exceed screening values.

7.9.1.5 Drainage Ditch Sediment

Section 7.6.2.5 presented the results of the Step 2 screening level risk calculation for drainage ditch sediment. Screening level risk estimates were also provided in Table 7-24. Acetone, bis(2-ethylhexyl)phthalate, 4,4'-DDD, 4,4'-DDE, alpha-chlordane, gamma-chlordane, heptachlor, barium, copper, lead, mercury, nickel, vanadium, and zinc were detected and identified as ecological COPCs for drainage ditch sediment because maximum detected concentrations exceed sediment screening values. The spatial extent of detected ecological COPC concentrations greater than freshwater sediment screening values is depicted on Figure 7-15. Beryllium and thallium were detected and identified as ecological COPCs based on the lack of sediment screening values. Five non-detected VOCs (3-chloropropene, acrylonitrile, bromomethane, ethylbenzene, and o-xylene), sixty-two non-detected SVOCs, four non-detected pesticides (gamma-BHC, endrin, heptachlor epoxide, and toxaphene), and one non-detected metal (tin) were identified as ecological COPCs because maximum RLs exceed sediment screening values. Finally, four VOCs (1,4-dioxane, acrolein, isobutyl alcohol, and propionitrile) and one SVOC (1,4-phenylenediamine) were identified as ecological COCs based on the lack of any usable data (all sediment analytical data for these five organics were rejected during data validation activities).

The refined risk calculation for drainage ditch sediment is presented in Table 7-48. As discussed in Section 7.9, risk estimates for sediment were recalculated using 95 percent UCL of the mean concentrations for those ecological COPCs having a minimum of eight detected values and less than 70 percent non-detected results (i.e., copper, lead, and zinc). Additional refinements that were applied in Step 3a of the BERA are presented and discussed within Section 7.9.

Four VOCs (1,4-dioxane, acrolein, isobutyl alcohol, and propionitrile) and one SVOC (1,4-phenylenediamine) were identified as ecological COPCs for drainage ditch sediment in Step 2 of the SERA because all analytical data were rejected during data validation activities. However, based on the lines of evidence presented in Section 7.9.1.1.1 (in the case of 1,4-dioxane, acrolein, isobutyl alcohol, and 1,4-phenylenediamine) and Section 7.9.1.2.1 (in the case of propionitrile), these five organic chemicals are not likely to represent site-related chemicals, nor are they likely to be present in drainage ditch sediment. As such, 1,4-dioxane, acrolein, isobutyl alcohol,

propionitrile, and 1,4-phenylenediamine are not identified as ecological COCs for drainage ditch sediment, and no additional evaluation is recommended.

Five non-detected VOCs (3-chloropropene, acrylonitrile, bromomethane, ethylbenzene, and o-xylene) and sixty-two non-detected SVOCs were identified as ecological COPCs because maximum RLs exceed sediment screening values. With the exception of acrylonitrile, bromomethane, acenaphthene, benzo(a)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, dibenz(a,h)anthracene, dibenzofuran, di-n-octylphthalate, naphthalene, and pentachlorobenzene, none of these chemicals were detected in SWMU 59 surface soil, subsurface soil (all depth intervals), or groundwater collected during the 2010 and 2012 CMS field investigations or the 2004 Phase II ECP field investigation (see Appendix B). The absence of detected concentrations in SWMU 59 surface soil, subsurface soil, and groundwater indicates that these chemicals are not likely to be site-related, nor are they likely to be present in drainage ditch sediment. For this reason, they are not identified as ecological COCs, and no additional evaluation is recommended.

Acrylonitrile, bromomethane, acenaphthene, benzo(a)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, dibenz(a,h)anthracene, dibenzofuran, di-n-octylphthalate, and naphthalene were detected in SWMU 59 surface soil and/or subsurface collected during the 2010 CMS field investigation, while pentachlorobenzene was detected in subsurface soil collected during the 2012 CMS field investigation. Detections for acrylonitrile, bromomethane, di-n-octylphthalate, and pentachlorophenol are summarized below.

- Acrylonitrile was detected in one of nineteen (1/19) surface soil samples collected during the 2010 CMS field investigation at 3.4J µg/kg (59SB12-00). This VOC was not detected in subsurface soil (all depth intervals) and groundwater collected during the 2010 CMS field investigation, surface and subsurface soil collected during the 2012 CMS field investigation, or surface soil, subsurface soil, and groundwater collected during the 2004 Phase II ECP field investigation.

- Bromomethane was detected in three of nineteen (3/19) surface soil samples (6.3 µg/kg in 59SB11-00, 2.4J µg/kg in 59SB12-00, and 3.4J µg/kg in 59SB23-00) and three of forty-six (4/46) subsurface soil (all depth intervals) collected during the 2010 CMS field investigation (1.4J µg/kg in 59SB02-01, 1.2J µg/kg in 59SB11-01, and 1.6J µg/kg in 59SB17-01). Bromomethane was not detected in groundwater collected during the 2010 CMS field investigation, surface and subsurface soil collected during the 2012 CMS field investigation, or surface soil, subsurface soil, or groundwater collected during the 2004 Phase II ECP investigation.

- Di-n-octylphthalate was detected in one of forty-six (1/46) subsurface soil samples (all depth intervals) collected during the 2010 CMS field investigation (55J µg/kg in 59SB22-01). This SVOC was not detected in surface soil and groundwater collected during the 2010 CMS investigation, surface soil and subsurface soil collected during the 2012 CMS field investigation, or surface soil, subsurface soil, and groundwater collected during the 2004 Phase II ECP field investigation.
- Pentachlorobenzene was detected in one of ten (1/10) subsurface soil samples collected during the 2012 CMS field investigation at 5.6J µg/kg (59SB24-01). This SVOC was not detected in surface soil, subsurface soil, or groundwater collected during the 2010 CMS field investigation, surface soil collected during the 2012 CMS field investigation, or surface soil, subsurface soil, and groundwater collected during the 2004 Phase II ECP field investigation.

Based on the low frequency and magnitude of detections in SWMU 59 surface and/or subsurface soil, as well as the lack of detections in SWMU 59 groundwater, acrylonitrile, bromomethane, di-n-octylphthalate, and pentachlorobenzene are not identified as ecological COCs for drainage ditch sediment, and no additional evaluation of these four organic chemicals is recommended.

Dibenzofuran, acenaphthene, benzo(a)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, dibenz(a,h)anthracene, and naphthalene were detected at a high magnitude and/or frequency of detection in SWMU 59 surface soil and subsurface soil collected during the 2010 CMS field investigation. As such, they have the greatest potential to migrate with storm water to the drainage sediment. As evidenced by Table 7-8, the sediment screening values used in the Step 2 screening level risk calculation for these seven organics were bulk sediment toxicological thresholds (i.e., TEC, LEL, or AET values). Bulk sediment screening values do not take into consideration site-specific factors that can influence bioavailability. For nonionic organic chemicals such as acenaphthene, benzo(a)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, dibenz(a,h)anthracene, dibenzofuran, and naphthalene, the primary factor affecting bioavailability is TOC (USEPA 1993a, Di Toro and McGrath, 2000, and Fuchsman, 2003). Di Toro and McGrath (2000) developed a narcosis target lipid model that provides a method to evaluate the impact TOC has on the bioavailability of organic chemicals. Based on this model and an assumed organic carbon content of one percent, Di Toro and McGrath (2000) report SQGs of 8,312 µg/kg for acenaphthene, 16,324 for benzo(a)pyrene, 4,222 µg/kg for benzo(a)anthracene, 16,324 µg/kg for benzo(a)pyrene, 18,515 for benzo(g,h,i)perylene, 16,603 µg/kg for benzo(k)fluoranthene, 18,983 µg/kg for dibenz(a,h)anthracene, 16,500 µg/kg for dibenzofuran, and 11,792 µg/kg for pyrene. Given that maximum RLs for acenaphthene, benzo(a)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, dibenz(a,h)anthracene, dibenzofuran, and naphthalene (360 µg/kg for each chemical) are over an order of magnitude less than the Di Toro and McGrath (2000) SQGs, it is unlikely that RLs above bulk sediment screening values are ecologically relevant. Given that the minimum TOC concentration measured in drainage ditch sediment was 21,000 mg/kg (i.e., 2.1 percent), the narcosis target lipid model would predict even lower potential for bioavailability when site-specific TOC is considered:

Chemical	Maximum MDL (µg/kg)	Sediment Quality Guideline (µg/kg)	Hazard Quotient
Acenaphthene	360	17,455	<0.01
Benzo(a)pyrene	360	34,281	<0.01
Benzo(g,h,i)perylene	360	38,881	<0.01
Benzo(k)fluoranthene	360	34,866	<0.01
Dibenz(a,h)anthracene	360	39,865	<0.01
Dibenzofuran	360	34651	<0.01
Naphthalene	360	13,702	<0.01

Because PAH toxicities in sediments are additive or nearly additive (USEPA 2003c), a comparison of the maximum total PAH concentration in drainage ditch sediment to a total PAH SQG may be more appropriate. In addition to individual PAH SQGs, Di Toro and McGrath (2000) used the narcosis target lipid model to developed a total PAH SQG based on one percent organic carbon (5.70 micromoles per gram organic carbon [µmol/g OC] or 9,861 µg/kg). The sum of maximum PAHs concentrations in drainage ditch sediment (2,636 µg/kg; maximum RLs used for non-detected PAHs) is less than the total PAH SQG. Based on the comparison of maximum reporting limits to individual and total PAH SQGs developed by Di Toro and McGrath (2000), acenaphthene, benzo(a)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, dibenz(a,h)anthracene, dibenzofuran, and naphthalene are not identified as ecological COCs for drainage ditch sediment, and no additional evaluation of these seven SVOCs is recommended.

Four pesticides (gamma-BHC, endrin, heptachlor epoxide, and toxaphene) were identified as ecological COPCs in Step 2 of the SERA because maximum RLs exceed sediment screening values. The Step 2 risk estimates (i.e., HQ values) range from 1.46 (for heptachlor epoxide) to 1,800 (for toxaphene). Gamma-BHC, heptachlor epoxide, and toxaphene were not detected in SWMU 56 surface soil, subsurface soil, or groundwater collected during the 2010 CMS field

investigation. In the case of gamma-BHC and toxaphene, these two pesticides were also not detected in surface, subsurface soil or groundwater collected during the 2004 Phase II ECP field investigation. Although heptachlor epoxide was detected in a single Phase II ECP groundwater sample (0.02JP µg/L in 5E-GW05), this pesticide was not detected in Phase II ECP surface or subsurface soil. Endrin was detected in one of forty-six (1/46) subsurface soil samples (all depth intervals) collected during the 2010 CMS field investigation 0.56J µg/kg in 59SB04-01). However, endrin was not detected in SWMU 56 surface soil and groundwater collected during the 2010 CMS field investigation, nor was this pesticide detected in surface soil, subsurface soil, and groundwater collected during the 2004 Phase II ECP field investigation. Based on the absence of detections in SWMU 56 abiotic media (in the case of gamma-BHC and toxaphene) or the low frequency and magnitude of detections in SWMU 56 abiotic media (in the case of endrin and heptachlor epoxide), it is unlikely that gamma-BHC, endrin, heptachlor epoxide, and toxaphene are site-related. In addition, the absence of detections in SWMU 56 surface soil indicates that these pesticides are not migrating with storm water to drainage ditch sediment. For the reasons discussed above, gamma-BHC, endrin, heptachlor epoxide, and toxaphene are not identified as ecological COCs for drainage ditch sediment, and no additional evaluation of these four organochlorine pesticides is recommended.

Tin was identified as an ecological COPC in Step 2 of the ERA because the maximum RL exceeds the sediment screening value (HQ = 3.09). The sediment screening value used in the Step 2 screening level risk calculation was an AET value from Buchman (2008). The AET value, reported as >3.4 mg/kg, is a marine value based on tributyltin toxicity to *Neanthes* sp. Use of this value as a sediment screening value is extremely conservative since it does not represent a threshold effect concentration. Furthermore, the AET value is based on the most toxic form of tin (USEPA, 2002c). An alternative value for tin, also based on tributyltin, was identified from the literature. Kristin et al. (1998) investigated the toxicity of tributyltin in sediment using spiked sediment toxicity tests with four freshwater benthic macroinvertebrate species (an oligochaete [*Tubifex tubifex*], a chironomid (*Chironomus riparius*], an amphipod [*Hyalella azteca*], and a mayfly [*Hexagonia sp.*]). *Hexagonia* sp. was the most sensitive benthic invertebrate tested. The test endpoint for this species was a median inhibition concentration (IC_{50}) based on growth. The reported IC_{50} value of 600 mg/kg (dry weight) resulted in a fifty percent reduction in the growth of the test organism when compared to a control. The maximum reporting limit for tin (10.5 mg/kg [25.6 mg/kg when expressed as tributyltin ion since the tributyltin ion has a mass that is 2.44 times greater than that of tin; ATSDR, 2005]) is less than the *Hexagonia* sp. IC_{50} value reported by Kristin et al. (1998). Based on this comparison, it is unlikely that tin is adversely impacting aquatic receptor populations within the drainage ditch. As such, this non-detected metal is not identified as an ecological COC for drainage ditch sediment, and no additional evaluation is recommended.

Beryllium and thallium were detected in drainage ditch sediment collected during the 2010 CMS field investigation and identified as ecological COPCs in Step 2 of the ERA based on the lack of sediment screening values. Beryllium was detected in each sediment sample (0.38J mg/kg in 59SD02, 0.45J mg/kg in 59SD02, and 0.35J mg/kg in 59SD03), while thallium was detected in two of three (2/3) sediment samples (0.14J mg/kg in 59SD02 and 0.053J mg/kg in 59SD03). The descriptive statistics presented in Table 7-49 show that beryllium concentrations in drainage ditch sediment are not elevated relative to background concentrations. Maximum and arithmetic mean beryllium concentrations in drainage ditch sediment (0.45J mg/kg and 0.39 mg/kg, respectively) are less than maximum and arithmetic mean background concentrations (0.77J mg/kg and 0.43 mg/kg, respectively. The descriptive statistics presented in Table 7-49 also show that thallium concentrations in drainage ditch sediment are not elevated relative to background concentrations. Specifically, maximum and arithmetic mean concentrations in drainage ditch sediment (0.14J mg/kg and 0.4 mg/kg, respectively) are less than maximum and arithmetic mean background

concentrations (0.19J mg/kg and 0.57 mg/kg, respectively). It is noted that the elevated arithmetic mean concentrations for the SWMU 59 and background sediment data sets can be attributed to elevated RLs for non-detected results. Based on the descriptive statistics presented in Table 7-49, beryllium and thallium are not identified as ecological COCs for drainage ditch sediment, and no additional evaluation is recommended.

Acetone was detected in two of two (2/2) sediment samples collected during the 201 CMS field investigation at 150J µg/kg (59SD02) and 78 µg/kg (59SD03). Both of the detected concentrations exceed the sediment screening value of 78 µg/kg (see Figure 7-15). The sediment screening value used in Step 2 of the ERA is an EqP-based value derived in accordance with the procedures presented in Appendix E. As discussed in Appendix E, the EqP approach derives a sediment benchmark by setting the dissolved chemical concentration in pore water equal to the surface water benchmark and calculates a corresponding particle-sorbed chemical concentration. This approach is appropriate for highly sorptive chemicals (e.g., PAHs), but it produces overly conservative sediment quality benchmarks for VOCs (Fuchsman, 2003). To further evaluate the significance of acetone detections in drainage ditch sediment, an alternative screening value was identified from the literature. Di Toro and McGrath (2000) developed a narcosis target lipid model that provides a method to evaluate the impact TOC has on the bioavailability of organic chemicals. Based on this model and an assumed TOC of one percent, Di Toro and McGrath (2000) report a SQG of 2,265 µg/kg for acetone. The maximum detected acetone concentration in drainage ditch sediment (150J µg/kg) is over an order of magnitude less than the Di Toro and McGrath (2000) SQG. Furthermore, given that the minimum TOC concentration measured in drainage ditch sediment was 21,000 mg/kg (i.e., 2.1 percent), the Di Toro and McGrath (2000) target lipid model predicts even lower potential for bioavailability when site-specific TOC is considered (i.e., SQG of 4,757 µg/kg for acetone based on 2.1 percent TOC). Based on the comparison of detected concentrations to the SQG value developed by Di Toro and McGrath (2000), acetone is not identified as an ecological COC for drainage ditch sediment, and no additional evaluation is recommended. It is noted that detected acetone concentrations in drainage ditch sediment may have results from the preservation method used for VOCs during the 2010 CMS field investigation (SW-846 Method 5035). As discussed in Section 7.9.1.3, sodium bisulfide was used as a preservative during this field investigation. Sodium bisulfide can interact with naturally occurring organic matter to form acetone.

Bis(2-ethylhexyl)phthalate, 4,4'-DDD, 4,4'-DDE, alpha-chlordane, gamma-chlordane, and heptachlor were identified as an ecological COPC in Step 2 of the SERA because maximum detected concentrations exceed sediment screening values (see Table 7-24). Bis(2-ethylhexyl)phthalate, 4,4'-DDD, and 4,4'-DDE were each detected in three of three (3/3) drainage ditch sediment samples collected during the 2010 CMS field investigation. Detected concentrations range from 110J µg/kg to 730 µg/kg for bis(2-ethylhexyl)phthalate, 1.6J µg/kg to 5.9J µg/kg for 4,4'-DDD, and 32J µg/kg to 160 µg/kg for 4,4'-DDE. Alpha-chlordane and gamma-chlordane were each detected in two of three (2/3) sediment samples (2.1NJ µg/kg and 25NJ µg/kg for alpha-chlordane and 18J µg/kg and 31J µg/kg for gamma-chlordane), while heptachlor was detected in one of three (1/3) sediment samples (1.2J µg/kg). Each of these organics were detected in one or more of the SWMU 59 surface soil samples collected during the 2010 CMS field investigation. As such, they may be migrating with storm water to drainage ditch sediment.

The screening values used in Step 2 of the ERA for bis(2-ethylhexyl)phthalate, 4,4'-DDD, 4,4'-DDE, alpha-chlordane, gamma-chlordane, and heptachlor are bulk sediment screening values (TECs or, in the case of heptachlor, an AET). As was previously discussed, bulk sediment screening values do not take into consideration site-specific factors (i.e., TOC) that can influence the bioavailability of SVOCs. Although SQGs are not available from Di Toro and McGrath

(2000), EqP-based screening values can be derived using the procedures presented in Appendix E, the surface water screening values presented in Table 7-7, and the minimum organic carbon content measured in drainage ditch sediment (2.1 percent). These EqP-based values are presented and compared to maximum detected drainage ditch sediment concentrations within the table below:

Ecological COPC	EqP-Based Screening Value (µg/kg)	Maximum Detected Sediment Concentration (µg/kg)
Bis(2-ethylhexyl)phthalate	94,519	730
4,4'-DDD	20.8	5.9J
4,4'-DDE	92.8	160
alpha-Chlordane	147	25NJ
gamma-Chlordane	147	31J
Heptachlor	114	1.2J

As evidenced by the table above, maximum detected bis(2-ethylhexyl)phthalate, 4,4'-DDD, alpha-chlordane, gamma-chlordane, and heptachlor concentrations are less than the EqP-based screening values. However, the maximum 4,4'-DDE concentration exceeds the EqP-based sediment screening value. The surface water screening value used in the derivation of the EqP-based sediment screening value for 4,4-DDE is a PRWQS for 4,4'-DDT and metabolites and is identical to the USEPA NRWQC (USEPA, 2013b), derived suing FRV procedures. As discussed in Section 7.9.1.4, NRWQC derived using FRV procedures are designed to be protective of piscivorous organisms (e.g., birds), not aquatic organisms (e.g., fish and invertebrates). Therefore, a surface water screening value derived from toxicological data for aquatic organisms would be more appropriate when deriving an EqP-based sediment screening value. A Tier I chronic value for 4,4'-DDT is available from the GLI Toxicity Data Clearinghouse USEPA (2011b). If this Tier I chronic value (0.032 µg/L; derived by IDEM using GLI methodology), is used as a surrogate value for 4,4'-DDE and applied to the procedures included Appendix E, an EqP-based screening value of 2,970 µg/kg is calculated. This value is over an order of magnitude greater than the maximum detected 4,4'-DDE concentration. Based on the comparison of maximum detected concentrations to EqP-based sediment screening values, 4,4'-DDD, 4,4-DDE, alpha-chlordane, gamma-chlordane, heptachlor, and bis(2-ethylhexyl)phthalate are not identified as ecological COCs for drainage ditch sediment, and no additional evaluation is recommended.

Barium, copper, lead, mercury, nickel, vanadium, and zinc were identified as ecological COPCs in Step 2 of the ERA because maximum detected concentrations exceed sediment screening values. Due to the small number of barium, mercury, nickel, and vanadium data points (n = 3), risk estimates for these four metals were not re-calculated using 95 percent UCL of the mean concentrations. However, the number of copper, lead, and zinc data points (n = 10 for lead and n = 12 for copper and zinc) are sufficiently large enough to allow for the derivation of 95 percent UCL of the mean concentrations. As part of the Step 3a refinement, the SWMU 59 sediment data set were statistically compared to the non-airfield freshwater drainage ditch sediment background data set presented within the Revised Addendum C and Addendum D to the Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds (Baker 2013b) in accordance with Navy guidance (NFESC, 2004). However, the size of the SWMU data set for barium, mercury, nickel, and vanadium prevented statistical comparisons evaluating the mean/medium and right-tail of the distributions. As such, the statistical evaluations conducted on the SWMU and background data sets for these four metals were limited to descriptive comparisons of maximum and arithmetic mean concentrations. In the case of copper, lead, and zinc, the SWMU data set was sufficiently large enough to allow for statistical comparisons evaluating the mean/median and right-tail of the SWMU and background distributions. Supporting statistics for the SWMU and background data sets, including 95 percent UCL of the mean calculations, are provided in Appendix M.

As discussed in Section 7.9, two of the three sediment samples collected during the 2010 CMS field investigation (59SD02 and 59SD03) were analyzed for AVS and SEM. AVS is a reactive pool of solid-phase sulfide that represents an important partitioning phase controlling the bioavailability and toxicity of cadmium, copper, lead, nickel, silver, and zinc to sediment-associated biota (Ankley et al, 1996 and Berry et al., 1999). Cadmium, copper, lead, nickel, silver, and zinc, collectively termed SEM, represent those metals that form a more stable complex with sulfide than does iron. A summary of the AVS and SEM analytical data (total SEM concentrations and SEM-to-AVS ratios) for 59SD02 and 59SD03 is presented in Table 7-50. For a given sample, the total SEM molar concentration was derived by summing individual SEM metal concentrations using the following formula:

$$[SEM]_{Total} = [SEM]_{Cd} + [SEM]_{Cu} + [SEM]_{Pb} + [SEM]_{Ni} + [SEM]_{Zn} + (0.5)[SEM]_{Ag}$$

One-half the molar concentration of silver was added into the SEM totals because this metal is largely in a monovalent state. If an individual SEM metal was not detected in a given sediment sample, the total SEM molar concentration for that sample was derived using the non-detected result. If the AVS concentration for a given sediment sample was a non-detected result, the SEM-to-AVS ratio for that sample was derived using the non-detected AVS result.

Sediment samples collected during the 2012 CMS field investigation were not analyzed for AVS and SEM. As such, an evaluation of the bioavailability of SEM metals within the drainage ditch encompassed by these samples cannot be made.

Barium

Barium was detected in three of three (3/3) sediment samples at concentrations ranging from 81.6J mg/kg (59SED01) to 164J mg/kg (59SD02). Each of the detected concentrations exceed the sediment screening value of 20.0 mg/kg (MacDonald et al., 2003, see Figure 7-15). The Step 2 screening level risk estimate (HQ = 8.20; see Table 7-24), derived using the maximum detected concentration, indicates that barium may be presenting unacceptable risk to aquatic receptor groups within the drainage ditch. However, as evidenced by the descriptive statistics presented in in Table 7-49, the maximum barium concentration in drainage ditch sediment (164J mg/kg) is less than maximum and ULM background concentrations (210 mg/kg and 230 mg/kg, respectively), while the arithmetic mean concentration (118 mg/kg) is only slightly elevated above the arithmetic mean background concentration (114 mg/kg). Based on descriptive statistics presented in Table 7-49, barium is not identified as an ecological COC for drainage ditch sediment, and no additional evaluation of this metal is recommended.

Copper

Copper was detected in each sediment sample at concentrations ranging from 36.2J mg/kg (59SD09) to 187J mg/kg (59SD05). Each of the detected concentrations exceeds the sediment screening value of 31.6 mg/kg (MacDonald et al., 2000; see Figure 7-15). The Step 2 screening level risk estimate (HQ = 5.20; see Table 7-24), derived using the maximum detected concentration, indicates that copper may be presenting unacceptable risk to aquatic receptor groups within the drainage ditch. The refined risk estimate (HQ = 4.35; see Table 7-48), derived using the 95 percent UCL of the mean concentrations (138 mg/kg) also indicates that this metal may be presenting unacceptable risk to aquatic receptor group populations. As evidenced by Table 7-50, the SEM-to-AVS ratio at 59SD02 and 59SD03 (9.75 and 10.51, respectively) exceed 1.0, indicating that benthic invertebrates may be exposed to toxic concentrations of copper in sediment pore water at 59SD02 and 59SD03.

The descriptive statistics presented in Table 7-49 show that copper concentrations in drainage ditch sediment are elevated relative to background concentrations. Maximum, arithmetic mean, and 95 percent UCL of the mean concentrations in drainage ditch sediment (187J mg/kg, 114 mg/kg, and 138 mg/kg, respectively) exceed maximum, arithmetic mean, and 95 percent UCL of the mean background concentrations (111J mg/kg, 81.0 mg/kg, and 94.0 mg/kg, respectively). The statistical tests that were used to evaluate the mean and right-tail of the SWMU and background data set distributions (two sample t-test, quantile test, and slippage test) also concluded that copper concentrations in drainage ditch sediment are elevated relative to background concentrations.

Distribution tests indicate that the SWMU 59 data set follows a normal, lognormal, and gamma distribution. The normal, lognormal, and gamma probability plots included within Appendix M show that the data set best fits a normal distribution. A box plot of non-transformed copper concentrations in SWMU 59 sediment (see Appendix M), indicates that there are no potential outliers within the SWMU data set at the upper end of the range. The normal probability plot also shows that individual data points within the SWMU data set, including data points at the upper end of the range, fall along or near a straight line and form a continuous distribution. Data points that exhibit these characteristics are likely to represent natural conditions (NFESC, 2002, 2003, and 2004).

Although the probability plots do not indicate that potential outliers are present within the SWMU 59 data set, copper is identified as a ecological COC based on the 95 percent UCL of the mean HQ value (4.35), which indicates unacceptable risk to aquatic receptor group populations, SEM-to-AVS ratios for sediment collected at 59SD02 and 59SD03 (9.75 and 10.51, respectively), which indicate that benthic invertebrates may be exposed to toxic concentrations of copper in sediment pore water at these two locations, and the descriptive and distributional statistics summarized in Table 7-49. Therefore, additional evaluation in the form of corrective measures is recommended for this metal in drainage ditch sediment.

Lead

Lead was detected in each sediment sample at concentrations ranging from 4.92J mg/kg (59SD09) to 71.2J mg/kg (59SD01). Four of the detected concentrations exceed the sediment screening value of 35.8 mg/kg (McDonald et al., 2000; see Figure 7-15). The Step 2 screening level risk estimate (HQ = 1.99; see Table 7-24), derived using the maximum detected concentration, indicates that lead may be presenting unacceptable risk to aquatic receptor groups within the drainage ditch. The refined risk estimate (HQ = 1.33; see Table 7-48), derived using the 95 percent UCL of the mean concentrations (47.7 mg/kg) also indicates that this metal may be presenting unacceptable risk to aquatic receptor group populations. As evidenced by Table 7-50, the SEM-to-AVS ratio at 59SD02 and 59SD03 (9.75 and 10.51, respectively) exceed 1.0, indicating that benthic invertebrates may be exposed to toxic concentrations of lead in sediment pore water at 59SD02 and 59SD03.

The descriptive statistics presented in Table 7-49 show that lead concentrations in drainage ditch sediment are elevated relative to background concentrations. Maximum, arithmetic mean, and 95 percent UCL of the mean concentrations in drainage ditch sediment (71.2J mg/kg, 32.8 mg/kg, and 47.7 mg/kg, respectively) exceed maximum, arithmetic mean, and 95 percent UCL of the mean background concentrations (27J mg/kg, 14.0 mg/kg, and 18.0 mg/kg, respectively). The statistical tests that were used to evaluate the median and right-tail of the SWMU and background data set distributions (Wilcoxon rank sum test, quantile test, and slippage test) were contradictory. The statistical test evaluating the median of the distributions (Wilcoxon rank sum test) concluded that lead concentrations in drainage ditch sediment are elevated relative to background

concentrations, while the statistical tests evaluating the median of the distributions (quantile test and slippage test) concluded that lead concentrations in drainage ditch sediment are not elevated relative to background concentrations.

Distribution tests indicate that the SWMU 59 data set follows a normal, lognormal, and gamma distribution. Although the probability plots included within Appendix M do not indicate which distribution best fits the data, they show similar characteristics. Specifically, each show inflection points indicating that multiple populations are present within the data set. However, based on the box plots depicting non-transformed and log-transformed lead concentrations, each population is likely representative of background conditions. As evidenced by the plots, there are no potential outliers within the SWMU data set at the upper end of the range.

Based on the box plots depicting non-transformed and log-transformed data, which show that there are no potential outliers within the SWMU data set at the upper end of the range, lead is not identified as an ecological COC for drainage ditch sediment, and no additional evaluation of this metal is recommended.

Mercury

Mercury was detected in three of three (3/3) sediment samples at concentrations ranging from 0.033J mg/kg (59SD02) to 0.19 mg/kg (59SD03). Only the maximum detected concentration exceeds the sediment screening value of 0.18 mg/kg (MacDonald et al., 2000; see Figure 7-15). The Step 2 screening level risk estimate (HQ = 1.06; see Table 7-24), derived using the maximum detected concentration, indicates that mercury may be presenting unacceptable risk to aquatic receptor groups within the drainage ditch. The descriptive statistics presented in Table 7-49, show that mercury concentrations in drainage ditch sediment are comparable to background concentrations. Maximum and arithmetic mean mercury concentrations in drainage ditch sediment (0.19 mg/kg and 0.10 mg/kg, respectively) are only slightly elevated above maximum and arithmetic mean background concentrations (0.16 mg/kg and 0.09 mg/kg, respectively).

Mercury was not detected in surface or subsurface soil collected during the 2010 and 2012 CMS field investigations at concentrations elevated above background concentrations (see descriptive and/or distributional statistics summarized in Tables 7-38, 7-40, 7-42, and 7-44). As such, this metal would not be expected to migrate with storm water to drainage ditch sediment at concentrations greater than what would be expected under background conditions. Based on the lack of elevated concentrations in soil, the low magnitude of the maximum detected concentration above the sediment screening value (HQ = 1.06), and the descriptive statistics presented in Table 7-49, mercury is not identified as an ecological COC for drainage ditch sediment, and no additional evaluation of this metal is recommended.

Nickel

Nickel was detected in three of three (3/3) sediment samples at concentrations ranging from 18.7J mg/kg (59SD01) to 28.1 mg/kg (59SD03). Only the maximum detected concentration exceeds the sediment screening value of 22.7 mg/kg (MacDonald et al., 2000; see Figure 7-15). The Step 2 screening level risk estimate (maximum HQ = 1.24; see Table 7-24), derived using the maximum detected concentration, indicates that nickel may be presenting unacceptable risk to aquatic receptor groups within the drainage ditch. The AVS and SEM analytical data for drainage ditch sediment (see Table 7-50) indicate that benthic invertebrates may be exposed to toxic concentrations of nickel in sediment pore water at 59SD02 and 59SD03 (the AVS-to-SEM ratio for each sample exceeds 1.0 [9.75 for 59SD02 and 10.51 for 59SD03]. However, individual molar concentrations presented in Table 7-50 show that nickel is a minor contributor to total SEM

concentrations. In fact, the molar concentration of nickel in the SEM fraction of each sediment sample is less than the molar concentration of AVS.

As evidenced by the descriptive statistics presented in Table 7-49, maximum and arithmetic mean nickel concentrations in drainage ditch sediment (28.1 mg/kg and 23.1 mg/kg) are slightly elevated above maximum and arithmetic mean background concentrations (17.7J mg/kg and 12.9 mg/kg, respectively). Based on the low magnitude of the maximum detected concentration above the sediment screening value and maximum background concentration, nickel is not identified as an ecological COC for drainage ditch sediment, and no additional evaluation of this metal is recommended.

Vanadium

Vanadium was detected in three of three (3/3) sediment samples at concentrations ranging from 144J mg/kg (59SD03) to 232J mg/kg (59SD02). Each of the detected concentrations exceeds the sediment screening value of 57.0 mg/kg (Buchman, 2008; see Figure 7-15). The Step 2 screening level risk estimate (HQ = 4.07; see Table 7-24), derived using the maximum detected concentration, indicates that vanadium may be presenting unacceptable risk to aquatic receptor groups within the drainage ditch. The descriptive statistics presented in Table 7-49 show that vanadium concentrations in drainage ditch sediment are not elevated relative to background concentrations. Specifically, maximum and arithmetic mean concentrations in drainage ditch sediment (232J mg/kg and 177 mg/kg, respectively) are less than maximum and arithmetic mean background concentrations (260J mg/kg and 190 mg/kg, respectively). Based on the descriptive statistics presented in Table 7-49, vanadium is not identified as an ecological COC for drainage ditch sediment, and no additional evaluation of this metal is recommended.

Zinc

Zinc was detected in twelve of twelve (12/12) sediment samples at concentrations ranging from 108J mg/kg (59SD10) to 262J mg/kg (59SD12). Ten of the detected concentrations exceed the sediment screening value of 121 mg/kg (MacDonald et al., 2000; see Figure 7-15). Step 2 screening level risk estimate (HQ = 1.97; see Table 7-24), derived using the maximum detected concentration, indicates that zinc may be presenting unacceptable risk to aquatic receptor groups within the drainage ditch. The refined risk estimate (HQ = 1.97; see Table 7-48), derived using the 95 percent UCL of the mean concentrations (238 mg/kg) also indicates that this metal may be presenting unacceptable risk to aquatic receptor group populations. As evidenced by Table 7-50, the SEM-to-AVS ratio at 59SD02 and 59SD03 (9.75 and 10.51, respectively) exceed 1.0, indicating that benthic invertebrates may be exposed to toxic concentrations of zinc in sediment pore water at 59SD02 and 59SD03. Individual molar concentrations presented in Table 7-50 also shows that zinc is a major contributor to the total SEM concentration in both samples.
The descriptive statistics presented in Table 7-49 show that zinc concentrations in drainage ditch sediment are elevated relative to background concentrations. Maximum, arithmetic mean, and 95 percent UCL of the mean concentrations in drainage ditch sediment (357J mg/kg, 194 mg/kg, and 238 mg/kg, respectively) exceed maximum, arithmetic mean, and 95 percent UCL of the mean background concentrations (99 mg/kg, 70.8 mg/kg, and 79.9 mg/kg, respectively). The statistical tests that were used to evaluate the mean and right-tail of the SWMU and background data set distributions (Satterthwaite t-test, quantile test, and slippage test) also concluded that copper concentrations in drainage ditch sediment are elevated relative to background concentrations.

Distribution tests indicate that the SWMU 59 data set follows a normal, lognormal, and gamma distribution. The normal, lognormal, and gamma probability plots included within Appendix M show that the data set best fits either a lognormal or gamma distribution. A box plot of log-

transformed zinc concentrations in SWMU 59 sediment (see Appendix M), indicates that there are no potential outliers within the SWMU data set at the upper end of the range. The lognormal and gamma probability plots also show that individual data points within the SWMU data set, including data points at the upper end of the range, fall along or near a straight line and form a continuous distribution. Data points that exhibit these characteristics are likely to represent natural conditions (NFESC, 2002, 2003, and 2004).

Although the probability plots do not indicate that potential outliers are present within the SWMU 59 data set, zinc is identified as a ecological COC based on the 95 percent UCL of the mean HQ value (1.97), which indicates unacceptable risk to aquatic receptor group populations, SEM-to-AVS ratios for sediment collected at 59SD02 and 59SD03 (9.75 and 10.51, respectively), which indicate that benthic invertebrates may be exposed to toxic concentrations of zinc in sediment pore water at these two locations, and the descriptive and distributional statistics summarized in Table 7-49. Therefore, additional evaluation in the form of corrective measures is recommended for this metal in drainage ditch sediment..

In summary, copper and zinc are identified as ecological COCs for drainage ditch sediment. Although acetone, bis(2-ethylhexyl)phthalate, 4,4'-DDD, 4,4'-DDE, alpha-chlordane, gamma-chlordane, heptachlor, barium, beryllium, lead, mercury, nickel, thallium, and vanadium were detected and identified as ecological COPCs in Step 2 of the ERA, they are not identified as ecological COCs based on the discussion presented in the previous paragraphs, and no additional evaluation is recommended. No additional evaluation also is recommended for chemicals lacking usable data, as well as the non-detected VOCs, SVOCs, and organochlorine pesticides, and metals identified as ecological COPCs in Step 2 of the ERA because maximum RLs exceed screening values.

7.9.2 Step 3a Risk Evaluation for Avian and Mammalian Dietary Exposures

The refined risk evaluation for avian and mammalian dietary exposures to chemicals in surface soil, subsurface soil, groundwater, and drainage ditch sediment are present in the subsections that follow. Refined risk estimates are presented in Tables 7-51 through 7-55. Prey item tissue concentrations and dietary doses for each chemical-receptor combination are also provided in Appendix N. Screening level risk estimates were refined using the methods and procedures presented in Section 7.9.

7.9.2.1 Surface Soil

The refined risk evaluation for avian and mammalian dietary exposures to chemicals in surface soil collected during the 2010 and 2012 CMS field investigations is presented in Sections 7.9.2.1.1 and 7.9.2.1.2, respectively.

7.9.2.1.1 Surface Soil: 2010 CMS Field Investigation

Section 7.6.3.1.1 presented the results of the Step 2 screening level risk calculation for avian (American robin, mourning dove, and red-tailed hawk) and mammalian (brown flower bat) dietary exposures to chemicals in SWMU 59 surface soil collected during the 2010 CMS field investigation. Screening level risk estimates were also provided in Table 7-25. Two detected pesticides (4,4'-DDE and 4,4'-DDT) and eleven detected metals (cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, tin, vanadium, and zinc) were identified as ecological COPCs in Step 2 of the ERA because maximum dietary exposure doses for one or more of the avian receptors exceed NOAEL-based TRVs. Two detected SVOCs (butyl benzyl phthalate and dibenzofuran) and one detected metal (beryllium) were also identified as ecological COPCs for

avian dietary exposures based on the lack of TRVs. One non-detected SVOC (pentachlorophenol) and one non-detected pesticide (endrin) were identified as ecological COPCs for American robin dietary exposures because exposure doses, calculated using maximum RLs, exceed NOAEL-based TRVs. In the case of the brown flower bat, selenium and pyrene were detected and identified as ecological COPCs in Step 2 of the ERA for dietary exposures because maximum exposure doses for this mammalian receptor exceed NOAEL-based TRVs. Dibenzofuran was detected and also identified as an ecological COPC for brown flower bat dietary exposures based on the lack of a mammalian TRV.

Refined risk estimates (i.e., NOAEL-, MATC-, and LOAEL-based HQ values) for avian and mammalian dietary exposures are presented in Table 7-51 and discussed within the paragraphs that follow. 95 percent UCL of the mean surface soil concentrations were used in the refined dietary exposure calculations for those ecological COPCs having a minimum of eight detected values and less than 70 percent non-detected results (4,4'-DDE, 4,4'-DDT, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, tin, vanadium, and zinc). Additional refinements that were applied in Step 3a of the BERA are presented and discussed within Section 7.9.

Pentachlorophenol and endrin were identified as ecological COPCs in Step 2 of the ERA because American robin dietary exposure doses, calculated using maximum RLs, exceed NOAEL-based avian TRVs (HQs = 1.45 and 1.57, respectively). As evidenced by Table 7-51, refined American robin exposure doses for each ecological COPC are less than NOAEL-, MATC-, and LOAEL-based avian TRVs, indicating no unacceptable risk to avian omnivore populations. Based on refined HQ values less than 1.0, pentachlorophenol and endrin are not identified as ecological COCs for avian omnivore dietary exposures to chemicals in SWMU 59 surface soil collected during the 2010 CMS field investigation.

Butyl benzyl phthalate, dibenzofuran, and beryllium were detected in SWMU 59 surface soil and identified as ecological COPCs in Step 2 of the ERA for mourning dove, American robin, and red-tailed hawk dietary exposures based on the lack of avian TRVs. Dibenzofuran was also identified as an ecological COPC in Step 2 of the SERA for brown flower bat dietary exposures based on the lack of a mammalian TRV. Butyl benzyl phthalate and dibenzofuran were each detected in one of nineteen (1/19) surface soil samples collected during the 2010 CMS field investigation (butyl benzyl phthalate was detected in 59SB15-00 at 170J µg/kg, while dibenzofuran was detected in 59SB04-00 at 750 µg/kg). Beryllium was detected in sixteen of nineteen (16/19) surface soil samples at concentrations ranging from 0.14J mg/kg (59SB03-00) to 0.62J mg/kg (59SB20-00). These three ecological COPCs are not identified as important bioaccumulative chemicals (USEPA, 2000b). As such, they are considered to have low potential to bioaccumulate in terrestrial food items (terrestrial plants, terrestrial invertebrates, and small mammals). Furthermore, in the case of beryllium, distributional statistics performed on the median and right tail of the SWMU and background data set distributions (Gehan test and slippage test [see Table 7-38]) concluded that concentrations in SWMU 59 surface soil are not elevated relative to background concentrations. Based on their low potential to bioaccumulate in terrestrial food items and, in the case of beryllium, the distributional statistics presented in Table 7-38, butyl benzyl phthalate, dibenzofuran, and beryllium are not identified as ecological COCs for avian/mammalian dietary exposures to chemicals in SWMU 59 surface soil collected during the 2010 CMS field investigation.

4,4'-DDE and 4,4'-DDT were detected in surface soil and identified as ecological COPCs in Step 2 of the ERA because American robin dietary exposure doses exceed NOAEL-based TRVs. Refined American robin dietary exposure doses for both organochlorine pesticides are less than NOAEL-based TRVs (HQs = 0.26 for 4,4'-DDE and 0.38 for 4,4'-DDT [see Table 7-51]),

indicating no unacceptable risk to avian omnivore populations. Based on the refined risk estimates, 4,4'-DDE and 4,4'-DDT are not identified as ecological COCs for avian omnivore dietary exposures to chemicals in SWMU 59 surface soil collected during the 2010 CMS field investigation.

Cadmium, chromium, mercury, nickel, selenium, silver, tin, and zinc were detected in surface soil collected during the 2010 CMS field investigation and identified as ecological COPCs because maximum American robin dietary exposure doses exceed NOAEL-based avian TRVs. Copper was also detected and identified as an ecological COPC because maximum exposure doses for the mourning dove and American robin exceed NOAEL-based TRVs. Finally, lead and vanadium were detected and identified as ecological COCPs because maximum exposure doses for each avian receptor exceed NOAEL-based avian TRVs. In the case of the brown flower bat, selenium and pyrene were identified as ecological COPCs because maximum dietary exposure doses for this mammalian receptor exceed NOAEL-based mammalian TRVs.

Refined American robin dietary exposure doses for cadmium, chromium, mercury, nickel, selenium, silver, and tin are less than NOAEL-based avian TRVs (see Table 7-51), indicating no unacceptable risk to avian omnivore populations. Refined mourning dove and American robin exposure doses for copper are also less than avian TRVs, indicating no unacceptable risk to avian herbivore and omnivore populations. In addition, refined brown flower bat dietary exposure doses for selenium and pyrene are less than NAOEL-, MATC-and LOAEL-based TRVs, indicating no unacceptable risk to mammalian herbivore populations. Based on refined HQ values less than 1.0, cadmium, chromium, copper, mercury, nickel, selenium, silver, and tin are not identified as ecological COCs for avian herbivore and/or omnivore dietary exposures to chemicals in surface soil collected during the 2010 CMS field investigation. The refined risk estimates presented in Table 7-51 also indicate that selenium and pyrene do not warrant identification as ecological COCs for brown flower bat dietary exposures.

NOAEL-, MATC-, and LOAEL-based HQ values for lead are less than 1.0 for the red-tailed hawk (see Table 7-51), indicating no unacceptable risk to avian carnivore populations. However, refined mourning dove and American robin dietary exposure doses exceed NOAEL-based avian TRVs, indicating unacceptable risk to avian herbivore and omnivore populations (NOAEL-based HQs = 5.04 and 3.11, respectively). MATC-based and LOAEL-based HQs for lead also exceeded 1.0 for both the American robin and mourning dove (Table 7-51). The descriptive and distributional statistics summarized in Table 7-38, as well as the discussion presented in Section 7.9.1.1.1 show that lead concentrations in SWMU 59 surface soil are elevated relative to background concentrations. Based on refined HQ values greater than 1.0 for the mourning dove and American robin, as well as the descriptive and distributional statistics presented in Table 7-38 and the discussion presented in Section 7.9.1.1.1, lead is identified as an ecological COC for avian omnivore and herbivore dietary exposures to chemicals in SWMU 59 surface soil collected during the 2010 CMS field investigation, and additional evaluation in the form of corrective measures is recommended.

NOAEL-, MATC-, and LOAEL-based HQ values for vanadium are less than 1.0 for the red-tailed hawk (see Table 7-51), indicating no unacceptable risk to avian carnivore populations. However, NOAEL-based HQs for this metal exceed 1.0 for the American robin (HQ = 7.81) and mourning dove (HQ = 3.80). Identical to lead, MATC- and LOAEL-based HQs for vanadium also exceeded 1.0 for both the American robin and mourning dove (see Table 7-51). The descriptive and distributional statistics summarized in Table 7-38 and presented in Section 7.9.1.1.1 show that vanadium concentrations in SWMU 59 surface soil are not elevated relative to background concentrations, indicating that this metal is not presenting ecological risks to avian herbivore and omnivore populations at the SWMU above background risks. Based on the refined

HQ values for the red-tailed hawk, as well as the descriptive and distributional statistics presented in Table 7-38, vanadium is not identified as an ecological COC for avian dietary exposures to chemicals in SWMU 59 surface soil collected during the 2010 CMS field investigation.

The refined NOAEL-based HQ for American robin dietary exposures to zinc in SWMU 59 surface soil is only slightly elevated above 1.0 (i.e., HQ = 1.01), while MATC- and LOAEL-based HQs are less than 1.0 (HQs = 0.63 and 0.39, respectively). The descriptive and distributional statistics presented in Table 7-38 and discussed in Section 7.9.1.1.1 for the SWMU 59 and background surface soil data sets show that zinc concentrations in SWMU 59 surface soil are elevated relative to background concentrations. However, given the low magnitude of the NOAEL-based HQ value above 1.0, as well as MATC- and LOAEL-based HQ values less than 1.0, zinc is not identified as an ecological COC for avian dietary exposures to chemicals in SWMU 59 surface soil collected during the 2010 CMS field investigation. It is noted that zinc was identified as an ecological COC for terrestrial plant and invertebrate direct contact exposures (see Section 7.9.1.1.1). Corrective measures addressing unacceptable risks to these terrestrial receptor groups will address the low potential risk to terrestrial avian omnivores indicated by the refined NOAEL-based HQ value of 1.01.

In summary, lead is identified as an ecological COC for avian herbivore and omnivore dietary exposures to chemicals in SWMU 59 surface soil collected during the 2010 CMS field investigation. Although detected and identified as ecological COPCs in Step 2 of the ERA for avian and/or mammalian dietary exposures, 4,4'-DDE, 4,4'-DDT, butyl benzyl phthalate, dibenzofuran, pyrene, beryllium, cadmium, chromium, copper, mercury, nickel, selenium, silver, tin, vanadium, and zinc are not identified as ecological COCs, and no additional evaluation is recommended for the reasons discussed in the preceding paragraphs. No additional evaluation is also recommended for the non-detected chemicals identified as ecological COPCs in Step 2 of the ERA (i.e., pentachlorophenol and endrin).

7.9.2.1.2 Surface Soil: 2012 CMS Field Investigation

Section 7.6.3.1.2 presented the results of the Step 2 screening level risk calculation for avian (American robin, mourning dove, and red-tailed hawk) and mammalian (brown flower bat) dietary exposures to chemicals in SWMU 59 surface soil collected during the 2012 CMS field investigation. Screening level risk estimates were also provided in Table 7-26. Seven detected metals (chromium, copper, mercury, nickel, tin, vanadium, and zinc) were identified as ecological COPCs in Step 2 of the SERA because maximum exposure doses for one or more of the avian receptors exceed NOAEL-based TRVs. One detected metal (beryllium) was also identified as an ecological COPC based on the lack of avian TRVs. No detected or non-detected chemical was identified as an ecological COPC for brown flower bat dietary exposures (see Section 7.6.3.2.2 and Table 7-28). However, based on the lack of any usable data with which to evaluate potential risks, lead was identified as an ecological COPC for avian and mammalian dietary exposures 9all analytical data were rejected during data validation activities).

Refined risk estimates (i.e., NOAEL-, MATC-, and LOAEL-based HQ values) for avian dietary exposures to ecological COPCs are presented in Table 7-52 and discussed within the paragraphs that follow. 95 percent UCL of the mean surface soil concentrations were used in the refined dietary exposure calculations for those ecological COPCs having a minimum of eight detected values and less than 70 percent non-detected results (beryllium, chromium, copper, nickel, selenium, vanadium, and zinc). Additional refinements that were applied in Step 3a of the BERA are presented and discussed within Section 7.9.

Beryllium was detected in SWMU 59 and identified as an ecological COPC for mourning dove, American robin, and red-tailed hawk dietary exposures in Step 2 of the ERA based on the lack of avian TRVs. This metal was detected in ten of ten (10/10) surface soil samples at concentrations ranging from 0.097 mg/kg (59SB27-00) to 0.63J mg/kg (59SB24-00). Beryllium is not identified as an important bioaccumulative chemical (USEPA, 2000b). As such, this metal has low potential to bioaccumulate in terrestrial food items (terrestrial plants, invertebrates, and small mammals). Statistical tests evaluating the median and right tail of the SWMU and background data set distributions (Gehan test, quantile test, and slippage test [see Table 7-40]) also concluded that concentrations in SWMU 59 surface soil are not elevated relative to background concentrations. Based on the low potential to bioaccumulate in terrestrial food items and the statistical evaluations presented in Table 7-40, beryllium is not identified as an ecological COC for avian dietary exposures to chemicals in SWMU 59 surface soil collected during the 2012 CMS field investigation.

Mercury, nickel, tin, and zinc were detected and identified as ecological COPCs because maximum American robin dietary exposure doses exceed NOAEL-based avian TRVs. Chromium and copper were detected and identified as ecological COPCs because maximum mourning dove and American robin dietary exposure doses also exceed NOAEL-based TRVs. In addition, vanadium was identified as an ecological COPC because maximum exposure doses for each avian receptor exceed NOAEL-based TRVs.

Refined American robin dietary exposure doses for mercury, nickel, tin, and zinc, as well as refined mourning dove and American robin dietary exposure doses for copper are less than NOAEL-based avian TRVs (see Table 7-52), indicating no unacceptable risk to avian herbivore and omnivore populations. Based on refined HQ values less than 1.0, copper, mercury, nickel, tin, and zinc are not identified as ecological COCs for avian herbivore and/or omnivore dietary exposures to chemicals in surface soil collected during the 2012 CMS field investigation.

The refined American robin dietary exposure doses for chromium exceeds the NOAEL-based avian TRV (HQ = 1.51), indicating unacceptable risk to avian omnivore populations. Although the descriptive and distributional statistics presented in Table 7-40 show that chromium concentrations in SWMU 59 surface soil are elevated relative to background concentrations, the box plot of log-transformed chromium concentrations discussed in Section 7.9.1.1.2 and included within Appendix I indicates that there are no potential outliers within the SWMU data set at the upper end of the range. The lognormal probability plot also included within Appendix I shows that individual data points within the SWMU data set fall along a straight line and form a continuous distribution. Data points that exhibit these characteristics are likely to represent natural conditions (NFESC, 2002, 2003, and 2004). Based on the low magnitude of the refined exposure dose above the NOAEL TRV (HQ = 1.51), MATC-, and LOAEL-based HQ values less than 1.0, and the box and probability plots depicting log-transformed concentrations, chromium is not identified as an ecological COC for avian omnivore dietary exposures to chemicals in surface soil collected during the 2012 CMS field investigation.

NOAEL-, MATC-, and LOAEL-based HQ values for vanadium are less than 1.0 for the red-tailed hawk (see Table 7-52), indicating no unacceptable risk to avian carnivore populations. However, NOAEL-based HQs for this metal exceed 1.0 for the American robin (HQ = 11.52) and mourning dove (HQ = 5.60). MATC- and LOAEL-based HQs also exceeded 1.0 for both avian receptors (see Table 7-52). Identical to chromium, the descriptive and distributional statistics presented in Table 7-40 show that vanadium concentrations in SWMU 59 surface soil collected during the 2012 CMS field investigation are elevated relative to background concentrations. However, the box plot of log-transformed vanadium concentrations in SWMU 59 surface soil (see Appendix I) shows that there are no potential outliers within the SWMU data set at the upper end of the range. The log-normal probability plot also shows that all data points fall on or near a straight line and follow a continuous distribution, indicating that vanadium concentrations are likely to represent natural conditions (NFESC, 2002, 2003, and 2004). Based on the refined HQ

values for the red-tailed hawk, as well as the graphical representations of log-transformed concentrations included within Appendix I, vanadium is not identified as an ecological COC for avian dietary exposures to chemicals in SWMU 59 surface soil collected during the 2012 CMS field investigation.

All surface soil analytical data for lead were rejected during data validation activities because the MS/MSD pair exhibited percent recoveries that exceeded 200 percent. The high percent recoveries indicate that the matrix may be providing an additive effect and the reported values could be higher than what is actually present in the samples (Type I Error). Given that samples results were rejected due to unacceptable high bias and the maximum rejected result (12R mg/kg; see Appendix B) is less than the maximum background concentration (21J mg/kg [Baker, 2010b]), it is unlikely that lead is present at concentrations that would impact avian and mammalian receptor populations above background risks. Based on the discussion presented above, lead is not identified as an ecological COC for avian and mammalian dietary exposures to chemicals in surface soil collected during the 2012 CMS field investigation.

In summary, no chemicals are identified as ecological COCs for avian or mammalian dietary exposures to chemicals in SWMU 59 surface soil collected during the 2012 CMS field investigation. Although detected and identified as ecological COPCs in Step 2 of the ERA for avian dietary exposures, beryllium, chromium, copper, mercury, nickel, tin, vanadium, and zinc are not identified as ecological COCs, and additional evaluation is recommended for the reasons discussed in the preceding paragraphs. No additional evaluation is also recommended for the ecological COPC with no useable analytical data (i.e., lead).

7.9.2.2 Subsurface Soil

The refined risk evaluation for avian and mammalian dietary exposures to chemicals in surface soil collected during the 2010 and 2012 CMS field investigations is presented in Sections 7.9.2.2.1 and 7.9.2.2.2, respectively.

7.9.2.2.1 Subsurface Soil: 2010 CMS Field Investigation

Section 7.6.3.2.1 presented the results of the Step 2 screening level risk calculation for avian (American robin, mourning dove, and red-tailed hawk) and mammalian (brown flower bat) dietary exposures to chemicals in SWMU 59 subsurface soil collected during the 2010 CMS field investigation. Screening level risk estimates were also provided in Table 7-27. Cadmium, chromium, copper, mercury, nickel, selenium, silver, tin, vanadium, and zinc were identified as ecological COPCs in Step 2 of the ERA because maximum dietary exposure doses for one or more of the avian receptors exceed NOAEL-based TRVs. Beryllium was detected and identified as an ecological COPC for avian dietary exposures based on the lack of TRVs. One non-detected SVOC (pentachlorophenol) was identified as an ecological COPC because the American robin exposure dose, calculated using the maximum RL, exceeds the NOAEL-based TRV. In the case of the brown flower bat, selenium was detected and identified as an ecological COPC in Step 2 of the ERA for dietary exposures because the maximum exposure dose for this mammalian receptor exceeds the NOAEL-based TRV.

Refined risk estimates (i.e., NOAEL-, MATC-, and LOAEL-based HQ values) for avian and mammalian dietary exposures are presented in Table 7-53 and discussed within the paragraphs that follow. 95 percent UCL of the mean subsurface soil concentrations were used in the refined dietary exposure calculations for those ecological COPCs having a minimum of eight detected values and less than 70 percent non-detected results (beryllium, cadmium, chromium, copper,

mercury, nickel, selenium, tin, vanadium, and zinc). Additional refinements that were applied in Step 3a of the BERA are presented and discussed within Section 7.9.

Beryllium was detected in SWMU 59 subsurface soil and identified as an ecological COPC for mourning dove, American robin, and red-tailed hawk dietary exposures in Step 2 of the ERA based on the lack of TRVs. This metal was detected in fifteen of twenty-three (15/23) subsurface soil samples at concentrations ranging from 0.091J mg/kg (59SB20-01) to 0.96 mg/kg (59SB13-01). Beryllium is not identified as an important bioaccumulative chemical (USEPA, 2000b). As such, this metal has low potential to bioaccumulate in terrestrial food items (terrestrial plants, invertebrates, and small mammals). As evidenced by Table 7-42, maximum and 95 percent UCL of the mean concentrations in SWMU 59 subsurface soil (0.96 and 0.48, respectively) are slightly elevated above maximum and 95 percent UCL of the mean background concentrations (0.70 mg/kg and 0.33 mg/kg, respectively). Although the descriptive statistics indicate that beryllium concentrations are slightly elevated relative to background concentrations, beryllium is not identified an ecological COC for avian dietary exposures to chemicals in subsurface soil collected during the 2010 CMS field investigation based on the low potential for this metal to bioaccumulate in terrestrial food.

Pentachlorophenol was identified as an ecological COPC in Step 2 of the ERA because the American robin dietary exposure dose, calculated using the maximum RL, exceeds the NOAEL-based avian TRV (HQs = 1.51). As evidenced by Table 7-53, the refined American robin exposure dose is less than NOAEL-, MATC-, and LOAEL-based avian TRVs, indicating no unacceptable risk to avian omnivore populations. Based on refined HQ values less than 1.0, pentachlorophenol is not identified as an ecological COC for avian omnivore dietary exposures to chemicals in SWMU 59 surface soil collected during the 2010 CMS field investigation.

Cadmium, chromium, mercury, nickel, selenium, silver, tin, and zinc were detected in subsurface soil collected during the 2010 CMS field investigation and identified as ecological COPCs because maximum American robin dietary exposure doses exceed NOAEL-based avian TRVs. Copper was also identified as an ecological COPC because maximum exposure doses for the mourning dove and American robin exceed NOAEL-based TRVs. Finally, vanadium was identified as an ecological COCP because maximum exposure doses for each avian receptor exceed NOAEL-based avian TRVs. In the case of the brown flower bat, selenium was identified as an ecological COPC because the maximum exposure dose for this mammalian receptor exceeds the NOAEL-based TRV.

Refined American robin dietary exposure doses for cadmium, chromium, mercury, nickel, selenium, silver, tin, and zinc are less than NOAEL-based avian TRVs (see Table 7-53), indicating no unacceptable risk to avian omnivore populations. Refined mourning dove and American robin exposure doses for copper are also less than avian TRVs, indicating no unacceptable risk to avian herbivore and omnivore populations. In addition, the refined brown flower bat dietary exposure dose for selenium is less than NAOEL-, MATC-and LOAEL-based mammalian TRVs. Based on refined HQ values less than 1.0, cadmium, chromium, mercury, nickel, selenium, silver, tin, and zinc are not identified as ecological COCs for avian herbivore and/or omnivore dietary exposures to chemicals in subsurface soil collected during the 2010 CMS field investigation. Selenium is also not identified as an ecological COC for brown flower bat dietary exposures based on the refined NOAEL-, MATC-, and LOAEL-based HQ values.
NOAEL-, MATC-, and LOAEL-based HQ values for vanadium are less than 1.0 for the red-tailed hawk (see Table 7-53), indicating no unacceptable risk to avian carnivore populations. However, NOAEL-based HQs for this metal exceed 1.0 for the American robin (HQ = 7.30) and mourning dove (HQ = 3.55). MATC- and LOAEL-based HQs also exceeded 1.0 for both receptors (see Table 7-53. However, the descriptive and distributional statistics presented in

Table 7-42 show that vanadium concentrations in SWMU 59 subsurface soil are not elevated relative to background concentrations. Based on the refined HQ values for the red-tailed hawk, as well as descriptive and distributional statistics presented in Table 7-42, vanadium is not identified as an ecological COC for avian dietary exposures to chemicals in SWMU 59 subsurface soil collected during the 2010 CMS field investigation.

In summary, no chemicals are identified as ecological COCs for avian and mammalian dietary exposures to chemicals in SWMU 59 subsurface soil collected during the 2010 CMS field investigation. Although detected and identified as ecological COPCs in Step 2 of the ERA for avian and/or mammalian dietary exposures, beryllium, cadmium, chromium, copper, mercury, nickel, selenium, silver, tin, vanadium, and zinc are not identified as ecological COCs, and no additional evaluation is recommended for the reasons discussed in the preceding paragraphs. No additional evaluation is also recommended for the non-detected chemicals identified as ecological COPCs in Step 2 of the ERA (i.e., pentachlorophenol).

7.9.2.2.2 Subsurface Soil: 2012 CMS Field Investigation

Section 7.6.3.2.2 presented the results of the Step 2 screening level risk calculation for avian (American robin, mourning dove, and red-tailed hawk) and mammalian (brown flower bat) dietary exposures to chemicals in SWMU 59 subsurface soil collected during the 2012 CMS field investigation. Screening level risk estimates were also provided in Table 7-28. Six detected metals (chromium, copper, mercury, nickel, vanadium, and zinc) were identified as ecological COPCs in Step 2 of the ERA because maximum exposure doses for one or more of the avian receptors exceed NOAEL-based TRVs. Pentachlorobenzene and beryllium were detected and also identified as ecological COPCs for avian dietary exposures based on the lack of TRVs. No detected or non-detected chemical was identified as an ecological COPC for brown flower bat dietary exposures (see Section 7.6.3.2.2 and Table 7-28). However, based on the lack of any analytical data with which to evaluate potential risks, lead was identified as an ecological COPC for avian and mammalian dietary exposures.

Refined risk estimates (i.e., NOAEL-, MATC-, and LOAEL-based HQ values) for avian and mammalian dietary exposures are presented in Table 7-54 and discussed within the paragraphs that follow. 95 percent UCL of the mean surface soil concentrations were used in the refined dietary exposure calculations for those ecological COPCs having a minimum of eight detected values and less than 70 percent non-detected results (chromium, copper, nickel, vanadium, and zinc). Additional refinements that were applied in Step 3a of the BERA are presented and discussed within Section 7.9.

Beryllium was detected in SWMU 59 subsurface soil and identified as an ecological COPC for avian dietary exposures in Step 2 of the ERA based on the lack of an avian TRV. This metal was detected in ten of ten (10/10) subsurface soil samples at concentrations ranging from 0.12 mg/kg (59SB27-01) to 0.5 mg/kg (59SB24-01). Beryllium is not identified as an important bioaccumulative chemical (USEPA, 2000b). As such, this metal has low potential to bioaccumulate in terrestrial food items (terrestrial plants, invertebrates, and small mammals). Statistical tests evaluating the mean and right tail of the SWMU and background data set distributions (two sample t-test, quantile test, and slippage test [see Table 7-44]) also concluded that concentrations in SWMU 59 subsurface soil are not elevated relative to background concentrations. Based on the low potential to bioaccumulate in terrestrial food items and the statistical evaluations summarized in Table 7-44, beryllium is not identified as an ecological COC for avian dietary exposures to chemicals in SWMU 59 subsurface soil collected during the 2012 CMS field investigation.

Pentachlorobenzene was detected at a low, estimated concentration in a single subsurface soil sample (5.6J µg/kg in 59SB24-01) and identified as an ecological COPC for avian dietary exposures based on the lack of a TRV. Pentachlorobenzene is identified as an important bioaccumulative chemical (USEPA, 2000b). As such, this SVOC has the potential to bioaccumulate in terrestrial food items (terrestrial plants, invertebrates, and small mammals). However, given that pentachlorobenzene was not detected in other soil samples collected during the 2010 and 2012 CMS field investigations, it is unlikely that the single detected concentration is impacting avian receptor populations at the SWMU. Based on the low magnitude and frequency of detection in soil collected during both CMS field investigations, pentachlorophenol is not identified as an ecological COC.

Chromium, copper, mercury, nickel, and zinc were detected and identified as ecological COPCs because maximum American robin dietary exposure doses exceed NOAEL-based avian TRVs. Vanadium was also identified as an ecological COPC because maximum exposure doses for each avian receptor exceed NOAEL-based TRVs. Refined American robin dietary exposure doses for copper, mercury, nickel, and zinc are less than NOAEL-based avian TRVs (see Table 7-54), indicating no unacceptable risk to avian omnivore populations. Based on refined HQ values less than 1.0, copper, mercury, nickel, and zinc are not identified as ecological COCs for avian omnivore dietary exposures to chemicals in subsurface soil collected during the 2012 CMS field investigation.

The refined NOAEL-based HQ for American robin dietary exposures to chromium in SWMU 59 subsurface soil is only slightly elevated above 1.0 (i.e., HQ = 1.36), while MATC- and LOAEL-based HQs are less than 1.0 (HQs = 0.56 and 0.23, respectively). As evidenced by Table 7-44, the maximum chromium concentration in SWMU 59 subsurface soil (120 mg/kg) is less than the maximum background concentration (148J mg/kg). The box plot of log-transformed chromium concentrations in SWMU 59 subsurface soil (see Appendix K) shows that there are no potential outliers within the SWMU data set at the upper end of the range. The log-normal probability plot also shows that all data points fall on or near a straight line and follow a continuous distribution, indicating that chromium concentrations are likely to represent natural conditions (NFESC, 2002, 2003, and 2004). Based on the low magnitude of the refined exposure dose above the NOAEL-based HQ value, MATC- and LOAEL-based HQ values less than 1.0, the descriptive statistics summarized in Table 7-44, which show that the maximum concentration in SWMU 59 subsurface soil is less than the maximum background concentration, as well as the graphical representations of log-transformed concentrations included within Appendix K, chromium is not identified as an ecological COC for American robin dietary exposures to chemicals in SWMU 59 surface soil collected during the 2012 CMS field investigation.

NOAEL-, MATC-, and LOAEL-based HQ values for vanadium are less than 1.0 for the red-tailed hawk (see Table 7-54), indicating no unacceptable risk to avian carnivore populations. However, NOAEL-based HQs for this metal exceed 1.0 for the American robin (HQ = 12.92) and mourning dove (HQ = 3.55). MATC- and LOAEL-based HQs also exceeded 1.0 for both receptors (see Table 7-54). The descriptive and distributional statistics summarized in Table 7-44 show that vanadium concentrations in SWMU 59 subsurface soil are not elevated relative to background concentrations. Based on refined HQ values for the red-tailed hawk, as well as descriptive and distributional statistics presented in Table 7-44, vanadium is not identified as an ecological COC for avian dietary exposures to chemicals in SWMU 59 subsurface soil collected during the 2012 CMS field investigation.

All surface soil analytical results for lead were rejected because the MS/MSD pair exhibited percent recoveries that exceeded 200 percent. The high percent recoveries indicate that the matrix may be providing an additive effect and the reported values could be higher than what is

actually present in the samples (Type I Error). Given that samples results were rejected due to unacceptable high bias, it is unlikely that lead is present at concentrations that would impact avian and mammalian receptor populations. Based on the discussion presented above, lead is not identified as an ecological COC for avian or mammalian dietary exposures to chemicals in subsurface soil collected during the 2012 CMS field investigation.

In summary, no chemicals are identified as ecological COCs for avian or mammalian dietary exposures to chemicals in SWMU 59 subsurface soil collected during the 2012 CMS field investigation. Although detected and identified as ecological COPCs in Step 2 of the ERA for avian and/or mammalian dietary exposures, pentachlorophenol, beryllium, chromium, copper, mercury, nickel, vanadium, and zinc are not identified as ecological COCs, and additional evaluation is recommended for the reasons discussed in the preceding paragraphs. No additional evaluation is also recommended for the ecological COPC with no useable analytical data (i.e., lead).

7.9.2.3 Avian Dietary Exposures: Drainage Ditch Sediment

Section 7.6.3.3 presented the results of the Step 2 screening level risk calculation for avian (green heron) dietary exposures to chemicals in drainage ditch sediment. Screening level risk estimates also were provided in Table 7-29. Based on the comparison of maximum exposure doses to NOAEL-based TRVs, Barium, chromium, copper, lead, mercury, vanadium, zinc, bis(2-ethylhexyl)phthalate), and 4,4'-DDE were identified as ecological COPCs in Step 2 of the ERA because maximum green heron dietary exposure doses exceed NOAEL-based TRVs. Butyl benzyl phthalate and beryllium were detected and also identified as ecological COPCs based on the lack of avian TRVs. Although not detected, endrin was identified as an ecological COPC because the green heron dietary exposure dose, calculated using the maximum RL, exceeds the NOAEL-based TRV.

Refined risk estimates (i.e., NOAEL-, MATC-, and LOAEL-based HQ values) for green heron dietary exposures are presented in Table 7-55 and discussed within the paragraphs that follow. 95 percent UCL of the mean sediment concentrations were used in the refined dietary exposure calculations for those ecological COPCs having a minimum of eight detected values and less than 70 percent non-detected results (copper, lead, and zinc). Additional refinements that were applied in Step 3a of the BERA are presented and discussed within Section 7.9.

Endrin was not detected in drainage ditch sediment. However this organochlorine pesticide was identified as an ecological COC in Step 2 of the ERA because the green heron dietary exposure dose, calculated using the maximum RL, exceeds the NOAEL-based TRV. As evidenced by Table 7-55, the refined green heron dietary exposure dose is less than the NOAEL-based TRV (HQ = 0.60), indicating no unacceptable risk to avian piscivore populations. It is noted that endrin was not detected in surface soil collected during the 2010 CMS field investigation. Therefore, it is unlikely that this organochlorine pesticide is site-relate or migrating with storm water to drainage ditch sediment at ecologically important concentrations. Based on the refined HQ values, as well as the lack of detections in surface soil, which indicates that this organochlorine pesticide is not site-related, endrin is not identified as an ecological COC for green heron dietary exposures.

Beryllium and butyl benzyl phthalate were detected and identified as ecological COCs for green heron dietary exposures in Step 2 of the ERA based on the lack of avian TRVs. Beryllium was detected in each sediment sample at concentrations ranging from 0.35J mg/kg (59SD03) to 0.45J mg/kg (59SD02), while butyl benzyl phthalate was detected in a single sediment sample (63J mg/kg in 59SD01). Beryllium and butyl benzyl phthalate are not identified as important

bioaccumulative chemicals (USEPA, 2000b) and therefore, have low potential to bioaccumulate in aquatic food items (aquatic invertebrates and fish). In the case of beryllium, the descriptive statistics summarized in Table 7-50 also show that beryllium concentrations in drainage ditch sediment are not elevated relative to background concentrations. Specifically, maximum and arithmetic mean concentrations in drainage ditch sediment are less than maximum and arithmetic mean background concentrations. Based on the low likelihood that beryllium and butyl benzyl phthalate are bioaccumulating in aquatic food items and, in the case of beryllium, the descriptive statistics presented in Table 7-50, these two chemicals are not identified as an ecological COC for green heron dietary exposures, and no additional evaluation is recommended.

Bis(2-ethylhexyl)phthalate and 4,4'-DDE were detected in each sediment sample. Detected concentrations range from 110J µg/kg (59SD02) to 730 µg/kg (59SD03) for bis(2-ethylhexyl)phthalate and 32J µg/kg (59SD02) to 160 µg/kg (59SD03) for 4,4'-DDE. As evidenced by Table 7-55, refined green heron dietary exposure doses for both chemicals exceed NOAEL-based TRVs (HQ = 2.29 for bis[2-ethylhexyl]phthalate and 4.29 for 4,4'-DDE). Refined dietary exposure doses for both organics also exceed MATC-based TRVs (HQs = 1.03 for bis[2-ethylhexyl]phthalate and 1.36 for 4,4'-DDE). Bis(2-ethylhexyl)phthalate was detected in six of nineteen (6/19) surface soil samples collected during the 2010 CMS field investigation, while 4,4'-DDE was detected in ten of nineteen (10/19) surface soil samples. Based on the relatively high frequency of detection, both chemicals may be migrating with storm water to drainage ditch sediment. Based on historical site activities (vehicle maintenance and vehicle refueling), the presence of 4,4'-DDE in SWMU 59 surface soil cannot be attributed to a site-related release. Detected concentrations are likely associated with applications related to historical pest control activities. For this reason, as well as the low magnitude of the 4,4'-DDE refined dietary exposure dose above the MATC-based TRV (HQ = 1.36), 4,4'-DDE is not identified as an ecological COC for avian food web exposures to chemicals in drainage ditch sediment, and no additional evaluation is recommended.

Although NOAEL- and MATC-based HQ values for bis(2-ethylhexyl)phthalate exceed 1.0, this SVOC is also not identified as an ecological COC for avian dietary exposures. This decision is based on the low magnitude of the refined MATC-based HQ value above 1.0 (HQ = 1.03) and the conservative exposure assumptions that were still used in the derivation of the Step 3a dietary dose (maximum detected concentration and an AUF of 1.0).

Refined green heron dietary exposure doses for barium, chromium, lead, and zinc are less than NOAEL-, MATC-, and LOAEL-based TRVs, indicating no unacceptable risk to avian piscivore populations. However, refined dietary exposure doses for copper, mercury and vanadium exceed NOAEL-based TRVs (HQ = 1.10 for copper, 2.37 for mercury and 82.82 for vanadium). Refined exposure doses for mercury and vanadium also exceed MATC-based TRVs (HQs = 1.37 for mercury and 58.56 for vanadium). The descriptive statistics presented in Table 7-50 show that mercury and vanadium concentrations are not elevated relative to background concentrations. Specifically, maximum and arithmetic mean mercury concentrations in drainage ditch sediment (0.19 mg/kg and 0.10 mg/kg, respectively) are comparable to maximum and arithmetic mean background concentrations (0.16 mg/kg and 0.90, mg/kg, respectively), while maximum and arithmetic mean vanadium concentrations in drainage ditch sediment (232J mg/kg and 177 mg/kg, respectively) are less than maximum and arithmetic mean background concentrations (260J mg/kg and 190 mg/kg, respectively). Based on the descriptive statistics presented in Table 7-50, mercury and vanadium are not identified as ecological COCs for green heron dietary exposures, and no additional evaluation of these two metals is recommended.

As discussed in the preceding paragraph, the refined green heron dietary exposure dose for copper exceeds the NOAEL-based TRV (HQ = 1.10). However, refined MATC- and LOAEL-

based HQ values are less than 1.0 (HQs = 0.63 and 0.37). Based on the low magnitude of the NOAEL-based HQ value above 1.0, as well as MATC- and LOAEL-based HQ values less than 1.0, copper is not identified as an ecological COC for green heron dietary exposures, and no additional evaluation of this metal is recommended.

In summary, no chemicals are identified as ecological COCs for green heron dietary exposures to chemicals in drainage ditch sediment. Although detected and identified as ecological COPCs in Step 2 of the ERA, bis(2-ethylhexyl)phthalate, butyl benzyl phthalate, 4,4'-DDE, barium, beryllium, chromium, copper, lead, mercury, vanadium, and zinc are not identified as ecological COCs, and additional evaluation is not recommended for the reasons detailed in the preceding paragraphs. No additional evaluation is also recommended for the non-detected chemicals identified as ecological COPCs in Step 2 of the ERA because exposure doses, calculated using maximum RLs, exceed NAOEL-based TRVs (i.e., endrin).

7.9.3 Uncertainties Associated With Step 3a of the BERA

Many of the uncertainties identified in Section 7.7 for the SERA (i.e. Steps 1 and 2 of the Navy ERA process) also apply to the refined risk calculation and evaluation (i.e. Step 3a of the BERA). Those uncertainties specific to the refined risk calculation for SWMU 59 are listed below.

- Due to the small sample size of the drainage ditch surface water and sediment data sets (excluding copper, lead, and zinc in sediment), risk estimates for these two media were not refined using 95 percent UCL of the mean concentrations. The result is a more conservative risk evaluation that may overstate risks to ecological receptor populations at the SWMU.

- For inorganic chemicals in surface soil, subsurface soil, groundwater, drainage ditch surface water, and drainage ditch sediment, consideration was given to available background data. However, due to the small sample size of the SWMU 59 drainage ditch surface water and sediment data sets (excluding copper, lead, and zinc in sediment), the statistical evaluations performed on the SWMU 59 and background data sets for these media were limited to a descriptive comparison.

- Non-detected chemicals lacking media-specific and/or avian and mammalian TRVs were not evaluated by the refined risk evaluation, nor were they identified as ecological COCs. This approach may have resulted in an understatement of the actual number of ecological COCs if any of the non-detected chemicals lacking screening values and/or TRVs are present at ecologically significant concentrations.

- Assumed sediment-to-fish BAFs of 1.0 were used in the Step 2 screening level risk calculation for chromium and copper. These assumed sediment-to-fish BAFs were replaced in the Step 3a risk calculation by mean BAF values (0.038 for chromium and 0.10 for copper) reported by Krantzberg and Boyd (1992). Use of these BAF values in the green heron dietary exposure model resulted in NOAEL-based HQ values of 0.11 for chromium and 1.10 for copper (see Table 7-55). The study area used by Krantzberg and Boyd (1992) to derive the BAF values had extremely high iron concentrations present in the sediment due to metal smelting, which may have affected metal bioavailability via co-precipitation of metals with iron hydroxide. As such, the BAF values used in Step 3a may have resulted in an understatement of potential risks to the green heron.

  To determine the impact that the Krantzberg and Boyd (1992) BAF values had on estimated green heron dietary intakes, risk estimates for chromium and copper were

derived using assumed BAF values of 1.0. The NOAEL-based HQ values (1.44 for chromium and 3.76 for copper) are elevated relative to NOAEL-based risk estimates derived using the Krantzberg and Boyd (1992) BAF values (0.11 for chromium and 1.10 for copper). It is noted that a literature search identified a compilation of sediment-to-fish BAF values reported by PTI Environmental Services in their report titled Bioaccumulation Factor Approach Analysis for Metals and Polar Organic Compounds (PTI Environmental Services, 1995). The compilation included a single sediment-to-fish BAF value for chromium, which is based on a laboratory study using yellow perch (*Perca flavescens*). This BAF value (0.043) is very comparable to the BAF value used in the refined risk calculation (0.038).

7.9.4 Step 3a Decision Point and Recommendations

Tables 7-56 presents a summary of the ecological COPCs identified in Step 2 of the SERA for surface and subsurface soil collected during the 2010 and 2012 CMS field investigations, while Table 7-57 presents a summary of ecological COPCs identified in Step 2 of the SERA for groundwater, surface water, sediment. Included within each table are the ecological COCs identified in Step 3a of the BERA.

7.9.4.1 Surface Soil

Recommendations for surface soil collected during the 2010 and 2012 CMS field investigations are presented below.

7.9.4.1.1 Surface Soil: 2010 CMS Field Investigation

Based on the refined media-specific risk evaluation presented in Section 7.9.1.1.1, copper, lead, and zinc were identified as ecological COCs for terrestrial plant and invertebrate direct contact exposures to chemicals in SWMU 59 surface soil collected during the 2010 CMS field investigation. Maximum and 95 percent UCL of the mean concentrations for each metal exceed soil screening values (i.e., HQs > 1.0; see Tables 7-18 and 7-38, respectively). The descriptive and distributional statistics presented in Table 7-38 also show that copper, lead, and zinc concentrations in SWMU 59 surface soil are elevated relative to background concentrations. Based on their identification as ecological COCs for terrestrial plant and invertebrate populations, CAOs for copper, lead, and zinc were developed for these lower trophic level receptor groups using the methodology presented in Section 7.10.1.

Lead was identified as an ecological COC for avian herbivore and avian omnivore dietary exposures to chemicals in SWMU 59 surface soil collected during the 2010 CMS field investigation (see Section 7.9.2.1.1). Dietary exposure doses derived using maximum and 95 percent UCL of the mean lead concentrations exceed NOAEL-, MATC-, LOAEL-based TRVs (i.e., HQs > 1.0; see Tables 7-25 and 7-51, respectively). Distributional statistics performed on the SWMU 59 and background surface soil data sets (see Table 7-38) also demonstrated that lead concentrations in SWMU 59 surface soil are elevated relative to background concentrations. Based on the identification of lead as an ecological COC for avian herbivore and omnivore dietary exposures, a CAO protective of these avian receptors was developed for this metal using the methodology presented in Section 7.10.1.

7.9.4.1.2 Surface Soil: 2012 CMS Field Investigation

Based on the refined risk evaluation presented in Section 7.9.1.1.2, copper was identified as an ecological COC for terrestrial plant and invertebrate direct contact exposures to chemicals in

SWMU 59 surface soil collected during the 2012 CMS field investigation. Maximum and 95 percent UCL of the mean concentrations for this metal exceed the soil screening value (i.e., HQs > 1.0; see Tables 7-19 and 7-39, respectively). The descriptive and distributional statistics presented in Table 7-40 also show that copper concentrations in SWMU 59 surface soil are elevated relative to background concentrations. Finally, the box plot depicting log-transformed concentrations indicates that the detected concentration at soil boring location 59SB24 is elevated relative to other detected concentrations at the SWMU, and may represent a potential outlier. Based on the identification of copper as an ecological COC for terrestrial plant and invertebrate populations, a CAO was developed for these lower trophic level receptor groups using the methodology presented in Section 7.10.1.

No chemicals were identified as ecological COCs for avian or mammalian dietary exposures to chemicals in SWMU 59 surface soil collected during the 2012 CMS field investigation (see Section 7.9.2.1.2).

7.9.4.2 Subsurface Soil

Recommendations for surface soil collected during the 2010 and 2012 CMS field investigations are presented below.

7.9.4.2.1 Subsurface Soil: 2010 CMS Field Investigation

Based on the refined risk evaluations presented in Section 7.9.1.2.1 and 7.9.2.2.1, no chemicals were identified as ecological COCs for terrestrial plant and invertebrate direct contact exposures or avian and mammalian dietary exposures to chemicals in SWMU 59 subsurface soil collected during the 2010 CMS field investigation.

7.9.4.2.2 Subsurface Soil: 2012 CMS Field Investigation

Based on the refined risk evaluations presented in Section 7.9.1.2.2 and 7.9.2.2.2, no chemicals were identified as ecological COCs for terrestrial plant and invertebrate direct contact exposures or avian and mammalian dietary exposures to chemicals in SWMU 59 subsurface soil collected during the 2012 CMS field investigation.

7.9.4.3 Groundwater

Based on the refined risk evaluation presented in Section 7.9.1.3, no chemicals were identified as ecological COCs for aquatic receptor group direct contact exposures to chemicals in SWMU 59 groundwater discharging to downgradient marine environments.

7.9.4.4 Drainage Ditch Surface Water

Based on the refined risk evaluation presented in Section 7.9.1.4, no chemicals were identified as ecological COCs for aquatic receptor group direct contact exposures to chemicals in drainage ditch surface water.

7.9.4.5 Drainage Ditch Sediment

Based on the refined risk evaluation presented in Sections 7.9.1.5, copper and zinc were identified as ecological COCs for aquatic receptor group exposures to chemicals in SWMU 59 sediment. Maximum and 95 percent UCL of the mean concentrations for each metal exceed sediment screening values (i.e., HQs > 1.0; see Tables 7-24 and 7-48, respectively). In addition, SEM-to-AVS ratios at 59SD02 and 59SD03 (9.75 and 10.51, respectively [see Table 7-50]) exceed 1.0,

indicating that benthic invertebrates may be exposed to toxic concentrations of copper and zinc at these two locations. The descriptive and distributional statistics presented in Table 7-49 also show that copper and zinc concentrations in SWMU 59 sediment are elevated relative to background concentrations. Based on the identification of copper and zinc as ecological COCs for aquatic receptor group populations, CAOs for these two metals were developed using the methodology presented in Section 7.10.1.

Based on the refined risk evaluation presented in 7.9.2.3, no chemicals were identified as ecological COCs for avian dietary exposures to chemicals in SWMU 59 sediment.

7.10 Development of Ecological Corrective Action Objectives

This section presents the methodology used to develop CAOs for the ecological COCs identified in Step 3a of the Navy ERA process (copper, lead and zinc in surface soil adjacent to concrete pads and paved surfaces [2010 surface soil data set], copper in surface soil beneath concrete pads and paved surfaces [2012 surface soil data set], and copper and zinc in drainage ditch sediment.

7.10.1 Methodology for CAO Development: Surface Soil

Copper, lead, and zinc were identified as ecological COCs for terrestrial plant and invertebrate direct contact exposures to chemicals in SWMU 59 surface soil collected during the 2010 CMS field investigation. Lead was also identified as an ecological COC for avian omnivore and herbivore dietary exposures to chemicals in SWMU 59 surface soil collected during the 2010 CMS field investigation. Finally, copper was identified as an ecological COC for terrestrial plant and invertebrate direct contact exposures to chemicals in SWMU 59 surface soil collected during the 20120 CMS field investigation. The sections that follow present the methodology used to develop risk- and background-based surface CAOs for these chemical-receptor-pathway combinations. Final CAOs are also identified in Section 7.10.3.

7.10.1.1 Risk-Based CAOs for Terrestrial Plant and Invertebrate Direct Contact Exposures

Copper, lead, and zinc were identified as ecological COCs for terrestrial plant and invertebrate direct contact exposures to chemicals in surface soil collected during the 2010 CMS field investigation. Copper was also identified as an ecological COC for terrestrial plant and invertebrate direct contact exposures to chemicals in surface soil collected during the 2012 CMS field investigation. The soil screening values listed in Table 7-4 and used in the derivation of screening level and refined risk estimates (i.e., 70 mg/kg for copper, 120 mg/kg for lead, and 120 mg/kg for zinc) were selected as CAOs protective of terrestrial receptor groups.

7.10.1.2 Risk-Based CAOs for Avian Dietary Exposures

Lead was identified as an ecological COC for avian omnivore (i.e., American robin) and avian herbivore (i.e., mourning dove) dietary exposures to chemicals in SWMU 59 surface soil collected during the 2010 CMS field investigation. The Step 3a risk calculation presented in Table 7-51 showed that the American robin represents the most sensitive receptor for dietary exposures to lead in SWMU 59 surface soil (American robin HQ = 5.04; mourning dove HQ = 3.11). Therefore, a CAO specific to mourning dove dietary exposures was not derived (the CAO derived for avian omnivores will be protective of avian herbivores). The CAO for American robin dietary exposures to lead in surface soil (96 mg/kg) was established through an interactive process using the dietary intake equation presented and discussed in Section 7.5.2.2.2:

$$DI_x = \frac{[[\sum_i[(FIR)(FC_{xi})(PDF_i)]]+[(FIR)(SC_x)(PDS)]][AUF]}{BW}$$

where:

DI_x	=	Dietary intake for chemical x (mg chemical/kg body weight/day)
BW	=	Body weight (kilogram [kg], wet weight)
FIR	=	Food ingestion rate (kilogram/day [kg/day], dry-weight)
FC_{xi}	=	Concentration of chemical x in food item i (mg/kg, dry weight)
PDF_i	=	Proportion of diet composed of food item i (dry weight basis)
SC_x	=	Concentration of chemical x in soil (mg/kg, dry weight)
PDS	=	Proportion of diet composed of soil (dry weight basis)
AUF	=	Area Use Factor (unitless)

The receptor-specific input parameters used for *BW*, PDF_i, *PDS*, *FIR*, and *AUF* are summarized below. The values selected for these parameters are identical to the values used to estimate American robin dietary intakes in Step 3a of the BERA.

- American robin body weight (*BW*): 0.0785 kg (Dunning, 2008)
- American robin food ingestion rate (*FIR*): 0.01033 kg/day-dry weight (Nagy, 2001)
- Proportion of American robin diet composed of food item i (PDF_i): 0.83 for earthworms and 0.083 for plants (Wheelwright, 1986)
- Proportion of American robin diet composed of soil (*PDS*): 0.087 (Sample and Suter II, 1994)
- Area use factor (*AUF*): 1.0 (assumed)

FC_{xi} was estimated using the soil-to-plant and soil-to-invertebrate uptake equations listed in Table 7-32 (i.e., for each dietary component, FC_{xi} was set equal to the appropriate uptake equation). For a given chemical, the iterative process mentioned above was conducted by entering values for SC_x into the equation until a dietary intake (DI_x) was calculated that equaled the NOAEL-based TRV (1.63 mg/kg-BW/day). The soil concentration that resulted in a dietary intake equal to the NOAEL-based TRV was selected as the CAO.

It is noted that chemical intakes via surface water ingestion were not considered when calculating surface soil CAOs due to the extremely low contribution that this exposure route has to the total risk (i.e., exclusion of drinking water exposures from the Step 2 and Step 3a risk calculations has a negligible effect on risk estimates). This approach is consistent with the USEPA's guidance for developing wildlife Eco-SSLs for upper trophic level receptors (USEPA, 2005a).

7.10.1.3 Background-Based CAOs

ULM concentrations for the NAPR basewide background surface soil data set presented in the Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds (Baker, 2010b) were selected as background-based CAOs for copper, lead, and zinc in surface soil (168 mg/kg, 22 mg/kg, and 115 mg/kg, respectively).

7.10.2 Identification of Final Corrective Action Objectives

Table 7-58 presents the CAOs developed for SWMU 59 surface soil collected during the 2010 and 2012 CMS field investigations. As evidenced by Table 7-58, the risk-based CAOs for lead and zinc (lead: 120 mg/kg for terrestrial plants and invertebrates and 96 mg/kg for avian omnivores; zinc: 120 mg/kg for terrestrial plants and invertebrates) exceed the background-based CAOs for these two metals (22 mg/kg for lead and 115 mg/kg for zinc). Therefore, the minimum risk-based CAO for lead (96 mg/kg; CAO for avian dietary exposures) and the risk-based CAO for zinc were selected as final CAOs for surface soil adjacent to concrete pads and paved surfaces (i.e., surface soil collected during the 2010 CMS field investigation). The risk-based CAO for copper (70 mg/kg for terrestrial plants and invertebrates) is less than the background-based CAO (168 mg/kg). Therefore, the background-based CAO was selected as the final CAO for copper adjacent to and beneath concrete pads and paved surfaces. This approach is consistent with the Navy policy for use of Background Chemical Levels (CNO, 2004), which states that "*The action level for the remediation of sites should be risk based, should not be below background levels, and should target the risk associated with the COC or contaminant concentration exceeding background chemical levels*".

7.10.3 Methodology for CAO Development: Drainage Ditch Sediment

Copper and zinc were identified as ecological COCs for aquatic receptor group direct contact exposures to chemicals in drainage ditch sediment. The sections that follow present the methodology used to develop risk- and background-based surface CAOs for these chemical-receptor-pathway combinations. Final CAOs are also identified in Section 7.10.3.

7.10.2.1 Risk-Based CAOs for Aquatic Receptor Group Direct Contact Exposures

Copper and zinc were identified as ecological COCs for aquatic receptor group direct contact exposures to chemicals in drainage ditch sediment. The sediment screening values listed in Table 7-8 and used in the derivation of screening level and refined risk estimates (i.e., 31.6 mg/kg for copper and 121 mg/kg for zinc) were selected as CAOs protective of aquatic receptor groups.

7.10.2.2 Background-Based CAOs

ULM concentrations for the non-airfield, freshwater drainage ditch background sediment data presented in the Revised Addendum C and Addendum D to the Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds (Baker 2013) were selected as background-based CAOs for copper and zinc in SWMU 59 sediment (131 mg/kg and 105 mg/kg, respectively).

7.10.2.3 Identification of Final Corrective Action Objectives

Table 7-59 presents the CAOs developed for drainage ditch sediment. As evidenced by Table 7-59, the risk-based CAO zinc (121 mg/kg) exceeds the background-based CAOs (105 mg/kg). Therefore, the risk-based CAO was selected as the final CAOs for zinc in drainage ditch sediment. In the case of copper, the risk-based CAO (31.6 mg/kg) is less than the background-based CAO (131 mg/kg). Therefore, the background-based CAO was selected as the final CAO for copper in drainage ditch sediment. As discussed in Section 7.10.1.4, this approach is consistent with the Navy policy for use of Background Chemical Levels (CNO, 2004).

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8.0 HUMAN HEALTH RISK ASSESSMENT AND DEVELOPMENT OF CAOs

8.1 Introduction

This section presents the Human Health Risk Assessment (HHRA) for SWMU 59 – Former Vehicle Maintenance and Refueling Area, located at NAPR, Ceiba, Puerto Rico. The baseline HHRA was conducted in accordance with the RAGS, Part A, Human Health Evaluation Manual (USEPA, 1989), and the most recent updates, such as RAGS Part D (USEPA, 2001), Part E (USEPA, 2004), and Part F (USEPA, 2009). The HHRA considers the most likely routes of potential human exposure for both current and future risk scenarios at SWMU 59. Should the results of the HHRA conclude that potential exposure to environmental media at SWMU 59 is considered to pose unacceptable levels of risk and hazard to human receptors, medium- and chemical-specific CAOs will be calculated for comparison to the site data to determine if and where potential cleanup may occur.

It is noted that the Navy identifies future use as aligned with current use (industrial) for the purpose of developing remedial alternatives. As such, the HHRA presented herein is prepared accordingly. The Navy recognizes that changes in future land usage from the present use (industrial) could result in additional receptors. If development other than industrial use (i.e., residential, or per the *Roosevelt Roads Redevelopment Addendum to the 2004 Reuse Plan* dated April 30, 2010) is proposed, the new owner would be required to work with the USEPA and PREQB to establish any additional investigation, risk assessment, and/or remediation activities.

8.2 Land Use and Potentially Exposed Receptors

To focus on developing practicable and cost-effective corrective measures alternatives and to streamline the environmental cleanup process, USEPA guidance ("Land Use in the Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA] Remedy Selection Process," [USEPA, 1995]) and United States Department of Defense (Longuemare, 1997) direct that CAOs should reflect the reasonably anticipated land use. As previously discussed, the Navy identifies future use as aligned with current use (industrial) for the purpose of developing remedial alternatives.

SWMU 59 (also known as ECP Site 5) covers an area of approximately 10 acres and is located within the east/central area of NAPR as shown on Figure 2-2. The site consists of a level area with the majority of the site paved. The site is surrounded by secondary growth vegetation. Located on the eastern side of Forrestal Drive and including existing buildings 60, 258, and 377, the aerial photography analysis (APA) from the Phase II ECP Report also described this area as Photo Identified (PI) Site 7 due to an observation of drums, vehicle racks, stains, and fuel islands from 1958 to 1985. During the Phase II ECP investigation, a large concrete pad was observed in the southwestern portion of the site where the suspected UST was believed to have been located. Four fueling islands were observed on this concrete pad. The field team located four 8-foot vent pipes protruding from the concrete pad. It was assumed that these were vent pipes since fill pipes are not generally 8 feet high. However, after thoroughly searching the area visually and with a metal detector, the UST was not identified. There were no signs of any stressed vegetation observed during the investigation.

No aquatic natural resources (i.e., streams, wetlands, or drainage ditches) were observed within the SWMU 59 boundary. However, a small pool (Appendix A, Photo 10), contiguous to a freshwater drainage ditch was identified west of SWMU 59, on the opposite side of Forrestal Drive. During the CMS investigation, the field team determined that storm water is diverted

through a series of culverts from the SWMU, underneath Forrestal Drive, to an outfall associated with the small pool.

The current primary mission of NAPR is to protect the physical assets remaining, comply with environmental regulations, and sustain the value of the property until final disposal of the property. It is assumed that long-term plans for the facility would be similar to those that had been in place prior to closure with land use also generally the same. As such, future property use of this site is expected to remain industrial.

Considering the assumed future property use of SWMU 59 and the potential human receptors/exposure pathways listed in Attachment II of the RCRA §7003 Administrative Order on Consent for NAPR (USEPA, 2007), the following human receptors are considered potentially exposed to site environmental media. For the continued industrial land use scenario at this site, the industrial worker is used to characterize potential future exposure to contaminated soil and groundwater. The assumption of USEPA's default industrial/commercial exposure scenario accounts for long term exposure (workers are assumed to be at the site eight hours per work day for 25 years) and is used to reflect future land use. Specifically, an industrial worker could be exposed to soil, ingestion of groundwater as a potable source, volatiles in groundwater emitted through soil into buildings in the vicinity of SWMU 59. The construction worker is also used to characterize potential future exposure to contaminated soil and groundwater. Construction workers that may perform excavation and construction at the site could be exposed to soil (0 to 10 feet) and shallow groundwater at SWMU 59. (Note that analytical results from subsurface soil samples collected from the 9 to 11 feet bgs interval were included in the total soil data set used in the HHRA because 10 feet bgs is included in this interval. Refer to Appendix O.) It is conservatively assumed that for potential current exposures, adult and youth trespassers or an on-site worker may access the site. These receptors could be exposed to contaminated soil, surface water, and sediment.

Future residential land use is conservatively considered for SWMU 59, although it is not included in the RCRA §7003 Administrative Order on Consent (USEPA, 2007) as a likely scenario given assumed future land use. However, the Navy recognizes that changes in future land usage from industrial could result in additional receptors. Therefore, the future residential exposure scenario is used to evaluate unrestricted land use and provide the most conservatively protective risk estimation. Potential exposures to soil, groundwater, surface water, and sediment were conservatively assumed for future residents.

8.3 Human Health Risk Assessment

This section presents the results of the HHRA prepared for this CMS. The baseline HHRA considers the most likely routes of potential human exposure for both current and future risk scenarios. The baseline HHRA is comprised of seven sections. Section 8.3.1 presents the Selection of Chemicals of Potential Concern, which evaluates the site investigation data and identifies COPCs across the site with regard to potential health effects. Sections 8.3.2 and 8.3.3 present the Exposure Assessment and Toxicity Assessment, respectively. The Risk Characterization, including a discussion of potential human health effects, is presented in Section 8.3.4. Section 8.3.5 presents a comparison with background levels. Section 8.3.6 outlines the potential sources of uncertainty encountered in the process of performing a risk assessment, and their potential effects on the estimation of human health risks. Section 8.3.7 presents the summary and conclusions of the HHRA. Additionally, Section 8.4 presents the development of CAOs, as applicable, and Section 8.5 presents the references.

8.3.1 Selection of Chemicals of Potential Concern

8.3.1.1 Data Evaluation

The data used in the revised HHRA are presented in full in Appendix O. A statistical analysis, including the minimum, maximum, mean, standard deviation, and 95% UCL (calculated using ProUCL Version 4.01.01), was run for applicable data sets (i.e., surface soil [0 to 1 foot bgs], total soil [0 to 11 feet bgs], groundwater, surface water, and sediment COPCs). The statistical summary of data used in the HHRA is located in Appendix P. Data utilized in the HHRA is discussed in the paragraphs below. For duplicate samples, the higher of the two concentrations (environmental versus duplicate) was used, not both. The total and dissolved metals analytical results from groundwater samples were included in the COPC selection. However, only the analytical results for total metals were used to estimate exposure concentrations. The dissolved metals data are presented to indicate that the observed metals in the groundwater samples could be associated with suspended particles in the water samples. Further, RAGS Part A (USEPA, 1989) guidance states that filtered groundwater data can provide useful information for understanding chemical transport within an aquifer. As appropriate, dissolved groundwater data will be qualitatively evaluated in relationship to corresponding total groundwater data. The following paragraphs describe the data used in the HHRA for SWMU 59.

Previously, a Phase II ECP investigation was conducted at SWMU 59 in 2004 and involved the collection of six surface soil samples (designated 5E-SS01 through 5E-SS06), two subsurface soil samples in the 1.0 to 3.0 foot depth interval (designated 5E-SB05-01 and 5E-SB07-01), and three groundwater samples (designated 13GW04, 5E-GW05, and 5E-GW08). Sample locations are depicted on Figure 4-2. Each sample was analyzed for Appendix IX VOCs, SVOCs, pesticides, and metals. Dissolved oxygen was also measured in the groundwater samples. A description of the Phase II ECP field investigation and associated analytical results were previously presented in the Final Phase I/II Environmental Condition of Property (NAVFAC Atlantic, 2005). It is noted that the quality of the analytical data obtained during the Phase II ECP field investigations is questionable due to the lack of independent, third party data validation. Based on the lack of validation, the soil and groundwater data were deemed unacceptable for use in the HHRA. However, these data are presented in Appendix B of this report.

The first of two CMS field investigations (see Section 4.0 of this report) was conducted in April and May 2010. The sampling event involved the collection of surface soil, subsurface soil, groundwater, surface water, and sediment samples. A total of 19 surface soil samples were collected from a depth of 0 to 1 foot bgs from soil boring locations 59SB01 through 59SB04, 59SB06 through 59SB09, 59SB11 through 59SB15, 59SB17 and 59SB18, and 59SB20 through 59SB23. Three field duplicate samples were collected: 59SB01-00D, 59SB11-00D, and 59SB17-00D. Soil borings 59SB05, 59SB10, 59SB16, and 59SB19 were located on the concrete slab. As such, surface soil was not present, and surface soil samples were not collected. All surface soil samples were analyzed for Appendix IX VOCs, SVOCs with LLPAHs, pesticides, and metals.

Two subsurface soil samples were collected from each of the 23 soil boring locations for a total of 46 environmental samples. In addition, five field duplicates (59SB02-01D, 59SB07-01D, 59SB11-01D, 59SB13-01D, and 59SB21-01D) were also collected. Subsurface soil samples were collected from the 1 to 3 foot interval and a deeper interval (i.e., 3.0 to 5.0-foot, 5.0 to 7.0-foot, 7.0 to 9.0-foot, or 9.0 to 11.0-foot depth intervals). All subsurface soil samples were analyzed for Appendix IX VOCs, SVOCs with LLPAHs, pesticides, and metals.

Permanent monitoring wells were installed in ten (59SB01, 59SB02, 59SB03, 59SB04, 59SB05, 59SB06, 59SB07, 59SB08, 59SB09, and 59SB10) of the 23 soil borings. Groundwater samples were collected from each of the wells and analyzed for Appendix IX VOCs, SVOCs with LLPAHs, pesticides, and total and dissolved metals.

During the April/May 2010 CMS investigation, the field team determined that storm water is diverted through a series of culverts from the SWMU, underneath Forrestal Drive, to an outfall that drains into a small pool adjacent to a freshwater drainage ditch. A total of three surface water/sediment samples were collected from the small pool. Sampling activities were not conducted within the drainage ditch downgradient from this pool since surface water and sediment quality can be influenced by storm water from AOC F, SWMU 14, and JP-5 Hill. By restricting sampling activities to the pool, it can be determined if site-related chemicals have migrated with storm water to the drainage ditch. Surface water sample 59SW01 was collected on April 20, 2010, while surface water samples 59SW02 and 59SW03 were collected on May 20, 2010. Analysis for all surface water samples included Appendix IX VOC, LLSVOC, pesticides, and total and dissolved metals. Sediment sample 59SD01 was collected on April 22, 2010, while sediment samples 59SD02 and 59SD03 were collected on May 20, 2010. Analysis for all sediment samples included Appendix IX VOC, LLSVOC, pesticides, TOC, and metals.

The second CMS field investigation (see Section 4.0 of this report) was conducted in September 2012. The sampling event involved the collection of surface soil and subsurface soil samples from beneath the concrete pads/paved surfaces and sediment samples from the drainage ditch that receives storm water run-off from the SWMU. The additional soil samples were collected to characterize soils beneath the concrete pads and pavement. A total of ten surface soil samples were collected from borings 59SB24 through 59SB33 from a depth of 0.0 to 1.0 foot bgs immediately below the concrete or asphalt surface and gravel sub-base. A total of ten subsurface soil samples were collected from borings 59SB24 through 59SB33 from the 1 to 3-foot depth interval below the concrete or asphalt surface and gravel sub-base. Only one subsurface soil sample was collected from each boring since impacts to subsurface soil were not evident based on visual, olfactory, or PID screening. All surface and subsurface soil samples were analyzed for Appendix IX VOCs, SVOCs with LLPAHs, and metals. The sediment sampling included the collection of nine sediment samples (59SD04 through 59SD12) from the drainage ditch. The samples were collected from a depth of 0 to 0.5 feet bgs and analyzed for copper, lead, and zinc.

All analytical data for surface soil, subsurface soil, groundwater, surface water, and sediment samples collected during the April/May 2010 and September 2012 CMS field investigations were quantitatively evaluated in the HHRA. Specifically, the soil data were quantitatively evaluated as two separate data sets. First, the 2010 and 2012 soil data were combined and quantitatively evaluated as a unified data set. The second soil data set consisted of only the 2012 soil data (soil from beneath the concrete pads/paved surfaces), which was evaluated independently as a conservative measure to compare with risks associated with the combined soil data set to determine evidence of releases to soil beneath the paved surfaces. Analytical data for the groundwater samples and drainage ditch surface water samples collected during the 2010 CMS field investigation were quantitatively evaluated in the HHRA. Analytical data for the 2010 and 2012 sediment samples were combined into a unified data set and quantitatively evaluated in the HHRA.

8.3.1.2 COPC Selection

COPCs are those chemicals having the greatest potential to cause adverse human health effects if receptors come in contact with site media. For each environmental medium, COPCs were selected in accordance with USEPA's RAGS, Volume I, Human Health Evaluation Manual (Part A), Interim Final, (USEPA, 1989). Although some metals occur above the risk-based screening values, but below background concentrations, no metals were eliminated from the risk evaluation based on their occurrence at background levels. The final site recommendations were based on results of the HHRA and comparisons with the background levels as appropriate for the metals.

8.3.1.2.1 COPC Selection Criteria

The COPCs were selected by comparing the maximum concentrations detected in environmental samples to risk-based screening levels. Chemicals exceeding screening levels were retained as COPCs for further evaluation; chemicals detected at concentrations below these criteria were not evaluated unless other circumstances (frequency of exposure detected in other media, same chemical class [i.e., PAHs] or documented usage) warrant the re-inclusion and further evaluation of chemicals selected as COPCs. The risk-based screening levels used in selecting chemicals as COPCs in the HHRA for SWMU 59 were the USEPA Regional Screening Levels (RSLs) (USEPA, 2013), which are described in greater detail below.

In conjunction with concentration comparisons to the USEPA RSLs, a comparison to concentrations detected in field and laboratory blanks was conducted by a third-party data validator, to ensure that only site-related chemicals are evaluated in the quantitative estimation of human health effects. Metals were also compared to corresponding background screening concentrations. A description of actual background screening concentrations used can be found later in this section. Note that metals are not eliminated from the risk evaluation during the COPC selection process based on their occurrence at background levels. The comparison of metals against background screening values is presented with the COPC selection for practicality. This comparison is then used to refine the risk assessment so that the portion of the total site risk that is attributable to background concentrations can be seen and used in risk management decisions.

The toxicity of a chemical detected in a given environmental medium, as well as the history of site-related activities are other important criteria applied in selecting COPCs at SWMU 59. Therefore, in conjunction with concentration comparisons to USEPA RSLs, evaluations of toxicity and site history were considered to determine whether chemicals eliminated by a direct comparison to RSL values should be re-included as COPCs. Each of the aforementioned criteria is discussed in the paragraphs that follow.

USEPA Regional Screening Levels – The RSLs were developed by the USEPA to support the risk assessment screening process, while improving consistency across Regions and incorporating updated guidance in a timely manner.

The RSL Table contains risk-based screening levels derived from standardized equations (representing ingestion, dermal contact, and inhalation exposure pathways), calculated using the latest toxicity values, default exposure assumptions, and physical and chemical properties. The RSLs contained in the RSL Table are generic; they are calculated without site-specific information. RSLs should be viewed as Agency guidelines, not legally enforceable standards. The RSLs for potentially carcinogenic chemicals are based on a target Incremental Lifetime Cancer Risk (ILCR) of $1x10^{-06}$. The RSLs for noncarcinogens are based on a target HQ of 1.0. However, in order to account for cumulative risk from multiple chemicals in a medium, the noncarcinogenic RSLs were divided by a factor of ten, yielding a target HQ of 0.1. For potential carcinogens, the toxicity criteria applicable to the derivation of RSL values are oral Cancer Slope Factors (CSFs) and inhalation unit risk (IUR) factors; for noncarcinogens, they are chronic oral reference doses (RfDs) and inhalation reference concentrations (RfCs). These toxicity criteria are subject to change as more updated information and results from the most recent toxicological/epidemiological studies become available. The RSL table is updated periodically to reflect such changes. The May 2013 version of the RSL table (USEPA, 2013) was used in this HHRA as it was the current version at the time of data screening.

In this HHRA, chemicals detected in groundwater are compared to tap water RSLs. Chemicals detected in soil are compared to residential soil RSLs. Chemicals detected in surface water were conservatively compared to tap water RSLs, while those detected in sediment were conservatively compared to residential soil RSLs. It should be noted that residential screening criteria were conservatively used in this HHRA.

Background or Naturally Occurring Levels - Generally, a comparison to naturally occurring levels applies only to metals, because the majority of organic chemicals are not naturally occurring. Background samples are collected from areas that are not influenced by site contamination. The background data used for comparison purposes in this HHRA are taken from the Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds (Baker, 2013) for NAPR. The criterion used for screening is the ULM, which is calculated as the mean plus two times the standard deviation of the mean.

Sample concentrations for metals in site-specific surface soil, groundwater, surface water, and sediment were compared to the ULM of the corresponding background data sets (NAPR base-wide surface soil, groundwater, non-airfield freshwater drainage ditch surface water, and non-airfield freshwater drainage ditch sediment, respectively). There is currently no established background data set for NAPR base-wide total soil. However, for the purposes of comparison to background, the established background data sets for NAPR base-wide surface soil and clay subsurface soil were combined. Total soil ULM values were calculated following the methodology outlined in the Revised Final II Summary Report (Baker, 2013) for comparison to site-specific total soil analytical results.

8.3.1.2.2 Use of Surrogate Chemicals for Missing Screening Values

If a screening value for a constituent was not available from the RSL tables, the constituent was evaluated using the screening values for a surrogate chemical, if appropriate and available. Soil and tap water screening values for phenanthrene and total chromium were not available from the RSL table. Pyrene was selected as a surrogate chemical for phenanthrene during the COPC selection process because of its structural similarity. Trivalent chromium was selected as a surrogate chemical for total chromium as there is no history of hexavalent chromium production operations at SWMU 59. Soil screening values for m/p-xylene, acenaphthylene, benzo(g,h,i)perylene, delta-BHC, alpha-chlordane, gamma-chlordane, endosulfan sulfate, and endrin aldehyde were not available from the RSL tables. Based on structural similarity, the following surrogate chemicals were used during the COPC selection process for the above listed chemicals.

- total xylene – m/p-xylene
- acenaphthene – acenaphthylene
- pyrene – benzo(g,h,i)perylene
- chlordane – alpha-chlordane and gamma-chlordane
- endosulfan – endosulfan sulfate
- endrin – endrin aldehyde

It should be noted that chromium will be present predominantly in the trivalent chromium oxidation state in most soils. While hexavalent chromium contamination is generally associated with industrial activity, it can occur naturally. Oxidation of trivalent chromium to hexavalent chromium can occur in the soil environment. The relation between trivalent chromium and hexavalent chromium strongly depends on pH (the process is enhanced at pH values greater than 6) and oxidative properties of the location, but in most cases, the trivalent chromium is the dominating species (Kotaś and Stasicka, 2000). Most trivalent chromium in soil is immobilized

due to adsorption and complexation with soil materials. As such, due to the lack of availability of mobile trivalent chromium, a large portion of chromium in soil will not be oxidized to hexavalent chromium even with favorable oxidation and pH conditions (ATSDR, 2008).

8.3.1.2.3 *Selection of COPCs*

The following paragraphs present the rationale for selection of COPCs. Tables 8-1 through 8-7 present the selection of COPCs. Constituents retained as COPCs are indicated by the shaded cells in the tables. These tables also include exposure concentrations for COPCs, which are discussed further in Section 8.3.2, Exposure Assessment. Information is presented in these tables only for those constituents detected at least once in the medium of interest. The geographic distribution of the COPCs is shown on Figures 8-1 through 8-7. Sample locations, analytical results, and corresponding figures for surface soil, subsurface soil, groundwater, surface water, and sediment are presented in Section 6.0 and appendices of this CMS Investigation Report.

For the soil exposure pathway evaluation for SWMU 59, COPCs were selected from both surface soil (0 to 1 foot bgs) and total soil (0 to 11 feet bgs for the 2010 soil data and 0 to 3 feet bgs for the 2012 soil data). As previously discussed, analytical results from subsurface soil samples collected from the 9 to 11 feet bgs interval were included in the total soil data set used in the HHRA because 10 feet bgs is included in this interval (refer to Appendix O). The most conservative exposure concentration for each COPC was used in the risk calculations to produce a conservative risk estimate (refer to Section 8.3.2.4 for further explanation).

Surface Soil (2010 and 2012 combined)

The data and COPC selection summary for surface soil samples collected at SWMU 59 are presented in Table 8-1. The spatial extent of surface soil COPC concentrations greater than residential soil RSLs is depicted on Figure 8-1. Note that only those detected concentrations exceeding corresponding residential soil RSLs are shown on the figure (i.e., those COPCs retained based on lack of screening/toxicity criteria or chemical similarity are not included).

There were no VOCs detected in the surface soil at concentrations above corresponding residential soil RSLs. Methyl iodide and propionitrile currently have no screening criteria available; therefore, they were retained as surface soil COPCs as a conservative measure.

The carcinogenic PAHs benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene were detected in the surface soil at maximum concentrations above corresponding residential soil RSLs and were retained as COPCs for surface soil. Benzo(a)anthracene, benzo(k)fluoranthene, and chrysene were detected at concentrations below corresponding residential soil RSLs. However, these carcinogenic PAHs were re-included as COPCs for surface soil because of the potential additive toxic effects of carcinogenic PAHs.

There were no pesticides detected in the surface soil at concentrations above corresponding residential soil RSLs. Therefore, pesticides were not retained as surface soil COPCs.

Antimony, arsenic, cobalt, and thallium, vanadium were detected in surface soil at concentrations exceeding corresponding residential soil RSLs and were retained as surface soil COPCs. Lead was detected at a maximum concentration exceeding its residential soil action level (400 mg/kg) and was retained as a surface soil COPC.

Surface Soil beneath the Concrete/Paved Surfaces (2012)

The data and COPC selection summary for surface soil samples collected beneath the concrete/paved surfaces are presented in Table 8-2. The spatial extent of surface soil beneath the concrete/paved surfaces COPC concentrations greater than residential soil RSLs is depicted on Figure 8-2. Note that only those detected concentrations exceeding corresponding residential soil RSLs are shown on the figure (i.e., those COPCs retained based on lack of screening/toxicity criteria or chemical similarity are not included).

There were no VOCs, SVOCs, or LLPAHs detected in the surface soil beneath the concrete/paved surfaces at concentrations above corresponding residential soil RSLs. As such, there were no VOCs, SVOCs, or LLPAHs retained as COPCs.

Arsenic, cobalt, and vanadium were detected in surface soil beneath the concrete/paved surfaces at concentrations exceeding corresponding residential soil RSLs and were retained as COPCs.

Total Soil (2010 and 2012 combined)

The data and COPC selection summary for total soil samples collected at SWMU 59 are presented in Table 8-3. The spatial extent of total soil COPC concentrations greater than residential soil RSLs is depicted on Figure 8-3. Note that only those detected concentrations exceeding corresponding residential soil RSLs are shown on the figure (i.e., those COPCs retained based on lack of screening/toxicity criteria or chemical similarity are not included).

There were no VOCs detected in the total soil at concentrations above corresponding residential soil RSLs. Methyl iodide and propionitrile currently have no screening criteria available; therefore, they were retained as total soil COPCs as a conservative measure.

The carcinogenic PAHs benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene were detected in the total soil at maximum concentrations above corresponding residential soil RSLs and were retained as COPCs for total soil. Benzo(a)anthracene, benzo(k)fluoranthene, and chrysene were detected at concentrations below corresponding residential soil RSLs. However, these carcinogenic PAHs were re-included as COPCs for total soil because of the potential additive toxic effects of carcinogenic PAHs.

There were no pesticides detected in the total soil at concentrations above corresponding residential soil RSLs. Therefore, pesticides were not retained as total soil COPCs.

Antimony, arsenic, cobalt, thallium, and vanadium were detected in total soil at concentrations exceeding corresponding residential soil RSLs and were retained as total soil COPCs. Lead was detected at a maximum concentration exceeding its residential soil action level (400 mg/kg) and was retained as a surface soil COPC.

Total Soil beneath the Concrete/Paved Surfaces (2012)

The SWMU 59 2012 surface soil (0-1 foot bgs) and 2012 subsurface soil (1-3 feet bgs) data sets were combined to create a total soil column (0-3 feet bgs) data set. The data and COPC selection summary for total soil samples collected beneath the concrete/paved surfaces are presented in Table 8-4. The spatial extent of total soil beneath the concrete/paved surfaces COPC concentrations greater than residential soil RSLs is depicted on Figure 8-4. Note that only those detected concentrations exceeding corresponding residential soil RSLs are shown on the figure

(i.e., those COPCs retained based on lack of screening/toxicity criteria or chemical similarity are not included).

There were no VOCs, SVOCs, or LLPAHs detected in the total soil beneath the concrete/paved surfaces at concentrations above corresponding residential soil RSLs. As such, there were no VOCs, SVOCs, or LLPAHs retained as COPCs.

Arsenic, cobalt, and vanadium were detected in total soil beneath the concrete/paved surfaces at concentrations exceeding corresponding residential soil RSLs and were retained as COPCs.

Groundwater

Table 8-5 summarizes the COPC selection performed for constituents detected in groundwater samples collected at SWMU 59. The spatial extent of groundwater COPC concentrations greater than tapwater RSLs is depicted on Figure 8-5. Note that only those detected concentrations of organics and total inorganics exceeding corresponding tapwater RSLs are shown on the figure.

There were no VOCs detected in the groundwater at concentrations above corresponding tap water RSLs. Therefore, VOCs were not retained as COPCs for groundwater.

The SVOC naphthalene was detected in the groundwater at a concentration above its tap water RSL. Therefore, naphthalene was retained as a COPC for groundwater.

There were no pesticides detected in the groundwater at concentrations above corresponding tap water RSLs. Therefore, pesticides were not retained as COPCs for groundwater.

Of the unfiltered (total) inorganic constituents detected in groundwater, arsenic, cadmium, cobalt, selenium, and vanadium were retained as COPCs since the detected concentrations exceeded corresponding tap water RSLs. Of the filtered (dissolved) inorganic constituents detected in groundwater, dissolved arsenic, cadmium, cobalt, selenium, and vanadium were of similar concentrations as those found in the total fraction.

Surface Water

Table 8-6 summarizes the COPC selection performed for constituents detected in surface water samples collected at SWMU 59. The spatial extent of surface water COPC concentrations greater than tapwater RSLs is depicted on Figure 8-6. Note that only those detected concentrations of total inorganics exceeding corresponding tapwater RSLs are shown on the figure.

Three VOCs were detected at concentrations exceeding corresponding screening values (tap water RSLs): bromodichloromethane, chloroform, and dibromochloromethane. Therefore, these VOCs were retained as COPCs for surface water.

There were no SVOCs detected in the surface water at concentrations above corresponding screening values. Therefore, SVOCs were not retained as COPCs for surface water.

There were no pesticides detected in the surface water at concentrations above corresponding screening values. Therefore, pesticides were not retained as COPCs for surface water.

Total arsenic and vanadium were detected in surface water at concentrations exceeding corresponding screening values and were retained as surface water COPCs.

Sediment

Table 8-7 summarizes the COPC selection performed for constituents detected in sediment samples collected at SWMU 59. The spatial extent of sediment COPC concentrations greater than residential soil RSLs is depicted on Figure 8-7. Note that only those detected concentrations exceeding corresponding residential soil RSLs are shown on the figure (i.e., those COPCs retained based on lack of screening/toxicity criteria or chemical similarity are not included).

There were no VOCs detected in the sediment at concentrations above corresponding screening criteria (residential soil RSLs). Therefore, VOCs were not retained as COPCs for sediment.

There were no SVOCs detected in the sediment at concentrations above corresponding screening values. Therefore, SVOCs were not retained as COPCs for sediment.

There were no pesticides detected in the sediment at concentrations above corresponding screening values. Therefore, pesticides were not retained as COPCs for sediment.

Arsenic, cobalt, thallium, and vanadium were detected in sediment at concentrations exceeding corresponding screening criteria and were retained as sediment COPCs.

8.3.1.2.3 *Summary of COPCs*

- *Surface Soil (2010 and 2012 combined)*: Methyl iodide, propionitrile, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, antimony, arsenic, cobalt, lead, thallium, and vanadium.

- *Surface Soil beneath the Concrete/Paved Surfaces (2012)*: Arsenic, cobalt, and vanadium.

- *Total Soil (2010 and 2012 combined)*: Methyl iodide, propionitrile, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h) anthracene, indeno(1,2,3-cd)pyrene, antimony, arsenic, cobalt, lead, thallium, and vanadium.

- *Total Soil beneath the concrete/paved surfaces (2012)*: Arsenic, cobalt, and vanadium.

- *Groundwater*: Naphthalene, total arsenic, cadmium, cobalt, selenium, and vanadium.

- *Surface Water*: Bromodichloromethane, chloroform, dibromochloromethane, total arsenic, and vanadium.

- *Sediment*: Arsenic, cobalt, thallium, and vanadium.

8.3.2 Exposure Assessment

An exposure assessment was performed to evaluate the potential exposure of the identified human receptors to the site media based on current and anticipated future land use for SWMU 59. The exposure assessment includes potential exposure pathways for human receptors, potential routes of exposure, exposure factor assumptions, and estimated exposure concentrations. In order to establish a complete exposure pathway, the following four elements were considered (USEPA, 1989):

- A source and potential mechanism of chemical release
- An environmental retention or transport medium
- A point of potential human contact with the contaminated medium; and
- A human exposure route (e.g., ingestion) at the contact point

The exposure scenarios discussed in this report represent USEPA's Reasonable Maximum Exposure (RME). Relevant equations for assessing intakes and exposure parameters were obtained from RAGS Part A (USEPA, 1989), Exposure Factors Handbook (USEPA, 2011a), RAGS Part E Supplemental Guidance for Dermal Risk Assessment (USEPA, 2004), RAGS Part F Supplemental Guidance for Inhalation Risk Assessment (USEPA, 2009), Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites (USEPA, 2002a), and Standard Default Exposure Factors, Interim Final (USEPA, 1991). Exposure parameters used in this HHRA are provided in Table 8-8.

8.3.2.1 Potential Human Receptors and Exposure Pathways

The Navy assumes that long-term plans for the facility would be similar to those that had been in place prior to closure with land use also generally the same for the purposes of developing remedial options. Based on information available regarding the physical features, site setting, site historical activities, and current and assumed land uses, seven potential human receptors have been selected for evaluation. These include:

- Current/Future On-site Adult Trespasser
- Current/Future On-site Youth (6-16 years) Trespasser
- Current/Future On-site Adult Worker
- Future Adult Resident
- Future Young Child (1-6 years) Resident
- Future Industrial/Commercial Adult Worker
- Future Construction Worker

At present, there is no activity at SWMU 59. As discussed in Section 8.2, for the continued industrial land use scenario at this site, the industrial/commercial worker and construction worker were evaluated to characterize potential future exposure to contaminated soil and groundwater. The future industrial/commercial worker is included in the RCRA § 7003 Administrative Order on Consent (USEPA, 2007) as a potential human receptor under assumed usage conditions (i.e., assumed future land usage being similar to the land usage patterns currently in place). In anticipation of excavation of soil during redevelopment of the site, it is considered possible that subsurface soil could be brought to the surface and exposure to this medium could occur in the future. At NAPR, it is considered that soil up to 10 feet bgs could be exposed during construction activities. Note that analytical results from subsurface soil samples collected from the 9 to 11 feet bgs interval were included in the total soil data set used in the HHRA because 10 feet bgs is included in this interval (refer to Appendix O). Therefore, potential exposures to surface soil (0 to 1 foot bgs), total soil (0 to 11 feet bgs), ingestion of groundwater as a potable source, and inhalation of volatiles in groundwater emitted through soil into hypothetical future buildings were evaluated for industrial workers. Potential exposure to surface soil, total soil, and shallow groundwater at SWMU 59 were evaluated for construction workers that may perform excavation and construction at the site. It was conservatively assumed that construction workers may be directly exposed to groundwater following excavation because groundwater at SWMU 59 is relatively shallow at some locations (i.e., less than 10 feet bgs in the western portion of the site). Potential exposures to surface soil, total soil, surface water, and sediment were evaluated for adult on-site workers that may perform maintenance or groundskeeping activities at SWMU 59 now or

in the future. Additionally, potential exposures to surface soil, total soil, surface water, and sediment were evaluated for adult and/or youth trespassers that may gain access to the site now or in the future and could be exposed to these environmental media. Construction workers, industrial/commercial workers, on-site workers, and trespasser receptors are listed in the RCRA §7003 Administrative Order on Consent (USEPA, 2007).

Future residential land use is conservatively evaluated for SWMU 59. Future residential adult and young child receptors are evaluated in this HHRA, although residential receptors are not included as potential human receptors in the RCRA §7003 Administrative Order on Consent (USEPA, 2007) as a likely scenario given assumed future industrial land use. However, the Navy recognizes that changes in future land usage from industrial could result in additional receptors. Therefore, the future residential exposure scenario is used to evaluate unrestricted land use and provide the most conservatively protective risk estimation. Potential exposures to all media (surface soil, total soil, groundwater, surface water, and sediment) were conservatively evaluated for future residents.

The two VOCs (benzene and carbon disulfide) detected in groundwater were screened against USEPA's vapor intrusion screening levels (VISLs) for groundwater (http://www.epa.gov/oswer/vaporintrusion/guidance.html), which are media-specific, risk-based screening-level concentrations developed as part of OSWER's final vapor intrusion guidance. The primary purpose of the VISLs is to assist in determining whether chemicals found in groundwater could pose a significant risk through vapor intrusion; and, if so, whether a site-specific vapor intrusion investigation is warranted. The VISLs used for this evaluation were calculated using the VISL calculator with a target cancer risk of 1×10^{-06} and a target hazard quotient of 0.1. As shown below, benzene and carbon disulfide were detected at concentrations below corresponding residential and commercial VISLs. More specifically, the maximum concentration of benzene was detected one order of magnitude less than the residential VISL, and the maximum concentration of carbon disulfide was detected three orders of magnitude less than the residential VISL. Therefore, based on the low concentrations of VOCs in groundwater, as well as, low, estimated VOC concentrations in soil, it is concluded that the vapor intrusion pathway is incomplete and no further vapor intrusion investigation is recommended.

VOC	Maximum Concentration (µg/L)	VISL – Residential (µg/L)	VISL – Commercial (µg/L)
Benzene	0.1J	1.4	6.9
Carbon disulfide	0.15J	120	520

Additionally, the benzene and carbon disulfide did not exceed corresponding tap water RSLs, indicating that potential exposure to vapors volatilizing directly from water into a shower or trench is not complete and no further evaluation is recommended for this exposure pathway.

As previously noted, metals detected in site media were retained for risk estimation, although they could reflect background conditions.

Specifically, the following potential human exposure receptors and exposure pathways were retained for quantitative evaluation in this HHRA.

Current/Future On-Site Adult and Youth (Ages 6-16 Years) Trespassers

- Ingestion of Soil, Surface Water, and Sediment
- Dermal Contact with Soil, Surface Water, and Sediment
- Inhalation of Fugitive Dusts/Volatiles Emanating from Soil

Current/Future On-Site Adult On-Site Workers

- Ingestion of Soil, Surface Water, and Sediment
- Dermal Contact with Soil, Surface Water, and Sediment
- Inhalation of Fugitive Dusts/Volatiles Emanating from Soil

Future Adult and Young Child (Ages 1-6 Years) Residents

- Ingestion of Soil, Groundwater, Surface Water, and Sediment
- Dermal Contact with Soil, Groundwater, Surface Water, and Sediment
- Inhalation of Fugitive Dusts/Volatiles Emanating from Soil

Future Adult Industrial/Commercial Workers

- Ingestion of Soil and Groundwater
- Dermal Contact with Soil
- Inhalation of Fugitive Dusts/Volatiles Emanating from Soil

Future Construction Workers

- Ingestion of Soil and Groundwater
- Dermal Contact with Soil and Groundwater
- Inhalation of Fugitive Dusts/Volatiles from Soil

8.3.2.2 Conceptual Site Model

Development of a conceptual site model of potential exposure is critical in evaluating exposures for the human receptors. The conceptual site model considers all reasonable current and future potential exposures and media of concern under a no-action scenario. Current and potential future exposure scenarios for SWMU 59 are summarized in the conceptual site model in Figure 8-8 of this HHRA. Current receptor exposure scenarios at SWMU 59 may consist of trespassers and on-site workers. Future receptor exposure scenarios at this site may consist of trespassers, on-site workers, residents, adult industrial/commercial workers, and construction workers.

Potential chemical release mechanisms from affected media include transport of chemicals associated with historical petroleum, POL, and HM spills to paved surfaces with storm water to downgradient surface soil and storm sewers with subsequent discharge to drainage ditch surface water and sediment, leaching to underlying groundwater, and advective transport in the direction of groundwater flow. Potentially affected media at SWMU 59 may include one or more of the following: surface and subsurface soil (i.e., total soil), groundwater, surface water, and sediment.

8.3.2.3 Quantification of Exposure

Exposure to chemicals is quantified using 1) data from the site (i.e., concentrations of chemicals) and 2) determining human exposure to the environmental media. The chemical concentrations

used in the estimation of chronic daily intakes (CDIs) and dermally absorbed doses (DADs) for each medium are considered representative of the types of potential exposures encountered by each receptor throughout the time of exposure. A discussion of site data and human exposure at SWMU 59 is presented in the following sections.

8.3.2.4 Data Analysis

USEPA recommends using the average concentration to represent "a reasonable estimate of the concentration likely to be contacted over time" (USEPA, 1989). This concentration, commonly termed the exposure point concentration (EPC), is a conservative estimate of the average chemical concentration in an environmental medium at hazardous waste sites. The EPC is determined for each individual exposure unit within a site. An exposure unit is the area throughout which a receptor moves and encounters an environmental medium for the duration of the exposure. Unless there is site-specific evidence to the contrary, an individual receptor is assumed to be equally exposed to media within all portions of the exposure unit over the time frame of the risk assessment (USEPA, 2002b).

USEPA's most recent guidance, Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites (USEPA, 2002b), provides tools to calculate upper confidence limits to be used as EPCs in risk assessments. The USEPA 2002 guidance recommends the use of the software package, ProUCL (USEPA, 2010a and 2010b), to calculate UCLs for use in risk assessments. ProUCL Version 4.01.01 (current at the time the calculations were performed) was used in this HHRA to calculate 95% UCLs. The ProUCL software has been developed by USEPA to compute an appropriate 95% UCL of the unknown population mean. All upper confidence limit computation methods contained in the USEPA guidance documents are available in ProUCL, Version 4.01.01. ProUCL 4.01.01 contains statistical methods to address various environmental issues for both full data sets without nondetects and for data sets with nondetects (also known as left-censored data sets). Note that the 95% UCLs were calculated in the "with NDs" mode, as applicable.

The 95% UCL on the mean concentration was used as the EPC for each COPC identified for a receptor group where the number of detected concentrations was four or more and where eight or more samples are available in the dataset. For the soil exposure pathway evaluation for SWMU 59, COPCs were selected from both surface soil (0 to 1 foot bgs) and total soil (0 to 11 feet bgs). EPCs were subsequently calculated for surface soil and total soil COPCs, and the higher of the two EPCs for each COPC was used in the risk calculations to produce a conservative risk estimate. For COPCs having less than four detected concentrations or less than eight samples in the dataset, the maximum detected concentration was used as the EPC for that data grouping. For the groundwater data sets, a contaminant plume was not identified and no extreme fluctuations in COPC concentrations were observed. Therefore, all groundwater data were combined into one data set, and the maximum concentrations of all COPCs were selected as EPCs as a conservative measure (refer to Table 8-5). Also, the surface water and sediment COPC data sets contained only three sample points (refer to Tables 8-6 and 8-7). Although it is preferred that the maximum detected concentration not be used as the EPC, the uncertainty added to the risk assessment errs on the side of conservativeness.

Measured concentrations were used in the HHRA for most EPCs. However, modeled concentrations were used as EPCs when evaluating inhalation exposures to particulates in air. Ambient air EPCs (resulting from particulate emissions from soil) were modeled based on the measured soil concentrations. A site-specific particulate emission factor (PEF) was calculated for use in intake calculations for construction workers. Climate Zone 9 (based on Miami, FL) and a 10 acre aerial extent of site contamination were used in the site-specific PEF calculation.

The computational output from the ProUCL calculations performed for each COPC is presented in Appendix P. The equations for estimating intakes due to direct exposures to site-related chemicals for the various identified pathways are presented in Appendix Q. The calculation of the site-specific PEF is included in Appendix R (Risk Calculation Spreadsheets).

It should be noted that estimated concentrations also were used to calculate the 95% UCL, such as "J" qualified (estimated) data. Reported concentrations qualified with an "R" (rejected) were not used in the statistical evaluation. Although some data were rejected (flagged "R"), the overall data completeness for the project was 96% (refer to Table 6-12). Those data that were flagged "R" were not chemicals of potential concern for SWMU 59. It is not expected that this will impact the results of this HHRA (i.e., underestimate potential risks). For further discussion of data qualifications specific to this investigation, laboratory data validation summaries can be found in Section 6.7 of this report.

8.3.2.5 Exposure Input Parameters

Table 8-8 presents the exposure parameters used in the estimation of potential CDIs/DADs for COPCs retained for each receptor identified below. When USEPA exposure parameters are not available, best professional judgment and site-specific information are used to derive a conservative and defensible value. The following paragraphs present the rationale for the RME assumptions for each receptor group evaluated in the HHRA. RME is defined as the highest exposure that is reasonably expected to occur at a site.

Current/Future Adult and Youth Trespassers

This scenario assumes that current adult and youth (6 - 16 years) trespassers could come into contact with soil, surface water, and sediment at SWMU 59. Therefore, these receptors were evaluated for potential exposure to soil (using the most conservative EPCs of the surface soil and total soil COPCs), surface water, and sediment via ingestion and dermal contact, as well as inhalation of volatiles and/or fugitive dust in soil. A summary of the exposure parameters is discussed in the following paragraphs and presented on Table 8-8.

A 70 kg adult and a 45 kg youth (USEPA, 1991) were assumed to have exposure durations (EDs) of 24 years (USEPA, 1991) and 11 years (professional judgment, represents youths from 6 to 16 years of age), respectively. Exposure times (ETs) were estimated to be 2 hours per day (VDEQ, 2013) in relationship to inhalation of fugitive dusts and surface water exposure. An ingestion rate (IR) of 100 milligrams per day (mg/day) for soil and sediment was assumed for both the youth and the adult (USEPA, 1991), with a conservative assumption of 100 percent fraction ingested from the source (professional judgment). An IR of 0.005 liter per hour (L/hour) was used for surface water for both the adult and youth assuming a wading scenario (professional judgment, assumes one order of magnitude less than the USEPA default ingestion rate for swimming). The exposure frequency (EF) was assumed to be 52 events/year (professional judgment), based on anticipated exposures of one day/week/year. Averaging times of 8,760 days for adults and 4,015 days for youths for noncarcinogens, and 25,550 days for carcinogens were also used (USEPA, 1989).

The USEPA recommended weighted soil to skin adherence factor (AF) of 0.07 milligrams per square centimeter (mg/cm^2) for the residential adult (USEPA, 2004) was used for the adult trespasser for soil. This is based on the 50th percentile weighted AF for gardeners, which is the activity determined to represent a reasonable, high-end contact activity. The USEPA recommended weighted 0.2 mg/cm^2 AF for the young child was conservatively used for the youth trespasser for soil and is based on the 95th percentile weighted AF for children playing at a day

care center or in wet soil (USEPA, 2004). An AF of 0.3 mg/cm^2 was used for sediment for both adult and youth trespassers and is based on contact with wet sediment (VDEQ, 2013). Skin surface areas of 3,200 square centimeters (cm^2) for the youth (mean of the total body surface area for youths ages 6 to <16) (USEPA, 2011a) and 5,700 cm^2 for the adult (USEPA, 2004) were assumed for the soil, surface water, and sediment scenarios.

Dermal absorption (ABS) values have been empirically determined for very few chemicals. USEPA (2004) provides recommended values for a limited number of chemicals and recommends treating dermal exposure to other compounds qualitatively in the uncertainty section or quantitatively using default values on a site-specific basis. RAGS Part E (USEPA, 2004) offers ABS values for a few organic and inorganic constituents, and these have been used in this HHRA. As cited in Exhibit 3-4 of RAGS Part E, the ABS for arsenic is set at 0.03 and for cadmium at 0.001 (USEPA, 2004). In the absence of USEPA Region II-specific guidance on dermal ABS for metals, ABS from all metals in soil except for arsenic and cadmium have been assumed to be 0.01 (VDEQ, 2013) based on the following rationale. RAGS Part E states that for metals, the speciation of the compound is critical to the dermal absorption and there are too little data to extrapolate a reasonable default value (USEPA, 2004). However, the guidance does allow for quantitative evaluation using default ABS values as an interim measure as long as uncertainties are presented and discussed. Therefore, in order to maintain a conservative approach and to account for dermal contact exposure pathway, an ABS value greater than zero (0) was assumed in this HHRA.

Current/Future Adult On-Site Workers

This scenario assumes that current/future adult on-site workers could come into contact with soil, surface water, and sediment at SWMU 59. This receptor would be involved in landscaping/maintenance activities on the property grounds and not exposed to groundwater. Therefore, this receptor was evaluated for potential exposure to soil (using the most conservative EPCs of the surface soil and total soil COPCs), surface water, and sediment via ingestion, dermal contact, and inhalation of fugitive dust in soil. A summary of the exposure parameters is discussed in the following paragraphs and presented on Table 8-8.

The IR for a 70 kg adult on-site worker exposed to soil and sediment was assumed to be 100 mg/day (USEPA, 2002a) and the fraction ingested was assumed to be 100 percent (professional judgment). An EF of 250 days per year (USEPA, 2004) for soil, surface water, and sediment was used in conjunction with an ED of 25 years (USEPA, 2004). An ET of 8 hours/day (professional judgment) assuming a typical 8 hour work day was used to evaluate inhalation of fugitive dusts from soil and an ET of 2 hours/day (VDEQ, 2013) was used for surface water exposure. An IR of 0.005 L/hour was used for surface water assuming a wading scenario (professional judgment, assumes one order of magnitude less than the USEPA default ingestion rate for swimming). An averaging time of 70 years or 25,550 days was used for exposure to potentially carcinogenic compounds while an averaging time of 9,125 days was used for noncarcinogens.

There is a potential for on-site workers to absorb COPCs by dermal contact. A skin surface area of 3,300 cm^2 for an adult (USEPA, 2004) assumed to wear a short-sleeved shirt, long pants, and shoes, was used to evaluate dermal contact with soil, surface water, and sediment. The USEPA recommended weighted AF of 0.2 mg/cm^2 (USEPA, 2004) was used for the on-site worker for soil and a value of 0.3 mg/cm^2 (VDEQ, 2013) was used for sediment. Dermal absorption values were applied as previously discussed.

Future Adult and Young Child Residents

This scenario assumes that future adult and young child (1-6 years) residents could come into contact with soil, groundwater, surface water, and sediment at SWMU 59. Therefore, these receptors were evaluated for potential exposure to soil (using the most conservative EPCs of the surface soil and total soil COPCs), groundwater, surface water, and sediment via ingestion and dermal contact, as well as inhalation of fugitive dust and/or volatiles in soil. Inhalation of VOCs was determined to be an incomplete exposure pathway and therefore, was not quantitatively evaluated. Exposures to organic and total inorganic COPCs were evaluated. A summary of the exposure parameters is discussed in the following paragraphs and presented on Table 8-8.

Future adult and young child residents could contact soil and sediment during outdoor recreational activities in the area immediately surrounding their homes. A 70 kg adult and a 15 kg child (USEPA, 1991) were assumed for exposure durations of 24 years and 6 years (USEPA, 1991), respectively. The exposure time was conservatively assumed to be 24 hours per day (professional judgment) for soil exposures. The IR for soil and sediment was assumed to be 200 mg/day for the young child and 100 mg/day for the adult (USEPA, 1991), with a 100 percent fraction ingested from source, over 350 days/year (USEPA, 2004) for soil and groundwater. An IR of 0.005 L/hour (professional judgment, assumes one order of magnitude less than the USEPA default ingestion rate for swimming) was used for surface water along with an ET of 2 hours/day (VDEQ, 2013) for both the adult and young child assuming a wading scenario. The EF was assumed to be 52 events/year (professional judgment) for surface water and sediment exposure. Averaging times of 8,760 days for adults and 2,190 days for children for non-carcinogens, and 25,550 days for carcinogens were also used (USEPA, 1989).

The USEPA recommended weighted AFs of 0.07 mg/cm^2 for the adult and 0.2 mg/cm^2 for the young child were used for soil (USEPA, 2004). An AF of 0.3 mg/cm^2 was used for sediment for both adult and child residents and is based on contact with wet sediment (VDEQ, 2013). Dermal absorption values were applied as previously discussed. Skin surface areas of 2,800 cm^2 for the young child and 5,700 cm^2 for the adult (USEPA, 2004) were assumed for the soil, surface water, and sediment scenarios.

A groundwater ingestion rate of 1 L/day was used for children and 2 L/day for adults (USEPA 1989). This value assumes that residents obtain all of their drinking water from the same source for the exposure duration. Groundwater ETs of 0.58 hours/day for the adult and 1.0 for the child (USEPA, 2004) were used. Equations and estimated, chemical-specific permeability constant (K_p) values presented by USEPA (USEPA, 2004) were used to estimate the absorption of organic COPCs by skin exposed to groundwater. Skin surface areas of 6,600 cm^2 for the young child and 18,000 cm^2 for the adult (USEPA, 2004) were assumed for the showering/bathing exposure scenario. Most of the same assumptions used for estimating exposures to soil (i.e., exposure duration, exposure frequency, body weight, and carcinogenic and noncarcinogenic averaging time) were also applied to the evaluation of ingestion, dermal, and inhalation exposures to groundwater.

Future Adult Industrial/Commercial Workers

This scenario assumes that future adult industrial/commercial workers could come into contact with soil and groundwater at SWMU 59. Therefore, this receptor was evaluated for potential exposure to soil (using the most conservative EPCs of the surface soil and total soil COPCs) via ingestion, dermal contact, and inhalation of volatiles and/or fugitive dust, as well as groundwater via ingestion. Exposure to volatiles in groundwater via vapor intrusion into a building was not evaluated for the future industrial/commercial worker because this was determined to be an incomplete exposure pathway. A summary of the exposure parameters is discussed in the following paragraphs and presented on Table 8-8.

The IR for a 70 kg adult industrial/commercial worker exposed to soil was assumed to be 100 mg/day (USEPA, 2002a), and the fraction ingested was assumed to be 100 percent (professional judgment). An EF of 250 days per year (USEPA, 2004) for soil was used in conjunction with an ED of 25 years (USEPA, 2004). An ET of 8 hours/day (professional judgment) assuming a typical 8 hour work day was also used. An averaging time (AT) of 70 years or 25,550 days was used for exposure to potentially carcinogenic compounds while an averaging time of 9,125 days was used for noncarcinogenic exposures.

There is a potential for industrial/commercial workers to absorb COPCs by dermal contact. A skin surface area of 3,300 cm^2 for an adult (USEPA, 2004) assumed to wear a short-sleeved shirt, long pants, and shoes, was used to evaluate dermal contact with soil. An AF of 0.2 mg/cm^2 was used for soil and is based on the 50th percentile weighted AF for utility workers, which is the activity determined by USEPA to represent a reasonable, high-end contact activity (USEPA, 2004). Dermal absorption values were applied as previously discussed.

A groundwater ingestion rate of 1 L/day was used for industrial/commercial workers (USEPA, 1991). This value assumes that all drinking water is obtained from the same source for the exposure duration. Most of the same assumptions used for estimating exposures to soil (i.e., exposure duration, exposure frequency, body weight, and carcinogenic and noncarcinogenic averaging time) were also applied to the evaluation of ingestion exposure to groundwater.

Future Adult Construction Workers

Potential exposures to soil COPCs may occur to construction workers while performing soil excavation and construction activities at SWMU 59. Soil exposure pathways evaluated include ingestion, dermal contact, and inhalation of fugitive dust (using the most conservative EPCs of the surface soil and total soil COPCs). Exposure to groundwater at SWMU 59 was also evaluated as a conservative measure. A summary of the exposure parameters is discussed in the following paragraphs and presented on Table 8-8.

Exposure to soil was assumed to occur for 8 hours per day (professional judgment assuming a typical 8 hour work day), 250 days per year (USEPA, 2004), for a construction period of 1 year (professional judgment conservatively assuming duration of a construction project). The USEPA default value for the soil IR of 330 mg/day (USEPA, 2002a) and a 100 percent fraction ingested from source (professional judgment) were also assumed for a 70 kg construction worker (USEPA, 1991). A skin surface area of 3,300 cm^2 for an adult (USEPA, 2004) assumed to wear a short-sleeved shirt, long pants, and shoes, was used to evaluate dermal contact with soil and groundwater. A soil to skin adherence factor of 0.3 mg/cm^2 (USEPA, 2002a) was used for soil, and dermal absorption values were applied as previously discussed. The averaging time of 365 days for noncarcinogens and 25,550 days for carcinogens, respectively, were also used (USEPA, 1989). A site-specific PEF of 2.9×10^{06} was calculated for the construction worker scenario (refer to Appendix R).

During excavation activities, it is possible that future construction workers may come in contact with shallow groundwater. To quantify the groundwater exposure it is conservatively assumed that 20% of their time (i.e., an EF of 50 days/year) will be spent in an open hole filled with groundwater at which time they can accidentally ingest small quantities of water, inhale volatiles emitted from the water, and be immersed from the waist down for an assumed duration of two hours. An ingestion rate of 0.02 L/day (VDEQ, 2013) for groundwater was used to represent a construction worker accidentally ingesting groundwater during excavation activities. Other relevant exposure parameters are the same as those discussed above for soil (e.g., exposure duration, body weight, skin surface area).

8.3.3 Toxicity Assessment

An important component of the HHRA process is the relationship between the dose of a compound (amount to which an individual or population is potentially exposed) and the potential for adverse health effects resulting from exposure to that dose. Dose-response relationships provide a means by which potential public health impacts may be evaluated. Standard RfDs and/or CSFs have been developed for many of the COPCs. This section provides a brief description of these parameters.

8.3.3.1 Reference Doses

The RfDs are developed for chronic and/or subchronic human exposure to chemicals, and are based solely on the noncarcinogenic effects of chemical substances. These values are defined as an estimate of a daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of adverse effects during a lifetime. The RfD is expressed as dose per unit body weight per unit time (mg/kg/day). For the inhalation route, an RfC was utilized. The RfC is expressed as milligrams per cubic meter (mg/m^3).

Quantitative indices of toxicity are presented in Table 8-9 for the identified COPCs.

8.3.3.2 Carcinogenic Slope Factors

CSFs are used to estimate an upper bound lifetime probability of an individual developing cancer as a result of exposure to a particular level of a potential carcinogen (USEPA, 1989). This factor is reported in units of proportion (of a population) affected per mg/kg/day and is derived through an assumed low-dosage, linear multistage model and an extrapolation from high to low dose-responses determined from animal studies. The slope factor represents the upper 95th percent confidence limit on the increased cancer risk from a lifetime exposure to an agent. CSFs can also be derived from USEPA promulgated unit risk values for air and/or water. CSFs derived from unit risks cannot, however, be applied to environmental media other than the medium considered in the unit risk estimate. For the inhalation route, an IUR was utilized. The IUR is expressed as the inverse of micrograms per cubic meter $(\mu g/m^3)^{-1}$.

Slope factors are also accompanied by weight-of-evidence classifications, which designate the strength of the evidence that the COPC is a potential human carcinogen.

Quantitative indices of toxicity and USEPA weight-of-evidence classifications are presented in Table 8-9 for the identified COPCs.

The hierarchy (USEPA, 2003) for choosing these toxicity values was:

- Tier 1 – Integrated Risk Information System (IRIS) (USEPA, 2011b)
- Tier 2 – USEPA's Provisional Peer Reviewed Toxicity Values (PPRTVs) (database of values developed on a chemical-specific basis when requested by USEPA's Superfund program)
- Tier 3 – Other Toxicity Values (includes additional USEPA and non-USEPA sources of toxicity information)

IRIS is the preferred source of human health toxicity values. IRIS generally contains RfDs, RfCs, CSFs, drinking water unit risk values, and IUR values that have gone through a peer review and USEPA consensus review process. IRIS normally represents the official Agency scientific position regarding the toxicity of the chemicals based on the data available at the time of the review.

The second tier is USEPA's PPRTVs. Generally, PPRTVs are derived for one of two reasons. First, the Superfund Health Risk Technical Support Center (STSC) reviews the toxicity values in the Health Effects Assessment Summary Table (HEAST) (USEPA, 1997), which is now a Tier 3 source. As the reviews are completed, those toxicity values will be removed from HEAST, and any new toxicity value developed in such a review becomes a PPRTV and placed in the PPRTV database. Second, Regional Superfund Offices may request a PPRTV for chemicals lacking a relevant IRIS value. The STSC uses the same methodologies for both situations.

The third tier includes other sources of information. These sources should provide toxicity information based on similar methods and procedures as those used for Tiers 1 and 2, contain values which are peer reviewed, are available to the public, and are transparent about the methods and processes used to develop the values. Tier 3 sources include, but are not limited to, the following:

- The California Environmental Protection Agency (Cal EPA) toxicity values;
- The ATSDR Minimal Risk Levels; and
- HEAST toxicity values.

8.3.3.3 Dermal Absorption Efficiency

The following discussion is presented to provide general information regarding the use of administered dose to estimate absorbed dose when assessing potential dermal exposures. Many of the RfDs and CSFs are derived from oral toxicological studies based on administered dose, and do not account for the amount of a substance that can penetrate exchange boundaries after contact (e.g., absorbed dose). As a result, there is very little information available regarding dermal toxicity criteria. Therefore, in order to account for a difference in toxicity between an administered dose and an absorbed dose, the RfDs and CSFs (that were based on an administered dose) were adjusted, as described by the USEPA (USEPA, 1989), using experimentally-derived oral absorption efficiencies. The adjustment for the oral RfD that would correspond to a dermally absorbed dose is represented by multiplying the RfD by an oral absorption efficiency. The adjustment for the oral CSF that would correspond to the dermally absorbed dose is represented by dividing the CSF by oral absorption efficiency. Recommended oral absorption efficiencies for those compounds/analytes with chemical-specific dermal absorption factors were obtained from RAGS Part E (USEPA, 2004) The oral absorption efficiencies were obtained from sources such as the National Center for Environmental Assessment (NCEA), IRIS, ATSDR toxicological profiles, toxicology publications, toxicology references, and USEPA Regional Offices. In some instances, published information is not available to determine the absorption efficiency. On these occasions, adjustments to the toxicity value are not conducted (e.g., an absorption efficiency of 100% was assumed) (USEPA, 2004).

8.3.3.4 Mutagenic Mode of Action Chemicals

For chemicals that USEPA has determined to be carcinogenic via a mutagenic mode of action (MMOA) (marked with an "M" in the RSL table [USEPA, 2013]), special adjustments are applied in estimating cancer risks. The carcinogenic PAHs benzo(a)pyrene and dibenz(a,h)anthracene are listed in USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005) as having a MMOA and were selected as COPCs in the SWMU 59 soil. USEPA's 2005 Supplemental Guidance recommends the application of generic age-dependent adjustment factors (ADAFs) to adjust cancer risk for receptors whose exposure includes early life. Additionally, it is recommended that the ADAFs be applied to other carcinogenic PAHs when assessing early life exposure for PAHs. As such, recommended default ADAFs are incorporated in the calculation of risk for the applicable

receptors for all carcinogenic PAHs selected as COPCs in this HHRA. The following ADAFs are used: 10 for age 0 to 2 years, 3 for age 2 to 16 years, and no adjustment for ages 16 and up (USEPA, 2005). These adjustments are incorporated in the risk calculations presented in Appendix R.

8.3.4 Risk Characterization

The risk characterization combines the selected COPCs, the exposure assessment, and the toxicity assessment to produce a quantitative estimate of current and future potential human health risks associated with SWMU 59. Sections 8.3.4.1 and 8.3.4.2 discuss the USEPA methodologies used for quantifying and characterizing carcinogenic and noncarcinogenic human health risks. ILCRs and HIs are calculated to characterize potential human health effects. These terms are defined in the sections that follow. ILCRs and HIs are estimated for current and future receptors exposure scenarios that were identified in Section 8.3.2, and are discussed in Section 8.3.4.3.

8.3.4.1 Quantification and Characterization of Carcinogenic Risks

Quantitative risk calculations for potentially carcinogenic compounds estimate inferentially (versus probabilistically) the potential ILCR for an individual in a specified population. This unit of risk refers to a potential cancer risk that is above the background cancer risk in unexposed individuals. For example, an ILCR of 1 x 10^{-06} indicates that an exposed individual has an increased probability of one in one million of developing cancer subsequent to exposure, over the course of their lifetime.

The potential lifetime ILCR for an individual was estimated from the following relationship:

$$ILCR = \sum_{i=1}^{n} (CDI_i or DAD_i) \times CSF_i$$

Where the CSF_i is expressed as $(mg/kg/day)^{-1}$ for compound i, and the CDI_i and DAD_i is expressed as mg/kg/day for compound i. Since the units of CSF are (mg chemical/kg body weight/day) $^{-1}$ and the units of intake or dose are milligram (mg) chemical/kg body weight/day, the ILCR value is dimensionless. The aforementioned equation was derived assuming that cancer is a non-threshold process and that the potential excess risk level is proportional to the cumulative intake over a lifetime.

As put forth in RAGS Part F (USEPA, 2009), for evaluation of the inhalation pathway, the potential lifetime ILCR for an individual was estimated from the following relationship:

$$ILCR = \sum_{i=1}^{n} EC_i \times IUR_i \times 10^3 \ \mu g / mg$$

IUR is expressed as $(\mu g/m^3)^{-1}$ for compound i, and the exposure concentration (EC) is expressed in mg/m^3 for compound i. The ILCR value here is also dimensionless such that the inhalation risks can be summed with the ingestion and dermal contact risks to yield a total risk over all potential pathways.

For quantitative estimation of risk, it is assumed that cancer risks from various exposure routes are additive. Estimated ILCR values will be compared to 1 x 10^{-06} to 1 x 10^{-04}, which represents the target risk range of ILCR values considered by the USEPA to represent an acceptable (i.e., de minimis) risk (USEPA, 1990).

8.3.4.2 Quantification and Characterization of Noncarcinogenic Risks

Noncarcinogenic compounds assume that a threshold toxicological effect exists. Therefore, the potential for noncarcinogenic effects are calculated by comparing (i.e., dividing) CDI_i and DAD_i levels with RfDs for each COPC.

Noncarcinogenic effects are estimated by calculating the HQ for individual chemicals and the HI for overall chemicals and pathways by the following equation:

$$HI = \sum_{i=1}^{n} HQ_i$$

$$where: HQ_i = \frac{(CDI_i or DAD_i)}{RfD_i} \text{ (ingestion/dermal contact)}$$

and

$$HQ_i = \frac{(EC_i)}{RfC_i} \text{ (inhalation)}$$

An HQ is the ratio of the daily intake or absorbed dose to the reference dose. CDI_i is the chronic daily intake (mg/kg/day) of chemical i; DAD_i is the dermally absorbed dose (mg/kg/day) of chemical i, and RfD_i is the reference dose (mg/kg/day) of the chemical i over a prolonged period of exposure. Since the units of RfD are mg/kg/day and the units of CDI/DAD are mg/kg/day, the HQ and HI are dimensionless. The RfC is expressed as mg/m^3 for compound i, and the EC is expressed in mg/m^3 for compound i. The HQ value here is also dimensionless such that the inhalation risks can be summed with the ingestion and dermal contact risks to yield a total risk over all potential pathways.

To account for the additivity of noncarcinogenic risk following exposure to numerous chemicals, the HI, which is the sum of all the HQs, will be calculated. A ratio of 1.0 is used for comparison to the HQ and HI (USEPA, 1990). Ratios less than 1.0 indicate that adverse noncarcinogenic health effects are unlikely. Ratios greater than 1.0 indicate that adverse noncarcinogenic health effects may occur at that exposure level. However, this does not mean that adverse effects will definitely occur, since the RfD incorporates safety and modifying factors to ensure that it is well below that dose for which adverse effects have been observed. This procedure assumes that the risks from exposure to multiple chemicals are additive, an assumption that is probably valid for compounds that have the same target organ or cause the same toxic effect.

8.3.4.3 Potential Human Health Effects

The estimated carcinogenic risks (i.e., ILCRs) and noncarcinogenic risks (i.e., HIs) provide a basis for site-specific risk management decisions. The conservative nature of the analysis and the uncertainty inherent in the risk assessment were considered when interpreting the results. The uncertainty associated with the risk estimations is discussed in Section 8.3.6. These results are presented in Tables 8-10 through 8-23. All calculation spreadsheets used for estimating potential carcinogenic and noncarcinogenic risks for receptors are presented in Appendix R. RAGS Part D tables are presented in Appendix S.

Current/Future Adult and Youth Trespassers

As shown in Tables 8-10 and 8-12, the total site ILCRs calculated for the adult and youth trespasser exposures (7.1×10^{-06} and 6.2×10^{-07}) to soil, surface water, and sediment at SWMU 59 fell within and below USEPA's target risk range of 1×10^{-06} to 1×10^{-04}. The total site HIs (0.15 for the adult trespasser and 0.2 for the youth trespasser) were less than USEPA's target hazard level of 1.0.

As shown in Tables 8-11 and 8-13, the total site ILCRs calculated for the adult and youth trespassers (1.6×10^{-07} and 1.2×10^{-07}) to soil beneath the concrete/paved surfaces at SWMU 59 fell within and below USEPA's target risk range of 1×10^{-06} to 1×10^{-04}. The total site HIs (0.04 for the adult trespasser and 0.08 for the youth trespasser) were less than USEPA's target hazard level of 1.0.

Current/Future On-Site Worker

As shown in Table 8-14, the total site ILCR for the current/future on-site worker was 2.8×10^{-06}, which is within the USEPA's target risk range of 1×10^{-06} to 1×10^{-04}. The current/future on-site worker was evaluated for exposures to soil, surface water, and sediment at SWMU 59. The total site HI (0.62) was less than USEPA's target hazard level of 1.0.

As shown in Table 8-15, the total site ILCR for the current/future on-site worker exposures (8.6×10^{-07}) to soil beneath the concrete/paved surfaces at SWMU 59 fell within and below USEPA's target risk range of 1×10^{-06} to 1×10^{-04}. The total site HI (0.26) was less than USEPA's target hazard level of 1.0.

Future Adult and Young Child Residents

As shown in Tables 8-16 and 8-18, the total site ILCRs calculated for adult and young child residential exposures (1.0×10^{-04} and 6.4×10^{-05}, respectively) to soil, groundwater, surface water, and sediment at SWMU 59 were within USEPA's target risk range of 1×10^{-06} to 1×10^{-04}. However, the total lifetime risk (1.6×10^{-04}) is greater than USEPA's target risk range. The exceedance of the total lifetime risk is primarily due to arsenic in groundwater.

The total site HIs (2.8 for the adult and 8.8 for the child) were greater than USEPA's target hazard level of 1.0 primarily as a result of potential exposure to arsenic, cobalt, and vanadium in groundwater (approximately 85% of the total site HI for the adult resident and 65% for the child resident). Total arsenic, cobalt, and vanadium were detected in groundwater at concentrations well below background. Concentrations of cobalt in soil (approximately 15% risk contribution to the site HI) also contributed to the total site HI exceedance for the child resident.

As shown in Tables 8-17 and 8-19, the total site ILCRs calculated for the adult and young child residential exposures (1.1×10^{-06} and 2.4×10^{-06}) to soil beneath the concrete/paved surfaces at SWMU 59 fell within and below USEPA's target risk range of 1×10^{-06} to 1×10^{-04}. The total site HI (0.3) for the adult resident was less than USEPA's target hazard level of 1.0. However, the total site HI for the young child resident exceeded the target hazard level at 2.5. The exceedance was due to concentrations of cobalt and vanadium in the soil beneath the concrete/paved surfaces.

Lead was identified as a COPC in both surface and total soil (maximum concentration detected in surface soil). As a conservative measure, potential human health risk from exposure to lead in soil was evaluated using the Integrated Exposure Uptake Biokinetic (IEUBK) Model for lead (USEPA, 2010c). The arithmetic mean for lead in surface soil (83 mg/kg) was used as the EPC,

as recommended in the IEUBK guidance. The lead concentration in surface soil was used as the EPC because it was more conservative than the arithmetic mean in total soil. All other variables used in the model were default parameters recommended for use in the model when only one variable is being changed. The USEPA considers remediation necessary if a 5% probability or greater exists that the predicted child blood level will exceed 10 micrograms per deciliter (µg/dl) (a level of concern to protect sensitive populations [neonates, infants, and children]) as a result of contact with lead-containing media at the site. As shown on Figure 8-9**,** there is a less than 1% probability that the predicted child blood level will exceed 10 microgram per deciliter (µg/dl). Therefore, this indicates that exposure to lead in soil at SWMU 59 does not constitute a risk to human health.

Future Industrial/Commercial Worker

As shown in Table 8-20, the total site carcinogenic risk for the future industrial/commercial worker was 3.4×10^{-05}, which is within the USEPA's target risk range of 1×10^{-06} to 1×10^{-04}. The total site HI (1.0) did not exceed USEPA's target hazard level of 1.0. The total site HI equaled the USEPA's target hazard level of 1.0 due to cumulative effects of COPCs in soil and groundwater. However, as presented on Table 8-20, none of the individual constituent HIs exceeded 1.0, and the target organ analysis demonstrates that none of the target organ HIs exceed 1.0.

As shown in Table 8-21, the total site carcinogenic risk for the future industrial/commercial worker exposures to soil beneath the concrete/paved surfaces at SWMU 59 was 8.6×10^{-07}, which is within the USEPA's target risk range of 1×10^{-06} to 1×10^{-04}. The total site HI (0.26) was less than USEPA's target hazard level of 1.0.

Future Construction Worker

As shown in Table 8-22, the total site carcinogenic risk for the future construction worker was 5.0×10^{-07}, which falls below the USEPA's target risk range of 1×10^{-06} to 1×10^{-04}. The construction worker was evaluated for exposures to soil and groundwater. The total site HI (1.2) was slightly greater than the USEPA's target hazard level of 1.0 due to cumulative effects of COPCs in soil and groundwater. However, as presented on Table 8-22, none of the individual constituent HIs exceeded 1.0, and the target organ analysis demonstrates that none of the target organ HIs exceed 1.0.

As shown in Table 8-23, the total site carcinogenic risk for the future construction worker exposures to soil beneath the concrete/paved surfaces at SWMU 59 was 3.6×10^{-07}, which falls below the USEPA's target risk range of 1×10^{-06} to 1×10^{-04}. The total site HI (1.2) was slightly greater than the USEPA's target hazard level of 1.0 due to cumulative effects of COPCs in soil. However, as presented on Table 8-23, none of the individual constituent HIs exceeded 1.0, and the target organ analysis demonstrates that none of the target organ HIs exceed 1.0.

8.3.5 Comparison to Background Levels

As part of the COPC selection process, the maximum detected concentrations of metals in environmental media sampled at SWMU 59 (specifically, surface soil, total soil, groundwater, surface water, and sediment) were compared to NAPR-specific background concentrations (specifically, basewide background surface soil, clay subsurface soil, groundwater, freshwater drainage ditch surface water, and freshwater drainage ditch sediment) established in the Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds (Baker, 2013), for NAPR. The comparison of metals against background screening

values is presented in Tables 8-1 through 8-7 for practicality. As previously discussed, metals were not eliminated as COPCs based on comparison to background concentrations. Therefore, it is possible that risks resulting from potential exposures to metals could represent background conditions. The comparison to NAPR-specific background concentrations is used to refine the risk assessment so that that the portion of the total site risk that is attributable to background concentrations can be seen and used in risk management decisions. When appropriate, risks from background concentrations were calculated using the same methodologies and exposure parameters that were used in this HHRA. Estimated risks associated with metals within background levels are presented in Appendix T.

8.3.5.1 Soil

Based on the soil characteristics at SWMU 59, the subsurface soil was determined to be a clay type. For the purpose of background comparison of total soil in this HHRA, the surface soil and clay subsurface soil data sets were combined to form a total soil background data set. The basewide surface soil and clay subsurface soil data sets were obtained from the approved Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds (Baker, 2013), which includes three unique data sets for basewide background subsurface soil (i.e., data sets for soil classified as (1) clay; (2) fine sand/silt; and (3) weathered bedrock). Total soil ULM values were calculated from the background data to which the site-specific total soil analytical results are compared.

COPCs were selected from both surface soil (0 to 1 foot bgs) and total soil (0 to 11 feet bgs for the 2010/2012 combined soil data and 0 to 3 feet bgs for the 2012 soil data) soil exposure pathway evaluation for SWMU 59. EPCs were subsequently calculated for surface soil and total soil COPCs, and the higher of the two EPCs for each COPC was used in the risk calculations to produce a conservative risk estimate. Specifically, the EPCs for all metals except cobalt and thallium from the 2010/2012 combined soil used in the risk calculations were from surface soil (since the 95% UCLs were greater than those in total soil). The EPCs for cobalt and thallium used in the risk calculations were from total soil. The EPCs for all metals from the 2012 soil data set were from surface soil.

As shown in Table 8-1, concentrations of antimony, arsenic, cobalt, lead, thallium, and vanadium exceeded corresponding background concentrations in the combined 2010 and 2012 surface soil data sets. Similarly, concentrations of antimony, arsenic, cobalt, lead, thallium, and vanadium exceeded corresponding background concentrations in the combined 2010 and 2012 total soil data sets (see Table 8-3). In the case of thallium, all detected concentrations in total soil were less than the background screening concentration, while thallium was not detected in surface soil background. Concerning the 2012 surface soil, all detected concentrations of arsenic were less than background, while cobalt and vanadium were detected at concentrations exceeding corresponding background screening values (see Table 8-2). As shown in Table 8-4, only vanadium was detected at concentrations exceeding background, while all detected concentrations of arsenic and cobalt were less than corresponding background in the 2012 total soil.

Although concentrations of antimony, arsenic, cobalt, lead, thallium, and vanadium exceeded corresponding background concentrations in the combined 2010 and 2012 surface soil data sets, with the exception of the future child resident, site risks from these metals did not exceed USEPA's target risk criteria for the receptors evaluated in the HHRA. Site-related noncarcinogenic risks from cobalt for the future child resident (cobalt HI = 1.3) slightly exceeded 1.0. As shown in Table 8-18, the site-specific cobalt HI for the future young child resident receptor is 1.31, while the background cobalt HI is 1.32 (see Appendix T). Therefore, the risk

from cobalt in background total soil is greater than the site-specific risk, and the contribution of risks from cobalt in soil at SWMU 59 to overall risk form site-related activities is below the acceptable hazard level for the future child resident receptor. Estimated risks associated with cobalt within background levels are presented in Appendix T.

Although concentrations of cobalt and vanadium exceeded corresponding background concentrations in the surface soil beneath the concrete pads/paved surfaces, with the exception of the future child resident, site risks from these metals did not exceed USEPA's target risk criteria for the receptors evaluated in the HHRA. As shown in Table 8-19, site-related noncarcinogenic risks from cobalt (HI = 1.09) and vanadium (HI = 1.31) for the future child resident exceeded 1.0. The background cobalt HI is 1.2 and the background vanadium HI is 66 (see Appendix T). Therefore, the risks from cobalt and vanadium in background surface soil is greater than the site-specific risk, and the contributions of risks from cobalt and vanadium in soil at SWMU 59 to overall risk from site-related activities is below the acceptable hazard level for the future child resident. Estimated risks associated with cobalt and vanadium within background levels are presented in Appendix T.

8.3.5.2 Groundwater

As shown in Table 8-5, total arsenic, cadmium, cobalt, selenium, and vanadium were detected in the groundwater at concentrations exceeding corresponding tapwater RSLs. However, these metals were all detected at concentrations less than corresponding background screening values. Therefore, risks from these metals in SWMU 59 groundwater would also be below those from background.

8.3.5.3 Surface Water

As shown in Table 8-6, total arsenic and vanadium were detected at concentrations less than corresponding background screening values. As such, site-related risks from total arsenic and vanadium would be less than those from background. Further, site-related risks from exposure to surface water did not exceed USEPA's target risk criteria for the receptors evaluated in the HHRA.

8.3.5.4 Sediment

As shown in Table 8-7, arsenic, cobalt, and vanadium were detected at concentrations less than corresponding background screening values. All site-specific concentrations of thallium exceeded background because thallium was not detected in NAPR basewide background freshwater drainage ditch sediment samples. Additionally, site risks from these metals did not exceed USEPA's target risk criteria for those receptors evaluated for sediment exposure in the HHRA.

8.3.6 Sources of Uncertainty

Uncertainties are encountered throughout the risk assessment process. This section discusses the sources of uncertainty inherent in the following elements of the HHRA performed for SWMU 59:

- Sampling and analysis
- Selection of COPCs
- Exposure assessment
- Toxicity assessment
- Risk characterization
- Comparison to background levels

Table 8-24 summarizes the potential effects of certain uncertainties on the estimation of human health risks. Uncertainties associated with this risk assessment are discussed in the following paragraphs.

8.3.6.1 Sampling and Analysis

The development of a risk assessment depends on the reliability of, and uncertainties associated with, the analytical data available to the risk assessor. These, in turn, are dependent on the operating procedures and techniques applied to the collection of environmental samples in the field and their subsequent analyses in the laboratory. To minimize the uncertainties associated with sampling and analysis at SWMU 59, USEPA-approved sampling and analytical methods were employed. Samples were taken from locations specified in the approved Work Plan along with the necessary QA/QC samples. The data were validated and found to meet the data quality objectives and all validation criteria.

As previously noted, the soil and groundwater data collected during the Phase II ECP Investigation were deemed unacceptable for use in the HHRA based on lack of third party validation. However, the exclusion of these data is not expected to impact the outcome of the HHRA because as shown on Figure 4-2, the spatial distribution of the soil boring/monitoring well locations from the CMS investigation provides adequate coverage of the excluded data.

Analytical data are limited by the precision and accuracy of the methods of analysis, which are reflected by the relative percent difference of duplicate analyses and the percent recovery of spikes, respectively. In addition, the statistical methods used to compile and analyze the data (mean concentrations, detection frequencies) are subject to the overall uncertainty in data measurement. Furthermore, chemical concentrations in environmental media fluctuate over time and with respect to sampling location. Analytical data must be sufficient to consider the temporal and spatial characteristics of contamination at the site with respect to exposure.

8.3.6.2 Selection of COPCs

Soil, groundwater, surface water, and sediment COPCs were selected based on comparisons of the maximum detected concentration with USEPA RSLs for residential soil (surface soil, total soil, and sediment) and tap water (groundwater and surface water). The application of the residential RSL values to COPC selection provides a list of COPCs that are very conservative for NAPR and specifically, SWMU 59. Although future on-site residential land use was conservatively used for screening criteria, it is not an assumed land use at SWMU 59. It is assumed that long-term plans for the facility would be similar to those that had been in place prior to closure with land use also generally the same (for the purpose of determining corrective action objectives).

The RSLs were derived using conservative, USEPA-promulgated default values, and the most recent toxicological criteria available. RfDs and CSFs have been combined with "standard" exposure scenarios to calculate the RSLs. Actual exposure scenarios and parameters may differ from those used to calculate the RSL. All noncarcinogenic RSLs were divided by 10 to account for potential additive effects. This adjustment corresponds to assuming an HQ of 0.1, rather than 1.0. This adds additional conservatism to the COPC selection process.

COPC selection is based on the detected concentrations of analytes, not their detection limits. This criterion introduces some uncertainty when analytes in site-specific environmental media have maximum detection limits in excess of the RSLs. For SWMU 59, the following chemicals had detection limits in excess of the RSLs: antimony in all media except sediment; arsenic in

surface soil and total soil; bis(2-ethylhexyl)phthalate and naphthalene in groundwater; bromodichloromethane, chloroform, dibromochloromethane, and antimony in surface water; and benzo(a)pyrene and indeno(1,2,3-cd)pyrene in sediment. However, antimony was retained as COPCs in surface soil and total soil, arsenic was retained as a COPC in all media, naphthalene was retained as a COPC in groundwater, and bromodichloromethane, chloroform, dibromochloromethane were retained as COPCs in surface water. In the case of some chemicals with extremely conservative risk-based RSLs (e.g., arsenic), conventional analytical techniques cannot produce detection levels less than these values. These chemicals were quantitatively evaluated in the HHRA, thereby reducing the uncertainty added to the HHRA.

8.3.6.3 Exposure Assessment

In performing exposure assessments, uncertainties arise from two main sources. First, uncertainties arise in estimating the fate of a compound in the environment, including estimating release and transport in a particular environmental medium. Second, uncertainties arise in the estimation of chemical intakes resulting from contact by a receptor with a particular medium.

To estimate an intake, certain assumptions must be made about exposure events, exposure durations, and the corresponding assimilation of constituents by the receptor. Exposure parameters have been generated by the scientific community and have been reviewed by the USEPA. The USEPA has published an Exposure Factors Handbook (USEPA, 2011a), which contains the best and latest values. These exposure parameters have been derived from a range of values generated by studies of limited numbers of individuals. It is assumed that all potential receptors remain on or near the site throughout the exposure periods and that their exposures to chemicals from the site are all uniform. In all instances, values used in this risk assessment, scientific judgments, and conservative assumptions agree with those of the USEPA.

The use of a RME approach, designed to avoid underestimating daily intakes, was employed throughout this risk assessment. The use of 95% UCL estimates of the arithmetic mean versus maximum values as the concentration term in estimating the CDI or DAD for exposure scenarios reduces the potential for underestimating exposure. In some cases, the data did not support the calculation of a 95% UCL due to an insufficient number of samples in the data set or a low frequency of detection. In those instances, the maximum detected concentration was used as the EPC. Specifically, due to the low sample size of the SWMU 59 surface water COPC data sets (n = 3 for each), risks were calculated based on the maximum detected COPC concentrations as the exposure concentrations. The result is a more conservative risk evaluation that may overstate risks to receptors at the SWMU. While it is not ideal to use a single data point to represent average intake, use of the maximum COPC concentration does err on the side of conservatism.

As discussed in Section 8.3.2.5, in the absence of USEPA Region II-specific guidance on dermal ABS for metals, an ABS of 0.01 was assumed for all metals in soil except for arsenic and cadmium. However, as acknowledged in RAGS Part E, there is a great deal of uncertainty associated with the evaluation of the dermal contact pathway for potential exposure to metals. RAGS Part E states that for metals, the speciation of the compound is critical to the dermal absorption and there are too little data to extrapolate a reasonable default value (USEPA, 2004). However, the guidance does allow for quantitative evaluation using default ABS values as an interim measure as long as uncertainties are presented and discussed. Therefore, in order to maintain a conservative approach and to account for dermal contact exposure pathway, an ABS value greater than zero (0) was assumed. Under this conservative assumption, risk estimates from dermal exposure to vanadium were responsible for a large percentage of the elevated HIs for soil and sediment. This is likely an overestimate of the true risk, since the dermal exposure pathway is assumed by USEPA guidance to more reasonably contribute only a small percentage to the total HI.

8.3.6.4 Toxicity Assessment

In making quantitative estimates of the toxicity of varying dosages of compounds to human receptors, uncertainties arise from two sources. First, data on human exposure and the subsequent effects are usually insufficient, if they are at all available. Human exposure data usually lack adequate concentration estimations and suffer from inherent temporal variability. Therefore, animal studies are often used and new uncertainties arise from the process of extrapolating animal results to humans. Second, to obtain observable effects with a manageable number of experimental subjects, high doses of a compound are often used. In this situation, a high dose means that high exposures are used in the experiment with respect to most environmental exposures. Therefore, when applying the results of the animal experiment to human exposures, the effects at the high doses must be extrapolated to approximate effects at lower doses.

In extrapolating effects from high doses in animals to low doses in humans, scientific judgment and conservative assumptions are employed. In selecting animal studies for use in dose-response calculations, the following factors are considered:

- Studies are preferred where the animal closely mimics human pharmacokinetics.
- Studies are preferred where dose intake most closely mimics the intake route and duration for humans.
- Studies are preferred which demonstrate the most sensitive response to the compound in question.

For compounds believed to cause threshold effects (i.e., noncarcinogens), safety factors are employed in the extrapolation of effects from animals to humans and from high doses to low doses. In deriving carcinogenic potency factors, the 95% UCL value is promulgated by the USEPA to prevent underestimation of potential risk.

All potential toxic endpoints for human receptors have been addressed to the extent allowed by the data evaluated from the most recent toxicological/epidemiological studies used to derive the cancer slope factors and reference doses. Therefore, any uncertainties associated with toxic endpoints are directly correlated to the information obtained from, and reliability of those studies.

Methyl iodide and propionitrile (in surface soil and total soil) were also retained as COPCs for SWMU 59 because there were no screening criteria for those chemicals. There were also no toxicity criteria with which to quantitatively evaluate potential exposure to these chemicals. However, it is not likely that this would underestimate risk because the majority of COPCs have very conservative toxicity criteria and were evaluated quantitatively. Furthermore, this HHRA uses conservative exposure parameters to quantitatively evaluate potential exposure to site-related COPCs.

8.3.6.5 Risk Characterization

The risk characterization bridges the gap between potential exposure and the possibility of systemic or carcinogenic human health effects, ultimately providing impetus for the remediation of the site or providing a basis for no remedial action.

Uncertainties associated with risk characterization include the assumption of chemical additivity and the inability to predict synergistic or antagonistic interactions between COPCs. These

uncertainties are inherent in any inferential risk assessment. USEPA promulgated inputs to the quantitative risk assessment and toxicological indices are calculated to be protective of the human receptor and to err conservatively, so as to not underestimate the potential human health risks.

8.3.6.6 Comparison to Background Levels

As previously discussed, inorganics were not eliminated as COPCs based on comparison to background concentrations. Therefore, it is possible that risks presented from metals could represent background conditions.

Although concentrations of antimony, arsenic, cobalt, lead, thallium, and vanadium exceeded corresponding background concentrations in the combined 2010 and 2012 surface soil data sets, with the exception of the future child resident, site risks from these metals did not exceed USEPA's target risk criteria for the receptors evaluated in the HHRA. Site-related noncarcinogenic risks from cobalt for the future child resident (cobalt HI = 1.3) slightly exceeded 1.0. The site-specific cobalt HI for the future young child resident receptor is 1.31, while the background cobalt HI is 1.32 (see Appendix T). Therefore, the risk from cobalt in background total soil is greater than the site-specific risk, and the contribution of risks from cobalt in soil at SWMU 59 to overall risk form site-related activities is below the acceptable hazard level for the future child resident receptor.

Although concentrations of cobalt and vanadium exceeded corresponding background concentrations in the 2012 surface soil data from beneath the concrete pads/paved surfaces, with the exception of the future child resident, site risks from these metals did not exceed USEPA's target risk criteria for the receptors evaluated in the HHRA. Site-related noncarcinogenic risks from cobalt (HI = 1.09) and vanadium (HI = 1.31) for the future child resident exceeded 1.0. The background cobalt HI is 1.2 and the background vanadium HI is 66 (see Appendix T). Therefore, the risks from cobalt and vanadium in background surface soil is greater than the site-specific risk, and the contributions of risks from cobalt and vanadium in soil at SWMU 59 to overall risk from site-related activities is below the acceptable hazard level for the future child resident.

Total arsenic, cadmium, cobalt, selenium, and vanadium were detected in the groundwater at concentrations exceeding corresponding tapwater RSLs. However, these metals were all detected at concentrations less than corresponding background screening values. Therefore, risks from these metals in SWMU 59 groundwater would also be below those from background.

8.3.7 Summary and Conclusions of the HHRA

The risk assessment evaluated the exposure of potential receptor populations including adult and youth trespassers, adult on-site worker, adult and child residents, construction workers, and industrial/commercial workers.

The estimated site risks exceeded USEPA's target risk levels for future residents. Although the Navy identifies future use as aligned with current use (industrial) for the purpose of developing remedial alternatives, the future residential land use scenario was used to evaluate unrestricted land use and provide the most conservatively protective risk estimation for SWMU 59

Other than the total lifetime carcinogenic risk (sum of the total site carcinogenic risks for the adult and child receptors) for the future residential receptor, the total site carcinogenic risks calculated for all media for all receptors were within or below USEPA's target risk range of 1×10^{-06} to 1×10^{-04}. It is noted that although the total lifetime carcinogenic risk exceeded the target risk range, the individual total site carcinogenic risks for the adult and child residential receptors

were within the target risk range. The exceedance of the total lifetime risk for the future residential receptor is primarily due to arsenic in groundwater. However, total arsenic was detected in groundwater at concentrations below background. Therefore, risk from arsenic is attributable to background concentrations, and site-related risk from arsenic does not exceed USEPA's target risk criteria for the future residential receptors.

The total site HIs for the future residential receptors were greater than USEPA's target hazard level of 1.0 primarily as a result of potential exposure to arsenic, cobalt, and vanadium in groundwater (approximately 85% of the total site HI for the adult resident and 65% for the child resident). Total arsenic, cobalt, and vanadium were detected in groundwater at concentrations below background. Therefore, these exceedances are attributable to background, and site-specific noncarcinogenic hazards from these metals are below USEPA's target level of 1.0. Similarly, although cobalt in soil also contributed slightly (approximately 15%) to the total site HI for the child resident, the majority of the exceedance is attributable to background concentrations of cobalt.

As previously mentioned, the estimated carcinogenic risks from all media were within or below USEPA's target risk range for the remaining receptors (i.e., current/future trespassers, current/future on-site workers, future construction workers, and future industrial/commercial workers). The total site HIs for the adult and youth trespassers and on-site worker were less than USEPA's target hazard level of 1.0. However, the total site HI for the future industrial/commercial worker was equal to 1.0, and the total site HI for the future construction was slightly greater than USEPA's target hazard level of 1.0. These results were due to cumulative effects of COPCs in soil and groundwater. After refinement of the total site noncarcinogenic risks addressing the magnitude of individual HQs and their contribution to target organs, none of the target organ HIs exceeded 1.0. Therefore, because target organ HI values were less than 1.0, cumulative adverse health effects are not likely for the future industrial/commercial and construction worker receptors from exposure to site media. For these reasons, no further actions are recommended for site media based on risk to trespassers, on-site workers, construction workers, and industrial/commercial workers.

Exposure to only soil underneath the concrete/paved surfaces was evaluated independently as a conservative measure to compare with risks associated with the combined 2010/2012 soil data set. The total site carcinogenic risks calculated for all media for all receptors were within or below USEPA's target risk range of 1×10^{-06} to 1×10^{-04}. With the exception of the future child resident and future construction worker, the total site HIs for the remaining receptors (i.e., current/future trespassers, current/future on-site workers, future adult residents, and future industrial/commercial workers) were less than USEPA's target hazard level of 1.0. Cobalt and vanadium in soil beneath the concrete/paved surfaces contributed to the total site HI for the child resident. However, the majority of the elevated HI is attributable to background concentrations of cobalt and vanadium. The total site HI for the future construction worker was slightly greater than USEPA's target hazard level of 1.0 due to cumulative effects of COPCs in soil. After refinement of the total site noncarcinogenic risk addressing the magnitude of individual HQs and their contribution to target organs, none of the target organ HIs exceeded 1.0. Therefore, because target organ HI values were less than 1.0, cumulative adverse health effects are not likely for the future construction worker receptors from exposure to soil beneath the concrete/paved surfaces. Based on these results, it is concluded that COPC concentration levels are comparable to those in the surrounding soils and there is no evidence of releases to soil beneath the paved surfaces. For these reasons, no further actions are recommended for soil beneath the concrete/paved surfaces based on risk to trespassers and industrial receptors.

8.4 Development of CAOs

The CMS process from a human health risk assessment perspective continues when potential exposure to a site is considered to pose unacceptable levels of risk and hazard and medium- and chemical-specific CAOs are calculated for comparison to the site data to determine if and where potential cleanup may occur.

CAOs are medium- and chemical-specific goals for protecting human health and the environment. The CAOs are used to focus the development of corrective measure alternatives on technologies that may achieve appropriate target levels, thereby limiting the number of alternatives analyzed.

CAOs can be general and descriptive (i.e., qualitative) or specific and numerical (i.e., quantitative). They are achieved by reducing exposure (e.g., installing a soil cover or limiting access) or by reducing contaminant levels (e.g., active remediation; USEPA, 1988). CAOs are used to evaluate which samples/areas within a site may require corrective measures, and which corrective measures alternative best protects human health and the environment.

8.4.1 Qualitative CAOs

Unrestricted land use cannot be recommended because risk estimates exceeded target limits for future residential receptors. Therefore, the recommended qualitative CAO is restricting potable use of groundwater and future residential use of the site.

The total site HIs for the adult and youth trespassers and on-site worker were less than USEPA's target hazard level of 1.0. However, the total site HI for the future industrial/commercial worker was equal to 1.0, and the total site HI for the future construction worker was slightly greater than USEPA's target hazard level of 1.0. These results were due to cumulative effects of COPCs in soil and groundwater. After refinement of the total site noncarcinogenic risk addressing the magnitude of individual HQs and their contribution to target organs, none of the target organ HIs exceeded 1.0. Therefore, because target organ HI values were less than 1.0, cumulative adverse health effects are not likely for the future industrial/commercial and construction worker receptors from exposure to site media. For these reasons, no further actions are recommended for site media based on risk to trespassers, on-site workers, construction workers, and industrial/commercial workers. Therefore, qualitative CAOs for soil, groundwater, surface water, and sediment for the protection of human health assuming continued industrial use were not developed for SWMU 59.

8.4.2 Quantitative CAOs

It is acknowledged that risk estimates were greater than USEPA's target limits for future residential receptors evaluated for exposure to environmental media at SWMU 59. The total lifetime carcinogenic risk (sum of the total site carcinogenic risks for the adult and child receptors) for the future residential receptor exceeded USEPA's target risk range of 1×10^{-06} to 1×10^{-04}. The exceedance of the total lifetime risk for the future residential receptor is primarily due to arsenic in groundwater. Although the total lifetime carcinogenic risk exceeded the target risk range, the individual total site carcinogenic risks for the adult and child residential receptors were within the target risk range.

The total site HIs for the future residential receptors were greater than USEPA's target hazard level of 1.0 primarily as a result of potential exposure to arsenic, cobalt, and vanadium in groundwater (approximately 85% of the total site HI for the adult resident and 65% for the child

resident). Total arsenic, cobalt, and vanadium were detected in groundwater at concentrations below background. Therefore, these exceedances are attributable to background, and site-specific noncarcinogenic hazards from these metals are below USEPA's target level of 1.0. Similarly, although cobalt in soil also contributed slightly (approximately 15%) to the total site HI for the child resident, the majority of the exceedance is attributable to background concentrations of cobalt. However, quantitative CAOs were not developed based on a residential scenario. The future residential land use scenario was used to evaluate unrestricted land use and provide the most conservatively protective risk estimation for SWMU 59. Potential human exposure is limited to industrial or commercial property use, now and in the future, for the purpose of developing remedial alternatives.

It is also acknowledged that the total site HI for the future industrial/commercial worker was equal to 1.0, and the total site HI for the future construction worker was slightly greater than USEPA's target hazard level of 1.0 due to cumulative effects of COPCs in soil and groundwater . However, after refinement of the total site noncarcinogenic risk addressing the magnitude of individual HQs and their contribution to target organs, none of the target organ HIs exceeded 1.0. Therefore, because target organ HI values were less than 1.0, cumulative adverse health effects are not likely for the future industrial/commercial and construction worker receptors from exposure to site media. Therefore, quantitative CAOs for soil, groundwater, surface water, and sediment for the protection of human health assuming continued industrial use were not developed for SWMU 59.

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9.0 SUMMARY OF CAOs AND EXTENT OF CONTAMINATION

The risk assessment processes discussed in Sections 7.0 and 8.0 were followed to identify specific COCs and develop media-specific CAOs that are protective of human and ecological receptors. The HHRA did not identify any COCs or unacceptable risks to human receptors (based on current/future trespasser, current/future on-site worker, future construction worker, and future industrial/commercial worker exposure scenarios) from potential exposure to constituents detected in soil, groundwater, or drainage ditch surface water and sediment. Therefore, human health quantitative CAOs were not developed.

The HHRA did conservatively consider a future residential exposure scenario in which potential risks were identified due to exposure to site soil and groundwater. The total lifetime carcinogenic risks for future adult and child residential receptors exceeded the target risk range. However, the individual total site carcinogenic risks were within the target risk range. The exceedance of the total lifetime carcinogenic risks for future residential receptors primarily was due to potential exposure to arsenic in groundwater. After refinement of the total lifetime carcinogenic risks, which addressed the contribution of background concentrations, overall risks from site-related activities are below the target risk level.

Noncarcinogenic risks also were identified for future residential receptors primarily due to potential exposure to arsenic, cobalt, and vanadium in groundwater and cobalt in soil. After refinement of the total site noncarcinogenic risks, which addressed the contribution of background concentrations, overall risks from site-related activities are below the target risk level.

As noted in the 2010 Supplemental Environmental Assessment for the Disposal of Naval Activity Puerto Rico (SEA), the Navy identifies future land use as aligned with current use (industrial) for the purpose of developing remedial alternatives and intends to clean the site y to historic land use (industrial). Since the risk estimates exceeded target limits for future adult and child residential receptors, and the property will not allow for Unrestricted Use/Unrestricted Exposure (UU/UE), Land Use Controls (LUCs) were developed as a human health qualitative CAO. These LUCs will be included in any lease or transfer deed to ensure protection of human health and the environment. In a letter to the Navy (February 20, 2015) the Roosevelt Roads Local Redevelopment Authority (RRLRA) agrees that the remedial alternative will be developed based on an industrial land use scenario and acknowledges and accepts the recommendation of Land Use Controls for SWMU 59. The RRLRA letter is provided in Appendix U.

Based on Step 3a of the BERA, no ecological COCs were identified for subsurface soil (1 to 3 feet bgs), groundwater, or drainage ditch surface water. Therefore, ecological CAOs for these media were not developed. However, copper, lead, and zinc were identified as ecological COCs in surface soil (0 to 1 foot bgs) and copper and zinc were identified as COCs in the drainage ditch sediment. It should be noted that different criteria are used to evaluate potential adverse ecological risks in different media (surface soil and shallow subsurface soil are considered different media from a risk perspective). Although concentrations of copper, lead and zinc in shallow subsurface soil may in some cases be of similar magnitude to the concentrations in surface soil, there are reduced levels of exposure with increasing depth and consequently less risk is posed by shallow subsurface soil than by surface soil.

A summary of the CAOs developed for copper, lead, and zinc in surface soil and for copper and zinc in drainage ditch sediment is discussed below. In addition, the extent of contamination requiring cleanup based on the CAOs is established.

9.1 Surface Soil

Based on Step 3a of the BERA, copper, lead, and zinc were identified as ecological COCs in surface soil (0 to 1 foot bgs) for terrestrial receptor group direct contact exposures as well as avian dietary exposures (lead only). Consequently, risk-based and background-based CAOs for these chemical-receptor-pathway combinations were developed using the methodology presented in Section 7.10. A summary of the CAOs is presented in Table 7-58. The recommended final CAOs also are presented in Table 7-58 and summarized below.

- Copper 168 mg/kg
- Lead 96 mg/kg
- Zinc 120 mg/kg

9.2 Extent of Contamination in Surface Soil Exceeding CAOs

As previously discussed, copper, lead, and zinc were identified as ecological COCs in surface soil requiring cleanup based on the established CAOs. The distribution of these three metals in surface soil exceeding the final CAOs is shown on Figure 9-1 and discussed below. The laboratory analytical results are presented in Table 9-1; concentrations greater than the CAOs are highlighted within the table.

Based on data collected during the 2004 ECP Investigation, 2010 CMS Investigation, and 2012 CMS Investigation and pre-excavation delineation sampling, the following five areas were identified as having one or more metals exceeding the corresponding CAOs.

Area 1 – This area includes surface soil (0 to 1 foot bgs) adjacent to the northeastern, eastern, and southeastern portions of the concrete slab. Copper (237 J to 415 mg/kg) exceeded the CAO (168 mg/kg) at locations 5E-03, 59SB09, 59SB14, and 59SS04. Lead (98 to 1,100 mg/kg) exceeded the CAO (96 mg/kg) at 11 locations. Zinc (123 to 930 mg/kg) exceeded the CAO (120 mg/kg) at 15 locations. Area 1 extends from the concrete slab and Building 60 outward to the base of the steep hillside. There is some uncertainty in the lateral extent of zinc northwest of location59SS31 and along the steep hillside. However, post-excavation confirmation samples will be collected from the excavation sidewalls to ensure removal of contaminated soil has been completed; additional soil will be excavated as necessary (see Section 10.1).

Area 2 – This area includes locations 59SB15 and 59SS15 where lead (638 mg/kg) and zinc (656 to 747 mg/kg) exceeded the CAOs (96 and 120 mg/kg, respectively) in surface soil (0 to 1 foot bgs). Area 2 extends from the asphalt pavement south to the base of the steep hillside and west to location 59SS14. There is some uncertainty in the lateral extent of zinc east and south of location 59SS15. However, post-excavation confirmation samples will be collected from the excavation sidewalls to ensure removal of contaminated soil has been completed; additional soil will be excavated as necessary (see Section 10.1).

Area 3 – This area includes locations 59SB17, 59SS20, and 59SS32 where zinc (132 to 2,100 D mg/kg) exceeded the CAO (120 mg/kg) in surface soil (0 to 1 foot bgs). Area 3 extends from the concrete slab/asphalt pavement west to location 59SS18, north to location 59SS17, and south to location 59SB13. There is some undertainty in the lateral extent of zinc around the southwestern edge of the excavation. However, post-excavation confirmation samples will be collected from the excavation sidewalls to establish removal of contaminated soil has been completed; additional soil will be excavated as necessary (see Section 10.1).

Area 4 – This area includes locations 59SB12, 59SS21, 59SS22, and 59SS33 where zinc (215 to 390 mg/kg) exceeded the CAO (120 mg/kg) in surface soil (0 to 1 foot bgs). Area 4 extends north to location 59SB06, south to location 59SS24, west to location 59SS34, and east to location 59SS23. There is some uncertainty in the lateral extent of zinc near the northern half of Area 4. However, post-excavation confirmation samples will be collected from the excavation sidewalls to ensure removal of contaminated soil has been completed; additional soil will be excavated as necessary (see Section 10.1).

Area 5 – This area includes soil beneath the concrete slab in the vicinity of location 59SB24 where copper (260 J mg/kg) exceeded the CAO (168 mg/kg). Area 5 extends from the edge of the concrete slab south to Building 258 and approximately 12.5 feet west and east of location 59SB24. There is some uncertainty in the lateral extent of copper to the north, west, and east. However, post-excavation confirmation samples will be collected from the excavation sidewalls to ensure removal of contaminated soil has been completed; additional soil will be excavated as necessary (see Section 10.1).

9.3 Sediment

The ecological risk-based and background based CAOs for sediment are presented in Section 7.10.2 and summarized on Table 7-59. Copper and zinc were identified as ecological CAOs for aquatic receptor groups within the drainage ditch system at SWMU 59. As discussed in Section 7.10.2, the background-based CAO for copper (131 mg/kg) was selected as the final CAO because the risk-based CAO for copper (31.6 mg/kg) was below the background-based CAO. Conversely, the minimum risk-based CAO for zinc (121 mg/kg) was selected as the final CAO because the risk-based CAO exceeded the background-based CAO for zinc (105 mg/kg).

The distribution of these two metals in sediment exceeding the final CAOs is shown on Figure 9.2. The laboratory analytical results are presented in Table 9.2; concentrations greater than the CAOs are highlighted within the table. Five sediment sample locations were identified as having conentrations of copper above the final CAO: 59SD02, 59SD05, 59SD06, 59SD08, and 59SD11. Zinc was detected above the final CAO at ten sediment sample locations: 59SD01, 59SD02. 59SD03, 59SD04 (59SD04D), 59SD05, 59SD06, 59SD07, 59SD08, 59SD11, and 59SD12. There is some uncertainty regarding the downstream extent of copper and zinc comtanination in the drainage ditch. However, post-excavation confirmation samples will be collected from the excavation endwall to establish that removal of the contaminated sediment has been completed (see Section 10.2).

The depth of sediment requiring cleanup of copper and zinc is limited to the depth required for the protection of benthic and aquatic life. This depth is typically considered as the top six inches of sediment. However, a conservative depth of one foot was assumed for SWMU 59.

10.0 JUSTIFICATION AND RECOMMENDATION OF THE CORRECTIVE MEASURE

Because of the limited nature of contamination identified at SWMU 59, as well as the easy accessibility to the SWMU by typical construction equipment, the recommended corrective measure to address contaminated soil/sediment is excavation and off-site disposal. Use of a presumptive remedy, such as excavation and off-site disposal, bypasses several steps of the CMS process (USEPA, 1994) including the screening of corrective measure technologies, identification and formulation of corrective measure alternatives (Task I from Attachment IV of the RCRA §7003 Administrative Order on Consent; USEPA, 2007), and evaluation of the corrective measure alternatives (Task II from Attachment IV of the Administrative Order). This results in a streamlined CMS that focuses on the description and justification of the recommended corrective measure.

Excavation and off-site disposal will be effective, reliable, and easily implemented and will ultimately result in a Corrective Action Complete designation with LUCs for SWMU 59 in the shortest period of time. LUCs are required for soil and groundwater since the human health risk estimates exceeded target limits for future adult and young child residents and the property will not allow for UU/UE.

It should be noted that SWMU 59 is located within Sale Parcel III, which was transferred from the Navy to the Commonwealth of Puerto Rico on January 25, 2012. However, SWMU 59 was not included in the transfer at the time. Rather, it was "carved out" of the transfer while the Navy continues with implementation of the remaining corrective action obligations in accordance with the RCRA §7003 Administrative Order on Consent (USEPA, 2007). Nonetheless, in accordance with Section VIII, Paragraph 27(G)(a) of the Administrative Order, the Navy continues to provide annual certification that acceptable LUCs have been implemented at SWMU 59 (and other SWMUs) and are being maintained to preclude unacceptable usage of the land and groundwater. Once ownership of the SWMU 59 parcel has been transferred, the following LUCs pertinent to soil and groundwater will be included in the Quitclaim Deed of Transfer.

- **Covenant and Restriction regarding Non-residential Use:** …no permanent residences shall be constructed or otherwise developed on the property, and that no portion of the property shall be used as a permanent residence.

- **Covenant and Restriction regarding Excavation Prohibited:** …excavation, drilling, or other disturbance or removal of soils or other invasive activities on the property shall be prohibited.

- **Covenant and Restriction regarding Groundwater:** …installation of any groundwater extraction wells or the use of any groundwater drawn from the property shall be prohibited.

If the new property owner wishes to remove the LUCs from the deed in the future, they are required to work with the USEPA and PREQB to establish any additional investigation, risk assessment, and/or remediation activities and to demonstrate the impacted media meet all federal and state requirements for increased protectiveness to human health and the environment. The property owner must obtain approval from the Navy, USEPA, and PREQB prior to removal of the LUCs.

As noted in Section 2.3.1, the final disposition of the suspected USTs at the fuel islands was not determined. Therefore, the corrective measure also will include efforts by the remedial contractor to locate the suspected tanks. These efforts may include, but not be limited to, geophysical methods (e.g., ground penetrating radar, radiodetection, electromagnetics, magnetics) and excavation of test trenches. If the location of the suspected tanks is identified and confirmed, their condition will be assessed and a corrective action plan developed, as appropriate. Specific activities and protocols associated with the UST investigation will be defined in the Corrective Measures Implementation (CMI) Project Plan.

The description and justification of the corrective measure presented herein focuses on the excavation and off-site disposal portion of the remedy. Justification for selecting excavation and off-site disposal was based on technical, human health, environmental, institutional, and cost considerations as detailed in Attachment IV of the RCRA §7003 Administrative Order on Consent (USEPA, 2007). Although the terminology and evaluation criteria that are required to be used and identified in the CMS are slightly different, the overall corrective measure requirements of the Administrative Order are generally consistent with other EPA guidance such as the Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (USEPA, 1988) and the RCRA Corrective Action Plan (USEPA, 1994). The technical approach to implementing the recommended corrective measure is discussed in Section 11.0.

10.1 Description of the Corrective Measure

Excavation and off-site disposal involves removal of contaminated surface soil and sub-slab soil exceeding the CAOs for copper (168 mg/kg), lead (96 mg/kg), and zinc (120 mg/kg). The estimated extent of soil requiring excavation is limited to five areas as shown on Figure 10-1 and discussed below.

Area 1 – This area is approximately 20,916 square feet and includes surface soil (0 to 1 foot bgs) adjacent to the northeastern, eastern, and southeastern portions of the concrete slab where copper, lead, and zinc exceeded the CAOs. The total depth of excavation will be 1 foot bgs, which results in approximately 775 bank cubic yards of soil requiring excavation and off-site disposal.

Area 2 – This area is approximately 1,545 square feet and includes locations 59SB15 and 59SS15 where lead and zinc exceeded the CAO in surface soil (0 to 1 foot bgs). The total depth of excavation will be 1 foot bgs, which results in approximately 57 bank cubic yards of soil requiring excavation and off-site disposal.

Area 3 – This area is approximately 4,012 square feet and includes locations 59SB17, 59SS20, and 59SS32 where zinc exceeded the CAO in surface soil (0 to 1 foot bgs). The total depth of excavation will be 1 foot bgs, which results in approximately 149 bank cubic yards of soil requiring excavation and off-site disposal.

Area 4 – This area is approximately 6,536 square feet and includes locations 59SB12, 59SS21, 59SS22, and 59SS33 where zinc exceeded the CAO in surface soil (0 to 1 foot bgs). The total depth of excavation will be 1 foot bgs, which results in approximately 242 bank cubic yards of soil requiring excavation and off-site disposal.

Area 5 – This area is approximately 1,415 square feet and includes soil beneath the concrete slab in the vicinity of location 59SB24 where copper exceeded the CAO. Prior to excavation, the portion of the concrete slab (approximately 26 cubic yards) within the excavation limits will be demolished and disposed of along with the excavated soil. The total depth of excavation will be 1 foot below the bottom of the concrete slab, which results in approximately 52 bank cubic yards of soil requiring excavation and off-site disposal.

Dense vegetation is present at the majority of excavation areas, and clearing will be necessary prior to the removal action to allow for adequate site access. It is anticipated that approximately one acre will be cleared. Existing roads, including Forrestal Drive, will be used to accommodate construction-related traffic. Therefore, construction of haul roads likely will not be required.

Contaminated soil at Area 1 through Area 5 (approximately 1,275 bank cubic yards) will be excavated to the pre-determined limits and depths shown on Figure 10-1 and temporarily stockpiled on site. Excavation depth will be limited to 1 foot bgs (1 foot below the bottom of the concrete slab at Area 5) since no adverse risks to ecological receptors were identified upon exposure to constituents detected in subsurface soil.

Post-excavation confirmation samples will be collected from the excavation areas to ensure removal of contaminated soil has been completed. The samples will be collected at a frequency of one sample every 25 linear feet (approximate) along the excavation sidewalls. Samples will not be collected from excavation sidewalls that extend up to concrete slabs, asphalt surfaces, building foundations, or other site structures because contaminated soil within the targeted depth interval of concern (0 to 1 foot bgs) adjacent to these structures will have been removed. However, samples will be collected from excavation sidewalls where excavation exposes 4 to 12 inches of soil beneath aforementioned manmade structures. In addition, samples will not be collected from the excavation bottoms since no adverse risks to ecological receptors were identified upon exposure to constituents detected in subsurface soil.

Upon verification that removal of contaminated soil has been completed, the excavations will be backfilled using borrow material purchased from an off-site source. The final graded surfaces and any disturbed areas will then be re-vegetated with native grasses. Replacement of the concrete slab at Area 5 will not be required. However, the backfill will be brought to ground surface.

Contaminated soil (and the concrete from Area 5) will be transported to an on-island, permitted, disposal facility unless characterization testing indicates levels exceeding landfill acceptance criteria. The on-island disposal facilities are located in Peñuelas and Humacao. Licensed waste haulers are available and will transport the soil to the disposal facility. No hazardous waste is anticipated at this SWMU. However, if the waste is characterized as hazardous, then it must be disposed of off-island at a facility in the continental United States thereby substantially increasing project costs.

Minimal maintenance will be required subsequent to completion of the removal action. Periodic visual inspections will be conducted by remedial contractor personnel to verify that the soil cover is not eroding and permanent vegetation has established. Any areas that exhibit signs of erosion or lack of adequate vegetation will be repaired as soon as practicable.

10.2 Sediment

Sediment will be removed from areas where metals contaminant concentrations exceed the established CAOs as determined in Section 7.0 through 9.0 of this document. The proposed cleanup levels are the following:

- Copper 131 mg/kg
- Zinc 121 mg/kg

The extent of sediment contamination in excess of the CAOs is shown on Figure 10-2. The area for sediment excavation includes three segments of the drainage ditch. A description of each segment and the associated volume of sediment are as follows.

Segment 1 consists of a small pool that has a small outlet discharing into the drainage ditch system. The pool covers an approximate area of 271 SF and is lined with vegetation. Segment 1

encompasses samples 59SD01, 59SD02, and 59SD03 as shown on Figure 10-2. All three samples indicated COCs in excess of the CAOs at SWMU 59.

Segment 2 is approximately 5 feet wide, covers and area of 945 SF, and is lined with vegetation. Segment 2 encompasses sample locations 50SD04 through 59SD08 as shown on Figure 10-2. All sample locations within Segemnt 2 indicated COCs in excess of the CAOs at SWMU 59. Sample 59SD04 is located where the small pool discharges into the drainage ditch system, approximtately fourteen feet from the outfall. Segment 2 extends downgradient of location 59SD08 to approximately half the distance to 59SD09 where COCs in excess of the CAOs were not present. Segment 2 represetns the estimated extent of sediment contamination at locations 59SD04 through 59SD08.

Segment 3 is apprioximately 5 feet wide, covers an area of 432 SF, and is lined with vegetation. Segment 3 encompasses sample locations 59SD11 and 59SD12, as shown on Figure 10-2. Both samples located in Segment 3 indicate COCs in excess of the CAOs. Segement 3 extends upgradient of location 59SD11 to approximately half the distance to 59SD10 where COCs in excees of the CAOs were not present. Segement 3 also extends approximately 25 feet downgradient of location 59SD12 due to zinc detected in excess of the CAO. Segment 3 represents the estimated extent of sediment contamination at locations 59SD11 and 59SD12.

Based on the above, the total volume of sediment requiring excavation at SWMU 59 is approximately 61 cubic yards.

For the sediment excavation, it is assumed within the channel that only sediment will be excavated and the excavation depth will not exceed one foot, which is of sufficient depth for protection of ecological and human receptors. Confirmation samples will be collected along the edge of excavation that extends perpendicular to the channel (endwall) to verify the extent of contamination has been removed. Confirmation sampling will not be required along the sidewall of the channel bank since the entire width of the channel will be excavated to a conservative depth of one foot. The excavated sediment will be dewatered by placing it on polyethylene sheeting and allowing the excess water to drain or evaporate. The drained water will be containerized and samples will be collected for hazardous waste characterization. Similarly, the sediment will be sampled for hazardous waste characteristics. If the waste streams are determined to be hazardous, then they must be disposed of off-island to a facility in the continental United States, thereby substantially increasing project costs. Otherwise, the contaminated sediment then will be transported to an on-island, permitted, disposal facility. The on-island disposal facilities are located in Ponce and Penuelas. Licensed waste haulers are available and will be used to transport the sediment to the disposal facility. Finally, the excavation area will be backfilled with compacted low permeability soil, graded to promote positive drainage, and revegetated, as needed. The ditch invert will be armored with riprap to prevent future erosion.

The remedy for SWMU 59 consists of excavation and off-site disposal of the contaminated sediment. The outermost extent of contamination of the combined COCs above the proposed remediation levels will govern the extent of sediment excavation. Consequently, prior to excavation, additional sediment samples will be collected in an effort to further delineate and minimize the uncertainty associated with the lateral extent of contamination beyond the furthest downgradient location (59SD12).

10.3 Justification of the Corrective Measure

Justification for selecting excavation and off-site disposal based on technical (performance, reliability, implementability, and safety), human health, environmental, institutional, and cost considerations is provided below.

10.3.1 Technical Considerations

Performance – Excavation and off-site disposal are proven methods for protecting human health and the environment (currently and in the future) that can be applied to SWMU 59. These actions result in a permanent corrective measure because contaminated media will be removed.

Reliability – Excavation and off-site disposal is a viable corrective measure with respect to its demonstrated and expected reliability since contaminated media will be excavated and disposed of in an off-site, permitted landfill. Other than inspecting the soil cover to ensure that it is not eroding and permanent vegetation has been established, no long-term or operation and maintenance activities are required.

Implementability – Excavation and off-site disposal has an easy level of difficulty to implement due to the shallow excavation depths (1 foot) and volume of contaminated soil and sediment requiring disposal (approximately 1,275 bank cubic yards and 61 cubic yards, respectively). Commonly used earth moving equipment, erosion and sedimentation controls, clearing, excavation and on-site management of contaminated soil, management of storm water, laboratory testing of confirmation and characterization/profile samples, transportation and off-site disposal of contaminated media, site restoration, and professional services for planning and design will be required. SWMU 59 is easily accessible and has limited site features that would interfere with the excavation. No easements or right-of-ways will be required. The on-island disposal facilities are located in Peñuelas and Humacao. Licensed waste haulers are available and will transport the contaminated media to the disposal facility. The removal action should require less than one month to complete.

Safety – Safety concerns while implementing the removal action are anticipated to be low due to the excavation requirements and depths (1 foot). Any construction-related safety concerns will be addressed through preparation and implementation of a site-specific Health and Safety Plan (HASP).

10.3.2 Human Health Considerations

No unacceptable human health risks upon potential exposure to constituents detected in soil, groundwater, or drainage ditch surface water and sediment were identified for SWMU 59 based on an industrial/commercial exposure scenario, which is consistent with the current/intended future land use. However, the human health risk assessment did conclude that LUCs are required to restrict future residential land and groundwater use. Consequently, excavation and off-site disposal (with LUCs) will be protective of human health. Workers may be exposed to typical construction-related site risks. However, any construction-related site risks will be addressed through preparation and implementation of a site-specific HASP as previously discussed.

10.3.3 Environmental Considerations

Excavation and off-site disposal is protective of the environment and ecological receptors and will provide an immediate benefit/improvement by virtue of removing contaminated soil that poses a potential risk to ecological receptors. Excavation of contaminated soil will be required, which could increase contaminant migration and exposure of ecological receptors to

contaminated materials in the short term. However, these factors will be minimized by proper use of storm water management measures, erosion and sedimentation control measures, and dust controls as necessary. Some clearing of vegetated land (approximately one acre) will be required, which would alter the natural habitat. However, the disturbed areas will be re-vegetated and eventually return to a coastal scrub forest community through secondary succession.

10.3.4 Institutional Considerations

The corrective measure will satisfy federal, state, and local requirements to the extent practicable. A permit for solid waste generation and an air permit for fugitive dust emissions may be required from the PREQB. However, it is anticipated that the requirements will be moderate for the application and approval of these permits. Because the property will not allow for UU/UE, annual inspections and five year reviews will be required in perpetuity to ensure compliance with the land use and activity restrictions.

10.3.5 Cost Considerations

The overall estimated capital cost of implementing the recommended corrective measure is $512,660 as summarized in Table 10-1. The cost estimate considers capital costs for the principle components of the alternative. Other than costs associated with inspecting the soil cover to ensure that it is not eroding and permanent vegetation has been established, there are no long-term or operation and maintenance costs.

10.4 References

USEPA, 2007. RCRA § 7003 Administrative Order on Consent. In the Matter of: United States The Department of the Navy, Naval Activity Puerto Rico formerly Naval Station Roosevelt Roads, Puerto Rico. Environmental Protection Agency, EPA Docket No. RCRA-02-2007-7301. January 29, 2007.

USEPA. 1994. RCRA Corrective Action Plan. Office of Solid Waste and Emergency Response. OSWER Directive 9902.3-2A. May 1994.

USEPA 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA. October 1988. EPA/540/G-89/004.

11.0 TECHNICAL APPROACH TO IMPLEMENTATION OF THE CORRECTIVE MEASURE

This section details the recommended corrective measure proposed to be implemented at SWMU 59. The layout of the conceptual design, design considerations, planning documents, reporting requirements, and schedule are presented below.

Upon concurrence by the regulatory agencies that the recommended corrective measure is appropriate, a Statement of Basis will be prepared and the public given an opportunity to comment. A public notice of that comment period will be published in both Spanish and English in select Puerto Rico newspapers. Following completion of public review and comment, the USEPA will advise of any required modifications based on the public comments, or its acceptability.

11.1 Conceptual Design

The recommended corrective measure is excavation and off-site disposal, which involves removal of contaminated surface soil and sub-slab soil exceeding the CAOs for copper (168 mg/kg), lead (96 mg/kg), and zinc (120 mg/kg), and contaminated sediment exceededing the CAOs for copper (131 mg/kg) and zinc (121 mg/kg). A discussion of activities associated with the corrective measure, including (1) excavation and staging (soil and sediment), (2) confirmation and characterization/profile sampling, (3) contaminated soil loadout, transportation, and disposal, and (4) site restoration, is presented below.

11.1.1 Excavation and Staging

11.1.1.1 Soil

Dense vegetation is present at the majority of excavation areas, and clearing will be necessary prior to the removal action to allow for adequate site access. It is anticipated that approximately one acre will be cleared. Existing roads, including Forrestal Drive, will be used to accommodate construction-related traffic. Therefore, construction of haul roads likely will not be required.

Prior to excavation, the portion of the concrete slab (approximately 26 cubic yards) within Area 5 will be demolished and disposed of along with the excavated soil. Contaminated soil at Area 1 through Area 5 (approximately 1,275 bank cubic yards) will be excavated to the pre-determined limits and depths shown on Figure 10-1. Excavation depth will be limited to 1 foot bgs (1 foot below the bottom of the concrete slab at Area 5) since no adverse risks to ecological receptors were identified upon exposure to constituents detected in subsurface soil. In the case where an existing monitoring well(s) is present within a specified excavation area, contaminated soil will be carefully removed from around the well(s). Monitoring wells will not be abandoned prior to excavation due to the shallow excavation depths (1 foot bgs) in the vicinity of the wells.

Excavated soil will be temporarily stockpiled on site. This temporary soil stockpile may be located on the concrete slab or asphalt surface at the SWMU. The stockpile area will be underlain with 20-mil, polyethylene sheeting, bermed, and covered at the end of each day to prevent runoff of potentially contaminated soil.

Storm water management controls such as diversion berms will be used, as needed, to divert storm water away from the excavation areas. In addition, silt fence and/or hay bales will be used to control erosion and sedimentation. Groundwater is not expected to be encountered during the removal activities due to the shallow excavation depths (1 foot). However, if pumping or

excavation dewatering are necessary, appropriate water management measures will be discussed with the Navy, USEPA, and PREQB and follow applicable regulations/guidelines.

11.1.1.2Sediment

Dense vegetation is present at the majority of excavation areas, and clearing will be necessary prior to the removal action to allow for adequate site access. It is anticipated that approximately one acre will be cleared. Existing roads, including Forrestal Drive, will be used to accommodate construction-related traffic. Therefore, construction of haul roads likely will not be required

Prio to excavation, delineation sediment samples will be collected downgradient of location 59SD12. It is anticipated that this sampling will delineate contamination present at 59SD12 and investigate any impacts further downgradient in the ditch. In the event a delineation sample indicates contamination above the CAOs, excavation will be extended to that location. Sampling and excavation will not proceed beyond the confluence of the ditches west of the site. In general, the delineation samples will be collected from the top six inches of sediment and will be analyzed for the two COCs identified for sediment. It is anticipated that four delineation samples will be collected downgradient of 59SD12. The actual samples locations will be defined in the Corrective Action Project Plan, as described in Section 11.3.

The pre-determined limits of sediment excavation (Figure 11-2) will be excavated to a maximum depth of 1 foot at Segment 1, Segment 2, and Segment 3. The removal of the upper one foot of drainage ditch sediment removes the potential pathways to potential ecological/human receptors. Any contamination in excess of the CAOs that remain below the one foot excavation will not pose a risk to receptors because the excavation will be backfilled with one foot of clean soil. Clean low permeability soil graded to promote positive drainage will be used for backfill. Aggregate rip rap will be placed along disturbed portions of the ditch banks to provide furture erosion resistsance.

Excavated sediment will be placed onto polyethylene sheeting for dewatering and drying. The excavated/dewatered sediment will be placed into lined roll-off boxes for transportation. The roll-off boxes will be placed so that they slope to drain to one corner of the box.

Storm water management controls such as diversion berms will be used, as needed, to divert storm water away from the excavation areas. In addition, silt fence and/or hay bales will be used to control erosion and sedimentation. Groundwater is not expected to be encountered during the removal activities due to the shallow excavation depths (1 foot). However, if pumping or excavation dewatering are necessary, appropriate water management measures will be discussed with the Navy, USEPA, and PREQB and follow applicable regulations/guidelines.

11.1.2 Confirmation and Characterization/Profile Sampling

Sampling activities associated with the corrective measure are summarized below and include post-excavation confirmation soil sampling, borrow pit soil stockpile sampling, and contaminated soil stockpile sampling. Specific sampling and analytical protocols will be defined in the CMI Project Plan.

Post-Excavation Confirmation Soil Sampling – Post-excavation confirmation samples will be collected from the excavation areas to ensure removal of contaminated soil has been completed. The samples will be collected at a frequency of one sample every 25 linear feet (approximate) along the excavation sidewalls. Samples will not be collected from excavation sidewalls that extend up to concrete slabs, asphalt surfaces, building foundations, or other site structures

because contaminated soil within the targeted depth interval of concern (0 to 1 foot bgs) adjacent to these structures will have been removed. In addition, samples will not be collected from the excavation bottoms since no adverse risks to ecological receptors were identified upon exposure to constituents detected in subsurface soil.

The samples will be submitted to a qualified laboratory and analyzed for the respective metal(s) applicable to each area (i.e., copper, lead, and zinc at Area 1; lead and zinc at Area 2; zinc at Area 3 and Area 4; copper at Area 5). An expedited turn-around time will be requested to minimize the amount of time that the excavations remain open. The results will be compared to the corresponding CAOs. If the respective metal(s) applicable to an area is less than the CAO(s), the excavation will be complete. Conversely, if a particular metal exceeds the CAO, additional soil will be removed from the excavation sidewall in approximate 2-foot increments within the area represented by the confirmatory sample (i.e., the area will require over-excavation). Confirmation sampling will then be repeated as described above until sampling results show that the metal is less than the CAO.

Post-Excavation Confirmation Sediment Sampling – A confirmation sample will be collected from the excavation edge perpendicular to the channel to verify the extent of contamination has been removed. Confirmation samples will be analyzed for the same COCs exceeding the respective CAOs for each sediment sample adjacent to the excavation edge. Confirmation sampling will not be required along the sidewall of the channel bank since the entire width of the channel will be excavated to a conservative depth of one foot. The sample identification, depth, number of samples, and QC samples within each area will be identified in the Corrective Action Project Plan.

Borrow Pit Soil Stockpile Sampling – Backfill material purchased from an off-site source(s) will be tested in accordance with Navy technical specifications to ensure the material is suitable for use as backfill. One composite sample will be collected from each borrow source (e.g., general backfill soil, topsoil) and analyzed for the following chemical and geotechnical parameters:

- Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX)
- TPH GRO and DRO
- Appendix IX Metals
- TCLP VOCs, SVOCs, Pesticides, Herbicides, and Metals
- Ignitability, Reactivity, and Corrosivity
- Grain Size
- % Passing #200 Sieve
- Atterberg Limits
- Unified Soil Classification System (USCS) Classification

As per Navy technical specifications, the backfill will contain less than 100 mg/kg of TPH, less than 5 mg/kg of the sum of BTEX, and will not be characteristically hazardous.

Contaminated Soil Stockpile Sampling – Stockpiled soil will be sampled and characterized for disposal purposes to ensure the soil is non-hazardous and meets the landfill's acceptance criteria. Composite samples will be collected from the stockpile at a frequency of one sample per 1,000 cubic yards of soil (estimated). The specific analytical requirements will be dictated by the chosen disposal facility. However, for cost estimating purposes, it is assumed that the samples will be analyzed for TCLP metals, ignitability, reactivity, corrosivity, and paint filter test.

Dewatering Sampling – Water from the roll-off boxes will be sampled and characterized for disposal purposes to ensure the water is non-hazardous and meets the landfill's acceptance criteria. One aqueous sample will be collected from each roll-off box. The specific analytical

requirements will be dictated by the chosen disposal facility. However, for cost estimating purposes, it is assumed that the samples will be analyzed for metals, ignitability, reactivity, and corrosivity.

11.1.3 Contaminated Soil Loadout, Transportation, and Disposal

Contaminated soil (and the concrete from Area 5), dewatered sediment, and dewatering liquid will be transported to an on-island, permitted, disposal facility unless characterization testing indicates levels exceeding landfill acceptance criteria. The on-island disposal facilities are located in Peñuelas and Humacao. Licensed waste haulers are available and will transport the soil to the disposal facility. No hazardous waste is anticipated at this SWMU. However, if the waste is characterized as hazardous, then it must be disposed of off-island at a facility in the continental United States thereby substantially increasing project costs.

11.1.4 Site Restoration

11.1.4.1 Soil

Upon verification that removal of contaminated soil has been completed, the excavations will be backfilled and compacted to approximately 4 inches below finish grade using borrow material purchased from an off-site source. The depth of backfill at each excavated area will correspond with the depth of excavated soil. Approximately 4 inches of topsoil cover will be placed over the backfill material to bring the excavations to finish grade and promote growth of the vegetative cover. The excavations and any disturbed areas will be graded to provide positive surface drainage and restore ground conditions to match the surrounding topography. Common Bermuda grass seed, fertilizer, and mulch will then be applied to the final graded surfaces and all disturbed areas. Replacement of the concrete slab at Area 5 will not be required. However, the backfill (and topsoil cover) will be brought to ground surface.

Minimal maintenance will be required subsequent to completion of the removal action. Periodic visual inspections will be conducted by remedial contractor personnel to verify that the soil cover is not eroding and permanent vegetation has established. Any areas that exhibit signs of erosion or lack of adequate vegetation will be repaired as soon as practicable.

The general processes to be followed for implementation of the removal action are as follows:

- Survey the locations of the excavation limits.
- Mobilize the appropriate excavation equipment, front end loader, and other support equipment.
- Clear the vegetated areas required for completion of the work as applicable.
- Install the required erosion and sedimentation controls.
- Construct a decontamination pad, equipment lay down area, and staging area for contaminated soil.
- Collect and analyze representative, composite samples from each off-site borrow source (general backfill soil, topsoil) in accordance with Navy technical specifications to ensure the material is suitable for use as backfill.

- Demolish the portion of the concrete slab within Area 5 and temporarily stockpile on site.

- Excavate contaminated soil from the defined areas and temporarily stockpile on site; where present, carefully excavate around existing monitoring wells and building foundations.

- Collect post-excavation confirmation soil samples from the sidewalls of the excavations; analyze the samples for the respective metal(s) applicable to each area (i.e., copper, lead, and zinc at Area 1; lead and zinc at Area 2; zinc at Area 3 and Area 4; copper at Area 5).

- If a particular metal exceeds the corresponding CAO, remove additional soil from the excavation sidewall in approximate 2-foot increments within the area represented by the confirmatory sample. Repeat the confirmation sampling until sampling results show that constituents are less than the CAOs.

- Collect and analyze representative, composite samples of stockpiled soil. It is assumed that the analytical requirements will include TCLP metals, ignitability, reactivity, corrosivity, and paint filter test. Upon receipt of the data, complete a waste profile form and secure approval from the disposal facility.

- Survey the final limits of any areas that required over-excavation.

- Backfill and compact each excavation area with clean soil purchased from an off-site source.

- Place topsoil and grade to match the pre-existing conditions; re-vegetate each excavation area and any disturbed areas.

- Load the contaminated soil into trucks and transport to the approved, on-island disposal facility.

- Decontaminate and demobilize the equipment.

- Dismantle decontamination pad and staging areas and dispose of decontamination residuals.

- Remove the erosion and sedimentation controls once permanent vegetation has established.

11.1.4.2 Sediment

The processes to be followed for implementation of the sediment excavation and disposal portion of this corrective measure include:

- Collection of pre-excavation sediment delineation samples downgradient of location 59SD12.

- Mobilization of a small backhoe or grade all, small front end loader, and roll-off boxes

- Construction of a decontamination pad and equipment lay down areas (use same area for soil and sediment excavation)

- Survey locate the excavation limits
- Installation of erosion controls within each reach of the drainage ditch
- Construction of sediment drying areas with erosion and sedimentation controls along the edge of the drainage ditch
- Excavation of sediment from each reach of the drainage ditch to maximum one foot depth
- Collect confirmation sample from edge of excavation perpendicular to the channel
- Placement of excavated sediment onto polyethylene sheeting for dewatering and drying
- Transportation of the excavated/dewatered sediment to lined roll-off boxes. The roll-off boxes will be placed so that they slope to drain to one corner of the box.
- Collection and analysis of representative soil samples for toxicity characteristics in accordance with 40 CFR Part 261.24
- Collection, analysis and disposal of water from the roll-off boxes
- Receipt of confirmation sample results indicating the contaminated sediment has been removed. If the results indicate that contamination remains, excavation will extend halfway to the closest sediment sample location below the CAOs and resampled.
- Transportation and disposal of sediment to an approved on-island disposal facility
- Survey of the achieved lateral and vertical limits of excavation prior to initiation of backfilling
- Backfill excavated areas with clean, low-permeability soil graded to promote positive drainage; place aggregate rip rap along disturbed portions of the ditch banks to provide future erosion resistance
- Revegetation of any disturbed areas
- Demobilization of all equipment, etc.
- Removal of erosion and sediment control structures

11.2 Design Considerations for Corrective Measure Implementation

Many factors affect the ease with which a corrective measure can be implemented at a site. Some of these items include site ownership, site access, existing structures, disruption of adjacent facilities, available utilities, utility clearance, determination of the extent of contamination, adequate space for staging and decontamination areas, and availability of off-site waste disposal facilities. Each of these design considerations with respect to the proposed removal action at SWMU 59 are presented in Table 11-1.

11.3 Required Planning Documents

The initial step in the corrective action process will be preparation of a CMI Project Plan. This is a planning document that will outline the approach and requirements for completing the

corrective action and the actions the remedial contractor will take to meet the project objectives. The CMI Project Plan will consist of a Work Plan, HASP, Field Sampling and Analysis Plan (FSAP), and Erosion and Sediment Control Plan (ESCP). A brief description of each of these elements is provided below.

- Work Plan – The Work Plan for the corrective action will discuss the overall objective of the work, basis for evaluating the work, site background and physical setting, remediation operations and activities, and project organization and schedule. In addition, the Work Plan will include a listing of the hazardous materials that may be brought onto the site and Material Safety Data Sheets for each material, training documentation for any remedial contractor employees conducting work at the site, a hazardous waste storage plan, and a listing of hazardous waste to be generated on site. Any permits required for implementing the removal action, including excavation, transportation of hazardous materials, disposal of hazardous materials, and an air permit for fugitive dust emissions, will also be detailed in the Work Plan.

- Health and Safety Plan – The site-specific HASP will present the mechanism and procedures to establish safe working conditions at the site. The HASP will include specific hazard control methods to minimize the potential for accident or injury. In addition, the HASP will include the names of the health and safety officer and alternates and will meet the requirements of 29 CFR 1910 and 1926 and the National Fire Protection Act (NFPA) 241.

- Field Sampling and Analysis Plan – The FSAP will outline the procedures for post-excavation confirmation soil sampling, pre- and post-excavation confirmation sediment sampling, borrow pit soil stockpile sampling, contaminated soil stockpile sampling, and sediment dewatering liquid sampling. In addition, the FSAP will identify sampling locations, rationale, and logistics including laboratory information, sample handling and analysis requirements, and QA/QC requirements.

- Erosion and Sediment Control Plan – The ESCP will include, at a minimum, information required for the erosion and sedimentation controls as required by the PREQB.

11.4 Reporting

Documents required to report the progression of a site from investigation to remediation include the CMS, CMI Design, and Construction Closeout Report. This document represents the CMS Investigation and CMS Final Report. The CMI Design and Construction Closeout Report are discussed in the following sections.

11.4.1 Presumptive Remedy CMI Design

Designs must be prepared to detail the proposed corrective measure. Because the corrective measure is an accepted construction practice (i.e., excavation and off-site disposal), it is anticipated that the design will not be complicated and consist of a Basis of Design and Plans and Technical Specifications.

A Draft and Final Basis of Design Report will be prepared for implementation of the corrective measure. The Basis of Design Report will follow the Navy's most recent Remedial Action Construction Guidance and include, but not be limited to, the following:

- Site background data for the removal action

- Description of the primary elements of the remedial design and recommend criteria
- Assumptions and any special requirements that may affect the design
- Pertinent corrective measures implementation work breakdown structure
- Construction schedule

A 100% Design Package and Final Design Package (Plans and Technical Specifications) will be prepared for the removal action. The following items are typically submitted with the 100% Design Package:

- Applicable SPECSINTACT specification sections
- Submittal status log
- 100% drawings
- Cover sheet and general notes
- Existing conditions plans
- Removal action plans
- Grading and re-vegetation plans
- Civil details

Final Design submittals typically consist of the following:

- Marked-up SPECSINTACT specification sections
- Final submittal approval and distribution chart for specifications
- Final drawings
- Final cost estimate
- Final construction schedule
- Written responses to comments on the 100% design

11.4.2 Construction Closeout Report

The Construction Closeout Report will be provided upon completion of the corrective measure. The report will include, but not be limited to, the following:

- Introduction
- Pertinent background information
- Summary of the removal action activities
- Summary of contractor quality control and health and safety
- Summary of unexpected conditions, field changes, and other deviations
- Contract modifications and final cost data
- A complete set of analytical laboratory results
- Documentation of off-site transportation and disposal of soil

The report will also include an evaluation of the corrective measure including the quantities of impacted media removed. As-built drawings and other supporting documentation will be included as appendices to the report.

11.5 Schedule

A schedule for implementation of this corrective measure is provided on Figure 11-1.

TABLES

TABLE 4-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - ENVIRONMENTAL SAMPLES
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

					Laboratory Analysis										
Media	**Site ID**	**Sample ID**	**Sample Depth (ft bgs)**	**Sample Date**	App. IX VOCs	App. IX Low-Level SVOCs (inc. PAHs)	App. IX Pesticides	App. IX Metals (Total)	Copper	Lead	Zinc	App. IX Metals (Dissolved)	TOC	AVS/SEM	**Comment**
Surface Soil	59SB01	59SB01-00	0.0-1.0	4/19/2010	X	X	X	X							
		59SB01-00D	0.0-1.0	4/19/2010	X	X	X	X							Duplicate
	59SB02	59SB02-00	0.0-1.0	4/20/2010	X	X	X	X							
		59SB02-00 (MS/MSD)	0.0-1.0	4/20/2010	X	X	X	X							Matrix Spike/Matrix Spike Duplicate
	59SB03	59SB03-00	0.0-1.0	4/19/2010	X	X	X	X							
	59SB04	59SB04-00	0.0-1.0	4/22/2010	X	X	X	X							
	59SB06	59SB06-00	0.0-1.0	4/20/2010	X	X	X	X							
	59SB07	59SB07-00	0.0-1.0	4/21/2010	X	X	X	X							
	59SB08	59SB08-00	0.0-1.0	4/21/2010	X	X	X	X							
	59SB09	59SB09-00	0.0-1.0	4/22/2010	X	X	X	X							
	59SB11	59SB11-00	0.0-1.0	5/19/2010	X	X	X	X							
		59SB11-00D	0.0-1.0	5/19/2010	X	X	X	X							Duplicate
	59SB12	59SB12-00	0.0-1.0	5/18/2010	X	X	X	X							
	59SB13	59SB13-00	0.0-1.0	5/18/2010	X	X	X	X							
		59SB13-00 (MS/MSD)	0.0-1.0	5/18/2010	X	X	X	X							Matrix Spike/Matrix Spike Duplicate
	59SB14	59SB14-00	0.0-1.0	5/19/2010	X	X	X	X							
	59SB15	59SB15-00	0.0-1.0	5/18/2010	X	X	X	X							
	59SB17	59SB17-00	0.0-1.0	5/18/2010	X	X	X	X							
		59SB17-00D	0.0-1.0	5/18/2010	X	X	X	X							Duplicate
	59SB18	59SB18-00	0.0-1.0	5/19/2010	X	X	X	X							
	59SB20	59SB20-00	0.0-1.0	5/19/2010	X	X	X	X							
	59SB21	59SB21-00	0.0-1.0	5/18/2010	X	X	X	X							
	59SB22	59SB22-00	0.0-1.0	5/18/2010	X	X	X	X							
	59SB23	59SB23-00	0.0-1.0	5/19/2010	X	X	X	X							
	59SB24	59SB24-00	0.0-1.0	9/13/2012	X	X		X							
		59SB24-00D	0.0-1.0	9/13/2012	X	X		X							Duplicate
		59SB24-00 (MS/MSD)	0.0-1.0	9/13/2012	X	X		X							Matrix Spike/Matrix Spike Duplicate
	59SB25	59SB25-00	0.0-1.0	9/13/2012	X	X		X							
	59SB26	59SB26-00	0.0-1.0	9/13/2012	X	X		X							
	59SB27	59SB27-00	0.0-1.0	9/13/2012	X	X		X							
	59SB28	59SB28-00	0.0-1.0	9/13/2012	X	X		X							
	59SB29	59SB29-00	0.0-1.0	9/13/2012	X	X		X							

TABLE 4-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - ENVIRONMENTAL SAMPLES
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

					Laboratory Analysis										
Media	**Site ID**	**Sample ID**	**Sample Depth (ft bgs)**	**Sample Date**	App. IX VOCs	App. IX Low-Level SVOCs (inc. PAHs)	App. IX Pesticides	App. IX Metals (Total)	Copper	Lead	Zinc	App. IX Metals (Dissolved)	TOC	AVS/SEM	**Comment**
Surface Soil (continued)	59SB30	59SB30-00	0.0-1.0	9/13/2012	X	X		X							
	59SB31	59SB31-00	0.0-1.0	9/13/2012	X	X		X							
	59SB32	59SB32-00	0.0-1.0	9/13/2012	X	X		X							
	59SB33	59SB33-00	0.0-1.0	9/13/2012	X	X		X							
Surface Soil - Pre-Excavation Delineation	59SS01	59SS01	0.0-1.0	9/14/2012						X	X				
	59SS02	59SS02	0.0-1.0	9/14/2012						X	X				
	59SS03	59SS03	0.0-1.0	9/14/2012						X	X				
	59SS04	59SS04	0.0-1.0	9/14/2012					X	X	X				
		59SS04D	0.0-1.0	9/14/2012					X	X	X				Duplicate
		59SS04 (MS/MSD)	0.0-1.0	9/14/2012					X	X	X				Matrix Spike/Matrix Spike Duplicate
	59SS05	59SS05	0.0-1.0	9/14/2012					X	X	X				
	59SS06	59SS06	0.0-1.0	9/14/2012					X	X	X				
	59SS07	59SS07	0.0-1.0	9/14/2012					X	X	X				
	59SS08	59SS08	0.0-1.0	9/14/2012						X	X				
	59SS09	59SS09	0.0-1.0	9/14/2012						X	X				
	59SS10	59SS10	0.0-1.0	9/14/2012						X	X				
	59SS11	59SS11	0.0-1.0	9/14/2012					X		X				
	59SS12	59SS12	0.0-1.0	9/14/2012					X		X				
	59SS13	59SS13	0.0-1.0	9/14/2012					X		X				
	59SS14	59SS14	0.0-1.0	9/14/2012						X	X				
		59SS14D	0.0-1.0	9/14/2012						X	X				Duplicate
		59SS14 (MS/MSD)	0.0-1.0	9/14/2012						X	X				Matrix Spike/Matrix Spike Duplicate
	59SS15	59SS15	0.0-1.0	9/14/2012						X	X				
	59SS16	59SS16	0.0-1.0	9/14/2012						X	X				
	59SS17	59SS17	0.0-1.0	9/14/2012							X				
	59SS18	59SS18	0.0-1.0	9/14/2012							X				
	59SS19	59SS19	0.0-1.0	9/14/2012							X				
	59SS20	59SS20	0.0-1.0	9/14/2012							X				
	59SS21	59SS21	0.0-1.0	9/14/2012							X				
		59SS21D	0.0-1.0	9/14/2012							X				Duplicate
	59SS22	59SS22	0.0-1.0	9/14/2012							X				
	59SS23	59SS23	0.0-1.0	9/14/2012							X				

TABLE 4-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - ENVIRONMENTAL SAMPLES
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

					Laboratory Analysis										
Media	**Site ID**	**Sample ID**	**Sample Depth (ft bgs)**	**Sample Date**	App. IX VOCs	App. IX Low-Level SVOCs (inc. PAHs)	App. IX Pesticides	App. IX Metals (Total)	Copper	Lead	Zinc	App. IX Metals (Dissolved)	TOC	AVS/SEM	**Comment**
Surface Soil Pre-Excavation Delineation (continued)	59SS24	59SS24	0.0-1.0	9/14/2012							X				
	59SS25	59SS25	0.0-1.0	11/10/2012							X				
	59SS26	59SS26	0.0-1.0	11/10/2012					X	X	X				
		59SS26D	0.0-1.0	11/10/2012					X	X	X				Duplicate
		59SS26 (MS/MSD)	0.0-1.0	11/10/2012					X	X	X				Matrix Spike/Matrix Spike Duplicate
	59SS27	59SS27	0.0-1.0	11/10/2012						X	X				
	59SS28	59SS28	0.0-1.0	11/10/2012						X	X				
	59SS29	59SS29	0.0-1.0	11/10/2012						X					
	59SS30	59SS30	0.0-1.0	11/10/2012						X					
	59SS31	59SS31	0.0-1.0	11/10/2012							X				
	59SS32	59SS32	0.0-1.0	11/10/2012							X				
	59SS33	59SS33	0.0-1.0	11/10/2012							X				
	59SS34	59SS34	0.0-1.0	11/10/2012							X				
Subsurface Soil	59SB01	59SB01-01	1.0-3.0	4/19/2010	X	X	X	X							
		59SB01-03	5.0-7.0	4/19/2010	X	X	X	X							
	59SB02	59SB02-01	1.0-3.0	4/20/2010	X	X	X	X							
		59SB02-01D	1.0-3.0	4/20/2010	X	X	X	X							Duplicate
		59SB02-01 (MS/MSD)	1.0-3.0	4/20/2010	X	X	X	X							Matrix Spike/Matrix Spike Duplicate
		59SB02-04	7.0-9.0	4/20/2010	X	X	X	X							
	59SB03	59SB03-01	1.0-3.0	4/19/2010	X	X	X	X							
		59SB03-04	7.0-9.0	4/19/2010	X	X	X	X							
	59SB04	59SB04-01	1.0-3.0	4/22/2010	X	X	X								
		59SB04-05	9.0-11.0	4/22/2010	X	X	X	X							
	59SB05	59SB05-01	1.0-3.0	4/20/2010	X	X	X	X							
		59SB05-05	9.0-11.0	4/20/2010	X	X	X	X							
	59SB06	59SB06-01	1.0-3.0	4/20/2010	X	X	X	X							
		59SB06-03	5.0-7.0	4/20/2010	X	X	X	X							
	59SB07	59SB07-01	1.0-3.0	4/21/2010	X	X	X	X							
		59SB07-01D	1.0-3.0	4/21/2010	X	X	X	X							Duplicate
		59SB07-05	9.0-11.0	4/21/2010	X	X	X	X							
	59SB08	59SB08-01	1.0-3.0	4/21/2010	X	X	X	X							
		59SB08-05	9.0-11.0	4/21/2010	X	X	X	X							

TABLE 4-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - ENVIRONMENTAL SAMPLES
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

					Laboratory Analysis										
Media	**Site ID**	**Sample ID**	**Sample Depth (ft bgs)**	**Sample Date**	App. IX VOCs	App. IX Low-Level SVOCs (inc. PAHs)	App. IX Pesticides	App. IX Metals (Total)	Copper	Lead	Zinc	App. IX Metals (Dissolved)	TOC	AVS/SEM	**Comment**
Subsurface Soil (continued)	59SB09	59SB09-01	1.0-3.0	4/22/2010	X	X	X	X							
		59SB09-05	9.0-11.0	4/22/2010	X	X	X	X							
	59SB10	59SB10-01	1.0-3.0	4/21/2010	X	X	X	X							
		59SB10-05	9.0-11.0	4/21/2010	X	X	X	X							
	59SB11	59SB11-01	1.0-3.0	5/19/2010	X	X	X	X							
		59SB11-01D	1.0-3.0	5/19/2010	X	X	X	X							Duplicate
		59SB11-01 (MS/MSD)	1.0-3.0	5/19/2010	X	X	X	X							Matrix Spike/Matrix Spike Duplicate
		59SB11-02	3.0-5.0	5/19/2010	X	X	X	X							VOC sample recollected on 5/24/2010
	59SB12	59SB12-01	1.0-3.0	5/18/2010	X	X	X	X							
		59SB12-05	9.0-11.0	5/18/2010	X	X	X	X							
	59SB13	59SB13-01	1.0-3.0	5/18/10	X	X	X	X							
		59SB13-01D	1.0-3.0	5/18/10	X	X	X	X							Duplicate
		59SB13-01 (MS/MSD)	1.0-3.0	5/18/10	X	X	X	X							Matrix Spike/Matrix Spike Duplicate
		59SB13-05	9.0-11.0	5/18/10	X	X	X	X							
	59SB14	59SB14-01	1.0-3.0	5/19/2010	X	X	X	X							
		59SB14-05	9.0-11.0	5/19/2010	X	X	X	X							
	59SB15	59SB15-01	1.0-3.0	5/18/2010	X	X	X	X							
		59SB15-05	9.0-11.0	5/18/2010	X	X	X	X							
	59SB16	59SB16-01	1.0-3.0	5/18/2010	X	X	X	X							
		59SB16-05	9.0-11.0	5/18/2010	X	X	X	X							
	59SB17	59SB17-01	1.0-3.0	5/18/2010	X	X	X	X							
		59SB17-05	9.0-11.0	5/18/2010	X	X	X	X							
	59SB18	59SB18-01	1.0-3.0	5/19/2010	X	X	X	X							
		59SB18-02	3.0-5.0	5/19/2010	X	X	X	X							
	59SB19	59SB19-01	1.0-3.0	5/19/2010	X	X	X	X							
		59SB19-05	9.0-11.0	5/19/2010	X	X	X	X							
	59SB20	59SB20-01	1.0-3.0	5/19/2010	X	X	X	X							
		59SB20-05	9.0-11.0	5/19/2010	X	X	X	X							
	59SB21	59SB21-01	1.0-3.0	5/18/2010	X	X	X	X							
		59SB21-01D	1.0-3.0	5/18/2010	X	X	X	X							Duplicate

TABLE 4-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - ENVIRONMENTAL SAMPLES
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

					Laboratory Analysis										
Media	**Site ID**	**Sample ID**	**Sample Depth (ft bgs)**	**Sample Date**	App. IX VOCs	App. IX Low-Level SVOCs (inc. PAHs)	App. IX Pesticides	App. IX Metals (Total)	Copper	Lead	Zinc	App. IX Metals (Dissolved)	TOC	AVS/SEM	**Comment**
Subsurface Soil (continued)	59SB22	59SB21-05	9.0-11.0	5/18/2010	X	X	X	X							
		59SB22-01	1.0-3.0	5/18/2010	X	X	X	X							
		59SB22-05	9.0-11.0	5/18/2010	X	X	X	X							
	59SB23	59SB23-01	1.0-3.0	5/19/2010	X	X	X	X							
		59SB23-05	9.0-11.0	5/19/2010	X	X	X	X							
	59SB24	59SB24-01	1.0-3.0	9/13/2012	X	X		X							
		59SB24-01D	1.0-3.0	9/13/2012	X	X		X							Duplicate
	59SB25	59SB25-01	1.0-3.0	9/13/2012	X	X		X							
	59SB26	59SB26-01	1.0-3.0	9/13/2012	X	X		X							
	59SB27	59SB27-01	1.0-3.0	9/13/2012	X	X		X							
	59SB28	59SB28-01	1.0-3.0	9/13/2012	X	X		X							
	59SB29	59SB29-01	1.0-3.0	9/13/2012	X	X		X							
	59SB30	59SB30-01	1.0-3.0	9/13/2012	X	X		X							
	59SB31	59SB31-01	1.0-3.0	9/13/2012	X	X		X							
	59SB32	59SB32-01	1.0-3.0	9/13/2012	X	X		X							
	59SB33	59SB33-01	1.0-3.0	9/13/2012	X	X		X							
Surface Water	59SW01	59SW01	NA	4/20/2010	X	X	X	X				X			
	59SW02	59SW02	NA	5/20/2010	X	X	X	X				X			
	59SW03	59SW03	NA	5/20/2010	X	X	X	X				X			
Sediment	59SD01	59SD01	0.0-0.5	4/22/2010	X	X	X	X					X		
	59SD02	59SD02	0.0-0.5	5/20/2010	X	X	X	X					X	X	
	59SD03	59SD03	0.0-0.5	5/20/2010	X	X	X	X					X	X	
	59SD04	59SD04	0.0-0.5	9/15/2012					X	X	X				
		59SD04D	0.0-0.5	9/15/2012					X	X	X				Duplicate
		59SD04 (MS/MSD)	0.0-0.5	9/15/2012					X	X	X				Matrix Spike/Matrix Spike Duplicate
	59SD05	59SD05	0.0-0.5	9/15/2012					X	X	X				
	59SD06	59SD06	0.0-0.5	9/15/2012					X	X	X				
	59SD07	59SD07	0.0-0.5	9/15/2012					X	X	X				
	59SD08	59SD08	0.0-0.5	9/15/2012					X	X	X				
	59SD09	59SD09	0.0-0.5	9/15/2012					X	X	X				

TABLE 4-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - ENVIRONMENTAL SAMPLES
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

					Laboratory Analysis										
Media	**Site ID**	**Sample ID**	**Sample Depth (ft bgs)**	**Sample Date**	App. IX VOCs	App. IX Low-Level SVOCs (inc. PAHs)	App. IX Pesticides	App. IX Metals (Total)	Copper	Lead	Zinc	App. IX Metals (Dissolved)	TOC	AVS/SEM	**Comment**
Sediment (continued)	59SD10	59SD10	0.0-0.5	9/15/2012					X	X	X				
	59SD11	59SD11	0.0-0.5	9/15/2012					X	X	X				
	59SD12	59SD12	0.0-0.5	9/15/2012					X	X	X				
Groundwater	59SB01	59GW01	NA	5/22/2010	X	X	X	X				X			
	59SB02	59GW02	NA	5/23/2010	X	X	X	X				X			
		59GW02D	NA	5/23/2010	X	X	X	X				X			Duplicate
		59GW02 (MS/MSD)	NA	5/23/2010	X	X	X	X				X			Matrix Spike/Matrix Spike Duplicate
	59SB03	59GW03	NA	5/22/2010	X	X	X	X				X			
	59SB04	59GW04	NA	5/23/2010	X	X	X	X				X			
	59SB05	59GW05	NA	5/23/2010	X	X	X	X				X			
	59SB06	59GW06	NA	5/21/2010	X	X	X	X				X			
	59SB07	59GW07	NA	5/21/2010	X	X	X	X				X			
	59SB08	59GW08	NA	5/22/2010	X	X	X	X				X			
	59SB09	59GW09	NA	5/21/2010	X	X	X	X				X			
	59SB10	59GW10	NA	5/22/2010	X	X	X	X				X			

Notes:

App. IX - Appendix IX
AVS - Acid Volatile Sulfides
ft bgs - feet below ground surface
NA - Not Applicable
PAHs - Polynuclear Aromatic Hydrocarbons
SEM - Simultaneously Extracted Metals
SVOCs - Semivolatile Organic Compounds
TOC - Total Organic Carbon
VOCs - Volatile Organic Compounds

TABLE 4-2

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM - QA/QC AND IDW SAMPLES
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

			Aqueous Samples								Solid Samples			
Sample Type	**Sample ID**	**Sample Date**	App. IX VOCs	App. IX Low-Level SVOCs (inc. PAHs)	App. IX Pesticides	App. IX Metals (Total)	Copper, Lead, and Zinc	TCLP VOCs/ SVOCs	TCLP Metals	RCI	TCLP VOCs/ SVOCs	TCLP Metals	RCI	**Comment**
Trip Blank Samples	59TB01	4/19/2010	X											
	59TB02	4/20/2010	X											
	59TB03	4/22/2010	X											
	59TB04	5/18/2010	X											
	59TB05	5/20/2010	X											
	59TB06	5/22/2010	X											
	59TB07	9/13/2012	X											
Equipment Rinsate Samples	59ER01	4/19/2010	X	X	X	X								Acetate Geoprobe® Liner
	59ER02	4/20/2010	X	X	X	X								Acetate Geoprobe® Liner
	59ER03	4/21/2010	X	X	X	X								Acetate Geoprobe® Liner
	59ER04	4/22/2010	X	X	X	X								Acetate Geoprobe® Liner
	59ER05	5/18/2010	X	X	X	X								Acetate Geoprobe® Liner
	59ER06	5/19/2010	X	X	X	X								Acetate Geoprobe® Liner
	59ER07	5/20/2010	X	X	X	X								Acetate Geoprobe® Liner
	59ER08	5/21/2010	X	X	X	X								Teflon® Bladder
	59ER09	5/22/2010	X	X	X	X								Teflon®-Lined Polyethylene Tubing
	59ER10	5/23/2010	X	X	X	X								Stainless steel bladder pump
	59ER11	5/24/2010	X											Stainless Steel Bucket Auger
	59ER12	9/13/2012	X	X		X								Acetate Geoprobe® Liner
	59ER13	9/14/2012				X								Disposable Zip-Lock Baggie
	59ER14	9/15/2012				X								Disposable Stainless Steel Spoon
	59ER15	11/10/2012					X							Disposable Stainless Steel Spoon
Field Blanks	59FB01	4/19/2010	X	X	X	X								Laboratory-Grade Deionized Water
	59FB02	5/18/2010	X	X	X	X								Store-Bought Distilled Water
	59FB03	9/13/2012	X	X		X								Laboratory-Grade Deionized Water
	59FB05	11/10/2012					X							Laboratory-Grade Deionized Water
IDW Samples	59IDW01	5/24/2010									X	X	X	Soil
	59IDW02	5/24/2010						X	X	X				Aqueous

Notes:

App. IX - Appendix IX
IDW - Investigation Derived Waste
PAHs - Polynuclear Aromatic Hydrocarbons
QA/QC - Quality Assurance/Quality Control
RCI - Reactivity, Corrosivity, Ignitability
RCRA - Resource Conservation and Recovery Act
SVOCs - Semivolatile Organics Compounds
TCLP - Toxicity Characteristic Leaching Procedure
VOCs - Volatile Organic Compounds

TABLE 4-3

SUMMARY OF SOIL BORING AND MONITORING WELL SPECIFICATIONS
SWMU 59 - FORMER MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Soil Boring Monitoring Well Designation	Date Installed	Ground Elevation (ft. datum)	Top of PVC Elevation (ft. datum)	Borehole Depth		Well Depth		Screened Interval		Groundwater Level May 24, 2010		Groundwater Level January 13, 2011		Groundwater Level August 30, 2011	
				Feet (approx. bgs)	Elevation (ft. datum)	Feet (approx. bgs)	Elevation (ft. datum)	Feet (approx. bgs)	Elevation (ft. datum)	Feet (top of PVC casing)	Elevation (ft. datum)	Feet (top of PVC casing)	Elevation (ft. datum)	Feet (top of PVC casing)	Elevation (ft. datum)
59SB01	4/19/2010	111.8	115.16	15.0	96.8	15.0	96.8	5-15	106.8 to 96.8	11.90	103.26	8.05	107.11	4.75	110.41
59SB02	4/20/2010	113.6	116.75	16.0	97.6	16.0	97.6	6-16	107.6 to 97.6	13.43	103.32	9.43	107.32	6.00	110.75
59SB03	4/19/2010	118.4	121.05	18.0	100.4	17.0	101.4	7-17	111.4 to 101.4	17.85	103.20	13.4	107.65	9.01	112.04
59SB04	4/22/2010	118.8	121.68	22.0	96.8	22.0	96.8	12-22	106.8 to 96.8	18.42	103.26	14.15	107.53	10.47	111.21
59SB05	4/20/2010	117.1	116.76	24.0	93.1	22.0	95.1	12-22	105.1 to 95.1	13.36	103.40	9.17	107.59	5.53	111.23
59SB06	4/20/2010	111.1	114.14	15.0	96.1	15.0	96.1	5-15	106.1 to 96.1	10.91	103.23	7.11	107.03	3.79	110.35
59SB07	4/21/2010	116.8	119.82	19.0	97.8	18.0	98.8	8-18	108.8 to 98.8	16.53	103.29	12.52	107.30	9.01	110.81
59SB08	4/21/2010	117.9	121.17	22.0	95.9	22.0	95.9	12.22	105.9 to 95.9	17.99	103.18	13.8	107.37	9.79	111.38
59SB09	4/22/2010	118.7	121.50	22.0	96.7	22.0	96.7	12-22	106.7 to 96.7	18.56	102.94	14.24	107.26	9.47	112.03
59SB10	4/21/2010	118.5	118.04	23.0	95.5	23.0	95.5	13-23	105.5 to 95.5	14.68	103.36	10.41	107.63	6.61	111.43
59SB11	5/19/2010	109.8	NA	12.0	97.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
59SB12	5/18/2010	113.2	NA	12.0	101.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
59SB13	5/18/2010	114.9	NA	12.0	102.9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
59SB14	5/19/2010	118.8	NA	12.0	106.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
59SB15	5/18/2010	117.9	NA	12.0	105.9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
59SB16	5/18/2010	116.6	NA	12.0	104.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
59SB17	5/18/2010	115.7	NA	12.0	103.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
59SB18	5/19/2010	111.3	NA	12.0	99.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
59SB19	5/19/2010	118.5	NA	12.0	106.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
59SB20	5/19/2010	118.1	NA	12.0	106.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
59SB21	5/18/2010	117.9	NA	12.0	105.9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
59SB22	5/18/2010	117.8	NA	10.0	107.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
59SB23	5/19/2010	114.1	NA	12.0	102.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 4-3

SUMMARY OF SOIL BORING AND MONITORING WELL SPECIFICATIONS
SWMU 59 - FORMER MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

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				Feet (approx. bgs)	Elevation (ft. datum)	Feet (approx. bgs)	Elevation (ft. datum)	Feet (approx. bgs)	Elevation (ft. datum)	Feet (top of PVC casing)	Elevation (ft. datum)	Feet (top of PVC casing)	Elevation (ft. datum)	Feet (top of PVC casing)	Elevation (ft. datum)
59SB24	9/13/2012	118.8	NA	4.5	114.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
59SB25	9/13/2012	118.1	NA	4.5	113.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
59SB26	9/13/2012	118.6	NA	4.0	114.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
59SB27	9/13/2012	117.8	NA	4.5	113.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
59SB28	9/13/2012	118.0	NA	4.2	113.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
59SB29	9/13/2012	117.4	NA	4.2	113.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
59SB30	9/13/2012	117.8	NA	4.2	113.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
59SB31	9/13/2012	118.6	NA	4.5	114.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
59SB32	9/13/2012	115.7	NA	4.5	111.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
59SB33	9/13/2012	115.8	NA	4.4	111.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
74VP07b	5/15/2008	110.2	112.57	10	100.2	10	100.2	3-10	107.2 to 100.2	6.62	105.95	5.81	106.76	5.28	107.29
13MW04	9/17/1997	111.8	114.04	22	89.8	18	93.8	8-18	103.8 to 93.8	10.72	103.32	6.89	107.15	3.66	110.38

Notes:
NA = Not Applicable; soil boring only
bgs = Below Ground Surface
The datum plan used is the Mean Low Water + 100.00 feet as established by the U.S. Navy Survey Section (November 1941).

TABLE 5-1

SUMMARY OF HYDRAULIC CONDUCTIVITY TESTING
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Location	Date	Rising Head Test (feet/day)
59SB01	5/20/2010	0.27
59SB02	5/20/2010	0.43
59SB04	5/20/2010	0.15
59SB05	5/20/2010	0.73
59SB06	5/20/2010	0.21
59SB08	5/21/2010	0.22
59SB09	5/20/2010	0.20
59SB10	5/21/2010	0.71
Average Hydraulic Conductivity (ft/day)		**0.37**

Notes:

1. Slugs were inserted into the water column, and the water level was allowed to equilibrate prior to conducting rising head tests. Falling head tests were not conducted at these wells because water levels were within the screened interval.
2. Slug tests were not performed at monitoring wells 59SB03 and 59SB07.
3. Data was processed using Aqtesolv® software using the Bouwer and Rice Method (1976) for unconfined aquifers.

TABLE 6-1

SUMMARY OF DETECTED RESULTS - SURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	NAPR Basewide Background	59SB01	59SB01	59SB02	59SB03	59SB04	59SB06	59SB07	59SB08	59SB09	59SB11	59SB11
Sample ID		59SB01-00	59SB01-00D	59SB02-00	59SB03-00	59SB04-00	59SB06-00	59SB07-00	59SB08-00	59SB09-00	59SB11-00	59SB11-00D
Sample Date		4/19/2010	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	5/19/2010	5/19/2010
Sample Depth (ft bgs)		0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Volatile Organics (µg/kg)												
2-Hexanone (MBK)	NE	14 UJ	14 UJ	13 UJ	10 UJ	9.4 UJ	11 UJ	11 UJ	9.6 UJ	12 UJ	11 U	9.9 U
Acetone	NE	14 UJ	14 UJ	15 UJ	24 J	25 J	17 UJ	91 J	9.6 UJ	37 J	64	31
Acrylonitrile	NE	56 U	54 U	53 U	41 U	38 U	45 U	43 U	38 U	47 U	43 U	40 U
Benzene	NE	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	0.44 J	4 U
Bromomethane	NE	5.6 UJ	5.4 UJ	5.3 UJ	4.1 UJ	3.8 UJ	4.5 UJ	4.3 UJ	3.8 UJ	4.7 UJ	6.3	2 J
Carbon Disulfide	NE	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
Chloromethane	NE	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	0.99 J	0.36 J
Methyl Acrylonitrile	NE	56 U	54 U	53 U	41 U	38 U	45 U	43 U	38 U	47 U	43 U	40 U
Methyl Iodide	NE	5.6 U	5.4 U	0.97 J	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	12	2.9 J
Propionitrile (Ethyl Cyanide)	NE	280 R	270 R	260 R	210 R	190 R	220 R	210 R	8.1 J	240 R	210 R	200 R
Xylene, m/p-	NE	11 U	11 U	0.32 J	8.2 U	0.15 J	9 U	8.5 U	0.14 J	9.5 U	8.5 U	7.9 U
Xylenes, total	NE	5.6 U	5.4 U	0.32 J	4.1 U	0.15 J	4.5 U	4.3 U	0.14 J	4.7 U	4.3 U	4 U
Semivolatile Organics (µg/kg)												
Bis(2-ethylhexyl) Phthalate (BEHP)	NE	230 UJ	630 J	240	190 U	200 U	190 U	48 J	200	200 U	200 UJ	190 UJ
Butyl Benzyl Phthalate	NE	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Dibenzofuran	NE	230 U	240 U	220 U	190 U	750	190 U	200 U	200 U	200 U	200 UJ	190 UJ
PAHs (µg/kg)												
2-Methylnaphthalene	NE	11 UJ	1.2 J	11 UJ	9.1 UJ	31 J	9.2 UJ	9.8 UJ	9.8 U	9.5 UJ	9.5 UJ	9.4 UJ
Acenaphthene	NE	11 U	12 U	0.82 J	9.1 U	480	9.2 U	9.8 U	9.8 U	1.5 J	9.5 UJ	9.4 UJ
Acenaphthylene	NE	11 U	12 U	11 U	9.1 U	27	9.2 U	9.8 U	9.8 U	16	9.5 UJ	9.4 UJ
Anthracene	NE	11 U	1.9 J	2.3 J	9.1 U	690	0.57 J	0.82 J	0.64 J	12	9.5 UJ	0.6 J
Benzo(a)anthracene	NE	11 U	3.9 J	5.8 J	0.91 J	84 J	1.8 J	0.72 J	1.4 J	46	9.5 UJ	1.1 J
Benzo(a)pyrene (BaP)	NE	11 U	2.5 J	4.1 J	0.89 J	390	9.2 U	0.8 J	0.84 J	57	9.5 UJ	9.4 UJ
Benzo(b)fluoranthene	NE	11 U	2.5 J	3.7 J	0.99 J	750	9.2 U	1.2 J	0.86 J	51	9.5 UJ	1.3 J
Benzo(g,h,i)perylene	NE	11 UJ	2 J	2.5 J	9.1 UJ	220	1.3 J	1.5 J	9.8 UJ	53 J	9.5 UJ	0.53 J
Benzo(k)fluoranthene	NE	11 UJ	2.6 J	5 J	1.2 J	730	9.2 UJ	0.78 J	0.91 J	62 J	9.5 UJ	0.75 J
Chrysene	NE	11 U	3.7 J	3.9 J	0.77 J	1200	1.4 J	0.78 J	1.4 J	39	9.5 UJ	1.4 J
Dibenz(a,h)anthracene	NE	11 U	0.92 J	11 U	9.1 U	92	9.2 U	9.8 U	9.8 UJ	9.5 U	9.5 UJ	9.4 UJ
Fluoranthene	NE	11 U	6.9 J	11	9.1 U	4600	1.8 J	9.8 U	3.1 J	68	9.5 UJ	2.3 J
Fluorene	NE	11 U	0.82 J	0.73 J	9.1 U	580	9.2 U	9.8 U	9.8 U	1.1 J	9.5 UJ	9.4 UJ

TABLE 6-1

SUMMARY OF DETECTED RESULTS - SURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	NAPR Basewide Background	59SB01	59SB01	59SB02	59SB03	59SB04	59SB06	59SB07	59SB08	59SB09	59SB11	59SB11
Sample ID		59SB01-00	59SB01-00D	59SB02-00	59SB03-00	59SB04-00	59SB06-00	59SB07-00	59SB08-00	59SB09-00	59SB11-00	59SB11-00D
Sample Date		4/19/2010	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	5/19/2010	5/19/2010
Sample Depth (ft bgs)		0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
LLPAHs (µg/kg) (cont.)		0.58 J	3 J	3.6 J	9.1 UJ	240	1.8 J	9.8 UJ	9.8 UJ	65 J	9.5 UJ	9.4 UJ
Indeno(1,2,3-cd)pyrene	NE											
Naphthalene	NE	11 U	12 U	11 U	9.1 U	9.8 U	9.2 U	9.8 U	9.8 U	9.5 U	9.5 UJ	9.4 UJ
Phenanthrene	NE	11 U	8.1 J	8.2 J	9.1 U	7000	1.5 J	9.8 U	3.4 J	28	9.5 UJ	9.4 UJ
Pyrene	NE	11 U	6.5 J	8.3 J	1 J	3000	1.6 J	1.2 J	2.9 J	66	9.5 UJ	9.4 UJ
LLPAH Totals (µg/kg)												
Low molecular weight PAHs	NE	88	54.92	56.05	72.8	3202	49.87	69.42	56.14	145.6	76	59.3
High molecular weight PAHs	NE	88.58	27.62	47.9	33.06	14432	44.7	26.58	37.71	448.5	85.5	42.68
Pesticides (µg/kg)												
4,4'-DDD	NE	4.5 U	4.6 UJ	0.6 J	0.79 J	3.9 UJ	3.7 U	3.9 U	3.9 UJ	2.4 J	3.8 U	19 UJ
4,4'-DDE	NE	4.5 U	4.6 UJ	0.48 J	4.5	3.9 UJ	0.46 J	0.67 J	3.9 UJ	53	3.8 U	19 UJ
4,4'-DDT	NE	4.5 U	4.6 UJ	4.3 U	3.2 J	3.9 UJ	3.7 U	0.66 J	3.9 UJ	15	3.8 U	19 UJ
BHC, beta-	NE	2.3 U	2.4 UJ	2.2 U	0.47 J	2.4 R	1.9 U	0.57 J	2 UJ	1.9 U	0.98 U	4.8 UJ
Chlordane, alpha-	NE	2.3 U	2.4 UJ	2.2 U	1.2 J	1.1 J	1.9 U	1.2 J	2 UJ	1.9 U	2 U	1.3 NJ
Chlordane, gamma-	NE	2.3 U	2.4 UJ	2.2 U	1.8 U	2 UJ	0.57 J	2 U	2 UJ	1.9 U	2 U	9.7 UJ
Endosulfan Sulfate	NE	4.5 U	4.6 UJ	4.3 U	3.6 U	0.72 J	3.7 U	3.9 U	3.9 UJ	0.61 J	3.8 U	19 UJ
Endrin Aldehyde	NE	4.5 R	4.6 R	4.3 R	3.6 R	3.9 R	3.7 R	3.9 R	3.9 R	1.8 J	3.8 U	19 UJ
Methoxychlor	NE	23 U	24 UJ	22 U	18 U	20 UJ	19 U	20 U	20 UJ	19 U	20 U	26 NJ
Metals (mg/kg)												
Antimony	3.17	6.5 UJ	1.4 UJ	1.3 UJ	1.1 UJ	1.1 UJ	1.1 UJ	1.1 UJ	1.2 UJ	1.2 J	5.7 UJ	5.7 UJ
Arsenic	2.65	3.3 U	1.2	0.81	0.78	0.57 U	0.53 U	1.4	0.58 U	0.89	2.8 U	2.8 U
Barium	199	184 J	75.6 J	40.2 J	90.2 J	155 J	87.3 J	42.9 J	267 J	154 J	36.6	35.5
Beryllium	0.59	3.3 U	0.34 J	0.41 J	0.14 J	0.26 J	0.21 J	0.21 J	0.36 J	0.2 J	2.8 U	2.8 U
Cadmium	1.02	3.3 U	0.071 J	0.93	0.5 J	0.087 J	0.35 J	0.31 J	1.3	2	0.25 J	0.25 J
Chromium	49.8	16.7 J	31 J	41.9 J	24.3 J	5.3 J	41.6 J	40.7 J	19 J	45.6 J	15.9 J	25.9 J
Cobalt	46.2	6.4 J	10.4 J	27.1 J	25.9 J	18.4 J	20.2 J	26.4 J	19.2 J	26.9 J	25.5	22.9
Copper	168	93.6 J	96.8 J	84.7 J	106 J	24.8 J	91.7 J	126 J	41.5 J	237 J	107	92.2
Lead	22	5.9 J	17 J	31 J	51.3 J	3.4 J	10.5 J	27.3 J	2.6 J	654 J	5.5 J	8.7 J
Mercury	0.109	0.043 J	0.05	0.017 J	0.02 J	0.014 J	0.015 J	0.009 J	0.014 J	0.081	0.017 J	0.037 U
Nickel	20.7	5.2	6.1	13.5	22.3	7.9	14.1	26.8	11	27.5	8.9	11.7

TABLE 6-1

SUMMARY OF DETECTED RESULTS - SURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	NAPR Basewide Background	59SB01	59SB01	59SB02	59SB03	59SB04	59SB06	59SB07	59SB08	59SB09	59SB11	59SB11
Sample ID		59SB01-00	59SB01-00D	59SB02-00	59SB03-00	59SB04-00	59SB06-00	59SB07-00	59SB08-00	59SB09-00	59SB11-00	59SB11-00D
Sample Date		4/19/2010	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	5/19/2010	5/19/2010
Sample Depth (ft bgs)		0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Metals (mg/kg) (cont.)												
Selenium	1.48	16.3 U	1 J	1.1 J	0.21 J	0.22 J	0.36 J	0.46 J	0.57 J	0.47 J	14.2 U	14.2 U
Silver	NE	3.3 U	0.68 U	0.65 U	0.53 U	0.57 U	0.53 U	0.57 U	0.58 U	2.6	2.8 U	2.8 U
Thallium	NE	3.3 U	0.68 U	0.65 U	0.53 U	0.57 U	0.53 U	0.57 U	0.58 U	0.56 U	2.8 U	2.8 U
Tin	3.76	2.5 J	3 J	5.7 J	6.3	3.8 J	3.8 J	5.6 J	3.3 J	36.5	5.7 U	5.7 U
Vanadium	259	143 J	260 J	226 J	118 J	91.7 J	132 J	157 J	72.8 J	191 J	139	169
Zinc	115	33.8 J	34.1 J	57 J	101 J	62.3 J	77.9 J	82.4 J	80.5 J	468 J	53.5	64.5

TABLE 6-1

SUMMARY OF DETECTED RESULTS - SURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	NAPR Basewide Background	59SB12	59SB13	59SB14	59SB15	59SB17	59SB17	59SB18	59SB20	59SB21	59SB22	59SB23
Sample ID		59SB12-00	59SB13-00	59SB14-00	59SB15-00	59SB17-00	59SB17-00D	59SB18-00	59SB20-00	59SB21-00	59SB22-00	59SB23-00
Sample Date		5/18/2010	5/18/2010	5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010
Sample Depth (ft bgs)		0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Volatile Organics (µg/kg)												
2-Hexanone (MBK)	NE	4.8 J	12 U	11 U	11 U	11 U	11 U	11 U	10 U	11 U	10 U	11 U
Acetone	NE	110 J	16 U	14 U	59 J	72	66	34	31	190	97	38
Acrylonitrile	NE	3.4 J	47 U	45 U	46 U	45 U	43 U	42 U	41 U	45 U	40 U	44 U
Benzene	NE	0.37 J	4.7 U	4.5 U	0.73 J	4.5 U	4.3 U	0.53 J	4.1 U	4.5 U	4 U	4.4 U
Bromomethane	NE	2.4 J	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	3.4 J
Carbon Disulfide	NE	0.52 J	4.7 U	4.5 U	4.6 U	1 J	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Chloromethane	NE	0.39 J	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	0.35 J	0.52 J	0.47 J
Methyl Acrylonitrile	NE	3.3 J	47 U	45 U	46 U	45 U	43 U	42 U	41 U	45 U	40 U	44 U
Methyl Iodide	NE	1.9 J	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	2.6 J
Propionitrile (Ethyl Cyanide)	NE	220 R	240 R	230 R	230 R	220 R	210 R	210 R	200 R	220 R	200 R	220 R
Xylene, m/p-	NE	8.9 U	9.5 U	9.1 U	9.2 U	8.9 U	8.6 U	8.4 U	8.1 U	8.9 U	8 U	8.8 U
Xylenes, total	NE	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Semivolatile Organics (µg/kg)												
Bis(2-ethylhexyl) Phthalate (BEHP)	NE	190 UJ	210 U	210 UJ	470 J	200 UJ	200 UJ	200 U	180 U	200 U	200 U	53 J
Butyl Benzyl Phthalate	NE	190 UJ	210 U	210 UJ	170 J	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Dibenzofuran	NE	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
PAHs (µg/kg)												
2-Methylnaphthalene	NE	9.2 UJ	10 U	10 UJ	1.2 J	9.5 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Acenaphthene	NE	9.2 UJ	10 U	10 UJ	9.2 UJ	9.5 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Acenaphthylene	NE	9.2 UJ	10 U	10 UJ	1.7 J	9.5 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Anthracene	NE	2.2 J	10 U	10 UJ	3.8 J	9.5 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Benzo(a)anthracene	NE	9.6 J	10 U	10 UJ	22 J	0.87 J	0.7 J	9.5 U	9 U	9.5 U	9.8 U	10 U
Benzo(a)pyrene (BaP)	NE	11 J	10 U	10 UJ	9.2 UJ	9.5 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Benzo(b)fluoranthene	NE	9.9 J	10 U	10 UJ	9.2 UJ	9.5 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Benzo(g,h,i)perylene	NE	9.2 UJ	10 U	10 UJ	9.2 UJ	9.5 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Benzo(k)fluoranthene	NE	9.8 J	10 U	10 UJ	9.2 UJ	9.5 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Chrysene	NE	9.9 J	10 U	10 UJ	32 J	1.2 J	0.9 J	1.5 J	9 U	9.5 U	9.8 U	2.3 J
Dibenz(a,h)anthracene	NE	9.2 UJ	10 U	10 UJ	9.2 UJ	9.5 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Fluoranthene	NE	16 J	10 U	10 UJ	15 J	9.5 UJ	9.9 UJ	1.8 J	9 U	9.5 U	9.8 U	4.6 J
Fluorene	NE	0.63 J	10 U	10 UJ	9.2 UJ	9.5 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U

TABLE 6-1

SUMMARY OF DETECTED RESULTS - SURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	NAPR Basewide Background	59SB12	59SB13	59SB14	59SB15	59SB17	59SB17	59SB18	59SB20	59SB21	59SB22	59SB23
Sample ID		59SB12-00	59SB13-00	59SB14-00	59SB15-00	59SB17-00	59SB17-00D	59SB18-00	59SB20-00	59SB21-00	59SB22-00	59SB23-00
Sample Date		5/18/2010	5/18/2010	5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010
Sample Depth (ft bgs)		0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
LLPAHs (µg/kg) (cont.)												
Indeno(1,2,3-cd)pyrene	NE	9.2 UJ	10 U	10 UJ	9.2 UJ	9.5 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Naphthalene	NE	0.92 J	10 U	1.4 J	2.2 J	1.2 J	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Phenanthrene	NE	9.2 UJ	10 U	10 UJ	9.2 UJ	9.5 UJ	9.9 UJ	9.5 U	9 U	1.7 J	9.8 U	10 U
Pyrene	NE	18 J	10 U	10 UJ	81 J	9.5 UJ	9.9 UJ	2.1 J	3.2 J	9.5 U	9.8 U	3.5 J
LLPAH Totals (µg/kg)												
Low molecular weight PAHs	NE	56.55	80	71.4	51.5	67.7	79.2	68.3	72	68.2	78.4	74.6
High molecular weight PAHs	NE	95.8	90	90	190.2	68.57	70.9	70.1	75.2	85.5	88.2	75.8
Pesticides (µg/kg)												
4,4'-DDD	NE	3.7 U	4.1 UJ	4.1 U	8.1 J	3.8 U	3.9 U	3.8 U	3.6 U	3.8 U	3.9 U	4.1 U
4,4'-DDE	NE	3.7 U	4.1 UJ	4.1 U	160	3.8 U	1.2 J	12	3.6 U	3.8 U	3.4 J	1.6 J
4,4'-DDT	NE	0.85 J	4.1 UJ	4.1 U	160	3.8 U	1.7 J	2.7 J	3.6 U	3.8 U	1.2 J	2.3 J
BHC, beta-	NE	0.95 U	0.63 NJ	1.1 U	8.6 NJ	0.98 U	9.2 NJ	2 U	1.8 U	2 U	2 U	2.1 U
Chlordane, alpha-	NE	0.25 J	2.1 UJ	2.1 U	19 U	2 U	2 U	2 U	1.8 U	2 U	1.9 J	1.1 J
Chlordane, gamma-	NE	1.9 U	2.1 UJ	2.1 U	3.5 J	2 U	2 U	2 U	1.8 U	2 U	2 U	2.1 U
Endosulfan Sulfate	NE	0.52 J	4.1 UJ	4.1 U	37 U	3.8 U	3.9 U	3.8 U	3.6 U	3.8 U	3.9 U	4.1 U
Endrin Aldehyde	NE	3.7 U	4.1 UJ	4.1 U	37 U	3.8 U	3.9 U	3.8 U	3.6 U	3.8 U	3.9 U	4.1 U
Methoxychlor	NE	19 U	21 UJ	21 U	190 U	20 U	20 U	20 U	18 U	20 U	20 U	21 U
Metals (mg/kg)												
Antimony	3.17	0.77 J	0.29 J	5.9 UJ	8.5 J	5.7 UJ	5.7 UJ	0.17 J	0.88 J	5.6 UJ	5.7 UJ	0.17 J
Arsenic	2.65	0.69	0.63 U	2.9 U	5.5	2.9 U	2.9 U	0.29 J	2.5 U	2.8 U	2.9 U	0.71
Barium	199	81.5	33.4	122	145	82.5	86.7	48	104	102	107	81.6
Beryllium	0.59	0.23 J	0.23 J	2.9 U	0.31 J	0.27 J	0.29 J	0.15 J	0.62 J	0.27 J	2.9 U	0.19 J
Cadmium	1.02	0.8	0.15 J	0.34 J	2.6	0.33 J	2.9 U	0.26 J	0.64 J	0.26 J	0.42 J	0.35 J
Chromium	49.8	15.7 J	7.4	45.7 J	32.5 J	30 J	28.5 J	19.6	54.4	29.4	29.5	51.2
Cobalt	46.2	14.1	20.2 J	45.2	15.6	23.3	8.1	15.2 J	30.2 J	18.3 J	21.2 J	29 J
Copper	168	81.3	94.9 J	291	120	76.3	68.8	59.5 J	94.2 J	102 J	76.6 J	73.9 J
Lead	22	47.4	5.2	3.5	638	22.4	9.8	7.1	3.6	15.1	16.7	11.8
Mercury	0.109	0.095	0.041 U	0.041 U	0.053	0.026 J	0.019 J	0.038 U	0.01 J	0.009 J	0.011 J	0.041 U
Nickel	20.7	12	6.6	20.7	13.1	12.5	7.3	10.3	22.2	13.9	16.1	22.2

TABLE 6-1

SUMMARY OF DETECTED RESULTS - SURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	NAPR Basewide Background	59SB12	59SB13	59SB14	59SB15	59SB17	59SB17	59SB18	59SB20	59SB21	59SB22	59SB23
Sample ID		59SB12-00	59SB13-00	59SB14-00	59SB15-00	59SB17-00	59SB17-00D	59SB18-00	59SB20-00	59SB21-00	59SB22-00	59SB23-00
Sample Date		5/18/2010	5/18/2010	5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010
Sample Depth (ft bgs)		0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Metals (mg/kg) (cont.)												
Selenium	1.48	0.5 J	0.27 J	14.7 U	0.61 J	14.3 U	0.86 J	0.34 J	2.4 J	13.9 U	14.3 U	0.46 J
Silver	NE	0.55 U	0.093 J	2.9 U	0.55 U	2.9 U	2.9 U	0.1 J	0.48 J	2.8 U	2.9 U	0.14 J
Thallium	NE	0.032 J	0.05 J	2.9 U	0.065 J	2.9 U	2.9 U	0.032 J	0.37 J	2.8 U	2.9 U	0.027 J
Tin	3.76	8.5	6.3 UJ	5.9 U	10.5	6	5.7 U	5.6 UJ	5.1 UJ	5.6 UJ	5.7 UJ	6.2 UJ
Vanadium	259	84.3	129 J	249	94.9	155	184	102 J	109 J	107 J	126 J	115 J
Zinc	115	232	58.6	123	747	132	63.2	59.9	81.5	87.7	77.4	52

Notes:

J - Estimated: The analyte was positively identified; the quantitation is an estimation.
U - Non detected at the Reporting Limit.
UJ - Reported quantitation limit is qualified as estimated.
R - Rejected data; data is not usable.
NJ - Analyte has been tentatively identified.; the quantitation is an estimation.
ft bgs - feet below ground surface
LLPAHs - Polynuclear Aromatic Hydrocarbons
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram
NAPR - Naval Activity Puerto Rico
NE - Not Established

TABLE 6-2

SUMMARY OF DETECTED RESULTS - SURFACE SOIL, 2012 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	NAPR Basewide Background	59SB24	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID		59SB24-00	59SB24-00D	59SB25-00	59SB26-00	59SB27-00	59SB28-00	59SB29-00	59SB30-00	59SB31-00	59SB32-00	59SB33-00
Date		9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Depth Range (ft bgs)		0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Volatile Organics (µg/kg)												
Acetone	NE	10 U	11 UJ	27 J	10 U	11 U	9.7 U	7.9 U	15 J	30 J	45 J	11 U
Semivolatile Organics (µg/kg)												
Bis(2-ethylhexyl) phthalate	NE	43 J	21 J	78 J	7.5 U	84 U	34 U	36 U	35 J	11 J	8.3 U	19 J
LLPAHs (µg/kg)												
2-Methylnaphthalene	NE	4.3 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	6.4 J	4.6 U	4.4 U
Phenanthrene	NE	8.8 U	8.7 U	8.8 U	8.3 U	93 U	38 U	40 U	39 UJ	6 J	9.3 U	9 U
LLPAH Totals (µg/kg)												
Low Molecular Weight PAHs	NE	38.9	38.8	39.6	37	415	171	180	172	38.2	41.5	39.8
High Molecular Weight PAHs	NE	43.2	43.1	44	41.1	461	190	200	191	43	46.1	44.2
Metals (mg/kg)												
Arsenic	2.65	1.8	1.6	1.3	0.69	0.84	0.46	0.9	1	0.82	1.7	1.4
Barium	199	210 J	140 J	160	110	100	24	160	130	99	91	130
Beryllium	0.59	0.63 J	0.42 J	0.28	0.38	0.097	0.11	0.22	0.26	0.37	0.33	0.18
Cadmium	1.02	0.1	0.16	0.47	0.075	0.1	0.062	0.11	0.071	0.11	0.047 J	0.12
Chromium	49.8	71	91	61	47	71	33	36	32	51	73	150
Cobalt	46.2	27 J	19 J	25 J	36 J	22 J	14 J	15 J	17 J	19 J	6 J	20 J
Copper	168	260 J	170 J	71	100	50	66	130	83	99	120	110
Mercury	0.109	0.011 U	0.01 U	0.069	0.0098 U	0.011 U	0.0093 U	0.014 J	0.017 J	0.01 U	0.038	0.012 U
Nickel	20.7	33 J	32	30	30	33	17	17	16	23	15	47
Selenium	1.48	0.32 U	0.32 U	0.74	0.31 U	0.35 U	0.29 U	0.3 U	0.47 J	0.32 U	1.2	0.33 U
Silver	NE	0.088 J	0.064 U	0.15	0.062 U	0.069 U	0.057 U	0.06 U	0.059 U	0.064 U	0.35	0.066 U
Thallium	NE	0.039 J	0.038 J	0.043 J	0.031 U	0.035 U	0.029 U	0.03 U	0.073 J	0.032 U	0.035 U	0.033 U
Tin	3.76	3.3 U	8.3 J	3.3 U	3.1 U	3.5 U	2.9 U	3 U	3 U	3.3 U	3.5 U	3.4 U
Vanadium	259	280 J	180 J	180	140	230	110	140	170	240	240	330
Zinc	115	100 J	67 J	73	76	42	44	68	50	78	46	57

TABLE 6-2

SUMMARY OF DETECTED RESULTS - SURFACE SOIL, 2012 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Notes/Qualifiers:

J - Estimated: The analyte was positively identified; the quantitation is an estimation.
U - Not detected at the Limit of Detection.
UJ - Reported quantitation is qualified as estimated.
ft bgs - feet below ground surface
LLPAHs - Low Level Polynuclear Aromatic Hydrocarbons
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram
NAPR - Naval Activity Puerto Rico
NE - Not Established

TABLE 6-3

SUMMARY OF DETECTED RESULTS - 2012 PRE-EXCAVATION DELINEATION SAMPLING
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	CAOs	59SS01	59SS02	59SS03	59SS04	59SS04D	59SS05	59SS06	59SS07	59SS08	59SS09	59SS10	59SS11
Sample ID		59SS01	59SS02	59SS03	59SS04	59SS04D	59SS05	59SS06	59SS07	59SS08	59SS09	59SS10	59SS11
Sample Date		9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012
Sample Depth (ft bgs)		0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Metals (mg/kg)													
Copper	168	NA	NA	NA	415	244	46	89	100	NA	NA	NA	67.8
Lead	96	45.2	23	5.49	230	214	0.92	4	75.2	242	580	1.4	NA
Zinc	120	132	61	66.7	284	289	37	70	250	302	74	59	63.3

TABLE 6-3

SUMMARY OF DETECTED RESULTS - 2012 PRE-EXCAVATION DELINEATION SAMPLING
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	CAOs	59SS12	59SS13	59SS14	59SS14D	59SS15	59SS16	59SS17	59SS18	59SS19	59SS20	59SS21	59SS21D
Sample ID		59SS12	59SS13	59SS14	59SS14D	59SS15	59SS16	59SS17	59SS18	59SS19	59SS20	59SS21	59SS21D
Sample Date		9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012
Sample Depth (ft bgs)		0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Metals (mg/kg)													
Copper	168	113	136	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead	96	NA	NA	19.9	26.5	66.7	3.96	NA	NA	NA	NA	NA	NA
Zinc	120	140	66.8	72.7	99.2	656	119	97.9	60	111	150	240	237

TABLE 6-3

SUMMARY OF DETECTED RESULTS - 2012 PRE-EXCAVATION DELINEATION SAMPLING
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	CAOs	59SS22	59SS23	59SS24	59SS25	59SS26	59SS26D	59SS27	59SS28	59SS29	59SS30	59SS31
Sample ID		59SS22	59SS23	59SS24	59SS25	59SS26	59SS26D	59SS27	59SS28	59SS29	59SS30	59SS31
Sample Date		9/14/2012	9/14/2012	9/14/2012	11/10/2012	11/10/2012	11/10/2012	11/10/2012	11/10/2012	11/10/2012	11/10/2012	11/10/2012
Sample Depth (ft bgs)		0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Metals (mg/kg)												
Copper	168	NA	NA	NA	NA	140 J	150	NA	NA	NA	NA	NA
Lead	96	NA	NA	NA	NA	59 J	68	49	100	110	270	NA
Zinc	120	215	86	110	120	120 J	130	200	240	NA	NA	230

TABLE 6-3

SUMMARY OF DETECTED RESULTS - 2012 PRE-EXCAVATION DELINEATION SAMPLING
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	CAOs	59SS32	59SS33	59SS34
Sample ID		59SS32	59SS33	59SS34
Sample Date		11/10/2012	11/10/2012	11/10/2012
Sample Depth (ft bgs)		0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Metals (mg/kg)				
Copper	168	NA	NA	NA
Lead	96	NA	NA	NA
Zinc	120	2100 D	390	86

Notes:

J - Estimated: The analyte was positively identified; the quantitation is an estimation.
D - The reported value is from a dilution
CAOs - Corrective Action Objectives
ft bgs - feet below ground surface
mg/kg - milligram per kilogram
NA - Not Analyzed

TABLE 6-4

SUMMARY OF DETECTED RESULTS - SUBUSRFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITIY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	NAPR Basewide Background	59SB01	59SB01	59SB02	59SB02	59SB02	59SB03	59SB03	59SB04	59SB04	59SB05	59SB05
Sample ID		59SB01-01	59SB01-03	59SB02-01	59SB02-01D	59SB02-04	59SB03-01	59SB03-04	59SB04-01	59SB04-05	59SB05-01	59SB05-05
Sample Date		4/19/2010	4/19/2010	4/20/2010	4/20/2010	4/20/2010	4/19/2010	4/19/2010	4/22/2010	4/22/2010	4/20/2010	4/20/2010
Sample Depth (ft bgs)		1.0 - 3.0	5.0 - 7.0	1.0 - 3.0	1.0 - 3.0	7.0 - 9.0	1.0 - 3.0	7.0 - 9.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Volatile Organics (µg/kg)												
Acetone	NE	13 U	15 U	140	150	15 U	12 U	11 U	25 UJ	11 UJ	9.6 U	11 U
Benzene	NE	5.4 U	6 U	0.35 J	0.4 J	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
Bromoform	NE	5.4 U	6 U	4.8 U	5.2 U	35	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
Bromomethane	NE	5.4 U	6 U	1.4 J	5.2 U	5.9 U	5 U	4.6 U	5.5 UJ	4.2 UJ	3.8 U	4.4 U
Carbon Disulfide	NE	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
Chloromethane	NE	5.4 U	6 U	1.1 J	1.1 J	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 UJ	4.4 UJ
Dibromochloromethane	NE	5.4 U	6 U	4.8 U	5.2 U	0.9 J	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
Methyl Iodide	NE	5.4 U	6 U	21	30 J	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 UJ	4.4 UJ
Xylene, m/p-	NE	0.19 J	12 U	9.7 U	0.19 J	12 U	9.9 U	0.2 J	11 U	0.15 J	0.15 J	0.24 J
Xylenes, total	NE	0.19 J	6 U	4.8 U	0.19 J	5.9 U	5 U	0.2 J	5.5 U	0.15 J	0.15 J	0.24 J
Semivolatile Organics (µg/kg)												
Bis(2-ethylhexyl) Phthalate (BEHP)	NE	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	230	190 U	98 J
Di-n-octyl Phthalate	NE	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
LLPAHs (µg/kg)												
2-Methylnaphthalene	NE	12 UJ	12 UJ	7.9 J	11 UJ	12 UJ	10 UJ	9.8 UJ	11 U	10 U	0.96 J	11 UJ
Acenaphthene	NE	12 U	12 U	7.7 J	11 U	12 U	10 U	9.8 U	11 U	10 U	9.2 U	11 U
Acenaphthylene	NE	12 U	12 U	11 U	11 U	12 U	10 U	9.8 U	11 U	10 U	9.2 U	11 U
Anthracene	NE	12 U	12 U	3.1 J	11 U	12 U	10 U	9.8 U	11 U	10 U	9.2 U	11 U
Benzo(a)anthracene	NE	12 U	12 U	8.6 J	11 U	12 U	10 U	9.8 U	11 U	10 U	9.2 U	11 U
Benzo(a)pyrene (BaP)	NE	12 UJ	12 UJ	6 J	11 UJ	12 UJ	10 UJ	9.8 UJ	11 U	10 U	9.2 UJ	11 UJ
Benzo(b)fluoranthene	NE	12 U	12 U	11 U	11 U	12 U	10 U	9.8 U	11 U	10 U	9.2 U	11 U
Benzo(g,h,i)perylene	NE	12 U	12 U	20 J	11 UJ	12 U	10 U	9.8 U	11 U	10 U	1.8 J	11 U
Benzo(k)fluoranthene	NE	12 U	12 U	2.3 J	11 U	12 U	10 U	9.8 U	11 U	10 U	0.8 J	11 U
Chrysene	NE	12 U	12 U	1 J	11 U	12 U	10 U	9.8 U	11 U	10 U	0.94 J	11 U
Dibenz(a,h)anthracene	NE	12 U	12 U	1 J	11 UJ	12 U	10 UJ	9.8 UJ	11 U	10 U	1.2 J	11 UJ
Fluoranthene	NE	12 U	12 U	1.2 J	11 UJ	12 U	10 UJ	9.8 UJ	11 UJ	10 UJ	9.2 UJ	11 UJ
Fluorene	NE	12 UJ	12 UJ	1.5 J	11 U	12 UJ	10 U	9.8 U	11 UJ	10 UJ	0.49 J	11 U
Indeno(1,2,3-cd)pyrene	NE	12 UJ	12 UJ	2 J	11 UJ	12 UJ	10 UJ	9.8 UJ	11 U	10 U	2 J	11 UJ
Naphthalene	NE	12 U	12 U	11 U	11 U	12 U	10 U	9.8 U	11 UJ	10 UJ	9.2 U	11 U
Phenanthrene	NE	12 UJ	12 UJ	0.77 J	11 UJ	12 UJ	10 UJ	9.8 UJ	11 UJ	10 UJ	9.2 UJ	11 UJ
Pyrene	NE	12 U	12 U	5.7 J	11 U	12 U	10 U	9.8 U	11 U	10 U	1.1 J	0.92 J

TABLE 6-4

SUMMARY OF DETECTED RESULTS - SUBUSRFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITIY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	NAPR Basewide Background	59SB01	59SB01	59SB02	59SB02	59SB02	59SB03	59SB03	59SB04	59SB04	59SB05	59SB05
Sample ID		59SB01-01	59SB01-03	59SB02-01	59SB02-01D	59SB02-04	59SB03-01	59SB03-04	59SB04-01	59SB04-05	59SB05-01	59SB05-05
Sample Date		4/19/2010	4/19/2010	4/20/2010	4/20/2010	4/20/2010	4/19/2010	4/19/2010	4/22/2010	4/22/2010	4/20/2010	4/20/2010
Sample Depth (ft bgs)		1.0 - 3.0	5.0 - 7.0	1.0 - 3.0	1.0 - 3.0	7.0 - 9.0	1.0 - 3.0	7.0 - 9.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
LLPAH Totals (µg/kg)												
Low molecular weight PAHs	NE	96	96	75.3	88	96	80	78.4	88	80	57.96	88
High molecular weight PAHs	NE	108	108	26.47	99	108	90	88.2	99	90	34.13	88.92
Pesticides (µg/kg)												
4,4'-DDD	NE	4.9 U	4.9 U	4.2 U	4.3 U	4.7 U	4 U	3.9 U	4.4 U	4 U	3.7 U	4.2 U
4,4'-DDE	NE	4.9 U	4.9 U	4.2 U	4.3 U	4.7 U	4 U	3.9 U	4.4 U	4 U	3.5 J	4.2 U
4,4'-DDT	NE	4.9 U	4.9 U	4.2 U	4.3 U	4.7 U	4 U	3.9 U	4.4 U	4 U	0.77 J	4.2 U
BHC, beta-	NE	2.5 U	0.91 J	2.2 U	0.87 J	2.4 U	2 U	2 U	2.3 U	0.57 J	0.84 J	2.2 U
BHC, delta-	NE	2.5 U	2.5 U	2.2 U	2.2 U	2.4 U	2 U	0.27 J	2.3 U	2 U	1.9 U	2.2 U
Chlordane, alpha-	NE	2.5 U	2.5 U	2.2 U	2.2 U	2.4 U	2 U	8.4	2.3 U	2 U	1.9 U	2.2 U
Endrin	NE	4.9 U	4.9 U	4.2 U	4.3 U	4.7 U	4 U	3.9 U	0.56 J	4 U	3.7 U	4.2 U
Endrin Aldehyde	NE	4.9 U	4.9 U	4.2 U	4.3 U	4.7 U	4 U	3.9 U	4.4 R	4 R	0.46 J	4.2 U
Heptachlor	NE	2.5 U	2.5 U	2.2 U	2.2 U	2.4 U	2 U	2 U	2.3 U	2 U	1.9 U	2.2 U
Metals (mg/kg)												
Antimony	NE	7.1 UJ	7.3 UJ	6.5 UJ	1.3 UJ	6.9 UJ	1.2 UJ	1.2 UJ	6.5 UJ	1.2 UJ	1.1 UJ	1.2 UJ
Arsenic	1.59	3.5 UJ	3.6 UJ	1.3 J	0.74 J	3.5 UJ	0.6 UJ	0.26 J	3.2 U	0.41 J	1.2 J	0.61 UJ
Barium	220	33.3 R	16.4 R	186 R	80.7 R	79.2 R	62.1 R	23.7 R	229 J	25.3 J	69.9 R	21 R
Beryllium	0.596	3.5 U	3.6 U	0.47 J	0.47 J	0.79 J	0.24 J	0.19 J	3.2 U	0.28 J	0.3 J	0.21 J
Cadmium	0.622	3.5 U	3.6 U	0.76 J	0.53 J	0.26 J	0.22 J	0.22 J	0.75 J	0.5 J	0.34 J	0.4 J
Chromium	114.5	13 J	10.3 J	50.9 J	36.2 J	35.4 J	50.3 J	25.5 J	63.5 J	9.6 J	17.2 J	86.2 J
Cobalt	26.9	9.6 J	28.5 J	51.6 J	72.1 J	83.9 J	32.6 J	30.3 J	53.4 J	16.7 J	15.9 J	25.1 J
Copper	246	126 J	41 J	91.9 J	65 J	90.4 J	71.1 J	98.4 J	217 J	88.1 J	82.6 J	164 J
Lead	6.3	3.5 UJ	3.6 UJ	33 J	29.6 J	3.5 UJ	1 J	0.72 J	3.2 UJ	1.3 J	14.1 J	3.6 J
Mercury	0.108	0.048 U	0.005 J	0.098	0.1	0.047 U	0.04 U	0.039 U	0.009 J	0.04 U	0.014 J	0.042 U
Nickel	24.7	9.1 J	8.8 J	17.8 J	12 J	22 J	18.5 J	16.4 J	20.7	7.1	10.8 J	28.8 J
Selenium	5.94	17.7 UJ	18.2 UJ	2.6 J	1.7 J	17.3 UJ	0.41 J	0.3 J	16.2 U	0.3 J	0.48 J	0.46 J
Silver	NE	3.5 U	3.6 U	0.41 J	0.65 U	3.5 U	0.6 U	0.58 U	3.2 U	0.6 U	0.56 U	0.61 U
Thallium	0.92	3.5 U	3.6 U	3.2 U	0.041 J	3.5 U	0.6 U	0.58 U	3.2 U	0.6 U	0.036 J	0.61 U
Tin	4	2.8 J	2.8 J	2 J	1.8 J	2.2 J	2.5 J	3.1 J	2.7 J	2.6 J	2.8 J	2.3 J
Vanadium	434	73.1 J	67.2 J	282 J	175 J	344 J	161 J	136 J	138 J	123 J	85.1 J	188 J
Zinc	88	66.8 J	87.3 J	77.3 J	53.3 J	105 J	63.2 J	55.6 J	242 J	87.8 J	49.5 J	140 J

TABLE 6-4

SUMMARY OF DETECTED RESULTS - SUBUSRFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITIY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	NAPR Basewide Background	59SB06	59SB06	59SB07	59SB07	59SB07	59SB08	59SB08	59SB09	59SB09	59SB10
Sample ID		59SB06-01	59SB06-03	59SB07-01	59SB07-01D	59SB07-05	59SB08-01	59SB08-05	59SB09-01	59SB09-05	59SB10-01
Sample Date		4/20/2010	4/20/2010	4/21/2010	4/21/2010	4/21/2010	4/21/2010	4/21/2010	4/22/2010	4/22/2010	4/21/2010
Sample Depth (ft bgs)		1.0 - 3.0	5.0 - 7.0	1.0 - 3.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0
Volatile Organics (µg/kg)											
Acetone	NE	11 U	12 U	11 U	10 U	10 U	9.4 U	12 U	26	12 U	12 U
Benzene	NE	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U
Bromoform	NE	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U
Bromomethane	NE	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U
Carbon Disulfide	NE	4.4 U	10	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U
Chloromethane	NE	4.4 UJ	4.6 UJ	4.6 UJ	4.2 UJ	4.2 UJ	3.8 UJ	4.7 UJ	4.1 UJ	4.8 UJ	4.7 UJ
Dibromochloromethane	NE	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U
Methyl Iodide	NE	1.9 J	4.6 UJ	4.6 UJ	4.2 UJ	4.2 UJ	3.8 UJ	4.7 UJ	1.3 J	4.8 UJ	4.7 UJ
Xylene, m/p-	NE	0.16 J	0.13 J	0.19 J	8.4 U	8.4 U	0.12 J	9.4 U	0.15 J	9.7 U	0.14 J
Xylenes, total	NE	0.16 J	0.13 J	0.18 J	4.2 U	4.2 U	0.12 J	4.7 U	0.15 J	4.8 U	0.14 J
Semivolatile Organics (µg/kg)											
Bis(2-ethylhexyl) Phthalate (BEHP)	NE	200 U	210 U	58 J	200 U	200 U	83 J	200 U	190 U	200 U	220 U
Di-n-octyl Phthalate	NE	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U
LLPAHs (µg/kg)											
2-Methylnaphthalene	NE	9.7 UJ	10 UJ	10 UJ	9.8 UJ	9.8 UJ	9.3 UJ	9.9 UJ	9.1 UJ	9.9 UJ	11 UJ
Acenaphthene	NE	9.7 U	10 U	10 U	9.8 U	9.8 U	9.3 U	9.9 U	9.1 U	9.9 U	11 U
Acenaphthylene	NE	9.7 U	10 U	10 U	9.8 U	9.8 U	0.65 J	9.9 U	9.1 U	9.9 U	11 U
Anthracene	NE	9.7 U	10 U	10 U	9.8 U	9.8 U	9.3 U	9.9 U	9.1 U	9.9 U	11 U
Benzo(a)anthracene	NE	9.7 U	10 U	10 U	9.8 U	9.8 U	7.3 J	9.9 U	9.1 U	9.9 U	11 U
Benzo(a)pyrene (BaP)	NE	9.7 UJ	10 UJ	10 UJ	9.8 UJ	9.8 UJ	9.3 UJ	9.9 UJ	9.1 UJ	9.9 UJ	11 U
Benzo(b)fluoranthene	NE	9.7 U	10 U	10 U	9.8 U	9.8 U	9.3 U	9.9 U	9.1 U	9.9 U	11 U
Benzo(g,h,i)perylene	NE	9.7 U	10 U	10 U	9.8 U	9.8 U	5.6 J	9.9 U	9.1 U	9.9 U	11 U
Benzo(k)fluoranthene	NE	9.7 U	10 U	10 U	9.8 U	9.8 U	1.2 J	9.9 U	0.63 J	9.9 U	11 U
Chrysene	NE	9.7 U	10 U	10 U	9.8 U	9.8 U	3 J	9.9 U	0.85 J	9.9 U	11 U
Dibenz(a,h)anthracene	NE	9.7 UJ	10 UJ	10 UJ	9.8 UJ	9.8 UJ	2.8 J	9.9 UJ	0.64 J	9.9 UJ	11 U
Fluoranthene	NE	9.7 UJ	10 UJ	10 UJ	9.8 UJ	9.8 UJ	1.9 J	9.9 UJ	0.58 J	9.9 UJ	11 UJ
Fluorene	NE	9.7 U	10 U	10 U	9.8 U	9.8 U	4.1 J	9.9 U	0.92 J	9.9 U	11 U
Indeno(1,2,3-cd)pyrene	NE	9.7 UJ	10 UJ	10 UJ	9.8 UJ	9.8 UJ	3 J	9.9 UJ	9.1 UJ	9.9 UJ	11 UJ
Naphthalene	NE	9.7 U	10 U	10 U	9.8 U	9.8 U	0.39 J	9.9 U	9.1 U	9.9 U	11 U
Phenanthrene	NE	9.7 UJ	10 UJ	10 UJ	9.8 UJ	9.8 UJ	2.8 J	9.9 UJ	0.84 J	9.9 UJ	11 UJ
Pyrene	NE	9.7 U	10 U	10 U	9.8 U	9.8 U	6.1 J	9.9 U	9.1 U	9.9 U	11 U

TABLE 6-4

SUMMARY OF DETECTED RESULTS - SUBUSRFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITIY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	NAPR Basewide Background	59SB06	59SB06	59SB07	59SB07	59SB07	59SB08	59SB08	59SB09	59SB09	59SB10
Sample ID		59SB06-01	59SB06-03	59SB07-01	59SB07-01D	59SB07-05	59SB08-01	59SB08-05	59SB09-01	59SB09-05	59SB10-01
Sample Date		4/20/2010	4/20/2010	4/21/2010	4/21/2010	4/21/2010	4/21/2010	4/21/2010	4/22/2010	4/22/2010	4/21/2010
Sample Depth (ft bgs)		1.0 - 3.0	5.0 - 7.0	1.0 - 3.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0
LLPAH Totals (µg/kg)											
Low molecular weight PAHs	NE	77.6	80	80	78.4	78.4	60.05	79.2	72.8	79.2	88
High molecular weight PAHs	NE	87.3	90	90	88.2	88.2	25.29	89.1	31.76	89.1	99
Pesticides (µg/kg)											
4,4'-DDD	NE	3.8 U	4.1 U	4.1 U	3.9 U	3.9 U	3.7 U	3.9 U	3.6 U	3.9 U	4.3 U
4,4'-DDE	NE	3.8 U	4.1 U	4.1 U	3.9 U	3.9 U	3.7 U	1.6 J	3.6 U	3.9 U	4.3 U
4,4'-DDT	NE	3.8 U	4.1 U	4.1 U	3.9 U	3.9 U	3.7 U	1.5 J	3.6 U	3.9 U	4.3 U
BHC, beta-	NE	0.88 J	2.1 U	2.1 U	2 U	2 U	1.9 U	2 U	1.9 U	2 U	2.2 U
BHC, delta-	NE	2 U	2.1 U	2.1 U	2 U	2 U	1.9 U	2 U	1.9 U	2 U	2.2 U
Chlordane, alpha-	NE	2 U	2.1 U	2.1 U	2 U	2 U	1.9 U	2 U	1.9 U	2 U	2.2 U
Endrin	NE	3.8 U	4.1 U	4.1 U	3.9 U	3.9 U	3.7 U	3.9 U	3.6 U	3.9 U	4.3 U
Endrin Aldehyde	NE	3.8 U	4.1 U	4.1 U	3.9 U	3.9 U	3.7 U	3.9 U	3.6 U	3.9 U	0.54 J
Heptachlor	NE	2 U	2.1 U	2.1 U	2 U	2 U	1.9 U	2 U	1.9 U	2 U	2.2 U
Metals (mg/kg)											
Antimony	NE	5.8 UJ	6 UJ	6 UJ	1.2 UJ	5.9 UJ	1.1 UJ	1.2 UJ	5.3 UJ	1.2 UJ	1.3 UJ
Arsenic	1.59	2.9 UJ	1.6 J	3 UJ	0.59 UJ	2.9 UJ	0.19 J	0.58 UJ	2.7 UJ	0.6 UJ	0.65 UJ
Barium	220	151 R	23.6 R	173 R	143 R	54 R	149 R	171 R	127 R	184 R	163 R
Beryllium	0.596	2.9 U	3 U	3 U	0.27 J	0.26 J	0.38 J	0.36 J	2.7 U	0.13 J	0.44 J
Cadmium	0.622	0.22 J	3 U	0.35 J	0.31 J	2.9 U	0.62	5	0.31 J	0.39 J	0.28 J
Chromium	114.5	46.4 J	37.4 J	57.3 J	73.5 J	41.4 J	16.2 J	14.6 J	59.5 J	40.6 J	22.5 J
Cobalt	26.9	17.5 J	4.3 J	26.7 J	28.8 J	24 J	13 J	21.7 J	32.6 J	32.8 J	28 J
Copper	246	77.7 J	64.7 J	74.3 J	70.4 J	194 J	5.1 J	49.3 J	77.6 J	66.9 J	49.3 J
Lead	6.3	5.3 J	21.3 J	3 UJ	4.7 J	2.9 UJ	1.8 J	2.4 J	3 J	2.5 J	1.3 J
Mercury	0.108	0.038 U	0.15	0.04 U	0.039 U	0.039 U	0.037 U	0.039 U	0.016 J	0.017 J	0.009 J
Nickel	24.7	16.3 J	4.7 J	25.1 J	27.9 J	18 J	8.7 J	8.8 J	27.9 J	24 J	29.6 J
Selenium	5.94	14.5 UJ	2.1 J	15 UJ	0.48 J	14.7 UJ	0.56 J	0.3 J	13.3 UJ	0.34 J	0.64 J
Silver	NE	2.9 U	3 U	3 U	0.59 U	2.9 U	0.55 U	0.58 U	2.7 U	0.6 U	0.65 U
Thallium	0.92	2.9 U	3 U	3 U	0.59 U	2.9 U	0.029 J	0.58 U	2.7 U	0.027 J	0.65 U
Tin	4	2.3 J	2.3 J	2.6 J	2.5 J	3 J	1.9 J	2.8 J	2.7 J	3.3 J	2.3 J
Vanadium	434	146 J	245 J	111 J	151 J	56.8 J	73.6 J	81 J	190 J	153 J	46.9 J
Zinc	88	61.9 J	35.2 J	69.6 J	78.6 J	88.4 J	90.6 J	114 J	75.4 J	61.3 J	68.7 J

TABLE 6-4

SUMMARY OF DETECTED RESULTS - SUBUSRFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITIY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	NAPR Basewide Background	59SB10	59SB11	59SB11	59SB11	59SB12	59SB12	59SB13	59SB13	59SB13	59SB14
Sample ID		59SB10-05	59SB11-01	59SB11-01D	59SB11-02	59SB12-01	59SB12-05	59SB13-01	59SB13-01D	59SB13-05	59SB14-01
Sample Date		4/21/2010	5/19/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010
Sample Depth (ft bgs)		9.0 - 11.0	1.0 - 3.0	1.0 - 3.0	3.0 - 5.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0
Volatile Organics (µg/kg)											
Acetone	NE	13 U	10 U	11 U	15 U	27 U	12 U	13 U	19 U	11 U	19 U
Benzene	NE	5 U	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U
Bromoform	NE	5 U	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U
Bromomethane	NE	5 U	0.98 J	1.2 J	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U
Carbon Disulfide	NE	5 U	4 U	3.7 U	4.7 U	5.4 U	5 U	0.76 J	4.8 U	4.6 U	4.6 U
Chloromethane	NE	5 UJ	4 U	3.7 U	4.7 U	0.37 J	5 U	4.7 U	4.8 U	4.6 U	4.6 U
Dibromochloromethane	NE	5 U	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U
Methyl Iodide	NE	5 UJ	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U
Xylene, m/p-	NE	10 U	8 U	7.4 U	9.4 U	11 U	9.9 U	9.5 U	9.7 U	9.1 U	9.2 U
Xylenes, total	NE	5 U	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U
Semivolatile Organics (µg/kg)											
Bis(2-ethylhexyl) Phthalate (BEHP)	NE	230 U	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ
Di-n-octyl Phthalate	NE	230 U	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ
LLPAHs (µg/kg)											
2-Methylnaphthalene	NE	11 UJ	9.8 UJ	9.4 UJ	10 UJ	10 UJ	11 UJ	11 U	11 U	11 U	11 UJ
Acenaphthene	NE	11 U	9.8 UJ	9.4 UJ	10 UJ	10 UJ	11 UJ	11 U	11 U	11 U	11 UJ
Acenaphthylene	NE	11 U	9.8 UJ	9.4 UJ	10 UJ	10 UJ	11 UJ	11 U	11 U	11 U	11 UJ
Anthracene	NE	11 U	9.8 UJ	9.4 UJ	10 UJ	10 UJ	11 UJ	11 UJ	11 UJ	11 UJ	11 UJ
Benzo(a)anthracene	NE	11 U	9.8 UJ	9.4 UJ	1.7 J	10 UJ	11 UJ	11 U	11 U	11 U	11 UJ
Benzo(a)pyrene (BaP)	NE	11 UJ	9.8 UJ	9.4 UJ	10 UJ	10 UJ	11 UJ	11 U	11 U	11 U	11 UJ
Benzo(b)fluoranthene	NE	11 U	9.8 UJ	9.4 UJ	10 UJ	10 UJ	1.2 J	11 U	11 U	11 U	11 UJ
Benzo(g,h,i)perylene	NE	11 U	9.8 UJ	9.4 UJ	10 UJ	10 UJ	11 UJ	11 U	11 U	11 U	11 UJ
Benzo(k)fluoranthene	NE	11 U	9.8 UJ	9.4 UJ	4.7 J	10 UJ	11 UJ	11 U	11 U	11 U	11 UJ
Chrysene	NE	11 U	9.8 UJ	9.4 UJ	10 UJ	10 UJ	11 UJ	11 U	11 U	11 U	11 UJ
Dibenz(a,h)anthracene	NE	11 UJ	9.8 UJ	9.4 UJ	10 UJ	10 UJ	11 UJ	11 U	11 UJ	11 UJ	11 UJ
Fluoranthene	NE	11 UJ	9.8 UJ	9.4 UJ	10 UJ	10 UJ	11 UJ	11 U	11 UJ	11 UJ	11 UJ
Fluorene	NE	11 U	9.8 UJ	9.4 UJ	10 UJ	10 UJ	11 UJ	11 U	11 UJ	11 UJ	11 UJ
Indeno(1,2,3-cd)pyrene	NE	11 UJ	9.8 UJ	9.4 UJ	16 J	10 UJ	11 UJ	11 U	11 U	11 U	11 UJ
Naphthalene	NE	11 U	9.8 UJ	9.4 UJ	10 UJ	10 UJ	11 UJ	11 U	11 U	11 U	11 UJ
Phenanthrene	NE	11 UJ	9.8 UJ	9.4 UJ	10 UJ	10 UJ	11 UJ	11 U	11 U	11 U	11 UJ
Pyrene	NE	11 U	9.8 UJ	9.4 UJ	21 J	10 UJ	11 UJ	11 U	11 UJ	11 UJ	11 UJ

TABLE 6-4

SUMMARY OF DETECTED RESULTS - SUBUSRFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITIY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	NAPR Basewide Background	59SB10	59SB11	59SB11	59SB11	59SB12	59SB12	59SB13	59SB13	59SB13	59SB14
Sample ID		59SB10-05	59SB11-01	59SB11-01D	59SB11-02	59SB12-01	59SB12-05	59SB13-01	59SB13-01D	59SB13-05	59SB14-01
Sample Date		4/21/2010	5/19/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010
Sample Depth (ft bgs)		9.0 - 11.0	1.0 - 3.0	1.0 - 3.0	3.0 - 5.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0
LLPAH Totals (µg/kg)											
Low molecular weight PAHs	NE	88	78.4	75.2	71.7	80	78.2	88	88	88	88
High molecular weight PAHs	NE	99	88.2	84.6	101.7	90	99	99	99	99	99
Pesticides (µg/kg)											
4,4'-DDD	NE	4.5 U	3.9 U	3.8 U	4 UJ	4 U	4.4 U	4.2 U	4.1 U	4.5 U	4.2 U
4,4'-DDE	NE	4.5 U	3.9 U	3.8 U	4 UJ	4 U	4.4 U	4.2 U	4.1 U	4.5 U	4.2 U
4,4'-DDT	NE	4.5 U	3.9 U	3.8 U	4 UJ	4 U	4.4 U	4.2 U	4.1 U	4.5 U	4.2 U
BHC, beta-	NE	2.3 U	1 U	0.97 U	1 UJ	1 U	12 NJ	1.1 U	1.1 U	1.2 U	1.1 U
BHC, delta-	NE	2.3 U	2 U	1.9 U	2 UJ	2.1 U	2.3 U	2.2 U	2.1 U	2.3 U	2.2 U
Chlordane, alpha-	NE	2.3 U	2 U	1.9 U	2 UJ	2.1 U	2.3 U	2.2 U	2.1 U	2.3 U	2.2 U
Endrin	NE	4.5 U	3.9 U	3.8 U	4 UJ	4 U	4.4 U	4.2 U	4.1 U	4.5 U	4.2 U
Endrin Aldehyde	NE	4.5 U	3.9 U	3.8 U	4 UJ	4 U	4.4 U	4.2 U	4.1 U	4.5 U	4.2 U
Heptachlor	NE	2.3 U	2 U	1.9 U	2 UJ	2.1 U	2.3 U	2.2 U	0.22 J	2.3 U	2.2 U
Metals (mg/kg)											
Antimony	NE	1.4 UJ	5.9 UJ	5.7 UJ	5.8 UJ	6.1 UJ	6.5 UJ	0.39 J	0.34 J	0.38 J	6.4 UJ
Arsenic	1.59	0.68 UJ	2.9 U	2.9 U	2.9 U	3.1 U	1.9 J	0.54 J	0.63 U	0.67 U	3.2 U
Barium	220	198 R	70.5	86.8	69	82.8	4.1 J	267 J	144 J	45.3 J	76
Beryllium	0.596	0.075 J	2.9 U	2.9 U	0.25 J	0.3 J	0.32 J	0.88	0.96	0.11 J	3.2 U
Cadmium	0.622	0.45 J	2.9 U	0.2 J	0.45 J	3.1 U	3.3 U	0.28 J	0.25 J	0.7 J	0.36 J
Chromium	114.5	29 J	17.7 J	25.3 J	52.9 J	79.3 J	19.9 J	8	6.9	18.5	39.8 J
Cobalt	26.9	14.3 J	24.8	26.9	21.4	28.8	15.6	67.6 J	43.6 J	21.2 J	41.6
Copper	246	65.2 J	89.6	65.1	86.9	76.2	123	83.1 J	75 J	58.5 J	270
Lead	6.3	1.8 J	2.9 U	2.9 U	2.9 U	3.1 U	37.4	28.4 R	11.2 R	2.3 R	4.1
Mercury	0.108	0.005 J	0.039 U	0.038 U	0.012 J	0.04 U	0.044 U	0.042 U	0.042 U	0.045 U	0.01 J
Nickel	24.7	25.3 J	12.4	14.9	26.8	22.6	11	5.9	6.3	16.9	21.6
Selenium	5.94	0.38 J	14.7 U	14.3 U	14.6 U	15.3 U	16.3 U	0.48 J	0.43 J	0.32 J	16 U
Silver	NE	0.68 U	2.9 U	2.9 U	2.9 U	3.1 U	3.3 U	0.1 J	0.1 J	0.11 J	3.2 U
Thallium	0.92	0.68 U	2.9 U	0.1 J	2.9 U	3.1 U	3.3 U	0.055 J	0.04 J	0.67 U	3.2 U
Tin	4	2.5 J	5.9 U	5.7 U	5.8 U	6.1 U	6.5 U	6.3 U	6.3 U	6.7 U	6.4 U
Vanadium	434	154 J	145	143	158	136	407	107 J	103 J	294 J	236
Zinc	88	53.5 J	59.4	71	61.8	75.3	117	152	160	59.7	92.8

TABLE 6-4

SUMMARY OF DETECTED RESULTS - SUBUSRFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITIY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	NAPR Basewide Background	59SB14	59SB15	59SB15	59SB16	59SB16	59SB17	59SB17	59SB18	59SB18	59SB19
Sample ID		59SB14-05	59SB15-01	59SB15-05	59SB16-01	59SB16-05	59SB17-01	59SB17-05	59SB18-01	59SB18-02	59SB19-01
Sample Date		5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/19/2010
Sample Depth (ft bgs)		9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	3.0 - 5.0	1.0 - 3.0
Volatile Organics (µg/kg)											
Acetone	NE	14 U	13 U	12 U	13 U	12 U	37	13 U	18 U	10 U	13 U
Benzene	NE	5.5 U	5 U	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	0.71 J	4.2 U	5.2 U
Bromoform	NE	5.5 U	5 U	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U
Bromomethane	NE	5.5 U	5 U	4.8 U	4.5 U	4.8 U	1.6 J	5.3 U	4.3 U	4.2 U	5.2 U
Carbon Disulfide	NE	5.5 U	5 U	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U
Chloromethane	NE	5.5 U	5 U	4.8 U	4.5 U	4.8 U	0.74 J	5.3 U	4.3 U	4.2 U	5.2 U
Dibromochloromethane	NE	5.5 U	5 U	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U
Methyl Iodide	NE	5.5 U	5 U	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U
Xylene, m/p-	NE	11 U	9.9 U	9.7 U	8.9 U	9.5 U	8.6 U	11 U	8.6 U	8.3 U	10 U
Xylenes, total	NE	5.5 U	5 U	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U
Semivolatile Organics (µg/kg)											
Bis(2-ethylhexyl) Phthalate (BEHP)	NE	240 UJ	190 UJ	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U
Di-n-octyl Phthalate	NE	240 UJ	190 UJ	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U
LLPAHs (µg/kg)											
2-Methylnaphthalene	NE	12 UJ	9.3 UJ	10 UJ	10 UJ	11 UJ	9.9 UJ	12 UJ	8.8 U	10 U	11 U
Acenaphthene	NE	12 UJ	9.3 UJ	10 UJ	10 UJ	11 UJ	9.9 UJ	12 UJ	2 J	10 U	11 U
Acenaphthylene	NE	12 UJ	9.3 UJ	10 UJ	10 UJ	11 UJ	9.9 UJ	12 UJ	0.61 J	10 U	11 U
Anthracene	NE	12 UJ	9.3 UJ	10 UJ	10 UJ	11 UJ	9.9 UJ	12 UJ	8.8 U	10 U	11 U
Benzo(a)anthracene	NE	12 UJ	9.3 UJ	10 UJ	10 UJ	11 UJ	9.9 UJ	12 UJ	21	10 U	11 U
Benzo(a)pyrene (BaP)	NE	12 UJ	9.3 UJ	10 UJ	10 UJ	11 UJ	9.9 UJ	12 UJ	8.8 U	10 U	11 U
Benzo(b)fluoranthene	NE	12 UJ	9.3 UJ	10 UJ	1.1 J	1.4 J	9.9 UJ	12 UJ	8.8 U	10 U	11 U
Benzo(g,h,i)perylene	NE	12 UJ	9.3 UJ	10 UJ	10 UJ	11 UJ	9.9 UJ	12 UJ	6.5 J	10 U	11 U
Benzo(k)fluoranthene	NE	12 UJ	9.3 UJ	0.75 J	10 UJ	11 UJ	0.7 J	12 UJ	12	10 U	11 U
Chrysene	NE	12 UJ	9.3 UJ	10 UJ	10 UJ	11 UJ	0.88 J	12 UJ	8.8 U	10 U	11 U
Dibenz(a,h)anthracene	NE	12 UJ	9.3 UJ	10 UJ	10 UJ	11 UJ	1.4 J	12 UJ	8.8 U	10 U	11 U
Fluoranthene	NE	12 UJ	9.3 UJ	10 UJ	10 UJ	11 UJ	9.9 UJ	12 UJ	8.8 U	10 U	11 U
Fluorene	NE	12 UJ	9.3 UJ	10 UJ	10 UJ	11 UJ	0.99 J	12 UJ	8.8 U	10 U	11 U
Indeno(1,2,3-cd)pyrene	NE	12 UJ	9.3 UJ	1 J	10 UJ	11 UJ	0.85 J	12 UJ	15	10 U	11 U
Naphthalene	NE	12 UJ	9.3 UJ	10 UJ	10 UJ	11 UJ	9.9 UJ	12 UJ	8.8 U	10 U	11 U
Phenanthrene	NE	12 UJ	9.3 UJ	10 UJ	10 UJ	11 UJ	9.9 UJ	12 UJ	8.8 U	10 U	11 U
Pyrene	NE	12 UJ	9.3 UJ	10 UJ	10 UJ	11 UJ	9.9 UJ	12 UJ	24	2.1 J	11 U

TABLE 6-4

SUMMARY OF DETECTED RESULTS - SUBUSRFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITIY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	NAPR Basewide Background	59SB14	59SB15	59SB15	59SB16	59SB16	59SB17	59SB17	59SB18	59SB18	59SB19
Sample ID		59SB14-05	59SB15-01	59SB15-05	59SB16-01	59SB16-05	59SB17-01	59SB17-05	59SB18-01	59SB18-02	59SB19-01
Sample Date		5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/19/2010
Sample Depth (ft bgs)		9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	3.0 - 5.0	1.0 - 3.0
LLPAH Totals (µg/kg)											
Low molecular weight PAHs	NE	96	74.4	80	71.1	78.4	79.2	96	65.31	80	88
High molecular weight PAHs	NE	108	83.7	71.75	90	99	44.42	108	103.8	82.1	99
Pesticides (µg/kg)											
4,4'-DDD	NE	4.7 U	3.7 U	4 U	4.1 U	4.3 U	3.9 U	4.6 U	0.39 J	4.1 U	4.3 U
4,4'-DDE	NE	4.7 U	0.66 J	4 U	4.1 U	4.3 U	3.9 U	4.6 U	1.2 J	4.1 U	4.3 U
4,4'-DDT	NE	4.7 U	3.7 U	4 U	4.1 U	4.3 U	3.9 U	4.6 U	1.3 J	4.1 U	4.3 U
BHC, beta-	NE	1.2 U	8.9 NJ	1 U	1.1 U	1.1 U	1 U	1.2 U	1.8 U	2.1 U	2.2 U
BHC, delta-	NE	2.4 U	1.9 U	2 U	2.1 U	2.2 U	2 U	2.4 U	1.8 U	2.1 U	2.2 U
Chlordane, alpha-	NE	2.4 U	1.9 U	2 U	2.1 U	2.2 U	2 U	2.4 U	1.8 U	2.1 U	2.2 U
Endrin	NE	4.7 U	3.7 U	4 U	4.1 U	4.3 U	3.9 U	4.6 U	3.5 U	4.1 U	4.3 U
Endrin Aldehyde	NE	4.7 U	3.7 U	4 U	4.1 U	4.3 U	3.9 U	4.6 U	0.53 J	4.1 U	4.3 U
Heptachlor	NE	2.4 U	1.9 U	2 U	2.1 U	2.2 U	2 U	2.4 U	1.8 U	2.1 U	2.2 U
Metals (mg/kg)											
Antimony	NE	7 UJ	1 J	5.9 UJ	6.2 UJ	6.3 UJ	5.7 UJ	6.7 UJ	1.1 J	0.97 J	1.2 J
Arsenic	1.59	3.5 U	0.63	3 U	3.1 U	3.2 U	1 J	3.4 U	1.8	0.23 J	0.51 J
Barium	220	61.8	58	139	76.8	31.4 J	89.1	49.1	51.2	62.6	161
Beryllium	0.596	3.5 U	0.18 J	3 U	0.34 J	3.2 U	0.37 J	0.86 J	0.4 J	0.65	0.71
Cadmium	0.622	0.52 J	0.23 J	0.38 J	3.1 U	0.38 J	0.43 J	3.4 U	0.68	0.75	0.77
Chromium	114.5	7 UJ	32.1 J	22.5 J	29.5 J	232 J	57.2 J	21 J	14.3	8.1	23.1
Cobalt	26.9	30.9	27.7	16.4	31.6	25.7	28.6	44.7	14.4 J	21.5 J	20.2 J
Copper	246	9.8	56.2	66.2	115	50.5	109	57.1	51.1 J	83.3 J	64.6 J
Lead	6.3	3.5 U	3.2	3	3.1 U	12.5	24.6	3.4 U	31.3	2	1.9
Mercury	0.108	0.016 J	0.037 U	0.04 U	0.041 U	0.13	0.032 J	0.012 J	0.009 J	0.008 J	0.043 U
Nickel	24.7	9	13.3	11.4	14.1	44.4	47.3	27.9	8.4	9.8	14.2
Selenium	5.94	17.4 U	0.21 J	14.8 U	15.5 U	15.8 U	0.95 J	16.8 U	2 J	2.1 J	2.4 J
Silver	NE	3.5 U	0.56 U	3 U	3.1 U	3.2 U	2.8 U	3.4 U	0.43 J	0.54 J	0.57 J
Thallium	0.92	3.5 U	0.072 J	3 U	3.1 U	3.2 U	2.8 U	3.4 U	0.4 J	0.53 J	0.5 J
Tin	4	7 U	5.6 U	5.9 U	6.2 U	6.3 U	26	6.7 U	5.1 UJ	6.1 UJ	6.5 UJ
Vanadium	434	152	125	189	214	71.3	188	89	65.3 J	118 J	87.2 J
Zinc	88	79.4	78.4	85.1	40.2	113	148	94.6	50.7	63.5	67.3

TABLE 6-4

SUMMARY OF DETECTED RESULTS - SUBUSRFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITIY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	NAPR Basewide Background	59SB19	59SB20	59SB20	59SB21	59SB21	59SB21	59SB22	59SB22	59SB23	59SB23
Sample ID		59SB19-05	59SB20-01	59SB20-05	59SB21-01	59SB21-01D	59SB21-05	59SB22-01	59SB22-05	59SB23-01	59SB23-05
Sample Date		5/19/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010
Sample Depth (ft bgs)		9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Volatile Organics (µg/kg)											
Acetone	NE	14 U	10 U	13 U	10 U	10 U	9.9 U	40	11 U	10 U	16 U
Benzene	NE	5.5 U	4.1 U	5.3 U	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
Bromoform	NE	5.5 U	4.1 U	5.3 U	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
Bromomethane	NE	5.5 U	4.1 U	5.3 U	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
Carbon Disulfide	NE	5.5 U	4.1 U	5.3 U	4.2 U	4 U	4 U	0.54 J	0.99 J	4.2 U	1.6 J
Chloromethane	NE	5.5 U	4.1 U	5.3 U	4.2 U	4 U	4 U	0.43 J	4.2 U	4.2 U	5.2 U
Dibromochloromethane	NE	5.5 U	4.1 U	5.3 U	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
Methyl Iodide	NE	5.5 U	4.1 U	5.3 U	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
Xylene, m/p-	NE	11 U	8.1 U	11 U	8.3 U	8.1 U	7.9 U	7.8 U	8.5 U	8.4 U	10 U
Xylenes, total	NE	5.5 U	4.1 U	5.3 U	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
Semivolatile Organics (µg/kg)											
Bis(2-ethylhexyl) Phthalate (BEHP)	NE	230 U	180 U	190 U	180 U	180 U	180 U	200 U	210 U	190 U	230 U
Di-n-octyl Phthalate	NE	230 U	180 U	190 U	180 U	180 U	180 U	55 J	210 U	190 U	230 U
LLPAHs (µg/kg)											
2-Methylnaphthalene	NE	11 U	9 U	9.4 U	9 U	8.9 U	8.9 U	9.5 U	10 U	9.4 U	11 U
Acenaphthene	NE	11 U	9 U	9.4 U	9 U	8.9 U	8.9 U	9.5 U	10 U	9.4 U	11 U
Acenaphthylene	NE	11 U	9 U	9.4 U	9 U	8.9 U	8.9 U	9.5 U	10 U	9.4 U	11 U
Anthracene	NE	11 U	9 U	9.4 U	9 U	8.9 U	8.9 U	9.5 U	10 U	9.4 U	11 U
Benzo(a)anthracene	NE	11 U	9 U	9.4 U	9 U	8.9 U	8.9 U	9.5 U	10 U	9.4 U	11 U
Benzo(a)pyrene (BaP)	NE	11 U	9 U	9.4 U	9 U	8.9 U	8.9 U	9.5 U	10 U	9.4 U	11 U
Benzo(b)fluoranthene	NE	11 U	9 U	9.4 U	9 U	8.9 U	8.9 U	9.5 U	10 U	9.4 U	11 U
Benzo(g,h,i)perylene	NE	11 U	9 U	9.4 U	9 U	8.9 U	8.9 U	9.5 U	10 U	9.4 U	11 U
Benzo(k)fluoranthene	NE	11 U	9 U	9.4 U	9 U	8.9 U	8.9 U	9.5 U	10 U	9.4 U	11 U
Chrysene	NE	11 U	9 U	9.4 U	9 U	8.9 U	8.9 U	9.5 U	10 U	9.4 U	11 U
Dibenz(a,h)anthracene	NE	11 U	9 U	9.4 U	9 U	8.9 U	8.9 U	9.5 U	10 U	9.4 U	11 U
Fluoranthene	NE	11 U	9 U	9.4 U	9 U	8.9 U	8.9 U	9.5 U	10 U	9.4 U	11 U
Fluorene	NE	11 U	9 U	9.4 U	9 U	8.9 U	8.9 U	9.5 U	10 U	9.4 U	11 U
Indeno(1,2,3-cd)pyrene	NE	11 U	9 U	9.4 U	9 U	8.9 U	8.9 U	0.88 J	10 U	9.4 U	11 U
Naphthalene	NE	11 U	9 U	9.4 U	9 U	8.9 U	8.9 U	9.5 U	10 U	9.4 U	11 U
Phenanthrene	NE	11 U	9 U	9.4 U	9 U	8.9 U	8.9 U	9.5 U	10 U	9.4 U	11 U
Pyrene	NE	11 U	9 U	9.4 U	9 U	8.9 U	8.9 U	1.5 J	10 U	9.4 U	11 U

TABLE 6-4

SUMMARY OF DETECTED RESULTS - SUBUSRFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITIY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	NAPR Basewide Background	59SB19	59SB20	59SB20	59SB21	59SB21	59SB21	59SB22	59SB22	59SB23	59SB23
Sample ID		59SB19-05	59SB20-01	59SB20-05	59SB21-01	59SB21-01D	59SB21-05	59SB22-01	59SB22-05	59SB23-01	59SB23-05
Sample Date		5/19/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010
Sample Depth (ft bgs)		9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
LLPAH Totals (µg/kg)											
Low molecular weight PAHs	NE	88	72	75.2	72	71.2	71.2	76	80	75.2	88
High molecular weight PAHs	NE	99	81	84.6	81	80.1	80.1	68.88	90	84.6	99
Pesticides (µg/kg)											
4,4'-DDD	NE	4.4 UJ	3.6 U	3.8 U	3.6 U	3.5 U	3.5 U	3.8 U	4.1 UJ	3.8 U	4.4 U
4,4'-DDE	NE	4.4 UJ	3.6 U	3.8 U	3.6 U	3.5 U	3.5 U	3.8 U	4.1 UJ	2.9 J	0.69 J
4,4'-DDT	NE	4.4 UJ	3.6 U	3.8 U	3.6 U	3.5 U	3.5 U	3.8 U	4.1 UJ	0.63 J	4.4 U
BHC, beta-	NE	2.3 UJ	1.8 U	1.9 U	1.8 U	1.8 U	1.8 U	2 U	2.1 UJ	1.9 U	2.3 U
BHC, delta-	NE	2.3 UJ	1.8 U	1.9 U	1.8 U	1.8 U	1.8 U	2 U	2.1 UJ	1.9 U	2.3 U
Chlordane, alpha-	NE	2.3 UJ	1.8 U	1.9 U	1.8 U	1.8 U	1.8 U	2 U	2.1 UJ	1.9 U	2.3 U
Endrin	NE	4.4 UJ	3.6 U	3.8 U	3.6 U	3.5 U	3.5 U	3.8 U	4.1 UJ	3.8 U	4.4 U
Endrin Aldehyde	NE	4.4 UJ	3.6 U	3.8 U	3.6 U	3.5 U	3.5 U	3.8 U	4.1 UJ	3.8 U	4.4 U
Heptachlor	NE	2.3 UJ	1.8 U	1.9 U	1.8 U	1.8 U	1.8 U	2 U	2.1 UJ	1.9 U	2.3 U
Metals (mg/kg)											
Antimony	NE	1.1 J	0.15 J	5.6 UJ	5.3 UJ	5.2 UJ	5.3 UJ	5.3 UJ	5.9 UJ	5.6 UJ	6.4 UJ
Arsenic	1.59	3 U	0.54 U	2.8 U	2.6 U	2.6 U	2.7 U	2.6 U	2.9 U	2.8 U	3.2 U
Barium	220	312	29.5	54.4	111	98.3	52.3	118	158	88.3	113
Beryllium	0.596	0.63 J	0.091 J	2.8 U	2.6 U	2.6 U	0.27 J	2.6 U	0.32 J	0.34 J	0.35 J
Cadmium	0.622	0.77 J	0.12 J	0.31 J	0.44 J	0.41 J	0.43 J	0.52 J	2.9 U	0.37 J	3.2 U
Chromium	114.5	33.5	24.4	63.9	16.3	9.7	17.3	32.7	54.7	34.5	67.2
Cobalt	26.9	12.9 J	9.8 J	19 J	21 J	19 J	15.2 J	22.1 J	16.8 J	22.6 J	20.1 J
Copper	246	37.4 J	34.9 J	73.1 J	54 J	44.3 J	104 J	74.8 J	119 J	79.4 J	74.8 J
Lead	6.3	3 U	2	2.8 U	2.6 U	3	2.7 U	15.7	13.7	18.7	6.8
Mercury	0.108	0.044 U	0.036 U	0.038 U	0.01 J	0.036 U	0.01 J	0.038 U	0.024 J	0.022 J	0.034 J
Nickel	24.7	10.2	9.8	25.6	7.9	6.3	5.3	16.9	12.6	14.4	20.3
Selenium	5.94	2.9 J	0.2 J	14 U	13.2 U	13.1 U	13.3 U	13.2 U	1.1 J	0.97 J	16 U
Silver	NE	0.56 J	0.12 J	2.8 U	2.6 U	2.6 U	2.7 U	2.6 U	2.9 U	2.8 U	3.2 U
Thallium	0.92	0.45 J	0.54 U	2.8 U	2.6 U	2.6 U	2.7 U	2.6 U	2.9 U	2.8 U	3.2 U
Tin	4	6.1 UJ	5.4 UJ	5.6 UJ	5.3 UJ	5.2 UJ	5.3 UJ	5.3 UJ	5.9 UJ	5.6 UJ	6.4 UJ
Vanadium	434	59.7 J	43.5 J	135 J	93.1 J	78.7 J	72.3 J	126 J	182 J	171 J	214 J
Zinc	88	57.9	39.3	54.1	132	126	88.1	71.8 J	49.9	119	58.6

TABLE 6-5

SUMMARY OF DETECTED RESULTS - SUBSURFACE SOIL, 2012 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	NAPR Basewide Background	59SB24	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID		59SB24-01	59SB24-01D	59SB25-01	59SB26-01	59SB27-01	59SB28-01	59SB29-01	59SB30-01	59SB31-01	59SB32-01	59SB33-01
Date		9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Depth Range (ft bgs)		1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0
Volatile Organics (µg/kg)												
Acetone	NE	11 UJ	11 U	16 J	11 U	12 U	9.1 U	40 J	14 J	15 U	9.5 U	12 U
Methylene Chloride	NE	0.99 U	0.98 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	7.2	0.86 U	1.1 U
Semivolatile Organics (µg/kg)												
2,4-Dimethylphenol	NE	9.7 U	9.7 U	17 J	10 U	11 U	8.6 U	10 U	10 U	11 U	9.6 U	10 U
Bis(2-ethylhexyl) phthalate	NE	12 J	8.3 J	59 J	43 J	14 J	15 J	7.9 U	18 J	8.6 J	8.5 J	8.3 U
Pentachlorobenzene	NE	4.2 U	5.6 J	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
LLPAHs (µg/kg)												
Phenanthrene	NE	8.6 U	8.5 U	8.8 U	9.2 U	9.5 U	7.6 U	4.6 J	9.1 U	9.5 U	8.4 U	9.2 U
LLPAH Totals (µg/kg)												
Low Molecular Weight PAHs	NE	38	37.9	38.9	40.7	42.4	33.5	35.4	40.6	42.4	37.8	40.7
High Molecular Weight PAHs	NE	42.2	42.1	43.2	45.2	47.1	37.2	44	45.1	47.1	42	45.2
Metals (mg/kg)												
Arsenic	1.59	1.2	1.1	1.1	1	0.7	1.1	0.95	1	0.74	1.1	0.86
Barium	220	120	120	120	77	120	30	110	120	81	51	43 J
Beryllium	0.596	0.5	0.44	0.24	0.42	0.12	0.13	0.27	0.22	0.24	0.31	0.14
Cadmium	0.622	0.048 J	0.04 J	0.45	0.22	0.11	0.043 J	0.049 J	0.034 U	0.041 J	0.016 J	0.066 J
Chromium	114.5	45	36	63	60	25	23	64	70	110	16	120
Cobalt	26.9	16 J	18 J	24 J	15 J	16 J	15 J	15 J	4.7 J	14 J	3.5 J	15 J
Copper	246	210	200	60	110	73	150	89	110	48	67	110
Mercury	0.108	0.01 U	0.011 U	0.067	0.011 U	0.013 J	0.0091 U	0.083	0.011 U	0.011 U	0.011 U	0.011 J
Nickel	24.7	18	16	29	43	26	14	25	17	32	5.7	44
Selenium	5.94	0.31 U	0.32 U	0.69	0.34 U	0.35 U	0.28 U	0.56 J	0.49 J	0.35 U	0.57 J	0.35 U
Silver	NE	0.063 U	0.063 U	0.064 U	0.068 U	0.07 U	0.055 U	0.065 U	0.067 U	0.07 U	0.064 U	0.26
Thallium	0.92	0.031 U	0.032 U	0.032 U	0.034 U	0.035 U	0.028 U	0.033 U	0.034 U	0.035 U	0.037 J	0.035 U
Vanadium	434	180	150	170	180	170	110	280	280	320	140	400
Zinc	88	62	51	61	77	41	47	56	35	39	68	47

TABLE 6-5

SUMMARY OF DETECTED RESULTS - SUBSURFACE SOIL, 2012 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Notes/Qualifiers:

J - Estimated: The analyte was positively identified; the quantitation is an estimation.
U - Not detected at the Limit of Detection.
ft bgs - feet below ground surface
LLPAHs - Low Level Polynuclear Aromatic Hydrocarbons
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram
NAPR - Naval Activity Puerto Rico
NE - Not Established

TABLE 6-6

SUMMARY OF DETECTED RESULTS - GROUNDWATER, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	NAPR	59SB01	59SB02	59SB02	59SB03	59SB04	59SB05	59SB06	59SB07	59SB08	59SB09	59SB10
Sample ID	Basewide	59GW01	59GW02	59GW02D	59GW03	59GW04	59GW05	59GW06	59GW07	59GW08	59GW09	59GW10
Sample Date	Background	5/22/2010	5/23/2010	5/23/2010	5/22/2010	5/23/2010	5/22/2010	5/21/2010	5/21/2010	5/22/2010	5/21/2010	5/22/2010
Volatile Organics (µg/L)												
Benzene	NE	0.5 U	0.5 U	0.5 U	0.5 U	0.06 J	0.5 U	0.5 U	0.04 J	0.07 J	0.1 J	0.5 U
Carbon Disulfide	NE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.06 J	0.05 J	0.5 U	0.15 J	0.5 U
Semivolatile Organics (µg/L)												
Bis(2-ethylhexyl) Phthalate (BEHP)	NE	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	2.4 J	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
LLPAHs (µg/L)												
Naphthalene	NE	0.2 UJ	0.21 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	1.3 J	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Phenanthrene	NE	0.2 UJ	0.21 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.05 J
Pyrene	NE	0.01 J	0.21 UJ	0.01 J	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Pesticides (µg/L)												
Chlordane, alpha-	NE	0.06 U	0.06 U	0.05 U	0.06 U	0.02 NJ	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Total Metals (µg/L)												
Antimony	12.24	0.5 J	2 U	2 U	0.52 J	0.36 J	0.26 J	2 U	0.26 J	2 U	0.54 J	2 U
Arsenic	18.89	6.2	4.5	4.4	1.1	2.9	3.1	4.1	4.3	0.94 J	2.9	2.1
Barium	686	22.2	46	46.5	20.4	16.2	6.5 J	49.1	15.1	27.9	7.5 J	34.4
Beryllium	2.21	1 U	1 U	1 U	0.06 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Cadmium	16.62	0.71 J	1 U	1 U	0.19 J	0.26 J	0.09 J	0.67 J	1 U	0.11 J	0.07 J	1 U
Chromium	162.41	1.4 J	0.48 J	0.48 J	5.5	0.6 J	1.3 J	2.2	0.67 J	0.46 J	0.58 J	0.6 J
Cobalt	633.21	2.6	2.1	2	5.8	1.9	1.5	5.5	0.81 J	0.77 J	0.3 J	1.8
Copper	324	21.3	4.7 J	4.5	20.1	8.7	8	10.9	8.2	3.9	5	4.3
Lead	26.25	1 U	1 U	1 U	5	1 U	1 U	1.7	1 U	1 U	1 U	1 U
Nickel	95.74	8	1.2	1.2	4.6	2.8	2.1	3.9	2.4	1 U	1.6	1.8
Selenium	29.88	24.2	13.9	13.2	0.48 J	11.7	15.3	18.1	10.1	4.1 J	2.1 J	2.5 J
Silver	18.31	0.65 J	1 UJ	1 UJ	0.06 J	0.19 J	0.05 J	0.41 J	0.08 J	1 UJ	1 UJ	1 UJ
Thallium	NE	0.43 J	1 U	1 U	1 U	0.2 J	0.1 J	1 U	0.2 J	1 U	0.1 J	1 U
Vanadium	484.66	24.9	9.1	9.2	66.2	20.2	107	22.2	97	30.1	85.1 J	171

TABLE 6-6

SUMMARY OF DETECTED RESULTS - GROUNDWATER, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	NAPR	59SB01	59SB02	59SB02	59SB03	59SB04	59SB05	59SB06	59SB07	59SB08	59SB09	59SB10
Sample ID	Basewide	59GW01	59GW02	59GW02D	59GW03	59GW04	59GW05	59GW06	59GW07	59GW08	59GW09	59GW10
Sample Date	Background	5/22/2010	5/23/2010	5/23/2010	5/22/2010	5/23/2010	5/22/2010	5/21/2010	5/21/2010	5/22/2010	5/21/2010	5/22/2010
Dissolved Metals (µg/L)												
Antimony	11.19	0.45 J	0.23 J	2 U	0.3 J	0.47 J	0.23 J	2 U	0.25 J	2 U	0.44 J	2 U
Arsenic	14.03	5.3	4.4	4	0.92 J	2.7	3	3.7	4.2	1	2.4	2.3
Barium	260	21.3	44.2	44.7	4.6 J	13.7	6.1 J	45.7	15.7	27.3	6.6 J	31.5
Cadmium	36.42	0.55 J	1 U	1 U	1 U	0.19 J	0.1 J	0.55 J	1 U	1 U	1 U	1 U
Chromium	6.5	1.4 J	0.42 J	0.54 J	2 U	0.6 J	1.2 J	1.3 J	0.69 J	0.27 J	0.47 J	0.33 J
Cobalt	580.5	2.6	2	1.9	0.4 J	1.3	1.3	3.5	0.84 J	0.69 J	0.19 J	1.5
Copper	29	19	5.8 J	4.5	2.3	9.7	8.2	8.3	8.4	3.4	4.3	3.9
Nickel	84.1	8.3	1 U	1.1	1 U	2.7	2.3	3.3	2.6	1 U	1.4	1.7
Selenium	23.92	23.8	14.1	12.6	0.6 J	12	16	19.3	10.4	4.7 J	2.2 J	2.8 J
Silver	3.67	0.05 J	1 U	1 U	1 U	0.06 J	1 U	1 U	1 U	1 U	1 U	1 U
Thallium	NE	0.39 J	1 U	1 U	1 U	0.29 J	0.08 J	1 U	0.19 J	1 U	0.1 J	1 U
Vanadium	20.96	22.8	9.5	9.4	57.6	19.8	106	16.8	102	29.6	113 J	179
Zinc	360.64	13.4 J	12.1 R	3.7 R	2.6 J	8.2 J	3.8 J	4.8 J	2.8 J	2 UJ	4.4 J	2 UJ

Notes:

J - Estimated: The analyte was positively identified; the quantitation is an estimation.
U - Non detected at the Limit of Detection.
UJ - Reported quantitation limit is qualified as estimated.
R - Rejected data; data is not usable.
NJ - Analyte has been tentatively identified; the quantitation is as estimation.
LLPAHs - Polynuclear Aromatic Hydrocarbons
µg/L - microgram per liter
NAPR - Naval Activity Puerto Rico
NE - Not Established

TABLE 6-7

SUMMARY OF DETECTED RESULTS - SURFACE WATER, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	NAPR	59SW01	59SW02	59SW03
Sample ID	Basewide	59SW01	59SW02	59SW03
Sample Date	Background	4/20/2010	5/20/2010	5/20/2010
Volatile Organics (µg/L)				
Bromodichloromethane	NE	0.34 J	0.5 U	0.5 U
Carbon Disulfide	NE	0.5 U	0.5 U	0.021 J
Chloroform	NE	1.2	0.5 U	0.5 U
Dibromochloromethane	NE	0.16 J	0.5 U	0.5 U
Semivolatile Organics (µg/L)		ND	ND	ND
PAHs (µg/L)				
Fluoranthene	NE	0.2 U	0.019 J	0.017 J
Pyrene	NE	0.2 U	0.02 J	0.018 J
Pesticides (µg/L)				
4,4'-DDE	NE	0.006 J	0.1 U	0.1 U
4,4'-DDT	NE	0.0065 J	0.1 U	0.1 U
Total Metals (µg/L)				
Antimony	NE	2 U	0.26 J	0.23 J
Arsenic	1.47	0.49 J	0.44 J	0.42 J
Barium	145	21.4	19.9	19.4
Calcium	NE	18900	NA	NA
Chromium	4.83	0.68 J	0.76 J	0.75 J
Cobalt	9.35	0.32 J	0.34 J	0.34 J
Copper	23.1	3.8	4	4
Selenium	NE	0.75 J	0.52 J	0.47 J
Vanadium	22.1	7	7.6	7.3
Zinc	13.4	7.9 J	7 R	7.1 R
Dissolved Metals (µg/L)				
Antimony	NE	2 U	0.23 J	0.23 J
Arsenic	NE	0.52 J	0.41 J	0.4 J
Barium	144	20.5	17.8	17.7
Chromium	NE	0.39 J	0.4 J	0.39 J
Cobalt	8.33	0.084 J	0.062 J	0.061 J
Copper	8.72	3.1	3	2.9
Selenium	NE	0.82 J	0.51 J	0.48 J
Vanadium	10.4	6.3	6.1	6.1
Zinc	NE	5.5 J	2.2 J	2.4 J

Notes:

J - Estimated_ The analyte was positively identified: the quantitation is an estimation.
U - Non detected at the Limit of Detection.
R - Rejected data; data is not usable.
µg/L - microgram per liter
NA - Not Analyzed
NAPR - Naval Activity Puerto Rico
ND - Not Detected
NE - Not established
PAHs - Polynuclear Aromatic Hydrocarbons

TABLE 6-8

SUMMARY OF DETECTED RESULTS - SEDIMENT, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	NAPR Basewide Background	59SD01	59SD02	59SD03
Sample ID		59SD01	59SD02	59SD03
Sample Date		4/22/2010	5/20/2010	5/20/2010
Sample Depth (ft bgs)		0.0 - 0.5	0.0 - 0.5	0.0 - 0.5
Volatile Organics (µg/kg)				
Acetone	NE	28 R	150 J	78
Carbon Disulfide	NE	2.3 J	12 UJ	6.7 U
Xylene, m/p-	NE	0.79 J	24 UJ	13 U
Xylenes, total	NE	0.79 J	12 UJ	6.7 U
Semivolatile Organics (µg/kg)				
Bis(2-ethylhexyl) Phthalate (BEHP)	NE	140 J	110 J	730
Butyl Benzyl Phthalate	NE	63 J	360 UJ	310 U
LLPAHs (µg/L)				
2-Methylnaphthalene	NE	4.4 J	360 UJ	310 U
Acenaphthylene	NE	1.6 J	360 UJ	310 U
Anthracene	NE	4.6 J	360 UJ	310 U
Benzo(a)anthracene	NE	5 J	360 UJ	310 U
Chrysene	NE	6.9 J	360 UJ	310 U
Fluoranthene	NE	7.2 J	360 UJ	36 J
Fluorene	NE	2.3 J	360 UJ	310 U
Indeno(1,2,3-cd)pyrene	NE	8.3 J	360 UJ	310 U
Phenanthrene	NE	6.3 J	360 UJ	310 U
Pyrene	NE	8.8 J	360 UJ	41 J
Pesticides (µg/kg)				
4,4'-DDD	NE	1.6 J	2.6 J	5.9 J
4,4'-DDE	NE	35 J	32 J	160
4,4'-DDT	NE	1.3 J	7 UJ	6 U
Aldrin	NE	3.5 UJ	3.6 UJ	0.66 J
Chlordane, alpha-	NE	2.1 NJ	25 NJ	3.1 U
Chlordane, gamma-	NE	18 J	31 J	3.1 U
Dieldrin	NE	0.9 J	7 UJ	6 U
Endrin Aldehyde	NE	1.1 J	0.87 J	6 U
Heptachlor	NE	3.5 UJ	1.2 J	3.1 U
Metals (mg/kg)				
Antimony	7.87	2.1 UJ	0.8 J	0.58 J
Arsenic	4.21	0.98 J	0.65 J	1.5
Barium	224	81.6 J	164 J	109 J
Beryllium	0.70	0.38 J	0.45 J	0.35 J
Cadmium	0.32	0.9 J	0.69 J	0.99 J
Chromium	63.9	39.1 J	42.1 J	37.3
Cobalt	58.9	20.9 J	31.9 J	22.4 J
Copper	131	125 J	144 J	90.7 J
Lead	26.8	71.2 J	37.6 R	36.9 R
Mercury	0.15	0.087	0.033 J	0.19
Nickel	18.5	18.7 J	22.6 J	28.1
Selenium	3.21	0.8 J	1 J	0.69 J
Silver	NE	0.17 J	0.23 J	0.17 J
Thallium	0.24	1 UJ	0.14 J	0.053 J
Vanadium	278	156 J	232 J	144 J
Zinc	105	122 J	139 J	176

TABLE 6-8

SUMMARY OF DETECTED RESULTS - SEDIMENT, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	NAPR Basewide Background	59SD01	59SD02	59SD03
Sample ID		59SD01	59SD02	59SD03
Sample Date		4/22/2010	5/20/2010	5/20/2010
Sample Depth (ft bgs)		0.0 - 0.5	0.0 - 0.5	0.0 - 0.5
TOC (mg/kg				
Total Organic Carbon	NE	21290	21000	68100
AVS/SEM Metals (µMole/g)				
Cadmium	NE	NA	0.00305	0.00269
Copper	NE	NA	0.588	0.339
Lead	NE	NA	0.071 J	0.0485 J
Nickel	NE	NA	0.075	0.066
Zinc	NE	NA	0.92	1.12
Sulfide (µMole/g)				
Sulfide	NE	NA	0.17 U	0.15
Total Solids (%)				
Solids, Total	NE	NA	50.3	62.5

Notes:

J - Estimated: The analyte was positively identified; the quantitation is an estimation.
U - Non detected at the Limit of Detection.
UJ - Reported quantitation limit is qualified as estimated.
R - Rejected data; data is not usable.
NJ - Analyte has been tentatively identified; the quantitation is an estimation.
% - percent
AVS - Acid Volatile Sulfide
ft bgs - feet below ground surface
LLPAHs - Polynuclear Aromatic Hydrocarbons
µg/kg microgram per kilogram
µMole/g - micromole per gram
mg/kg - milligram per kilogram
NA - Not Analyzed
NAPR - Naval Activity Puerto Rico
NE - Not Established
SEM - Simultaneously Extracted Metals.
TOC - Total Organic Carbon

TABLE 6-9

SUMMARY OF DETECTED RESULTS - SEDIMENT, 2012 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	NAPR Basewide Background	59SD04	59SD04	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Sample ID		59SD04	59SD04D	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Sample Date		9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012
Depth Range (ft bgs)		0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5
Metals (mg/kg)											
Copper	131	107	83.8	187 J	160 J	87.6 J	134 J	36.2 J	78.3 J	161 J	52.4 J
Lead	26.8	45.3 J	30.1 J	55 J	70 J	20.4 J	23.1 J	4.92 J	10.9 J	22.6 J	4.93 J
Zinc	105	193 J	130 J	357 J	319 J	191 J	154 J	71.7 J	108 J	232 J	262 J

Notes:

J - Estimated: The analyte was positively identified; the quantitation is an estimation.
ft bgs - feet below grounds surface
mg/kg - milligram per kilogram
NAPR - Naval Activity Puerto Rico

TABLE 6-10

SUMMARY OF DETECTED RESULTS - QA/QC SAMPLES, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENACNE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

	Equipment Rinsates										
Sample ID	59ER01	59ER02	59ER03	59ER04	59ER05	59ER06	59ER07	59ER08	59ER09	59ER10	59ER11
Sample Date	4/19/2010	4/20/2010	4/21/2010	4/22/2010	5/18/2010	5/19/2010	5/20/2010	5/21/2010	5/22/2010	5/23/2010	5/24/2010
Volatile Organics (µg/L)											
2-Butanone (MEK)	1.1 J	1.2 J	1.3 J	2.5 R	1.1 J	1 J	1.1 J	1.4 J	1.2 J	2.5 R	2.1 J
Acetone	3.4 J	2.8 J	3.6 J	0.71 J	3.4 J	3.9 J	82 J	88 J	100 J	90 J	5.7 J
Carbon Disulfide	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.055 J	0.029 J	0.5 U
Chlorobenzene	0.27 J	0.13 J	0.061 J	0.5 U	0.5 U	0.5 U	0.33 J	0.27 J	0.13 J	0.029 J	0.17 J
Chloroform	0.086 J	0.077 J	0.053 J	0.5 U	0.043 J	0.041 J	0.28 J	0.3 J	0.22 J	0.12 J	0.086 J
Methylene Chloride	4.6	4	3.4	0.34 J	1.2	1.2	4.7	4.6	4.6	2.7	4.5
Toluene	1.8	0.97	0.51	0.085 J	0.22 J	0.16 J	1.7	1.4	0.8	0.3 J	1.1 J
Xylene, m/p-	1 U	1 U	1 U	1 U	1 U	1 U	0.095 J	1 U	1 U	1 U	1 U
Xylene, o-	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.057 J	0.048 J	0.033 J	0.5 U	0.5 U
Xylenes, total	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.1 J	0.5 U	0.5 U	0.5 U	0.5 U
Semivolatile Organics (µg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
LLPAHs (µg/L)											
2-Methylnaphthalene	0.21 UJ	0.021 J	0.032 J	0.21 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.21 UJ	NA
Naphthalene	0.045 J	0.075 J	0.089 J	0.21 UJ	0.21 UJ	0.2 UJ	0.048 J	0.042 J	0.041 J	0.04 J	NA
Pesticides (µg/L)											
BHC, beta-	0.05 U	0.05 U	0.05 U	0.05 U	0.051 U	0.05 U	0.051 U	0.05 U	0.05 U	0.05 U	NA
Metals (µg/L)											
Copper	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	NA
Lead	0.11 J	0.068 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA
Nickel	0.12 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA
Zinc	2.2	3.3	1.8 J	2	2.7	0.7 J	0.82 J	0.7 J	1.2 J	1.3 J	NA

TABLE 6-10

SUMMARY OF DETECTED RESULTS - QA/QC SAMPLES, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENACNE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

	Field Blanks		Trip Blanks					
Sample ID	59FB01	59FB02	59TB01	59TB02	59TB03	59TB04	59TB05	59TB06
Sample Date	4/19/2010	5/18/2010	4/19/2010	4/20/2010	4/22/2010	5/18/2010	5/20/2010	5/22/2010
Volatile Organics (µg/L)								
2-Butanone (MEK)	1.2 J	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R
Acetone	3 J	5 J	2.5 R	2.5 R	2.5 R	2.5 R	1.3 J	2.5 R
Carbon Disulfide	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ
Chlorobenzene	0.34 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloroform	0.12 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methylene Chloride	5.5	0.16 J	0.19 J	0.18 J	0.19 J	0.22 J	0.2 J	0.5 U
Toluene	2.4	0.19 J	0.041 J	0.045 J	0.041 J	0.13 J	0.13 J	0.5 U
Xylene, m/p-	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Xylene, o-	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Xylenes, total	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Semivolatile Organics (µg/L)	ND	ND	NA	NA	NA	NA	NA	NA
LLPAHs (µg/L)								
2-Methylnaphthalene	0.21 UJ	0.2 UJ	NA	NA	NA	NA	NA	NA
Naphthalene	0.048 J	0.2 UJ	NA	NA	NA	NA	NA	NA
Pesticides (µg/L)								
BHC, beta-	0.05 U	0.012 J	NA	NA	NA	NA	NA	NA
Metals (µg/L)								
Copper	2 U	0.8 J	NA	NA	NA	NA	NA	NA
Lead	0.07 J	0.089 J	NA	NA	NA	NA	NA	NA
Nickel	1 U	0.14 J	NA	NA	NA	NA	NA	NA
Zinc	2.2	1.3 J	NA	NA	NA	NA	NA	NA

TABLE 6-10

SUMMARY OF DETECTED RESULTS - QA/QC SAMPLES, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENACNE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Notes:

J - Estimated: The analyte was positively identified; the quantitation is an estimation.
U - Non detected at the Limit of Detection.
UJ - Reported quantitation limit is qualified as estimated.
R - Rejected data; data is not usable.
LLPAHs - Polynuclear Aromatic Hydrocarbons
µg/L - microgram per liter
NA - Not Analyzed
ND - Not Detected
QA/QC - Quality Assurance/Quality Control

TABLE 6-11

SUMMARY OF DETECTED RESULTS - QA/QC SAMPLES, 2012 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

	Equipment Rinsates		Field Blanks	Trip Blanks
Sample ID	59ER12	59ER14	59FB03	59TB07
Date	9/13/2012	9/15/2012	9/13/2012	9/13/2012
Volatile Organics (µg/L)	ND	NA	ND	ND
Semivolatile Organics (µg/L)				
Acetophenone	0.25 J	NA	0.15 J	NA
Diethyl phthalate	0.12 J	NA	0.1 UJ	NA
LLPAHs (µg/L)	ND	NA	ND	NA
Metals (µg/L)				
Barium	7.3	7.2	7	NA
Thallium	0.25 U	0.25 J	0.26 J	NA
Tin	1.5 J	1.4 U	1.4 U	NA

Notes:

J - Estimated: The analyte was positively identified; the quantitation is an estimation.
U - Non detected at the Limit of Detection.
UJ - Reported quantitation limit is qualified as estimated.
LLPAHs - Low Level Polynuclear Aromatic Hydrocarbons
µg/L - microgram per liter
NA - Not Analyzed
ND - Not Detected
QA/QC - Quality Assurance/Quality Control

TABLE 6-12

SUMMARY OF DETECTED RESULTS - QA/QC SAMPLES, 2012 PRE-EXCAVATION DELINEATION SAMPLING
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

	Equipment Rinsates		Field Blank
Sample ID	59ER13	59ER15	59FB05
Date	9/14/2012	11/10/2012	11/10/2012
Pre-Excavation Delineation Metals (µg/L)			
Copper	1.1 U	1.1 U	1.1 U
Lead	0.5 U	0.5 U	0.5 U
Zinc	8.4 U	8.4 U	8.4 U

Notes:

U - Non detected at the Limit of Detection.
µg/L - microgram per liter
NA - Not Analyzed

TABLE 6-13

PERCENT COMPLETENESS BY METHOD AND MATRIX
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Matrix	Parameter Class	Analytical Method	Total Unique Results	Fully Rejected Results	Difference	Precent Complete
Surface Soil	VOCs	8260/8260B	1,925	142	1,783	92.6%
	SVOCs	8270/8270D LL	3,016	28	2,988	99.1%
	LLPAHs	8270/8270D LL	561	0	561	100%
	Pesticides	8081B/8270	506	16	490	96.8%
	Metals	6020A/6010B/7471A	561	11	550	98.0%
Subsurface Soil	VOCs	8260/8260B	3,578	288	3,290	92.0%
	SVOCs	8270/8270D LL	5,671	56	5,615	99.0%
	LLPAHs	8270/8270D LL	1,054	0	1,054	100%
	Pesticides	8081B/8270	1,173	35	1,138	97.0%
	Metals	6020A/6010B/7471A	1,054	46	1,008	95.6%
Sediment	VOCs	8260/8260B	171	16	155	90.6%
	SVOCs	8270/8270D LL	275	3	272	98.9%
	LLPAHs	8270/8270D LL	51	0	51	100%
	Pesticides	8081B/8270	69	0	69	100%
	Metals	6020A/6010B/7471A	81	2	79	97.5%
	TOC	Lloyd Kahn	3	0	3	100%
	AVS/SEM	6010B	2	0	2	100%
	Sulfide	Draft 1991	2	0	2	100%
	Solids	160.3 Modified	2	0	2	100%
Surface Water	VOCs	8260/8260B	171	21	150	87.7%
	SVOCs	8270/8270D LL	275	5	270	98.2%
	LLPAHs	8270/8270D LL	51	0	51	100%
	Pesticides	8081B/8270	69	1	68	99%
	Total Metals	6020A/6010B/7470A	53	4	49	92%
	Dissovled Metals	6020A/6010B/7470A	51	2	49	96%
Groundwater	VOCs	8260/8260B	627	77	550	87.7%
	SVOCs	8270/8270D LL	1,012	33	979	96.7%
	LLPAHs	8270/8270D LL	187	0	187	100%
	Pesticides	8081B/8270	253	0	253	100%
	Total Metals	6020A/6010B/7470A	187	22	165	88.2%
	Dissovled Metals	6020A/6010B/7470A	187	13	174	93.0%
Total			22,878	821	22,057	96.4%

Notes:

AVS/SEM - Acid Volatile Sulfides/Simultaneously Extracted Metals
LLPAHs - Low Level Polynuclear Aromatic Hydrocarbons
SVOCs - Semivolatile Organic Compounds
TOC - Total Organic Carbon
VOCs - Volatile Organic Compounds

TABLE 7-1
LIST OF BIRDS REPORTED FROM OR HAVING THE POTENTIAL TO OCCUR AT NAVAL ACTIVITY PUERTO RICO
SWMU 59 – FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Common Name [(1)]		
Pied-billed grebe	Red-billed tropicbird	Brown pelican
Brown booby	Magnificent frigatebird	Great blue heron
Louisiana heron	Snowy egret	Great egret
Striated heron	Little blue heron	Cattle egret
Least bittern	Yellow-crowned night heron	Black-crowned night heron
White-cheeked pintail	Blue-winged teal	American widgeon
Red-tailed hawk	Osprey	Merlin
Clapper rail	American coot	Caribbean coot
Common gallinule	Piping plover [(3)(4)]	Semipalmated plover
Black-bellied plover	Wilson's plover	Killdeer
Ruddy turnstone	Black-necked stilt	Whimbrel
Spotted sandpiper	Semipalmated sandpiper	Short-billed dowitcher
Greater yellowlegs	Lesser yellowlegs	Willet
Stilt sandpiper	Pectoral sandpiper	Laughing gull
Royal tern	Sandwich tern	Bridled tern
Least tern	Brown noddy	White-winged dove
Zenaida dove	White-crowned pigeon	Mourning dove
Red-necked pigeon	Common ground dove	Bridled quail dove
Ruddy quail dove	Caribbean parakeet	Smooth-billed ani
Yellow-billed cuckoo	Mangrove cuckoo	Short-eared owl
Chuck-will's-widow	Common nighthawk	Antillean crested hummingbird
Green-throated carib	Antillean mango	Belted kingfisher

TABLE 7-1
LIST OF BIRDS REPORTED FROM OR HAVING THE POTENTIAL TO OCCUR AT NAVAL ACTIVITY PUERTO RICO
SWMU 59 – FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Common Name [1]		
Gray kingbird	Loggerhead kingbird	Stolid flycatcher
Caribbean elaenia	Purple martin	Cave swallow
Barn swallow	Northern mockingbird	Pearly-eyed thrasher
Red-legged thrush	Black-whiskered vireo	American redstart
Parula warbler	Prairie warbler	Yellow warbler
Magnolia warbler	Cape May warbler	Black-throated blue warbler
Adelaide's warbler	Palm warbler	Black and white warbler
Ovenbird	Northern water thrush	Bananaquit
Striped-headed tanager	Shiny cowbird	Black-cowled oriole
Greater Antillean grackle	Yellow-shouldered blackbird [2]	Hooded manakin
Yellow-faced grassquit	Black-faced grassquit	Least sandpiper
Western sandpiper	Puerto Rican woodpecker	Rock dove
Puerto Rican emerald	Puerto Rican flycatcher	Pin-tailed whydah
Spice finch	Ruddy duck	Peregrine falcon
Marbled godwit	Puerto Rican lizard cuckoo	Prothonotary warbler
Green-winged teal	Orange-cheeked waxbill	Roseate tern [3][4]
Least grebe	West Indian whistling duck	Puerto Rican screech owl
Puerto Rican tody	Green heron	

Notes:

[1] List of birds taken from Geo-Marine, Inc. (1998).
[2] Federally-designated endangered species.
[3] Federally-designated threatened species.
[4] Species has the potential to occur at Naval Activity Puerto Rico.

TABLE 7-2
PRELIMINARY ASSESSMENT ENDPOINTS, RISK QUESTIONS, AND MEASUREMENT ENDPOINTS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Assessment Endpoints	Risk Questions	Measurement Endpoints
Terrestrial Habitat: Survival, growth, and reproduction of terrestrial soil invertebrate communities.	Are site-related chemical concentrations in surface and subsurface soil sufficient to adversely affect terrestrial soil invertebrate communities?	Comparison of maximum chemical concentrations in surface and subsurface soil with soil screening values.
Survival, growth, and reproduction of terrestrial plant communities.	Are site-related chemical concentrations in surface and subsurface soil sufficient to adversely affect terrestrial plant communities?	Comparison of maximum chemical concentrations in surface and subsurface soil with soil screening values.
Survival, growth, and reproduction of flying mammalian herbivores (i.e., bats).	Are site-related chemical concentrations in surface and subsurface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to flying mammal species (i.e., bats) that may consume terrestrial plants from the site?	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on maximum chemical concentrations in surface and subsurface soil
Survival, growth, and reproduction of terrestrial avian herbivores.	Are site-related chemical concentrations in surface and subsurface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to avian species that may consume terrestrial plants from the site?	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on maximum chemical concentrations in surface and subsurface soil
Survival, growth, and reproduction of terrestrial avian omnivores.	Are site-related chemical concentrations in surface and subsurface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to avian species that may consume terrestrial plants and soil invertebrates from the site?	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on maximum chemical concentrations in surface and subsurface soil
Survival, growth, and reproduction of terrestrial avian carnivores.	Are site-related chemical concentrations in surface and subsurface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to avian species that may consume small mammals from the site?	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on maximum chemical concentrations in surface and subsurface soil
Survival, growth, and reproduction of terrestrial reptile communities.	Are site-related chemical concentrations in surface and subsurface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to terrestrial reptiles?	Qualitative examination of exposures and risks to ecological receptors occupying similar trophic levels.

TABLE 7-2
PRELIMINARY ASSESSMENT ENDPOINTS, RISK QUESTIONS, AND MEASUREMENT ENDPOINTS
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Assessment Endpoints	Risk Questions	Measurement Endpoints
Terestrial Habitat (continued): Survival, growth, and reproduction of terrestrial amphibian communities.	Are site-related chemical concentrations in surface and subsurface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to terrestrial amphibians?	Qualitative examination of exposures and risks to ecological receptors occupying similar trophic levels.
Drainage Ditch: Survival, growth, and reproduction of aquatic invertebrate communities.	Are site-related chemical concentrations in drainage ditch surface water and sediment sufficient to adversely affect aquatic invertebrate communities?	Comparison of maximum chemical concentrations in surface water and sediment with surface water and sediment screening values.
Survival, growth, and reproduction of aquatic plant communities.	Are site-related chemical concentrations in drainage ditch surface water and sediment sufficient to adversely affect aquatic plant communities?	Comparison of maximum chemical concentrations in surface water and sediment with surface water and sediment screening values.
Survival, growth, and reproduction of fish communities.	Are site-related chemical concentrations in drainage ditch surface water and sediment sufficient to adversely affect fish communities?	Comparison of maximum chemical concentrations in surface water and sediment with surface water and sediment screening values.
Survival, growth, and reproduction of amphibian communities.	Are site-related chemical concentrations in drainage ditch surface water and sediment sufficient to cause adverse effects (on growth, survival, or reproduction) to aquatic amphibians?	Comparison of maximum chemical concentrations in surface water and sediment with surface water and sediment screening values.
Survival, growth, and reproduction of avian piscivores	Are site-related chemical concentrations in drainage ditch sediment sufficient to cause adverse effects (on growth, survival, or reproduction) to avian piscivore species that may consume fish from the site?	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on maximum chemical concentrations in drainage ditch sediment.

TABLE 7-3
LOG K_{ow} AND K_{oc} VALUES FOR ORGANIC CHEMICALS
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Chemical	Log K_{ow} Range	Recommended Log K_{ow}	Reference	K_{oc} (1) (L/Kg)	Bioaccumulative Chemical (2)
Volatile Organics:					
1,1,1,2-Tetrachloroethane	2.63 to 3.03	2.63	USEPA 1995	385	Yes
1,1,1-Trichloroethane	2.47 to 2.51	2.48	USEPA 1995	274	No
1,1,2,2-Tetrachloroethane	2.31 to 2.64	2.39	USEPA 1995	224	No
1,1,2-Trichloroethane	2.03 to 2.07	2.05	USEPA 1995	104	No
1,1-Dichloroethane	1.78 to 1.85	1.79	USEPA 1995	57.5	No
1,1-Dichloroethene	2.13 to 2.37	2.13	USEPA 1995	124	No
1,2,3-Trichloropropane	1.98 to 2.63	2.25	USEPA 1995	163	No
1,2-Dibromo-3-chloropropane	2.26 to 2.41	2.34	USEPA 1995	200	No
1,2-Dichloroethane	1.4 to 1.48	1.47	USEPA 1995	27.9	No
1,2-Dichloropropane	1.94 to 1.99	1.97	USEPA 1995	86.5	No
2-Butanone (MEK)	0.28 to 0.69	0.28	USEPA 1995	1.89	No
2-Chloro-1,3-butadiene	2.03 to 2.13	2.08	USEPA 1995	124.00	No
2-Hexanone	Not Reported	1.38	USEPA 2011	22.7	No
3-Chloro-1-propene	Not Reported	1.93	USEPA 2011	79.0	No
4-Methyl-2-pentanone (MIBK)	Not Reported	1.31	USEPA 2011	19.4	No
Acetone	-0.21 to -0.24	-0.24	USEPA 1995	0.58	No
Acetonitrile	-0.34 to -0.39	-0.34	USEPA 1995	0.46	No
Acrolein	-0.01 to 0.90	-0.01	USEPA 1995	0.98	No
Acrylonitrile	-0.92 to 1.20	0.25	USEPA 1995	1.76	No
Benzene	1.83 to 2.50	2.13	USEPA 1995	124	No
Bromoform	2.30 to 2.38	2.35	USEPA 1995	204	No
Bromomethane	Not Reported	1.19	USEPA 2011	14.8	No
Carbon disulfide	1.84 to 2.16	2.00	USEPA 1995	92.5	No
Carbon tetrachloride	2.03 to 3.10	2.73	USEPA 1995	483	Yes
Chlorobenzene	2.56 to 3.79	2.86	USEPA 1995	648	Yes
Clorodibromomethane	2.13 to 2.24	2.17	USEPA 1995	136	No
Chloroethane	Not Reported	1.43	USEPA 2011	25.5	No
Chloroform	1.81 to 3.04	1.92	USEPA 1995	77.2	Yes
Chloromethane	Not Reported	0.91	USEPA 2011	7.85	No
cis-1,3-Dichloropropene	Not Reported	2.03	USEPA 2011	99.0	No
Dibromomethane	Not Reported	1.70	USEPA 2011	46.9	No
Dichlorobromomethane	1.88 to 2.14	2.10	USEPA 1995	116	No
Dichlorodifluoromethane	2.0 to 2.37	2.16	USEPA 1995	133	No
Ethylbenzene	3.07 to 3.57	3.14	USEPA 1995	1,222	Yes
Ethylene dibromide	Not Reported	1.96	USEPA 2011	84.5	No
Ethyl methacrylate	1.59 to 1.65	1.59	USEPA 2011	36.6	No
Iodomethane	Not Reported	1.51	USEPA 2011	30.5	No
Isobutyl alcohol	0.65 to 0.76	0.75	USEPA 1995	5.46	No
Methacrylonitrile	0.54 to 0.70	0.68	USEPA 2011	4.66	No
Methylene chloride	1.22 to 1.40	1.25	USEPA 1995	16.9	No
Methyl methacrylate	1.11 to 1.38	1.38	USEPA 1995	22.7	No
Pentachloroethane	Not Reported	3.22	USEPA 2011	1,464	Yes
Propionitrile	Not Reported	0.16	USEPA 2011	1.44	No
Styrene	2.76 to 3.16	2.94	USEPA 1995	777	Yes

TABLE 7-3
LOG K_{ow} AND K_{oc} VALUES FOR ORGANIC CHEMICALS
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Chemical	Log K_{ow} Range	Recommended Log K_{ow}	Reference	K_{oc} (1) (L/Kg)	Bioaccumulative Chemical (2)
Volatile Organics:					
Tetrachloroethene	2.53 to 2.98	2.67	USEPA 1995	422	No
Toluene	2.21 to 3.13	2.75	USEPA 1995	505	Yes
trans-1,2-Dichloroethene	1.77 to 2.10	2.07	USEPA 1995	108	No
trans-1,3-Dichloropropene	Not Reported	2.03	USEPA 2011	99.0	No
trans-1,4-Dichloro-2-butene	Not Reported	2.60	USEPA 2011	360	No
Trichloroethene	2.42 to 3.14	2.71	USEPA 1995	462	Yes
Trichlorofluoromethane	2.44 to 2.58	2.53	USEPA 1995	307	No
Vinyl acetate	0.21 to 0.83	0.73	USEPA 1995	5.22	No
Vinyl chloride	1.23 to 1.52	1.50	USEPA 1995	29.8	No
o-Xylene	2.77 to 3.54	3.13	USEPA 1995	1,194	Yes
m,p-Xylene (3)	3.13 to 3.65	3.17	USEPA 1995	1,307	Yes
Xylenes (total) (4)	2.77 to 3.54	3.13	USEPA 1995	1,194	Yes
Semi-Volatile Organics:					
1,2,4,5-Tetrachlorobenzene	4.51 to 4.83	4.64	USEPA 1995	36,425	Yes
1,2,4-Trichlorobenzene	3.89 to 4.23	4.01	USEPA 1995	8,752	Yes
1,3,5-Trinitrobenzene	1.18 to 1.37	1.18	USEPA 1995	14.5	No
1,1-Biphenyl	Not Reported	3.98	USEPA 2011	8,177	Yes
1,2-Dichlorobenzene	3.20 to 3.61	3.43	USEPA 1995	2,355	Yes
1,3-Dichlorobenzene	Not Reported	3.53	USEPA 2011	2,953	Yes
1,3-Dinitrobenzene	1.49 to 1.63	1.50	USEPA 1995	29.8	No
1,4,-Dichlorobenzene	3.26 to 3.78	3.42	USEPA 1995	2,302	Yes
1,4-Dioxane	Not Reported	-0.27	USEPA 2011	0.54	No
1,4-Naphthoquinone	Not Reported	1.71	USEPA 2011	48.0	No
1-Naphthylamine	2.09 to 2.48	2.24	USEPA 1995	159	No
2,3,4,6-Tetrachlorophenol	Not Reported	4.45	USEPA 2011	23,694	Yes
2,4,5-Trichlorophenol	Not Reported	3.72	USEPA 2011	4,540	Yes
2,4,6-Trichlorophenol	3.29 to 4.05	3.70	USEPA 1995	4,339	Yes
2,2'-Oxybis(1-chloropropane)	Not Reported	2.48	USEPA 2011	274	No
2,4-Dichlorophenol	2.80 to 3.30	3.08	USEPA 1995	1,066	Yes
2,4-Dimethylphenol	1.99 to 2.49	2.36	USEPA 1995	209	No
2,4-Dinitrophenol	1.40 to 1.79	1.55	USEPA 1995	33.4	No
2,4-Dinitrotoluene	1.98 to 2.05	2.01	USEPA 1995	94.6	No
2,6-Dichlorophenol	Not Reported	2.75	USEPA 2011	505	No
2,6-Dinitrotoluene	1.72 to 2.03	1.87	USEPA 1995	68.9	No
1-Naphthylamine	2.09 to 2.40	2.24	USEPA 1995	159	No
2-Acetylaminofluorene	Not Reported	3.12	USEPA 2011	1,167	Yes
2-Chloronaphthalene	Not Reported	3.90	USEPA 2011	6,823	Yes
2-Chlorophenol	0.83 to 2.32	2.15	USEPA 1995	130	No
2-Methylphenol	1.90 to 2.04	1.99	USEPA 1995	90.5	No
2-Naphthylamine	2.09 to 2.42	2.28	USEPA 1995	174	No
2-Nitroaniline	Not Reported	1.85	USEPA 2011	65.9	No
2-Nitrophenol	Not Reported	1.79	USEPA 2011	57.5	No
2-Picoline	Not Reported	1.11	USEPA 2011	12.3	No
2-Toluidine	Not Reported	1.32	USEPA 2011	19.9	No
3,3'-Dichlorobenzidine	3.51 to 3.95	3.51	USEPA 1995	2,822	Yes

TABLE 7-3
LOG K_{ow} AND K_{oc} VALUES FOR ORGANIC CHEMICALS
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Chemical	Log K_{ow} Range	Recommended Log K_{ow}	Reference	K_{oc} (1) (L/Kg)	Bioaccumulative Chemical (2)
Semi-Volatile Organics:					
3,3'-Dimethylbenzidine	2.34 to 3.01	2.68	USEPA 1995	431	Yes
3-Methylcholanthrene	6.42 to 6.76	6.42	USEPA 1995	2,047,104	Yes
3-Methylphenol	1.92 to 2.05	1.97	USEPA 1995	86.5	No
3-Nitroaniline	Not Reported	1.37	USEPA 2011	22.2	No
4,6-Dinitro-2-methylphenol	Not Reported	2.13	USEPA 2011	124	No
4-Aminobiphenyl	Not Reported	2.86	USEPA 2011	648	No
4-Bromophenyl phenyl ether	4.89 to 5.24	5.00	USEPA 1995	82,277	Yes
4-Chloro-3-methylphenol	Not Reported	3.10	USEPA 2011	1,116	Yes
4-Chloroaniline	1.57 to 2.02	1.85	USEPA 1995	65.9	No
4-Chlorophenyl phenyl ether	4.08 to 5.09	4.95	USEPA 1995	73,473	Yes
4-Methylphenol	1.38 to 2.04	1.95	USEPA 1995	82.6	No
4-Nitroaniline	Not Reported	1.39	USEPA 2011	23.3	No
4-Nitrophenol	Not Reported	1.91	USEPA 2011	75.5	No
4-Nitroquinoline-N-oxide	Not Reported	1.09	USEPA 2011	11.8	No
7,12-Dimethylbenz(a)anthracene	5.98 to 6.66	6.62	USEPA 1995	3,219,141	Yes
Acetophenone	1.55 to 1.72	1.64	USEPA 1995	41.0	No
a,a-Dimethylphenethylamine	Not Reported	1.90	USEPA 2011	73.8	No
Aniline	0.78 to 1.24	0.98	USEPA 1995	9.20	No
Aramite, total	Not Reported	4.82	USEPA 2011	54,744	Yes
Benzidine	1.34 to 1.70	1.66	USEPA 1995	43	No
Benzoic Acid	1.33 to 2.18	1.86	USEPA 1995	67	No
Benzyl alcohol	0.87 to 1.22	1.11	USEPA 1995	12.3	No
bis(2-Chloroethoxy)methane	Not Reported	1.30	USEPA 2011	19.0	No
bis(2-Chloroethyl)ether	1.0 to 1.29	1.21	USEPA 1995	15.5	No
bis(2-Ethylhexyl)phthalate	4.20 to 8.61	7.30	USEPA 1995	15,003,065	Yes
Butyl benzyl phthalate	3.57 to 5.02	4.84	USEPA 1995	57,280	Yes
Carbazole	3.01 to 3.76	3.59	USEPA 1995	3,383	Yes
cis-Diallate	Not Reported	4.49	USEPA 2011	25,939	Yes
Dibenzofuran	Not Reported	4.12	USEPA 2011	11,226	Yes
Diethyl phthalate	1.40 to 3.00	2.50	USEPA 1995	287	Yes
Dimethyl phthalate	1.34 to 1.90	1.57	USEPA 1995	35.0	No
Di-n-butyl phthalate	3.74 to 4.79	4.61	USEPA 1995	34,034	Yes
Di-n-octyl phthalate	8.03 to 9.49	8.06	USEPA 1995	83,803,084	Yes
Dinoseb	Not Reported	3.56	USEPA 2011	3,161	Yes
Ethyl methanesulfonate	0.01 to 0.05	0.05	USEPA 1995	1.12	No
Hexachlorobenzene	5.00 to 7.42	5.89	USEPA 1995	616,808	Yes
Hexachlorobutadiene	4.74 to 5.16	4.81	USEPA 1995	53,519	Yes
Hexachlorocyclopentadiene	5.04 to 5.51	5.39	USEPA 1995	198,907	Yes
Hexachloroethane	3.82 to 4.14	4.00	USEPA 1995	8,556	Yes
Hexachlorophene	7.08 to 7.60	7.54	USEPA 1995	25,828,548	Yes
Hexachloropropene	Not Reported	4.38	USEPA 2011	20,222	Yes
Isophorone	1.67 to 1.90	1.70	USEPA 1995	46.9	No
Isosafrole	Not Reported	3.37	USEPA 2011	2,056	Yes
Methapyrilene	Not Reported	2.87	USEPA 2011	663	No
Methyl methanesulfonate	Not Reported	-0.66	USEPA 2011	0.22	No
N-Nitro-o-toluidine	Not Reported	1.87	USEPA 2011	68.90	No

TABLE 7-3
LOG K_{ow} AND K_{oc} VALUES FOR ORGANIC CHEMICALS
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Chemical	Log K_{ow} Range	Recommended Log K_{ow}	Reference	K_{oc} [1] (L/Kg)	Bioaccumulative Chemical [2]
Semi-Volatile Organics:					
n-Nitrosodiethylamine	0.29 to 0.56	0.48	USEPA 1995	2.97	No
n-Nitrosodimethylamine	-0.77 to -0.48	-0.57	USEPA 1995	0.28	No
n-Nitroso-di-n-butylamine	2.41 to 2.45	2.41	USEPA 1995	234	No
n-Nitroso-di-n-propylamine	1.31 to 1.45	1.40	USEPA 1995	23.8	No
n-Nitrosodiphenylamine	3.13 to 3.45	3.16	USEPA 1995	1,278	Yes
n-Nitrosomethylethylamine	-0.24 to 1.35	-0.12	USEPA 1995	0.76	No
n-Nitrosomorpholine	Not Reported	-0.44	USEPA 2011	0.37	No
n-Nitrosopiperidine	0.25 to 0.63	0.63	USEPA 1995	4.16	No
n-Nitrosopyrrolidine	-0.29 to -0.19	-0.19	USEPA 1995	0.65	No
Nitrobenzene	Not Reported	1.85	USEPA 2011	65.9	No
p-Dimethylamino azobenzene	Not Reported	4.58	USEPA 2011	31,799	Yes
Pentachlorobenzene	4.88 to 6.12	5.26	USEPA 1995	148,204	Yes
Pentachloronitrobenzene	4.18 to 4.64	4.64	USEPA 1995	36,425	Yes
Pentachlorophenol	3.29 to 5.24	5.09	USEPA 1995	100,867	Yes
Phenacetin	Not Reported	1.58	USEPA 2011	35.8	No
Phenol	0.79 to 1.55	1.48	USEPA 1995	28.5	No
p-Phenylenediamine	Not Reported	-0.30	USEPA 2011	0.51	No
Pronamide	3.26 to 3.86	3.51	USEPA 1995	2,822	Yes
Pryridine	0.62 to 1.28	0.67	USEPA 1995	4.56	No
Safrole, total	2.66 to 2.88	2.66	USEPA 1995	412	No
trans-Diallate [5]	Not Reported	4.49	USEPA 2011	25,939	Yes
PAHs:					
2-Methylnaphthalene	Not Reported	3.86	USEPA 2011	6,232	Yes
Acenaphthene	3.77 to 4.49	3.92	USEPA 1995	7,139	Yes
Acenaphthylene	Not Reported	3.94	USEPA 2011	7,470	Yes
Anthracene	3.45 to 4.80	4.55	USEPA 1995	29,712	Yes
Benzo(a)anthracene	4.00 to 5.79	5.70	USEPA 1995	401,218	Yes
Benzo(a)pyrene	5.98 to 6.42	6.11	USEPA 1995	1,014,869	Yes
Benzo(b)fluoranthene	5.79 to 6.40	6.20	USEPA 1995	1,244,171	Yes
Benzo(g,h,i)perylene	6.63 to 7.05	6.70	USEPA 1995	3,858,158	Yes
Benzo(k)fluoranthene	6.12 to 6.27	6.20	USEPA 1995	1,244,171	Yes
Chrysene	5.41 to 5.79	5.70	USEPA 1995	401,218	Yes
Dibenzo(a,h)anthracene	6.50 to 6.88	6.69	USEPA 1995	3,771,812	Yes
Fluoranthene	4.31 to 5.39	5.12	USEPA 1995	107,954	Yes
Fluorene	4.04 to 4.40	4.21	USEPA 1995	13,763	Yes
Indeno(1,2,3-cd)pyrene	6.58 to 6.72	6.65	USEPA 1995	3,445,323	Yes
Naphthalene	3.01 to 4.70	3.36	USEPA 1995	2,010	Yes
Phenanthrene	4.28 to 4.57	4.55	USEPA 1995	29,712	Yes
Pyrene	4.76 to 5.52	5.11	USEPA 1995	105,538	Yes
Organochlorine Pesticides:					
4,4'-DDD	4.73 to 6.38	6.10	USEPA 1995	992,156	Yes
4,4'-DDE	5.63 to 6.94	6.76	USEPA 1995	4,419,366	Yes
4,4'-DDT	4.64 to 7.01	6.53	USEPA 1995	2,625,851	Yes
Aldrin	5.11 to 7.50	6.50	USEPA 1995	2,453,466	Yes
alpha-BHC	3.75 to 3.81	3.80	USEPA 1995	5,441	Yes
alpha-Chlordane	5.80 to 6.41	6.32	USEPA 1995	1,632,450	Yes

TABLE 7-3
LOG K_{ow} AND K_{oc} VALUES FOR ORGANIC CHEMICALS
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Chemical	Log K_{ow} Range	Recommended Log K_{ow}	Reference	K_{oc} [1] (L/Kg)	Bioaccumulative Chemical [2]
Organochlorine Pesticides:					
beta-BHC	3.75 to 3.84	3.81	USEPA 1995	5,566	Yes
Chlorobenzilate	Not Reported	4.74	USEPA 2011	45,677	Yes
delta-BHC	Not Reported	4.14	USEPA 2011	11,746	Yes
Dieldrin	Not Reported	5.20	USEPA 2011	129,384	Yes
Endosulfan I	Not Reported	3.83	USEPA 2011	5,823	Yes
Endosulfan II	Not Reported	3.83	USEPA 2011	5,823	Yes
Endosulfan sulfate	Not Reported	3.66	USEPA 2011	3,963	Yes
Endrin	2.92 to 5.20	5.06	USEPA 1995	94,245	Yes
Endrin aldehyde	Not Reported	4.00	USEPA 1995	8,556	Yes
gamma-BHC (lindane)	3.00 to 4.95	3.73	USEPA 1995	4,644	Yes
gamma-Chlordane	5.80 to 6.41	6.32	USEPA 1995	1,632,450	Yes
Heptachlor	4.93 to 6.26	6.26	USEPA 1995	1,425,148	Yes
Heptachlor epoxide	3.50 to 5.40	5.00	USEPA 1995	82,277	Yes
Isodrin	Not Reported	6.50	USEPA 2011	2,453,466	Yes
Kepone	4.45 to 5.30	5.30	USEPA 1995	162,248	Yes
Methoxychlor	3.31 to 5.60	5.08	USEPA 1995	98,610	Yes
Toxaphene	3.23 to 5.56	5.50	USEPA 1995	255,141	Yes

Notes:

K_{ow} = Octanol-Water Partition Coefficient
K_{oc} = Organic Carbon Partition Coefficient
L/kg = liter per kilogram
PAH = Polynuclear Aromatic Hydrocarbon
USEPA = United States Environmental Protection Agency

(1) K_{oc} values were estimated from the following equation: Log K_{oc} = 0.00028 + (0.983)(Log K_{ow}) (USEPA 1993 and 1996).
(2) An organic chemical is considered a bioaccumulative chemical if its Log K_{ow} value is greater than or equal to 3.0. When a range of Log K_{ow} values was reported, the upper value within the range was conservatively used to identify bioaccumulative chemicals.
(3) The K_{ow} values shown are for p-xylene.
(4) The K_{ow} values shown are for o-xylene
(5) The K_{ow} value shown is for cis-diallate.

Table References:

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TABLE 7-4
SOIL SCREENING VALUES FOR PLANTS AND INVERTEBRATES
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Chemical	Soil Screening Value	Reference	Comment
Volatile Organics (µg/kg):			
1,1,1,2-Tetrachloroethane	100	CCME 2007	Canadian soil quality guideline based on agricultural land uses
1,1,1-Trichloroethane	100	CCME 2007	Canadian soil quality guideline based on agricultural land uses
1,1,2,2-Tetrachloroethane	100	CCME 2007	Canadian soil quality guideline based on agricultural land uses
1,1,2-Trichloroethane	100	CCME 2007	Canadian soil quality guideline based on agricultural land uses
1,1-Dichloroethane	100	CCME 2007	Canadian soil quality guideline based on agricultural land uses
1,1-Dichloroethene	100	CCME 2007	Canadian soil quality guideline based on agricultural land uses
1,2,3-Trichloropropane	NA	---	---
1,2-Dibromo-3-chloropropane	NA	---	---
1,2-Dichloroethane	402 (1)	MHSPE 2000	---
1,2-Dichloropropane	700,000	Efroymson et al. 1997a	Toxicological threshold for earthworms
2-Butanone (MEK)	NA	---	---
2-Chloro-1,3-butadiene	NA	---	---
2-Hexanone	NA	---	---
3-Chloro-1-propene (allyl chloride)	NA	---	---
4-Methyl-2-pentanone (MIBK)	NA	---	---
Acetone	NA	---	---
Acetonitrile	NA	---	---
Acrolein	NA	---	---
Acrylonitrile	1,000,000	Efroymson et al. 1997a	Toxicological threshold for soil microorganisms and microbial processes
Benzene	101 (1)	MHSPE 2000	---
Bromoform	NA	---	---
Bromomethane	NA	---	---
Carbon disulfide	NA	---	---
Carbon tetrachloride	1,000,000	Efroymson et al. 1997a	Toxicological threshold for soil microorganisms and microbial processes
Chlorobenzene	40,000	Efroymson et al. 1997a	Toxicological threshold for earthworms
Chlorodibromomethane	NA	---	---
Chloroethane	NA	---	---
Chloroform	1,002 (1)	MHSPE 2000	---
Chloromethane	NA	---	---
cis-1,3-Dichloropropene	100	CCME 2007	Canadian soil quality guideline based on agricultural land uses
Dibromomethane	NA	---	---
Dichlorobromomethane (Bromodichloromethane)	NA	---	---
Dichlorodifluoromethane	NA	---	---
Ethylbenzene	5,003 (1)	MHSPE 2000	---
Ethylene dibromide (1,2-Dibromoethane)	300	CCME 2007	Canadian soil quality guideline based on agricultural land uses
Ethyl methacrylate	NA	---	---

TABLE 7-4
SOIL SCREENING VALUES FOR PLANTS AND INVERTEBRATES
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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Chemical	Soil Screening Value	Reference	Comment
Volatile Organics (µg/kg):			
Iodomethane	NA	---	---
Isobutyl alcohol	NA	---	---
Methacrylonitrile	NA	---	---
Methylene chloride	1,040 (1)	MHSPE 2000	---
Methyl methacrylate	NA	---	---
Pentachloroethane	NA	---	---
Propionitrile	NA	---	---
Styrene	10,030 (1)	MHSPE 2000	---
Tetrachloroethene	400 (1)	MHSPE 2000	---
Toluene	13,001 (1)	MHSPE 2000	---
trans-1,2-Dichloroethene	100	CCME 2007	Canadian soil quality guideline based on agricultural land uses
trans-1,3-Dichloropropene	100	CCME 2007	Canadian soil quality guideline based on agricultural land uses
trans-1,4-Dichloro-2-butene	1,000,000	Efroymson et al. 1997a	Toxicological threshold for soil microorganisms and microbial processes
Trichloroethene	6,010 (1)	MHSPE 2000	---
Trichlorofluoromethane	NA	---	---
Vinyl acetate	NA	---	---
Vinyl chloride	11.0 (1)	MHSPE 2000	---
o-Xylene	1,000	---	Value for total xylenes used as a surrogate
m,p-Xylene	1,000	---	Value for total xylenes used as a surrogate
Xylenes, total	1,000	USEPA 2003	Region 5 ecological screening level based on exposures to plants
Semi-Volatile Organics (µg/kg):			
1,1-Biphenyl	60,000	Efroymson et al. 1997b	Toxicological threshold for plants
1,2,4,5-Tetrachlorobenzene	50.0	CCME 2007	Canadian soil quality guideline based on agricultural land uses
1,2,4-Trichlorobenzene	20,000	Efroymson et al. 1997a	Toxicological threshold for earthworms
1,2-Dichlorobenzene	3,003 (1)	MHSPE 2000	Value for total chlorobenzenes (2)
1,3,5-Trinitrobenzene	40,000	---	Value for nitrobenzene used as a surrogate
1,3-Dichlorobenzene	3,003 (1)	MHSPE 2000	Value for total chlorobenzenes (2)
1,3-Dinitrobenzene	40,000	---	Value for nitrobenzene used as a surrogate
1,4-Dichlorobenzene	20,000	Efroymson et al. 1997a	Toxicological threshold for earthworms
1,4-Dioxane	NA	---	---
1,4-Naphthoquinone	NA	---	---
1-Naphthylamine	NA	---	---
2,2'-Oxybis(1-chloropropane)	NA	---	---
2,3,4,6-Tetrachlorophenol	1,001 (1)	MHSPE 2000	Value for total chlorophenols (3)
2,4,5-Trichlorophenol	4,000	Efroymson et al. 1997b	Toxicological threshold for plants

TABLE 7-4
SOIL SCREENING VALUES FOR PLANTS AND INVERTEBRATES
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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Chemical	Soil Screening Value	Reference	Comment
Semi-Volatile Organics (µg/kg):			
2,4,6-Trichlorophenol	10,000	Efroymson et al. 1997a	Toxicological threshold for earthworms
2,4-Dichlorophenol	1,001 (1)	MHSPE 2000	Value for total chlorophenols (3)
2,4-Dimethylphenol	10	USEPA 2003	Region 5 ecological screening level based on exposures to plants
2,4-Dinitrophenol	20,000	Efroymson et al. 1997b	Toxicological threshold for plants
2,4-Dinitrotoluene	NA	---	---
2,6-Dichlorophenol	1,001 (1)	MHSPE 2000	Value for total chlorophenols (3)
2,6-Dinitrotoluene	NA	---	---
2-Acetylaminofluorene	NA	---	---
2-Chloronaphthalene	NA	---	---
2-Chlorophenol	1,001 (1)	MHSPE 2000	Value for total chlorophenols (3)
2-Methylphenol	100	CCME 2007	Canadian soil quality guideline based on agricultural land uses
2-Naphthylamine	NA	---	---
2-Nitroaniline	NA	---	---
2-Nitrophenol	7,000	---	Value for 4-nitrophenol used as a surrogate
2-Picoline	NA	---	---
2-Toluidine	NA	---	---
3,4-Methylphenol	100	CCME 2007	Canadian soil quality guideline based on agricultural land uses
3,3'-Dichlorobenzidine	NA	---	---
3,3'-Dimethylbenzidine	NA	---	---
3-Methylcholanthrene	NA	---	---
3-Methylphenol	100	CCME 2007	Canadian soil quality guideline based on agricultural land uses
3-Nitroaniline	NA	---	---
4,6-Dinitro-2-methylphenol	NA	---	---
4-Aminobiphenyl	NA	---	---
4-Bromophenyl phenyl ether	NA	---	---
4-Chloro-3-methylphenol	NA	---	---
4-Chloroaniline	NA	---	---
4-Chlorophenyl phenyl ether	NA	---	---
4-Methylphenol	100	CCME 2007	Canadian soil quality guideline based on agricultural land uses
4-Nitroaniline	NA	---	---
4-Nitrophenol	7,000	Efroymson et al. 1997a	Toxicological threshold for earthworms
4-Nitroquinoline-1-oxide	NA	---	---
7,12-Dimethylbenz(a)anthracene	NA	---	---
A,A-Dimethylphenethylamine	NA	---	---
Acetophenone	NA	---	---
Aniline	NA	---	---

TABLE 7-4
SOIL SCREENING VALUES FOR PLANTS AND INVERTEBRATES
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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Chemical	Soil Screening Value	Reference	Comment
Semi-Volatile Organics (µg/kg):			
Aramite, total	NA	---	---
Benzyl alcohol	NA	---	---
bis(2-Chloroethoxy)methane	NA	---	---
bis(2-Chloroethyl)ether	NA	---	---
bis(2-Ethylhexyl)phthalate	6,010 (1)	MHSPE 2000	Value for total phthalates (4)
Butyl benzyl phthalate	6,010 (1)	MHSPE 2000	Value for total phthalates (4)
cis-Diallate	NA	---	---
Dibenzofuran	NA	---	---
Diethyl phthalate	100,000	Efroymson et al. 1997b	Toxicological threshold for plants
Dimethyl phthalate	200,000	Efroymson et al. 1997a	Toxicological threshold for earthworms
Di-n-butyl phthalate	200,000	Efroymson et al. 1997b	Toxicological threshold for plants
Di-n-octyl phthalate	6,010 (1)	MHSPE 2000	Value for total phthalates (4)
Dinoseb	NA	---	---
Ethyl methanesulfonate	NA	---	---
Hexachlorobenzene	1,000,000	Efroymson et al. 1997a	Toxicological threshold for soil microorganisms and microbial processes
Hexachlorobutadiene	NA	---	---
Hexachlorocyclopentadiene	10,000	Efroymson et al. 1997b	Toxicological threshold for plants
Hexachloroethane	NA	---	---
Hexachlorophene	NA	---	---
Hexachlorophene	NA	---	---
Hexachloropropene	NA	---	---
Hexachloropropene	NA	---	---
Isophorone	NA	---	---
Isosafrole	NA	---	---
Methapyrilene	NA	---	---
Methyl methanesulfonate	NA	---	---
N-Nitro-o-toluidine	NA	---	---
N-Nitrosodiethylamine	20,000	---	Value for n-Nitrosdiphenylamine used as a surrogate
N-Nitrosodimethylamine	20,000	---	Value for n-Nitrosdiphenylamine used as a surrogate
N-Nitroso-di-n-butylamine	20,000	---	Value for n-Nitrosdiphenylamine used as a surrogate
N-Nitroso-di-n-propylamine	20,000	---	Value for n-Nitrosdiphenylamine used as a surrogate
N-Nitrosodiphenylamine	20,000	Efroymson et al. 1997a	Toxicological threshold for earthworms
N-Nitrosomethylethylamine	20,000	---	Value for n-Nitrosdiphenylamine used as a surrogate
Nitrobenzene	40,000	Efroymson et al. 1997a	Toxicological threshold for earthworms
N-Nitrosomorpholine	NA	---	---
N-Nitrosopiperidine	NA	---	---

TABLE 7-4
SOIL SCREENING VALUES FOR PLANTS AND INVERTEBRATES
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Chemical	Soil Screening Value	Reference	Comment
Semi-Volatile Organics (µg/kg):			
N-Nitrosopyrrolidine	NA	---	---
p-Dimethylamino azobenzene	NA	---	---
Pentachlorobenzene	1,150	USEPA 1999	Toxicological threshold for earthworms
Pentachloronitrobenzene	NA	---	---
Pentachlorophenol	5,000	USEPA 2007a	Ecological soil screening level for plants
Phenacetin	NA	---	---
Phenol	30,000	Efroymson et al. 1997a	Toxicological threshold for earthworms
p-Phenylenediamine (1,4-phenylenediamine)	NA	---	---
Pronamide	13.6	USEPA 2003	Region 5 ecological screening level based on exposures to plants
Pyridine	NA	---	---
Safrole, total	NA	---	---
trans-Diallate	NA	---	---
PAHs (µg/kg):			
Low molecular weight PAHs (5)	29,000	USEPA 2007b	Ecological soil screening level for soil invertebrates
High molecular weight PAHs (6)	18,000	USEPA 2007b	Ecological soil screening level for soil invertebrates
Organochlorine Pesticides (ug/kg):			
4,4'-DDD	401 (1)	MHSPE 2000	Value for total DDD, DDE, and DDT
4,4'-DDE	401 (1)	MHSPE 2000	Value for total DDD, DDE, and DDT
4,4'-DDT	401 (1)	MHSPE 2000	Value for total DDD, DDE, and DDT
Aldrin	401 (1)	MHSPE 2000	Value for total "drins" (aldrin, endrin, and dieldrin)
alpha-BHC	201 (1)	MHSPE 2000	Value for total BHC compounds (7)
alpha-Chlordane	224	USEPA 2003	Region 5 ecological screening level based on exposures to plants (value for chlordane)
beta-BHC	3.98	USEPA 2003	Region 5 ecological screening level based on exposures to plants
Chlorobenzilate	NA	---	---
delta-BHC	201 (1)	MHSPE 2000	Value for total BHC compounds (7)
Dieldrin	400 (1)	MHSPE 2000	Value for total "drins" (aldrin, endrin, and dieldrin)
Endosulfan I	100	Friday 1998	Background or detection limit value
Endosulfan II	100	Friday 1998	Background or detection limit value
Endosulfan sulfate	100	Friday 1998	Background or detection limit value
Endrin	401 (1)	MHSPE 2000	Value for total "drins" (aldrin, endrin, and dieldrin)
Endrin aldehyde	100	Friday 1998	Background or detection limit value
gamma-BHC (lindane)	5.0	USEPA 2003	Region 5 ecological screening level based on exposures to plants
gamma-Chlordane	224	USEPA 2003	Region 5 ecological screening level based on exposures to plants (value for chlordane)

TABLE 7-4
SOIL SCREENING VALUES FOR PLANTS AND INVERTEBRATES
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Chemical	Surface Soil Screening Value	Reference	Comment
Organochlorine Pesticides (ug/kg):			
Heptachlor	400 (1)	MHSPE 2000	---
Heptachlor epoxide	400 (1)	MHSPE 2000	---
Isodrin	3.32	USEPA 2003	Region 5 ecological screening level based on exposure to plants
Kepone	100	Friday 1998	Background or detection limit value
Methoxychlor	100	Friday 1998	Background or detection limit value
Toxaphene	100	Friday 1998	Background or detection limit value
Metals (mg/kg):			
Antimony	78.0	USEPA 2005a	Ecological soil screening level for soil invertebrates
Arsenic	18.0	USEPA 2005b	Ecological soil screening level for plants
Barium	330	USEPA 2005c	Ecological soil screening level for soil invertebrates
Beryllium	40.0	USEPA 2005d	Ecological soil screening level for soil invertebrates
Cadmium	32.0	USEPA 2005e	Ecological soil screening level for plants
Chromium, total	57.0	USEPA 2008	Reproduction-based MATC for *Eisenia andrei* (earthworm)
Cobalt	13.0	USEPA 2005f	Ecological soil screening level for plants
Copper	70.0	USEPA 2007c	Ecological soil screening level for plants
Lead	120	USEPA 2005g	Ecological soil screening level for plants
Mercury	0.10	Efroymson et al. 1997a	Toxicological threshold for earthworms
Nickel	38.0	USEPA 2007d	Ecological soil screening level for plants
Selenium	0.52	USEPA 2007e	Ecological soil screening level for plants
Silver	560	USEPA 2006	Ecological soil screening level for plants
Thallium	1.00	Efroymson et al. 1997b	Toxicological threshold for plants
Tin	50.0	Efroymson et al. 1997b	Toxicological threshold for plants
Vanadium	20.0	USEPA 2005h	Growth-based LOAEC for *Brassica oleracea* (broccoli) with a safety factor of 5
Zinc	120	USEPA 2007f	Ecological soil screening level for soil invertebrates

Notes:

NA = Not Available
MHSPE = Dutch Ministry of Housing, Spatial Planning and Environment
CCME = Canadian Council of Ministers of the Environment
USEPA = United States Environmental Protection Agency
MATC = Maximum Acceptable Toxicant Concentration
LOAEC = Lowest Observed Adverse Effect Concentration
PAH = Polynuclear Aromatic Hydrocarbon
µg/kg = microgram per kilogram
mg/kg = milligram per kilogram

(1) The screening value shown is an average of the Dutch target and intervention soil standards for soil remediation. The value is based on a default organic carbon content of 0.02 (2 percent), which represents a minimum value (adjustment range is 2 to 30 percent).

(2) The value represents a total concentration for chlorobenzenes (mono, di, tri, tetra, penta, and hexachlorobenzene).

TABLE 7-4
SOIL SCREENING VALUES FOR PLANTS AND INVERTEBRATES
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
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Notes (continued):

(3) The value represents a total concentration for all chlorophenols (mono, di, tri, tetra, and pentachlorophenol).

(4) The value represents a total concentration for all phthalates.

(5) Low molecular weight PAHs are defined by the USEPA (2007a) as PAH compounds composed of fewer than four rings. The low molecular weight PAH compounds analyzed for in SWMU 56 soil were 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, fluoranthene, fluorene, naphthalene, and phenanthrene.

(6) High molecular weight PAHs are defined by the USEPA (2007a) as PAH compounds composed of four or more rings. The high molecular weight PAH compounds analyzed for in SWMU 56 soil were benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, and pyrene.

(7) The value represents a total concentration for alpha-BHC, beta-BHC, delta-BMC, and gamma-BHC.

Table References:

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USEAP. 2007a. Ecological Soil Screening Levels for Pentachlorophenol (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-58.

USEPA. 2007b. Ecological Soil Screening Levels for Polycyclic Aromatic Hydrocarbons (PAHs) (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-78.

USEAP. 2007c. Ecological Soil Screening Levels for Copper (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-68.

USEAP. 2007d. Ecological Soil Screening Levels for Nickel (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-76.

USEAP. 2007e. Ecological Soil Screening Levels for Selenium (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-72.

TABLE 7-4
SOIL SCREENING VALUES FOR PLANTS AND INVERTEBRATES
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Table References (continued):

USEPA. 2007f. Ecological Soil Screening Levels for Zinc (Interim Final) Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-73.

USEPA. 2006. Ecological Soil Screening Levels for Silver (Interim Final) Office of Solid Waste and Emergency Response, Washington, D.C. OSWEER Directive 9285.7-77.

USEPA. 2005a. Ecological Soil Screening Levels for Antimony (Interim Final) Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-61.

USEPA. 2005b. Ecological Soil Screening Levels for Arsenic (Interim Final) Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-62.

USEPA. 2005c. Ecological Soil Screening Levels for Barium (Interim Final) Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-63.

USEPA. 2005d. Ecological Soil Screening Levels for Beryllium (Interim Final) Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-64.

USEPA. 2005e. Ecological Soil Screening Levels for Cadmium (Interim Final) Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-65.

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TABLE 7-5
DUTCH MINISTRY OF HOUSING, SPATIAL PLANNING AND ENVIRONMENT SOIL STANDARDS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte [1]	Standard Soil [2]		SWMU 59 Soil [3]	
	Target Value (µg/kg)	Intervention Value (µg/kg)	Target Value (µg/kg)	Intervention Value (µg/kg)
Volatile Organics (µg/kg):				
1,2-Dichloroethane	20	4,000	4	800
Benzene	10	1,000	2	200
Chloroform	20	10,000	4	2,000
Ethylbenzene	30	50,000	6	10,000
Methylene chloride	400	10,000	80	2,000
Styrene	300	100,000	60	20,000
Tetrachloroethene	0.2	4,000	0.04	800
Toluene	10	130,000	2	26,000
Trichloroethene	100	60,000	20	12,000
Vinyl chloride	10	100	2	20
Semivolatile Organics (µg/kg):				
1,2-Dichlorobenzene	30	30,000	6	6,000
1,3-Dichlorobenzene	30	30,000	6	6,000
2,3,4,6-Tetrachlorophenol	10	10000	2	2,000
2,4-Dichlorophenol	10	10,000	2	2,000
2,6-Dichlorophenol	10	10,000	2	2,000
2-Chlorophenol	10	10,000	2	2,000
bis(2-Ethylhexyl)phthalate	100	60,000	20	12,000
Butyl benzyl phthalate	100	60,000	20	12,000
Di-n-octyl phthalate	100	60,000	20	12,000
Organochlorine Pesticides (ug/kg):				
4,4'-DDD	10	4,000	2	800
4,4'-DDE	10	4,000	2	800
4,4'-DDT	10	4,000	2	800
Aldrin	5	4,000	1	800
alpha-BHC	10	2,000	2	400
delta-BHC	10	2,000	2	400
Endrin	5	4,000	1	800
Heptachlor	0.7	4,000	0.14	800
Heptachlor epoxide	0.0002	4,000	0.00004	800

TABLE 7-5
DUTCH MINISTRY OF HOUSING, SPATIAL PLANNING AND ENVIRONMENT SOIL STANDARDS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Notes:

(1) The analytes listed are those identified in Table 7-4 with soil screening values based on Dutch Ministry of Housing, Spatial Planning, and Environment soil standards.

(2) Target and intervention values for a standard soil based on an organic carbon content of 10 percent.

(3) Target and intervention values for SWMU 59 soil based on an organic carbon content of 2 percent.

TABLE 7-6
MARINE/ESTUARINE SURFACE WATER SCREENING VALUES USED FOR GROUNDWATER
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Surface Water Screening Value [1]	Reference	Comment [2]
Volatile Organics (µg/L):			
1,1,1,2-Tetrachloroethane	200 [3]	USEPA 2007	Minimum acute value (96-hour LC_{50} for *Lepomis macrochirus* [bluegill]) with a safety factor of 100
1,1,1-Trichloroethane	312	USEPA 2001	USEPA Region 4 chronic screening value
1,1,2,2-Tetrachloroethane	90.2	USEPA 2001	USEPA Region 4 chronic screening value
1,1,2-Trichloroethane	340	USEPA 2007	Minimum acute value (48-hr LC_{50} for *Pleuronectes platessa* [sand dab]) with a safety factor of 100
1,1-Dichloroethane	47.0 [3]	USEPA 2003	USEPA Region 5 ecological screening level
1,1-Dichloroethene	2,240	USEPA 2001	USEPA Region 4 chronic screening value
1,2,3-Trichloropropane	274 [3]	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Pimephales promelas* [fathead minnow]) with a safety factor of 100
1,2-Dibromo-3-chloropropane	100	USEPA 2007	Minimum acute value (48-hr EC_{50} for *Mercenaria mercenaria* [hard clam]) with a safety factor of 100
1,2-Dichloroethane	1,130	USEPA 2001	USEPA Region 4 chronic screening value
1,2-Dichloropropane	2,400	USEPA 2001	USEPA Region 4 chronic screening value
2-Butanone (MEK)	13,333	USEPA 2007	Minimum acute value (96-hour NOEC for *Cyprinodon variegatus* [sheepshead minnow]) with a safety factor of 30
2-Chloro-1,3-butadiene	NA	---	---
2-Hexanone	99.0 [3]	USEPA 2003	USEPA Region 5 ecological screening level
3-Chloro-1-propene	3.40 [3]	USEPA 2007	Minimum acute value (48-hr LC_{50} for *Xenopus laevis* [clawed toad]) with a safety factor of 100
4-Methyl-2-pentanone (MIBK)	170 [3]	USEPA 2003	USEPA Region 5 ecological screening level
Acetone	1,000	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Lumbriculus variegatus* [Oligochaete]) with a safety factor of 100
Acetonitrile	12,000 [3]	USEPA 2003	USEPA Region 5 ecological screening level
Acrolein	0.55	USEPA 2003	USEPA Region 4 chronic screening value
Acrylonitrile	58.1	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Americamysis bahia* [opossum shrimp]) with a safety factor of 100
Benzene	109	USEPA 2001	USEPA Region 4 chronic screening value
Bromoform	640	USEPA 2001	USEPA Region 4 chronic screening value
Bromomethane	120	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Menidia beryllina* [inland silverside]) with a safety factor of 100
Carbon disulfide	15.0 [3]	USEPA 2003	USEPA Region 5 ecological screening level
Carbon tetrachloride	1,500	USEPA 2001	USEPA Region 4 chronic screening value
Chlorobenzene	105	USEPA 2001	USEPA Region 4 chronic screening value
Chlorodibromomethane	340 [3]	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Cyprinus carpio* [common carp] with a safety factor of 100
Chloroethane	NA	---	---
Chloroform	815	USEPA 2001	USEPA Region 4 chronic screening value
Chloromethane	2,700	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Menidia beryllina* [inland silverside]) with a safety factor of 100
cis-1,3-Dichloropropene	7.90	USEPA 2001	USEPA Region 4 chronic screening value (cis and trans)
Dibromomethane	1,280	Buchman 2008	Chronic LOEL for chemical class with a safety factor of 5
Dichlorobromomethane	2,400 [3]	USEPA 2007	Minimum acute value (24-hr LC_{50} for *Tetrahymena pyriformis* [ciliate]) with a safety factor of 100
Dichlorodifluoromethane	1,280	---	Value for trichlorofluoromethane used as a surrogate
Ethylbenzene	4.30	USEPA 2001	USEPA Region 4 chronic screening value
Ethylene dibromide	48.0	USEPA 2007	Minimum acute value (48-hr LC_{50} for *Cyprinodon variegatus* [sheepshead minnow]) with a safety factor of 100
Ethyl methacrylate	18,000 [3]	USEPA 2007	Minimum chronic value (21-day NOEC for *Daphnia magna* [cladoceron] based on reproduction [progeny counts])
Iodomethane	NA	---	---
Isobutyl alcohol	10,000	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Alburnus alburnus* [bleak]) with a safety factor of 100
Methacrylonitrile	NA	---	---
Methylene chloride	2,560	USEPA 2001	USEPA Region 4 chronic screening value

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Chemical	Surface Water Screening Value [1]	Reference	Comment [2]
Volatile Organics (µg/L):			
Methyl methacrylate	2,800 [3]	USEPA 2003	USEPA Region 5 ecological screening level
Pentachloroethane	56.2	Buchman 2008	Chronic LOEL with a safety factor of 5
Propionitrile	15,200 [3]	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Pimephales promelas* [fathead minnow]) with a safety factor of 100
Styrene	170	USEPA 2007	Minimum acute value (96-hr NOEC for *Cyprinodon variegatus* [sheepshead minnow]) with a safety factor of 30
Tetrachloroethene	45.0	USEPA 2001	USEPA Region 4 chronic screening value
Toluene	37.0	USEPA 2001	USEPA Region 4 chronic screening value
trans-1,2-dichloroethene	4,480	Buchman 2008	Acute LOEL (summation of all isomers) with a safety factor of 50
trans-1,3-Dichloropropene	7.90	USEPA 2001	USEPA Region 4 chronic screening value (cis and trans)
trans-1,4-Dichloro-2-butene	NA	---	---
Trichloroethene	40.0	Buchman 2008	Acute LOEL with a safety factor of 50
Trichlorofluoromethane	1,280	Buchman 2008	Chronic LOEL for chemical class with a safety factor of 5
Vinyl acetate	100	USEPA 2007	Minimum acute value (48-hr LC_{50} for *Crangon crangon* [sand shrimp]) with a safety factor of 100
Vinyl chloride	930 [3]	USEPA 2003	USEPA Region 5 ecological screening level
o-Xylene	27.0 [3]	---	Value for total xylenes used as a surrogate.
m,p-Xylene	27.0 [3]	---	Value for total xylenes used as a surrogate.
Xylenes, total	27.0 [3]	USEPA 2003	USEPA Region 5 ecological screening level
Semi-Volatile Organics (µg/L):			
1,2,4,5-Tetrachlorobenzene	10.0	USEPA 2007	Minimum acute value (96-hr NOEC for *Cyprinodon variegatus* [sheepshead minnow]) with a safety factor of 30
1,2,4-Trichlorobenzene	4.50	USEPA 2001	USEPA Region 4 chronic screening value
1,3,5-Trinitrobenzene	80.0 [3]	USEPA 2007	Minimum chronic value (71-day NOEC for *Oncorhynchus mykiss* [rainbow trout] based on reproduction)
1,1-Biphenyl	230 [3]	USEPA 2007	Minimum chronic value (21-day MATC for *Daphnia magna* [cladoceron] based on reproduction)
1,2-Dichlorobenzene	19.7	USEPA 2001	USEPA Region 4 chronic screening value
1,3-Dichlorobenzene	28.5	USEPA 2001	USEPA Region 4 chronic screening value
1,3-Dinitrobenzene	22.0 [3]	USEPA 2003	USEPA Region 5 ecological screening level
1,4-Dichlorobenzene	19.9	USEPA 2001	USEPA Region 4 chronic screening value
1,4-Dioxane	67,000	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Menidia beryllina* [inland silverside]) with a safety factor of 100
1,4-Naphthoquinone	NA	---	---
1-Naphthylamine	70.0 [3]	USEPA 2007	Minimum acute value (48-hour LC_{50} for *Oryzias latipes* [medaka high eyes]) with a safety factor of 100
2,3,4,6-Tetrachlorophenol	8.80	Buchman 2008	Acute LOEL with a safety factor of 50
2,4,5-Trichlorophenol	11.0	Buchman 2008	Proposed Criteria Continuous Concentration
2,4,6-Trichlorophenol	12.1	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Palaemonetes pugio* [daggerblade grass shrimp]) with a safety factor of 100
2,2'-Oxybis(1-chloropropane)	NA	---	---
2,4-Dichlorophenol	1.67	USEPA 2007	Minimum acute value (96-hr NOEC for *Allorchestes compressa* [scud]) with a safety factor of 30
2,4-Dimethylphenol	131	USEPA 2007	Minimum chronic value (28-day NOEC for *Menidia beryllina* [inland silverside] based on survival)
2,4-Dinitrophenol	48.5	USEPA 2001	USEPA Region 4 chronic screening value
2,4-Dinitrotoluene	44.0 [3]	USEPA 2003	USEPA Region 5 ecological screening level
2,6-Dichlorophenol	54.0	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Platichthys flesus* [european flounder]) with a safety factor of 100
2,6-Dinitrotoluene	81.0 [3]	USEPA 2003	USEPA Region 5 ecological screening level
2-Acetylaminofluorene	20.0 [3]	USEPA 2007	Minimum acute value (96-hr LOEC for *Xenopus laevis* [clawed toad]) with a safety factor of 50
2-Chloronaphthalene	0.15	Buchman 2008	Acute LOEL for chemical class with a safety factor of 50
2-Chlorophenol	53.0	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Crangon septemspinosa* [bay shrimp]) with a safety factor of 100

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Chemical	Surface Water Screening Value [1]	Reference	Comment [2]
Semi-Volatile Organics (µg/L):			
2-Methylphenol	102	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Elasmopus pectinicrus* [scud]) with a safety factor of 100
2-Naphthylamine	NA	---	---
2-Nitroaniline	48.9 [3]	USEPA 2007	Minumum acute value (48-hr EC_{50} for *daphnia magna* [cladoceron]) with a safety factor of 100
2-Nitrophenol	10,000	USEPA 2007	Minimum chronic value (28-day MATC for *Cyprinodon variegatus* [sheepshead minnow] based on egg hatchability)
2-Picoline	8,979 [3]	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Pimephales promelas* [fathead minnow]) with a safety factor of 100
2-Toluidine	5.20 [3]	USEPA 2007	Minimum acute value (48-hr LC_{50} for *Daphnia magna* [cladoceron]) with a safety factor of 100
3,4-Methyphenol	33.6	---	Value for 4-methylphenol used as a surrogate
3,3'-Dichlorobenzidine	4.50 [3]	USEPA 2003	USEPA Region 5 ecological screening level
3,3'-Dimethylbenzidine	160 [3]	USEPA 2007	Minimum chronic value (21-day NOEC for *Daphnia magna* [cladoceron] based on behavior [equilibrium])
3-Methylcholanthrene	NA	---	---
3-Nitroaniline	9.80 [3]	USEPA 2007	Minimum acute value (48-hr EC_{50} for *Daphnia magna* [cladoceron]) with a safety factor of 100
3-Methylphenol	62.0[3]	USEPA 2003	USEPA Region 5 ecological screening level
4,6-Dinitro-2-methylphenol	23.0 [3]	USEPA 2003	USEPA Region 5 ecological screening level
4-Aminobiphenyl	NA	---	---
4-Bromophenyl phenyl ether	1.50 [3]	USEPA 2003	USEPA Region 5 ecological screening level
4-Chloro-3-methylphenol	0.30 [3]	USEPA 2003	USEPA Region 5 ecological screening level
4-Chloroaniline	10.0 [3]	USEPA 2007	Minimum chronic value (21-day NOEC for *Daphnia magna* [cladoceron]) based on reproduction)
4-Chlorophenyl phenyl ether	7.30 [3]	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Salvelinus fontinalis* [brook trout]) with a safety factor of 100
4-Methylphenol	33.6	USEPA 2007	Minimum acute value (96-hr LC_{50} for Oncorhynchus goruscha [pink salmon]) with a safety factor of 100
4-Nitroaniline	170 [3]	USEPA 2007	Minimum acute value (48-hr EC_{50} for *Daphnia magna* [cladoceron]) with a safety factor of 100
4-Nitrophenol	71.7	USEPA 2001	USEPA Region 4 chronic screening value
4-Nitroquinoline-1-oxide	NA	---	---
7,12-Dimethylbenz(a)anthracene	6.00	Buchman 2008	Acute LOEL for chemical class with a safety factor of 50 (value for high molecular weight PAHs)
Acetophenone	1,550 [3]	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Pimephales promelas* [fathead minnow]) with a safety factor of 100
A,A-Dimethyl phenethylamine	NA	---	---
Aniline	294	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Crangon septemspinosa* [sand shrimp]) with a safety factor of 100
Aramite, total	3.09 [3]	USEPA 2003	USEPA Region 5 ecological screening level
Benzyl alcohol	150	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Menidia beryllina* [inland silverside]) with a safety factor of 100
bis(2-Chloroethoxy)methane	1,840 [3]	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Pimephales promelas* [fathead minnow]) with a safety factor of 100
bis(2-Chloroethyl)ether	2,380 [3]	USEPA 2001	USEPA Region 4 chronic screeing value
bis(2-Ethylhexyl)phthalate	360	Buchman 2008	Proposed Criteria Continuous Concentration
Butyl benzyl phthalate	29.4	USEPA 2001	USEPA Region 4 chronic screening value
cis-Diallate	82.0 [3]	---	Value for diallate used as a surrogate
Diallate	82.0 [3]	USEPA 2007	Minimum acute value (48-hr LC_{50} for *Rasbora heteromorpha* [harlequinfish]) with a safety factor of 100
Dibenzofuran	33.3	USEPA 2007	Minimum acute value (96-hr NOEC for *Cyprinodon variegatus* [sheepshead minnow]) with a safety factor of 30
Diethyl phthalate	75.9	USEPA 2001	USEPA Region 4 chronic screening value
Dimethyl phthalate	580	USEPA 2001	USEPA Region 4 chronic screening value
Di-n-butyl phthalate	3.40	USEPA 2001	USEPA Region 4 chronic screening value (lowest reported plant value)
Di-n-octyl phthalate	1,150	USEPA 2007	Minimum acute value (96-hr NOEC for *Americamysis bahia* [opossum shrimp]) with a safety factor of 30
Dinoseb	1.70	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Americamysis bahia* [opossum shrimp]) with a safety factor of 100

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Chemical	Surface Water Screening Value [1]	Reference	Comment [2]
Semi-Volatile Organics (µg/L):			
Ethyl methanesulfonate	40.0 [3]	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Clarias batrachus* [walking catfish]) with a safety factor of 100
Hexachlorobenzene	0.077	USEPA 2007	Minimum acute value (48-hr NOEC [NR-ZERO] for *Penaeus duorarum* [northern pink shrimp]) with a safety factor of 30
Hexachlorobutadiene	0.32	USEPA 2001	USEPA Region 4 chronic screening value
Hexachlorocyclopentadiene	0.07	USEPA 2001	USEPA Region 4 chronic screening value
Hexachloroethane	9.40	USEPA 2001	USEPA Region 4 chronic screening value
Hexachlorophene	8.80 [3]	USEPA 2007	Minimum chronic value (34-day NOEC for *Pimephales promelas* [fathead minnow] based on survival and growth)
Hexachloropropene	NA	---	---
Isophorone	129	USEPA 2001	USEPA Region 4 chronic screening value
Isosafrole	NA	---	---
Methapyrilene	NA	---	---
Methyl methanesulfonate	NA	---	---
Nitrobenzene	66.8	USEPA 2001	USEPA Region 4 chronic screening value
N-Nitro-o-toluidine	220 [3]	USEPA 2007	Minimum acute value (48-hr EC_{50} for *Daphnia magna* [cladoceron] based on immobilization) with a safety factor of 100
N-Nitrosodiethylamine	768 [3]	USEPA 2003	USEPA Region 5 ecological screening level
N-Nitrosodimethylamine	25.0 [3]	---	Value for N-nitrosodiphenylamine used as a surrogate
N-Nitroso-di-n-butylamine	25.0 [3]	---	Value for N-nitrosodiphenylamine used as a surrogate
N-Nitroso-di-n-propylamine	25.0 [3]	---	Value for N-nitrosodiphenylamine used as a surrogate
N-Nitrosodiphenylamine	25.0 [3]	USEPA 2011	Indiana Department of Environmental Management Great Lakes Basin Tier II chronic criterion
N-Nitrosomethylethylamine	25.0 [3]	---	Value for N-nitrosodiphenylamine used as a surrogate
N-Nitrosomorpholine	NA	---	---
N-Nitrosopiperidine	NA	---	---
N-Nitrosopyrrolidine	NA	---	---
p-Dimethylamino azobenzene	NA	---	---
Pentachlorobenzene	129	USEPA 2001	USEPA Region 4 chronic screening value
Pentachloronitrobenzene	0.12	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Americamysis bahia* [opossum shrimp]) with a safety factor of 100
Pentachlorophenol	7.90	PREQB 2010	Puerto Rico Water Quality Standard for Class SB coastal and estuarine waters
Phenacetin	NA	---	---
Phenol	58.0	USEPA 2001	USEPA Region 4 chronic screening value
p-Phenylene diamine	200 [3]	USEPA 2007	Minimum acute value (48-hr LC_{50} for *Oryzias latires* [medika, high-eyes]) with a safety factor of 100
Pronamide	35.0	USEPA 2007	Minimum acute value (96-hr EC_{50} for *Crassostrea virginica* [Virginia oyster]) with a safety factor of 100
Pyridine	500	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Crangon septemspinosa* [sand shrimp]) with a safety factor of 100
Safrole	NA	---	---
trans-Diallate	82.0 [3]	---	Value for diallate used as a surrogate
PAHs (µg/L):			
2-Methylnaphthalene	6.00	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Penaeus aztecus* [brown shrimp]) with a safety factor of 100
Acenaphthene	9.70	USEPA 2001	USEPA Region 4 chronic screening value
Acenaphthylene	6.00	Buchman 2008	Acute LOEL for chemical class with a safety factor of 50 (value for low molecular weight PAHs)
Anthracene	5.35	USEPA 2007	Minimum acute value (48-hr LC_{50} for *Americamysis bahia* [opossum shrimp]) with a safety factor of 100
Benzo(a)anthracene	0.025 [3]	USEPA 2003	USEPA Region 5 ecological screening level
Benzo(a)pyrene	10.0	USEPA 2004	Acute value (LC_{50}) with a safety factor of 100
Benzo(b)fluoranthene	6.00	Buchman 2008	Acute LOEL for chemical class with a safety factor of 50 (value for high molecular weight PAHs)

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Chemical	Surface Water Screening Value [1]	Reference	Comment [2]
PAHs (µg/L):			
Benzo(g,h,i)perylene	6.00	Buchman 2008	Acute LOEL for chemical class with a safety factor of 50 (value for high molecular weight PAHs)
Benzo(k)fluoranthene	6.00	Buchman 2008	Acute LOEL for chemical class with a safety factor of 50 (value for high molecular weight PAHs)
Chrysene	10.0	USEPA 2004	Acute value (LC_{50}) with a safety factor of 100
Dibenzo(a,h)anthracene	6.00	Buchman 2008	Acute LOEL for chemical class with a safety factor of 50 (value for high molecular weight PAHs)
Fluoranthene	11.0	USEPA 1996	Final Chronic Value
Fluorene	10.0	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Nereis arenaceodentata* [polychaete]) with a safety factor of 100
Indeno(1,2,3-cd)pyrene	6.00	Buchman 2008	Acute LOEL for chemical class with a safety factor of 50 (value for high molecular weight PAHs)
Naphthalene	23.5	USEPA 2001	USEPA Region 4 chronic screening value
Phenanthrene	8.30	USEPA 1996	Final Chronic Value
Pyrene	0.248	USEPA 2007	Minimum acute value (48-hr LC_{50} for *Americamysis bahia* [opossum shrimp]) with a safety factor of 100
Organochlorine Pesticides (ug/L):			
4,4'-DDD	0.001	PREQB 2010	Puerto Rico Water Quality Standard for Class SB coastal and estuarine waters for 4,4'-DDT and metabolites
4,4'-DDE	0.001	PREQB 2010	Puerto Rico Water Quality Standard for Class SB coastal and estuarine waters for 4,4'-DDT and metabolites
4,4'-DDT	0.001	PREQB 2010	Puerto Rico Water Quality Standard for Class SB coastal and estuarine waters for 4,4'-DDT and metabolites
Aldrin	0.13	USEPA 2001	USEPA Region 4 chronic screening value
alpha-BHC	2.3 [3]	USEPA 2007	Minimum acute value (40-day LC_{50} for *Lymnaea stagnalis* [great pond snail]) with a safety factor of 100
alpha-Chlordane	0.004	PREQB 2010	Puerto Rico Water Quality Standard for Class SB coastal and estuarine waters based on total chlordane
beta-BHC	32 [3]	USEPA 2007	Minimum chronic value (12-week NOEC for *Poecilia reticulata* [guppy] based on general histological changes)
delta-BHC	0.125	USEPA 2007	Minimum acute value (96-hour LC_{50} for *Macrobrachium idella idella* [prawn]) with a safety factor of 100
Chlorobenzilate	0.025	USEPA 2007	Minimum acute value (96-hr NOEL for *Cyprinodon variegatus* [sheepshead minnow]) with a safety factor of 30
Dieldrin	0.0019	USEPA 2013	Criteria Continuous Concentration based on Final Residual Value
Endosulfan I	0.0087	PREQB 2010	Puerto Rico Water Quality Standard for Class SB coastal and estuarine waters based on total Endosulfan
Endosulfan II	0.0087	PREQB 2010	Puerto Rico Water Quality Standard for Class SB coastal and estuarine waters based on total Endosulfan
Endosulfan sulfate	0.92 [3]	USEPA 2007	Minimum chronic value (21-day LOEC for *Daphnia magna* [cladoceron] based on reproduction) with a safety factor of 10
Endrin	0.0023	PREQB 2010	Puerto Rico Water Quality Standard for Class SB coastal and estuarine waters
Endrin aldehyde	0.0023	---	Value for endrin used as a surrogate
gamma-BHC (lindane)	0.016	PREQB 2010	Puerto Rico Water Quality Standard for Class SB coastal and estuarine waters
gamma-Chlordane	0.004	PREQB 2010	Puerto Rico Water Quality Standard for Class SB coastal and estuarine waters based on total chlordane
Heptachlor	0.0036	USEPA 2013	Criteria Continuous Concentration based on Final Residual Value
Heptachlor epoxide	0.0036	PREQB 2010	Puerto Rico Water Quality Standard for Class SB coastal and estuarine waters
Kepone	0.094	USEPA 2007	Minimum chronic value (28-day MATC for *Americamysis bahia* [opposum shrimp] based on growth)
Isodrin	0.12 [3]	USEPA 2007	Minimum acute value (24-hr LC_{50} for *Lepomis macrochirus* [bluegill]) with a safety factor of 100
Methoxychlor	0.030	PREQB 2010	Puerto Rico Water Quality Standard for Class SB coastal and estuarine waters
Total Recoverable Metals (µg/L):			
Antimony	500	Buchman 2008	Proposed Criteria Continuous Concentration
Arsenic	36.0	PREQB 2010	Total recoverable Puerto Rico Water Quality Standard for Class SB coastal and estuarine waters
Barium	16,667	USEPA 2007	Minimum acute value (96-hr NOEC for *Cyprinodon variegatus* [sheepshead minnow]) with a safety factor of 30
Beryllium	167	USEPA 2007	Minimum acute value (96-hr NOEC [NR-ZERO] for *Fundulus heteroclitus* [mummichog]) with a safety factor of 30
Cadmium	8.85	PREQB 2010	Total recoverable Puerto Rico Water Quality Standard for Class SB coastal and estuarine waters
Chromium, total	50.4 [6]	PREQB 2010	Total recoverable Puerto Rico Water Quality Standard for Class SB coastal and estuarine waters
Cobalt	45.0	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Nitocra spinipes* [Harpacticoid copepod]) with a safety factor of 100
Copper	3.73	PREQB 2010	Total recoverable Puerto Rico Water Quality Standard for Class SB coastal and estuarine waters
Lead	8.52	PREQB 2010	Total recoverable Puerto Rico Water Quality Standard for Class SB coastal and estuarine waters

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Chemical	Surface Water Screening Value [1]	Reference	Comment [2]
Total Recoverable Metals (µg/L):			
Mercury	1.11	USEPA 2013	Total recoverable Criteria Continuous Concentration
Nickel	8.28	PREQB 2010	Total recoverable Puerto Rico Water Quality Standard for Class SB coastal and estuarine waters
Selenium	71.1	PREQB 2010	Total recoverable Puerto Rico Water Quality Standard for Class SB coastal and estuarine waters
Silver	2.24	PREQB 2010	Total recoverable Puerto Rico Water Quality Standard for Class SB coastal and estuarine waters
Thallium	21.3	USEPA 2001	USEPA Region 4 chronic screening value
Tin	180 [3]	USEPA 2003	USEPA Region 5 ecological screening level
Vanadium	12.0 [3]	USEPA 2003	USEPA Region 5 ecological screening level
Zinc	85.6	PREQB 2010	Total recoverable Puerto Rico Water Quality Standard for Class SB coastal and estuarine waters

Notes:

NA = Not Available
PREQB = Puerto Rico Environmental Quality Board
USEPA = United States Environmental Protection Agency
PAH = Polynuclear Aromatic Hydrocarbon
LOEL = Lowest Observed Effect Level
MATC = Maximum Acceptable Toxicant Concentration
NOEC = No Observed Effect Concentration
NR-ZERO = 0 percent mortality, or 100 percent survival of test organisms
EC_{50} = Median Effective Concentration
LC_{50} = Median Lethal Concentration
µg/L = microgram per liter

[1] The values shown are marine/estuarine screening values unless otherwise noted. Estuarine/marine surface water screening values were preferentially used as groundwater screening values since groundwater flow at SWMU 59 is toward an estuarine wetland.
[2] The safety factors applied to acute endpoints (i.e., LC_{50}, EC_{50}, NOEC, and LOEL values) and chronic endpoints (i.e., LOELs) are those recommended by Wentsel et al. (1996).
[3] The chemical lacks a marine/estuarine surface water screening value/literature-based toxicity value. The value shown is a freshwater screening value/toxicity value.
[4] The value shown is for hexavalent chromium.

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TABLE 7-6
MARINE/ESTUARINE SURFACE WATER SCREENING VALUES USED FOR GROUNDWATER
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
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TABLE 7-7
FRESHWATER SCREENING VALUES
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Chemical	Surface Water Screening Value [1]	Reference	Comment [2]
Volatile Organics (µg/L):			
1,1,1,2-Tetrachloroethane	200	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Lepomis macrochirus* [bluegill]) with a safety factor of 100
1,1,1-Trichloroethane	76.0	USEPA 2003	USEPA Region 5 ecological screening level
1,1,2,2-Tetrachloroethane	240	USEPA 2001	USEPA Region 4 chronic screening value
1,1,2-Trichloroethane	500	USEPA 2003	USEPA Region 5 ecological screening level
1,1-Dichloroethane	47.0	USEPA 2003	USEPA Region 5 ecological screening level
1,1-Dichloroethene	65.0	USEPA 2003	USEPA Region 5 ecological screening level
1,2,3-Trichloropropane	274	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Pimephales promelas* [fathead minnow]) with a safety factor of 100
1,2-Dibromo-3-chloropropane	200	USEPA 2007	Minimum acute value (48-hr LC_{50} for *Micropterus salmoides* [largemouth bass]) with a safety factor of 100
1,2-Dichloroethane	910	USEPA 2003	USEPA Region 5 ecological screening level
1,2-Dichloropropane	360	USEPA 2003	USEPA Region 5 ecological screening level
2-Butanone (MEK)	2,200	USEPA 2003	USEPA Region 5 ecological screening level
2-Chloro-1,3-butadiene	NA	---	---
2-Hexanone	99.0	USEPA 2003	USEPA Region 5 ecological screening level
3-Chloro-1-propene	3.40	USEPA 2007	Minimum acute value (48-hr LC_{50} for *Xenopus laevis* [African clawed frog]) with a safety factor of 100
4-Methyl-2-pentanone (MIBK)	170	USEPA 2003	USEPA Region 5 ecological screening level
Acetone	1,700	USEPA 2003	USEPA Region 5 ecological screening level
Acetonitrile	12,000	USEPA 2003	USEPA Region 5 ecological screening level
Acrolein	3.00	USEPA 2013	Criteria Continuous Concentration
Acrylonitrile	66.0	USEPA 2003	USEPA Region 5 ecological screening level
Benzene	53.0	USEPA 2001	USEPA Region 4 chronic screening value
Bromoform	230	USEPA 2003	USEPA Region 5 ecological screening level
Bromomethane	16.0	USEPA 2003	USEPA Region 5 ecological screening level
Carbon disulfide	15.0	USEPA 2003	USEPA Region 5 ecological screening level
Carbon tetrachloride	240	USEPA 2003	USEPA Region 5 ecological screening level
Chlorobenzene	47.0	USEPA 2003	USEPA Region 5 ecological screening level
Chlorodibromomethane	340	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Cyprinus carpio* [common carp]) with a safety factor of 100
Chloroethane	NA	---	---
Chloroform	140	USEPA 2003	USEPA Region 5 ecological screening level
Chloromethane	5,500	USEPA 2001	USEPA Region 4 chronic screening value
cis-1,3-Dichloropropene	24.4	USEPA 2001	USEPA Region 4 chronic screening value
Dibromomethane	220	Buchman 2008	Acute LOEL for chemical class with a safety factor of 50
Dichlorobromomethane	2,400	USEPA 2007	Minimum acute value (24-hr LC_{50} for *Tetrahymena pyriformis* [ciliate]) with a safety factor of 100
Dichlorodifluoromethane	220	---	Value for trichlorofluoromethane used as a surrogate
Ethyl methacrylate	18,000	USEPA 2007	Minimum chronic value (21-day NOEC for *Daphnia magna* [cladoceron] based on reproduction [progeny counts])
Ethylbenzene	14.0	USEPA 2003	USEPA Region 5 ecological screening level
Ethylene dibromide	150	USEPA 2007	Minimum acute value (48-hr LC_{50} for *Micropterus salmoides* [largemouth bass]) with a safety factor of 100
Iodomethane	NA	---	---
Isobutyl alcohol	4,000	USEPA 2007	Minimum chronic value (21-day NOEC for *Daphnia magna* [cladoceron] based on reproduction)
Methacrylonitrile	NA	---	---
Methyl methacrylate	2,800	USEPA 2003	USEPA Region 5 ecological screening level
Methylene chloride	159	USEPA 2003	USEPA Region 5 ecological screening level
Pentachloroethane	56.4	USEPA 2003	USEPA Region 5 ecological screening level
Propionitrile	15,200	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Pimephales promelas* [fathead minnow]) with a safety factor of 100

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Chemical	Surface Water Screening Value [1]	Reference	Comment [2]
Volatile Organics (µg/L):			
Styrene	32.0	USEPA 2003	USEPA Region 5 ecological screening level
Tetrachloroethene	45.0	USEPA 2003	USEPA Region 5 ecological screening level
Toluene	175	USEPA 2001	USEPA Region 4 chronic screening value
trans-1,2-dichloroethene	970	USEPA 2003	USEPA Region 5 ecological screening level
trans-1,3-Dichloropropene	24.4	USEPA 2001	USEPA Region 4 chronic screening value
trans-1,4-Dichloro-2-butene	NA	---	---
Trichloroethene	47.0	USEPA 2003	USEPA Region 5 ecological screening level
Trichlorofluoromethane	220	Buchman 2008	Acute LOEL for chemical class with a safety factor of 50
Vinyl acetate	248	USEPA 2003	USEPA Region 5 ecological screening level
Vinyl chloride	930	USEPA 2003	USEPA Region 5 ecological screening level
o-Xylene	27.0	USEPA 2003	Value for total xylene
m,p-Xylene	27.0	USEPA 2003	Value for total xylene
Xylenes, total	27.0	USEPA 2003	USEPA Region 5 ecological screening level
Semi-Volatile Organics (µg/L):			
1,1-Biphenyl	230	USEPA 2007	Minimum acute value (21-day MATC for *Daphnia magna* [cladoceron] based on reproduction)
1,2,4,5-Tetrachlorobenzene	3.00	USEPA 2003	USEPA Region 5 ecological screening level
1,2,4-Trichlorobenzene	30.0	USEPA 2003	USEPA Region 5 ecological screening level
1,2-Dichlorobenzene	14.0	USEPA 2003	USEPA Region 5 ecological screening level
1,3,5-Trinitrobenzene	80.0	USEPA 2007	Minimum chronic value (71-day NOEC for *Oncorhynchus mykiss* [rainbow trout] based on reproduction)
1,3-Dichlorobenzene	38.0	USEPA 2003	USEPA Region 5 ecological screening level
1,3-Dinitrobenzene	22.0	USEPA 2003	USEPA Region 5 ecological screening level
1,4-Dichlorobenzene	9.4	USEPA 2003	USEPA Region 5 ecological screening level
1,4-Dioxane	22,000	USEPA 2003	USEPA Region 5 ecological screening level
1,4-Naphthoquinone	0.40	USEPA 2007	Minimum acute value (14-day LC_{50} for *Oscillatoria* sp. [blue-green algae] based on population growth rates) with a safety factor of 100
1-Naphthylamine	70	USEPA 2007	48-hr LC_{50} with a safety factor of 100
2,2'-Oxybis(1-chloropropane)	NA	---	---
2,3,4,6-Tetrachlorophenol	1.20	USEPA 2003	USEPA Region 5 ecological screening level
2,4,5-Trichlorophenol	62.5	USEPA 2007	Minimum chronic value (12-day NOEC for *Oncorhynchus mykiss* [rainbow trout] growth)
2,4,6-Trichlorophenol	4.90	USEPA 2003	USEPA Region 5 ecological screening level
2,4-Dichlorophenol	11.0	USEPA 2003	USEPA Region 5 ecological screening level
2,4-Dimethylphenol	21.2	USEPA 2001	USEPA Region 4 chronic screening value
2,4-Dinitrophenol	6.20	USEPA 2001	USEPA Region 4 chronic screening value
2,4-Dinitrotoluene	44.0	USEPA 2003	USEPA Region 5 ecological screening level
2,6-Dichlorophenol	34.0	USEPA 2007	Minimum acute value (48-hr EC_{50} for *Daphnia magna* [cladoceron]) based on immobilization) with a safety factor of 100
2,6-Dinitrotoluene	81.0	USEPA 2003	USEPA Region 5 ecological screening level
2-Acetylaminofluorene	20.0	USEPA 2007	Minimum acute value (96-hr LOEC for *Xenopus laevis* [African clawed frog] based on growth [length]) with a safety factor of 50
2-Chloronaphthalene	32.0	Buchman 2008	Acute LOEL for chemical class with a safety factor of 50
2-Chlorophenol	24.0	USEPA 2003	USEPA Region 5 ecological screening level
2-Methylphenol	67.0	USEPA 2003	USEPA Region 5 ecological screening level
2-Naphthylamine	NA	---	---
2-Nitroaniline	48.9	USEPA 2007	Minimum acute value (48-hr EC_{50} for *Daphnia magna* [cladoceron]) based on immobilization) with a safety factor of 100
2-Nitrophenol	3,500	USEPA 2001	USEPA Region 4 chronic screening value
2-Picoline	8,970	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Pimephales promelas* [fathead minnow]) with a safety factor of 100

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Chemical	Surface Water Screening Value [1]	Reference	Comment [2]
Semi-Volatile Organics (µg/L):			
2-Toluidine	5.2	USEPA 2007	Minimum acute value (48-hr LC_{50} for *Daphnia magna* [cladoceron]) with a safety factor of 100
3,3'-Dichlorobenzidine	4.5	USEPA 2003	USEPA Region 5 ecological screening level
3,3'-Dimethylbenzidine	160	USEPA 2007	Minimum chronic value (21-day NOEC for *Daphnia magna* [cladoceron] based on reproduction)
3,4-Methylphenol	25.0	---	Value for 4-methylphenol used as a surrogate
3-Methylcholanthrene	NA	---	---
3-Methylphenol	62.0	USEPA 2003	USEPA Region 5 ecological screening level
3-Nitroaniline	9.80	USEPA 2007	Minimum acute value (48-hr EC_{50} for *Daphnia magna* [cladoceron]) based on immobilization) with a safety factor of 100
4,6-Dinitro-2-methylphenol	23.0	USEPA 2003	USEPA Region 5 ecological screening level
4-Aminobiphenyl	NA	---	---
4-Bromophenyl phenyl ether	1.50	USEPA 2003	USEPA Region 5 ecological screening level
4-Chloro-3-methylphenol	0.3	USEPA 2001	USEPA Region 4 chronic screening value
4-Chloroaniline	232	USEPA 2003	USEPA Region 5 ecological screening level
4-Chlorophenyl phenyl ether	7.30	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Salvelinus fontinalis* [brook trout]) with a safety factor of 100
4-Methylphenol	25.00	USEPA 2003	USEPA Region 5 ecological screening level
4-Nitroaniline	170	USEPA 2007	Minimum acute value (48-hr EC_{50} for *Daphnia magna* [cladoceron]) based on immobilization) with a safety factor of 100
4-Nitrophenol	60.0	USEPA 2003	USEPA Region 5 ecological screening level
4-Nitroquinoline-1-oxide	NA	---	---
7,12-Dimethylbenz(a)anthracene	6.00 [3]	Buchman 2008	Acute LOEL for chemical class with a safety factor of 50 (value for high molecular weight PAHs)
Acetophenone	1,550	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Pimephales promelas* [fathead minnow]) with a safety factor of 100
A,A-Dimethyl phenethylamine	NA	---	---
Aniline	4.10	USEPA 2003	USEPA Region 5 ecological screening level
Aramite (total)	3.09	USEPA 2003	USEPA Region 5 ecological screening level
Benzyl alcohol	8.60	USEPA 2003	USEPA Region 5 ecological screening level
bis(2-Chloroethoxy)methane	1,840	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Pimephales promelas* [fathead minnow]) with a safety factor of 100
bis(2-Chloroethyl)ether	2,380	USEPA 2001	USEPA Region 4 chronic screening value
bis(2-Ethylhexyl)phthalate	0.30	USEPA 2003	USEPA Region 5 ecological screening level
Butyl benzyl phthalate	22.0	USEPA 2001	USEPA Region 4 chronic screening value
cis-Diallate	82.0	---	Value for diallate used as a surrogate
Diallate	82 [3]	USEPA 2007	Minimum acute value (48-hr LC_{50} for *Rasbora heteromorpha* [harlequinfish]) with a safety factor of 100
Dibenzofuran	4.00	USEPA 2003	USEPA Region 5 ecological screening level
Diethyl phthalate	110	USEPA 2003	USEPA Region 5 ecological screening level
Dimethyl phthalate	330	USEPA 2001	USEPA Region 4 chronic screening value
Di-n-butyl phthalate	9.40	USEPA 2001	USEPA Region 4 chronic screening value (lowest reported plant value)
Di-n-octyl phthalate	30.0	USEPA 2003	USEPA Region 5 ecological screening level
Dinoseb (2-sec-butyl-4,6-Dinitrophenol)	0.48	USEPA 2003	USEPA Region 5 ecological screening level
Ethyl methanesulfonate	40.0	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Clarias batrachus* [walking catfish]) with a safety factor of 100
Hexachlorobenzene	0.13	USEPA 2007	Minimum chronic value (21-day NOEC for *Daphnia magna* [cladoceron] based on reproduction)
Hexachlorobutadiene	0.93	USEPA 2001	USEPA Region 4 chronic screening value
Hexachlorocyclopentadiene	0.07	USEPA 2001	USEPA Region 4 chronic screening value
Hexachloroethane	8.00	USEPA 2003	USEPA Region 5 ecological screening level
Hexachlorophene	8.80	USEPA 2007	Minimum chronic value (34-day NOEC for *Pimephales promelas* [fathead minnow] based on growth)
Hexachloropropene	NA	---	---
Isophorone	920	USEPA 2003	USEPA Region 5 ecological screening level

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Chemical	Surface Water Screening Value [1]	Reference	Comment [2]
Semi-Volatile Organics (µg/L):			
Isosafrole	NA	---	---
Methapyrilene	NA	---	---
Methyl methanesulfonate	NA	---	---
Nitrobenzene	220	USEPA 2003	USEPA Region 5 ecological screening level
N-Nitro-o-toluidine	220	USEPA 2007	Minimum acute value (48-hr EC_{50} for *Daphnia magna* [cladoceron]) based on immobilization) with a safety factor of 100
N-Nitrosodiethylamine	768	USEPA 2003	USEPA Region 5 ecological screening level
N-Nitrosodimethylamine	25.0	---	Value for N-nitrosodiphenylamine used as a surrogate
N-Nitroso-di-n-butylamine	25.0	---	Value for N-nitrosodiphenylamine used as a surrogate
N-Nitroso-di-n-propylamine	25.0	---	Value for N-nitrosodiphenylamine used as a surrogate
N-Nitrosodiphenylamine	25.0	USEPA 2011	Indiana Department of Environmental Management Great Lakes Basin Tier II chronic criterion
N-Nitrosomethylethylamine	25.0	---	Value for N-nitrosodiphenylamine used as a surrogate
N-Nitrosomorpholine	NA	---	---
N-Nitrosopiperidine	NA	---	---
N-Nitrosopyrrolidine	NA	---	---
p-Dimethylamino azobenzene	NA	---	---
Pentachlorobenzene	0.019	USEPA 2003	USEPA Region 5 ecological screening level
Pentachloronitrobenzene	1.00	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Lepomis macrochirus* [bluegill]) with a safety factor of 100
Pentachlorophenol	15	USEPA 2013	Criteria Continuous Concentration (value corresponds to a pH of 7.8)
Phenacetin	NA	---	---
Phenol	180	USEPA 2003	USEPA Region 5 ecological screening level
p-Phenylene diamine	200	USEPA 2007	Minimum acute value (48-hr LC_{50} for *Oryzias latipes* [medaka, high-eyes]) with a safety factor of 100
Pronamide	7.60	USEPA 2007	Minimum acute value (120-hr EC_{50} for *Pseudokirchneriella subcapitata* [green algae] based on abundance) with a safety factor of 100
Pyridine	2,380	USEPA 2003	USEPA Region 5 ecological screening level
Safrole	NA	---	---
trans-Diallate	82.0	---	Value for diallate used as a surrogate
PAHs (µg/L):			
2-Methylnaphthalene	14.56	USEPA 2007	Minimum acute value (96-hr LC_{50} for *Oncorhynchus mykiss* [rainbow trout]) with a safety factor of 100
Acenaphthene	23.0	USEPA 1996	Final Chronic Value
Acenaphthylene	6.00 [3]	Buchman 2008	Acute LOEL for chemical class with a safety factor of 50 (value for low molecular weight PAHs)
Anthracene	0.035	USEPA 2003	USEPA Region 5 ecological screening level
Benzo(a)anthracene	0.025	USEPA 2003	USEPA Region 5 ecological screening level
Benzo(a)pyrene	0.014	USEPA 2003	USEPA Region 5 ecological screening level
Benzo(b)fluoranthene	6.00 [3]	Buchman 2008	Acute LOEL for chemical class with a safety factor of 50 (value for high molecular weight PAHs)
Benzo(g,h,i)perylene	6.00 [3]	Buchman 2008	Acute LOEL for chemical class with a safety factor of 50 (value for high molecular weight PAHs)
Benzo(k)fluoranthene	6.00 [3]	Buchman 2008	Acute LOEL for chemical class with a safety factor of 50 (value for high molecular weight PAHs)
Chrysene	10.0	USEPA 2004	Acute value (LC_{50}) with a safety factor of 100
Dibenzo(a,h)anthracene	6.00 [3]	Buchman 2008	Acute LOEL for chemical class with a safety factor of 50 (value for high molecular weight PAHs)
Fluoranthene	8.10	USEPA 1996	Final Chronic Value
Fluorene	19.0	USEPA 2003	USEPA Region 5 ecological screening level
Indeno(1,2,3-cd)pyrene	6.00 [3]	Buchman 2008	Acute LOEL for chemical class with a safety factor of 50 (value for high molecular weight PAHs)
Naphthalene	13.0	USEPA 2003	USEPA Region 5 ecological screening level
Phenanthrene	6.30	USEPA 1996	Final Chronic Value
Pyrene	0.30	USEPA 2003	USEPA Region 5 ecological screening level

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Chemical	Surface Water Screening Value [1]	Reference	Comment[2]
Organochlorine Pesticides (µg/L):			
4,4'-DDD	0.001	PREQB 2010	Puerto Rico Water Quality Standard for Class SD surface waters for 4,4'DDT and metabolites
4,4'-DDE	0.001	PREQB 2010	Puerto Rico Water Quality Standard for Class SD surface waters for 4,4'DDT and metabolites
4,4'-DDT	0.001	PREQB 2010	Puerto Rico Water Quality Standard for Class SD surface waters for 4,4'DDT and metabolites
Aldrin	0.017	USEPA 2003	USEPA Region 5 ecological screening level
alpha-BHC	2.30	USEPA 2007	Minimum acute value (40-day EC_{50} for *Lymnaea stagnalis* [great pond snail]) with a safety factor of 100
alpha-Chlordane	0.0043	PREQB 2010	Puerto Rico Water Quality Standard for Class SD surface waters for total chlordane
beta-BHC	32.0	USEPA 2007	Minimum chronic value (12-week NOEC for *Poecilia reticulata* [guppy] based on general histological changes)
delta-BHC	1.20	USEPA 2007	Minimum acute value (48-hr LC_{50} for *Danio rerio* [zebra danio]) with a safety factor of 100
Chlorobenzilate	20.0	USEPA 2005	Minimum acute value (96-hr NOEC for *Lepomis macrochirus* [bluegill]) with a safety factor of 30
Dieldrin	0.056	USEPA 2013	Criteria Continuous Concentration
Endosulfan I	0.056	PREQB 2010	Puerto Rico Water Quality Standard for Class SD surface waters for total endosulfan
Endosulfan II	0.056	PREQB 2010	Puerto Rico Water Quality Standard for Class SD surface waters for total endosulfan
Endosulfan sulfate	0.92	USEPA 2007	Minimum chronic value (21-day LOEC for *Daphnia magna* [cladoceron] based on reproduction) with a safety factor of 10
Endrin	0.036	PREQB 2010	Puerto Rico Water Quality Standard for Class SD surface waters (hardness dependent)
Endrin aldehyde	0.036	---	Value for endrin used as a surrogate
gamma-BHC (lindane)	0.026	USEPA 2003	USEPA Region 5 ecological screening level
gamma-Chlordane	0.0043	PREQB 2010	Puerto Rico Water Quality Standard for Class SD surface waters for total chlordane
Heptachlor	0.0038	USEPA 2013	Criteria Continuous Concentration based on Final Residual Value
Heptachlor epoxide	0.0038	PREQB 2010	Puerto Rico Water Quality Standard for Class SD surface waters
Kepone	11.2	USEPA 2007	Minimum chronic value (28-day NOEC for *Daphnia magna* [cladoceron] based on survival and biochemical effects)
Isodrin	0.12 [3]	USEPA 2007	Minimum acute value (24-hr LC_{50} for *Lepomis macrochirus* [bluegill]) with a safety factor of 100
Methoxychlor	0.03	PREQB 2010	Puerto Rico Water Quality Standard for Class SD surface waters
Toxaphene	0.0002	PREQB 2010	Puerto Rico Water Quality Standard for Class SD surface waters
Total Recoverable Metals (µg/L):			
Antimony	80.0	USEPA 2003	USEPA Region 5 total recoverable ecological screening level
Arsenic	150	USEPA 2013	Total recoverable Criteria Continuous Concentration for trivalent arsenic
Barium	220	USEPA 2003	USEPA Region 5 total recoverable ecological screening level
Beryllium	1.69 [4]	USEPA 2011	Ohio Environmental Protection Agency Great Lakes Basin total recoverable chronic criterion (hardness dependent)
Cadmium	0.11 [4]	PREQB 2010	Total recoverable Puerto Rico Water Quality Standard for Class SD surface waters (hardness dependent)
Chromium, total	33.3 [4][5]	PREQB 2010	Total recoverable Puerto Rico Water Quality Standard for Class SD surface waters (hardness dependent)
Cobalt	24.0	USEPA 2003	USEPA Region 5 total recoverable ecological screening level
Copper	3.46 [4]	PREQB 2010	Total recoverable Puerto Rico Water Quality Standard for Class SD surface waters (hardness dependent)
Lead	0.73 [4]	PREQB 2010	Total recoverable Puerto Rico Water Quality Standard for Class SD surface waters (hardness dependent)
Mercury	0.91	USEPA 2013	Total recoverable Criteria Continuous Concentration
Nickel	19.55 [4]	PREQB 2010	Total recoverable Puerto Rico Water Quality Standard for Class SD surface waters (hardness dependent)
Selenium	5.00	PREQB 2010	Total recoverable Puerto Rico Water Quality Standard for Class SD surface waters
Silver	0.51 [4]	PREQB 2010	Total recoverable Puerto Rico Water Quality Standard for Class SD surface waters (hardness dependent)
Thallium	4.00	USEPA 2001	USEPA Region 4 total recoverable chronic screening value
Tin	180	USEPA 2003	USEPA Region 5 total recoverable ecological screening level
Vanadium	12.0	USEPA 2003	USEPA Region 5 total recoverable ecological screening level
Zinc	44.8 [4]	PREQB 2010	Total recoverable Puerto Rico Water Quality Standard for Class SD surface waters (hardness dependent)

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Notes:

NA = Not Available
LOEC = Lowest Observed Effect Conentration
PREQB = Puerto Rico Environmental Quality Board
PAH = Polynuclear Aromatic Hydrocarbon
USEPA = United States Environmental Protection Agency
LOEL = Lowest Observed Effect Level
NOEC = No Observed Effect Concentration
MATC = Maximum Acceptable Toxicant Concentration
µg/L = microgram per liter
LC_{50} = Median Lethal Concentration
EC_{50} = Median Effective Concentration

(1) The values shown are freshwater screening values unless otherwise noted.
(2) The safety factors applied to acute endpoints (i.e., EC_{50}, LC_{50} and LOEL values) are those recommended by Wentsel et al. (1996).
(3) The chemical lacks a freshwater toxicological benchmark/literature-based toxicity test data. The value shown is a marine/estuarine toxicological benchmark.
(4) The screening value shown is based on a water hardness of 31.35 mg/L as $CaCO_3$.
(5) The value shown is for trivalent chromium.

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TABLE 7-8
FRESHWATER SEDIMENT SCREENING VALUES
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Chemical	Sediment Screening Value [1]	Reference	Comment [2][3]
Volatile Organics (µg/kg):			
1,1,1,2-Tetrachloroethane	1,617	USEPA 1993 and 1996	EqP-based screening value
1,1,1-Trichloroethane	438	USEPA 1993 and 1996	EqP-based screening value
1,1,2,2-Tetrachloroethane	1,127	USEPA 1993 and 1996	EqP-based screening value
1,1,2-Trichloroethane	1,088	USEPA 1993 and 1996	EqP-based screening value
1,1-Dichloroethane	56.8	USEPA 1993 and 1996	EqP-based screening value
1,1-Dichloroethene	170	USEPA 1993 and 1996	EqP-based screening value
1,2,3-Trichloropropane	938	USEPA 1993 and 1996	EqP-based screening value
1,2-Dibromo-3-chloropropane	839	USEPA 1993 and 1996	EqP-based screening value
1,2-Dichloroethane	533	USEPA 1993 and 1996	EqP-based screening value
1,2-Dichloropropane	654	USEPA 1993 and 1996	EqP-based screening value
2-Butanone (MEK)	87.1	USEPA 1993 and 1996	EqP-based screening value
2-Chloro-1,3-butadiene	NA	---	---
2-Hexanone	47.3	USEPA 1993 and 1996	EqP-based screening value
3-Chloro-1-propene	5.64	USEPA 1993 and 1996	EqP-based screening value
4-Methyl-2-pentanone (MIBK)	69.3	USEPA 1993 and 1996	EqP-based screening value
Acetone	20.8	USEPA 1993 and 1996	EqP-based screening value
Acetonitrile	117	USEPA 1993 and 1996	EqP-based screening value
Acrolein	0.062	USEPA 1993 and 1996	EqP-based screening value
Acrylonitrile	2.44	USEPA 1993 and 1996	EqP-based screening value
Benzene	138	USEPA 1993 and 1996	EqP-based screening value
Bromoform	987	USEPA 1993 and 1996	EqP-based screening value
Bromomethane	4.97	USEPA 1993 and 1996	EqP-based screening value
Carbon disulfide	29.1	USEPA 1993 and 1996	EqP-based screening value
Carbon tetrachloride	2,434	USEPA 1993 and 1996	EqP-based screening value
Chlorobenzene	640	USEPA 1993 and 1996	EqP-based screening value
Chlorodibromomethane	971	USEPA 1993 and 1996	EqP-based screening value
Chloroethane	6,070	Di Toro and McGrath 2000	EqP-based toxicological threshold
Chloroform	227	USEPA 1993 and 1996	EqP-based screening value
Chloromethane	907	USEPA 1993 and 1996	EqP-based screening value
cis-1,3-Dichloropropene	54.3	USEPA 1993 and 1996	EqP-based screening value
Dibromomethane	147	USEPA 1993 and 1996	EqP-based screening value
Dichlorobromomethane	5,848	USEPA 1993 and 1996	EqP-based screening value
Dichlorodifluoromethane	614	USEPA 1993 and 1996	EqP-based screening value
Ethylbenzene	4.00 [4]	Buchman 2008	Minimum Apparent Effects Threshold (Echinoderm larvae and $larval_{max}$)
Ethylene dibromide	291	USEPA 1993 and 1996	EqP-based screening value
Ethyl methacrylate	13,827	USEPA 1993 and 1996	EqP-based screening value
Iodomethane	NA	---	---
Isobutyl alcohol	459	USEPA 1993 and 1996	EqP-based screening value
Methacrylonitrile	NA	---	---

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Chemical	Sediment Screening Value [1]	Reference	Comment [2][3]
Volatile Organics (µg/kg):			
Methylene chloride	56.6	USEPA 1993 and 1996	EqP-based screening value
Methyl methacrylate	1,337	USEPA 1993 and 1996	EqP-based screening value
Pentachloroethane	1,207	USEPA 1993 and 1996	EqP-based screening value
Propionitrile	459	USEPA 1993 and 1996	EqP-based screening value
Styrene	522	USEPA 1993 and 1996	EqP-based screening value
Tetrachloroethene	57.0 [4]	Buchman 2008	Minimum Apparent Effects Threshold (infaunal community impacts)
Toluene	1,857	USEPA 1993 and 1996	EqP-based screening value
trans-1,2-dichloroethene	2,208	USEPA 1993 and 1996	EqP-based screening value
trans-1,3-Dichloropropene	50.7	USEPA 1993 and 1996	EqP-based screening value
trans-1,4-Dichloro-2-butene	NA	---	---
Trichloroethene	456	USEPA 1993 and 1996	EqP-based screening value
Trichlorofluoromethane	1,419	USEPA 1993 and 1996	EqP-based screening value
Vinyl acetate	27.2	USEPA 1993 and 1996	EqP-based screening value
Vinyl chloride	583	USEPA 1993 and 1996	EqP-based screening value
o-Xylene	4.00 [4]	Buchman 2008	Value for total xylenes
m,p-Xylene	4.00 [4]	Buchman 2008	Value for total xylenes
Xylenes, total	4.00 [4]	Buchman 2008	Minimum Apparent Effects Threshold for total xylenes (bivalve)
Semi-Volatile Organics (µg/kg):			
1,2,4,5-Tetrachlorobenzene	2,295	USEPA 1993 and 1996	EqP-based screening value
1,2,4-Trichlorobenzene	4.80 [4]	Buchman 2008	Minimum Apparent Effects Threshold (Echinoderm larvae)
1,3,5-Trinitrobenzene	24.3	USEPA 1993 and 1996	EqP-based screening value
1,1-Biphenyl	39,495	USEPA 1993 and 1996	EqP-based screening value
1,2-Dichlorobenzene	13.0 [4]	Buchman 2008	Minimum Apparent Effects Threshold (Neanthes bioassay)
1,3-Dichlorobenzene	2,761	USEPA 1993 and 1996	EqP-based screening value
1,3-Dinitrobenzene	13.79	USEPA 1993 and 1996	EqP-based screening value
1,4-Dichlorobenzene	110 [4]	Buchman 2008	Minimum Apparent Effects Threshold (infaunal community impacts and Microtox bioassay)
1,4-Dioxane	251	USEPA 1993 and 1996	EqP-based screening value
1,4-Naphthoquinone	0.40	USEPA 1993 and 1996	EqP-based screening value
1-Naphthylamine	233.73	USEPA 1993 and 1996	EqP-based screening value
2,3,4,6-Tetrachlorophenol	597	USEPA 1993 and 1996	EqP-based screening value
2,4,5-Trichlorophenol	3.00 [4]	Buchman 2008	Minimum Apparent Effects Threshold (infaunal community impacts)
2,4,6-Trichlorophenol	6.00 [4]	Buchman 2008	Minimum Apparent Effects Threshold (infaunal community impacts)
2,2'-Oxybis(1-chloropropane)	NA	---	---
2,4-Dichlorophenol	0.2083 [4]	Buchman 2008	Minimum Apparent Effects Threshold (basis of value not specified)
2,4-Dimethylphenol	18.0 [4]	Buchman 2008	Minimum Apparent Effects Threshold (Neanthes bioassay)
2,4-Dinitrophenol	4.35	USEPA 1993 and 1996	EqP-based screening value
2,4-Dinitrotoluene	87.5	USEPA 1993 and 1996	EqP-based screening value

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Chemical	Sediment Screening Value [1]	Reference	Comment [2][3]
Semi-Volatile Organics (µg/kg):			
2,6-Dichlorophenol	361	USEPA 1993 and 1996	EqP-based screening value
2,6-Dinitrotoluene	117	USEPA 1993 and 1996	EqP-based screening value
2-Acetylaminofluorene	490	USEPA 1993 and 1996	EqP-based screening value
2-Chloronaphthalene	1,413	USEPA 1993 and 1996	EqP-based screening value
2-Chlorophenol	0.333 [4]	Buchman 2008	Minimum Apparent Effects Threshold (basis of value not specified)
2-Methylphenol	8.00 [4]	Buchman 2008	Minimum Apparent Effects Threshold (bivalve)
2-Naphthylamine	NA	---	---
2-Nitroaniline	67.7	USEPA 1993 and 1996	EqP-based screening value
2-Nitrophenol	4,228	USEPA 1993 and 1996	EqP-based screening value
2-Picoline	2,325	USEPA 1993 and 1996	EqP-based screening value
2-Toluidine	2.17	USEPA 1993 and 1996	EqP-based screening value
3,4-methylphenol	100 [4][5]	---	Value for 4-methylphenol used as a surrogate
3-Methylphenol	100 [4][5]	---	Value for 4-methylphenol used as a surrogate
3,3'-Dichlorobenzidine	267	USEPA 1993 and 1996	EqP-based screening value
3,3'-Dimethylbenzidine	1,449	USEPA 1993 and 1996	EqP-based screening value
3-Methylcholanthrene	NA	---	---
3-Nitroaniline	4.58	USEPA 1993 and 1996	EqP-based screening value
4,6-Dinitro-2-methylphenol	58.6	USEPA 1993 and 1996	EqP-based screening value
4-Aminobiphenyl	NA	---	---
4-Bromophenyl phenyl ether	656	Di Toro and McGrath 2000	EqP-based toxicological threshold
4-Chloro-3-methylphenol	7.03	USEPA 1993 and 1996	EqP-based screening value
4-Chloroaniline	321	USEPA 1993 and 1996	EqP-based screening value
4-Chlorophenyl phenyl ether	602	Di Toro and McGrath 2000	EqP-based toxicological threshold
4-Methylphenol	100.00 [4]	Buchman 2008	Minimum Apparent Effects Threshold (bivalve)
4-Nitroaniline	83.0	USEPA 1993 and 1996	EqP-based screening value
4-Nitrophenol	95.1	USEPA 1993 and 1996	EqP-based screening value
4-Nitroquinoline-1-oxide	NA	---	---
7,12-Dimethylbenz(a)anthracene	405,612	USEPA 1993 and 1996	EqP-based screening value
Acetophenone	1,333	USEPA 1993 and 1996	EqP-based screening value
A,A-Dimethylphenethylamine	NA	---	---
Aniline	0.79	USEPA 1993 and 1996	EqP-based screening value
Aramite, total	3,552	USEPA 1993 and 1996	EqP-based screening value
Benzyl alcohol	52.0 [4]	Buchman 2008	Minimum Apparent Effects Threshold (bivalve)
bis(2-Chloroethoxy)methane	211	USEPA 1993 and 1996	EqP-based screening value
bis(2-Chloroethyl)ether	774	USEPA 1993 and 1996	EqP-based screening value
bis(2-Ethylhexyl)phthalate	180	MacDonald et al. 2003	Threshold Effect Concentration
Butyl benzyl phthalate	63.0 [4]	Buchman 2008	Minimum Apparent Effects Threshold (Microtox)
Diallate, total	44,667	USEPA 1993 and 1996	EqP-based screening value

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Chemical	Sediment Screening Value [1]	Reference	Comment [2][3]
Semi-Volatile Organics (µg/kg):			
cis-Diallate	44,667	USEPA 1993 and 1996	EqP-based screening value
Dibenzofuran	110 [4]	Buchman 2008	Minimum Apparent Effects Threshold (Echinoderm larvae)
Diethyl phthalate	630	MacDonald et al. 2003	Threshold Effect Concentration
Dimethyl phthalate	6.00 [4]	Buchman 2008	Minimum Apparent Effects Threshold (bivalve)
Di-n-butyl phthalate	58.0 [4]	Buchman 2008	Minimum Apparent Effects Threshold (bivalve and $larval_{max}$)
Di-n-octyl phthalate	61.0 [4]	Buchman 2008	Minimum Apparent Effects Threshold (bivalve and $larval_{max}$)
Dinoseb	42.8	USEPA 1993 and 1996	EqP-based screening value
Ethyl methanesulfonate	0.94	USEPA 1993 and 1996	EqP-based screening value
Hexachlorobenzene	20.0	MacDoanld et al 2003/Persaud et al. 1993	Threshold Effect Conentration/Lowest Effect Level
Hexachlorobutadiene	55.0	MacDonald et al. 2003	Threshold Effect Concentration
Hexachlorocyclopentadiene	292	USEPA 1993 and 1996	EqP-based screening value
Hexachloroethane	73.0 [4]	Buchman 2008	Minimum Apparent Effects Threshold (bivalve and $larval_{max}$)
Hexachlorophene	4,773,116	USEPA 1993 and 1996	EqP-based screening value
Hexachloropropene	NA	---	---
Isophorone	907	USEPA 1993 and 1996	EqP-based screening value
Isosafrole	NA	---	---
Methapyrilene	NA	---	---
Methyl methanesulfonate	NA	---	---
N-Nitro-o-toluidine	318	USEPA 1993 and 1996	EqP-based screening value
N-Nitrosodiethylamine	47.8	USEPA 1993 and 1996	EqP-based screening value
N-Nitrosodimethylamine	0.14	USEPA 1993 and 1996	EqP-based screening value
N-Nitroso-di-n-butylamine	123	USEPA 1993 and 1996	EqP-based screening value
N-Nitroso-di-n-propylamine	12.5	USEPA 1993 and 1996	EqP-based screening value
N-Nitrosodiphenylamine	28.0 [4]	Buchman 2008	Minimum Apparent Effects Threshold (infaunal community impacts)
N-Nitrosomethylethylamine	0.40	USEPA 1993 and 1996	EqP-based screening value
N-Nitrosomorpholine	NA	---	---
N-Nitrosopiperidine	NA	---	---
N-Nitrosopyrrolidine	NA	---	---
Nitrobenzene	21.0 [4]	Buchman 2008	Minimum Apparent Effects Threshold (Neanthes bioassay)
p-Dimethylamino azobenzene	NA	---	---
Pentachlorobenzene	59.1	USEPA 1993 and 1996	EqP-based screening value
Pentachloronitrobenzene	765	USEPA 1993 and 1996	EqP-based screening value
Pentachlorophenol	17.0 [4]	Buchman 2008	Minimum Apparent Effects Threshold (bivalve)
Phenacetin	NA	---	---
Phenol	130 [4]	Buchman 2008	Minimum Apparent Effects Threshold (Echinoderm larvae)
p-Phenylene diamine	2.14	USEPA 1993 and 1996	EqP-based screening value
Pronamide	450	USEPA 1993 and 1996	EqP-based screening value

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Chemical	Sediment Screening Value [1]	Reference	Comment [2][3]
Semi-Volatile Organics (µg/kg):			
Pyridine	228	USEPA 1993 and 1996	EqP-based screening value
Safrole, total	NA	---	---
trans-Diallate	44,667	USEPA 1993 and 1996	EqP-based screening value
PAHs (µg/kg):			
2-Methylnaphthalene	20.2	CCME 2002	Interim Sediment Quality Guideline
Acenaphthene	6.70	MacDonald et al. 2003/CCME 2002	Threshold Effect Concentration/Interim Sediment Quality Guideline
Acenaphthylene	5.90	MacDonald et al. 2003/CCME 2002	Threshold Effect Concentration/Interim Sediment Quality Guideline
Anthracene	57.2	MacDonald et al. 2000	Consensus-based Threshold Effect Concentration
Benzo(a)anthracene	108	MacDonald et al. 2000	Consensus-based Threshold Effect Concentration
Benzo(a)pyrene	150	MacDonald et al. 2000	Consensus-based Threshold Effect Concentration
Benzo(b)fluoranthene	1,800 [4]	Buchman 2008	Minimum Apparent Effects Threshold (Echinoderm larvae and infaunal commuity impacts)
Benzo(g,h,i)perylene	170	Persaud et al. 1993	Lowest Effect Level
Benzo(k)fluoranthene	240	Persaud et al. 1993	Lowest Effect Level
Chrysene	166	MacDonald et al. 2000	Consensus-based Threshold Effect Concentration
Dibenzo(a,h)anthracene	33.0	MacDonald et al. 2000	Consensus-based Threshold Effect Concentration
Fluoranthene	423	MacDonald et al. 2000	Consensus-based Threshold Effect Concentration
Fluorene	77.4	MacDonald et al. 2000	Consensus-based Threshold Effect Concentration
Indeno(1,2,3-cd)pyrene	200	Persaud et al. 1993	Lowest Effect Level
Naphthalene	176	MacDonald et al. 2000	Consensus-based Threshold Effect Concentration
Phenanthrene	204	MacDonald et al. 2000	Consensus-based Threshold Effect Concentration
Pyrene	195	MacDonald et al. 2000	Consensus-based Threshold Effect Concentration
Organochlorine Pesticides (µg/kg):			
4,4'-DDD	4.88 [6]	MacDonald et al. 2000	Consensus-based Threshold Effect Concentration
4,4'-DDE	3.16 [6]	MacDonald et al. 2000	Consensus-based Threshold Effect Concentration
4,4'-DDT	5.28 [7]	MacDonald et al. 2000	Consensus-based Threshold Effect Concentration
Aldrin	2.00	Persaud et al. 1993	Lowest Effect Level
alpha-BHC	6.00	Persaud et al. 1993	Lowest Effect Level
alpha-chlordane	3.24	---	Value for chlordane used as a surrogate
beta-BHC	5.00	Persaud et al. 1993	Lowest Effect Level
Chlordane (technical)	3.24	MacDonald et al. 2000	Consensus-based Threshold Effect Concentration
Chlorobenzilate	NA	---	---
delta-BHC	140	USEPA 1993 and 1996	EqP-based screening value
Dieldrin	1.90	MacDonald et al. 2000	Consensus-based Threshold Effect Concentration
Endosulfan I	12.6	USEPA 1993 and 1996	EqP-based screening value
Endosulfan II	12.6	USEPA 1993 and 1996	EqP-based screening value
Endosulfan sulfate	76.6	USEPA 1993 and 1996	EqP-based screening value
Endrin	2.22	MacDonald et al. 2000	Consensus-based Threshold Effect Concentration
Endrin aldehyde	2.22	---	Value for endrin used as a surrogate

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Chemical	Sediment Screening Value [1]	Reference	Comment [2][3]
Organochlorine Pesticides (µg/kg):			
gamma-BHC (lindane)	2.37	MacDonald et al. 2000	Consensus-based Threshold Effect Concentration
gamma-Chlordane	3.24	---	Value for chlordane used as a surrogate
Heptachlor	0.30 [4]	Buchman 2008	Minimum Apparent Effects Threshold (bivalve)
Heptachlor epoxide	2.47	MacDonald et al. 2000	Consensus-based Threshold Effect Concentration
Isodrin	6,183	USEPA 1993 and 1996	EqP-based screening value
Kepone	38,161	USEPA 1993 and 1996	EqP-based screening value
Methoxychlor	62.1	USEPA 1993 and 1996	EqP-based screening value
Toxaphene	0.10	MacDonald et al. 2003/CCME 2002	Threshold Effect Concnetration/Interim Sediment Quality Guideline
Metals (mg/kg):			
Antimony	2.00	Long and Morgan 1991	Effects Range-Low
Arsenic	9.79	MacDonald et al. 2000	Consensus-based Threshold Effect Concentration
Barium	20.0	MacDonald et al. 2003	Threshold Effect Concentration
Beryllium	NA	---	---
Cadmium	0.99	MacDonald et al. 2000	Consensus-based Threshold Effect Concentration
Chromium, total	43.4	MacDonald et al. 2000	Consensus-based Threshold Effect Concentration
Cobalt	50.0	MacDonald et al. 2003	Threshold Effect Concentration
Copper	31.6	MacDonald et al. 2000	Consensus-based Threshold Effect Concentration
Lead	35.8	MacDonald et al. 2000	Consensus-based Threshold Effect Concentration
Mercury	0.18	MacDonald et al. 2000	Consensus-based Threshold Effect Concentration
Nickel	22.7	MacDonald et al. 2000	Consensus-based Threshold Effect Concentration
Selenium	2.00	Lemley 2002 (as cited in USEPA 2007)	USEPA Region 3 BTAG screening value
Silver	1.00	MacDonald et al. 2003	Threshold Effect Concentration
Thallium	NA	---	---
Tin	3.40 [4]	Buchman 2008	Minimum Apparent Effects Threshold for tributyl tin (Neanthes bioassay)
Vanadium	57.0 [4]	Buchman 2008	Minimum Apparent Effects Threshold (Neanthes bioassay)
Zinc	121	MacDonald et al. 2000	Consensus-based Threshold Effect Concentration

Notes:

NA = Not Available
EqP = Equilibrium partitioning
PAH = Polynuclear Aromatic Hydrocarbon
USEPA = United States Environmental Protection Agency
CCME = Canadian Council of Ministers of the Environment
BTAG = Biological Technical Assistance Group
µg/kg = microgram per kilogram
mg/kg = milligram per kilogram

[1] The values shown are literature-based freshwater screening values/toxicological benchmarks unless otherwise noted.

[2] EqP-based sediment screening values calculated using USEPA (1993 and 1996) methodology: $SV_{sed} = (K_{oc})(f_{oc})(SV_{sw})$ where K_{oc} is the organic carbon partition coefficient (L/kg), f_{oc} is the fraction of organic carbon (unitless), and SV_{sw} is the surface water screening value (ug/L). An f_{oc} of 0.021 was used (minimum value measured in drainage ditch sediment).

[3] EqP-based sediment screening values from Di Toro and McGrath (2000) are based on an f_{oc} of 0.021 (minimum value measured in drainage ditch sediment).

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Notes (continued):

(4) The chemical lacks a freshwater bulk sediment screening value/toxicological benchmark. The value shown is a marine/estuarine bulk sediment screening value/toxicological benchmark.
(5) The value shown is for 4-methylphenol.
(6) Value shown is for the sum of *p,p'* and *o,p'* isomers.
(7) The value shown is for total DDTs.

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TABLE 7-9
TOXICITY REFERENCE VALUES FOR BIRDS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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Chemical	Test Organism	Body Weight (kg)	Duration	Exposure Route	Effect/Endpoint	Test Material	NOAEL (mg/kg/d)	MATC [1] (mg/kg/d)	LOAEL (mg/kg/d)	Source Document [2]	Comments
Volatile Organics:											
1,1,1,2-Tetrachloroethane	---	---	---	---	---	---	NA	NA	NA	---	---
Carbon tetrachloride	---	---	---	---	---	---	NA	NA	NA	---	---
Chlorobenzene	---	---	---	---	---	---	NA	NA	NA	---	---
Chloroform	---	---	---	---	---	---	NA	NA	NA	---	---
Ethylbenzene	---	---	---	---	---	---	NA	NA	NA	---	---
Pentachloroethane	---	---	---	---	---	---	NA	NA	NA	---	---
Styrene	---	---	---	---	---	---	NA	NA	NA	---	---
Toluene	---	---	---	---	---	---	NA	NA	NA	---	---
Trichloroethene	---	---	---	---	---	---	NA	NA	NA	---	---
Xylene, m/p-	---	---	---	---	---	---	40.5 [3]	90.7	203 [4]	---	Value for total xylenes used as a surrogate
Xylene, o-	---	---	---	---	---	---	40.5 [3]	90.7	203 [4]	---	Value for total xylenes used as a surrogate
Xylenes, total	Quail	0.191	Unknown	Oral in diet	Mortality	---	40.5 [3]	90.7	203 [4]	Hill and Camardese 1986	---
Semi-Volatile Organics:											
1,2,4,5-Tetrachlorobenzene	---	---	---	---	---	---	NA	NA	NA	---	---
1,2,4-Trichlorobenzene	---	---	---	---	---	---	NA	NA	NA	---	---
1,1-Biphenyl	---	---	---	---	---	---	NA	NA	NA	---	---
1,2-Dichlorobenzene	---	---	---	---	---	---	16.0	35.8	80.0	---	Values for 1,4-dichlorobenzene used as surrogates
1,3-Dichlorobenzene	---	---	---	---	---	---	16.0	35.8	80.0	---	Values for 1,4-dichlorobenzene used as surrogates
1,4-Dichlorobenzene	Northern bobwhite	0.157	14 days	Oral (gavage)	Mortality	Not Applicable	16.0 [3]	35.8	80.0 [4]	USEPA 2005a [13]	---
2,3,4,6-Tetrachlorophenol	---	---	---	---	---	---	NA	NA	NA	---	---
2,4,5-Trichlorophenol	---	---	---	---	---	---	NA	NA	NA	---	---
2,4,6-Trichlorophenol	---	---	---	---	---	---	NA	NA	NA	---	---
2,4-Dichlorophenol	---	---	---	---	---	---	NA	NA	NA	---	---
2-Acetylaminofluorene	---	---	---	---	---	---	NA	NA	NA	---	---
2-Chloronaphthalene	---	---	---	---	---	---	NA	NA	NA	---	---
3,3'-Dichlorobenzidine	---	---	---	---	---	---	NA	NA	NA	---	---
3,3-Dimethylbenzidine	---	---	---	---	---	---	NA	NA	NA	---	---
3-Methylcholanthrene	---	---	---	---	---	---	NA	NA	NA	---	---
4-Bromophenyl phenyl ether	---	---	---	---	---	---	NA	NA	NA	---	---
4-Chloro-3-methylphenol	---	---	---	---	---	---	NA	NA	NA	---	---
4-Chlorophenyl phenyl ether	---	---	---	---	---	---	NA	NA	NA	---	---
7-12-Dimethylbenz(a)anthracene	European starling	0.055	5 days	Oral (gavage)	Growth	---	2.00	6.32	20.0	USEPA 2007a [13]	---
Aramite, total	---	---	---	---	---	---	NA	NA	NA	---	---
bis(2-Ethylhexyl) phthalate	Ringed dove	0.155	4 weeks	Oral in diet	Reproduction	Not Applicable	1.11	2.48	5.55 [4]	Sample et al. 1996 [13]	---
Butyl benzyl phthalate	---	---	---	---	---	---	NA	NA	NA	---	---
Diallate	---	---	---	---	---	---	NA	NA	NA	---	---
cis-Diallate	---	---	---	---	---	---	NA	NA	NA	---	---
trans-Diallate	---	---	---	---	---	---	NA	NA	NA	---	---
Dibenzofuran	---	---	---	---	---	---	NA	NA	NA	---	---
Diethyl phthalate	---	---	---	---	---	---	NA	NA	NA	---	---
Di-n-butyl phthalate	Ringed dove	0.155	4 weeks	Oral in diet	Reproduction	Not Applicable	0.222 [5]	0.50	1.11	Sample et al. 1996 [13]	---
Di-n-octyl phthalate	Ring-necked pheasant	1.00	5 days	Oral	Mortality	Not Applicable	50 [3]	112	250 [4]	USEPA 2007b [13]	---
Dinoseb	Ring-necked pheasant	Unknown	14 days	Oral (gavage)	Mortality	Not Applicable	0.264 [3]	0.590	1.32 [4]	USEPA 2005a [13]	---
Hexachlorobenzene	Japanese quail	0.15	90 days	Oral	Reproduction	Not Applicable	0.11	0.25	0.57	Coulston and Kolbye 1994	---
Hexachlorobutadiene	Japanese quail	0.15	90days	Oral	Reproduction	Not Applicable	17.0	7.59	3.39 [4]	Coulston and Kolbye 1994	---
Hexachlorocyclopentadiene	---	---	---	---	---	---	NA	NA	NA	---	---
Hexachloroethane	---	---	---	---	---	---	NA	NA	NA	---	---
Hexachlorophene	---	---	---	---	---	---	NA	NA	NA	---	---
Hexachloropropene	---	---	---	---	---	---	NA	NA	NA	---	---
Isosafrole	---	---	---	---	---	---	NA	NA	NA	---	---
N-Nitrosodiphenylamine	---	---	---	---	---	---	NA	NA	NA	---	---
p-Dimethylamino azobenzene	---	---	---	---	---	---	NA	NA	NA	---	---
Pentachlorobenzene	---	---	---	---	---	---	NA	NA	NA	---	---
Pentachloronitrobenzene	Chicken	1.50	35 weeks	Oral in diet	Reproduction	Not Applicable	7.07	22.4	70.7	Sample et al. 1996 [13]	---

TABLE 7-9
TOXICITY REFERENCE VALUES FOR BIRDS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Test Organism	Body Weight (kg)	Duration	Exposure Route	Effect/Endpoint	Test Material	NOAEL (mg/kg/d)	MATC [1] (mg/kg/d)	LOAEL (mg/kg/d)	Source Document [2]	Comments
Semi-Volatile Organics:											
Pentachlorophenol	Chicken	0.66	1 week	Oral in diet	Growth	Pentachlorophenol (purified)	6.73 [6]	21.3	67.3	USEPA 2007c [13]	---
Pronamide	---	---	---	---	---	---	NA	NA	NA	---	---
PAHs:											
2-Methylnaphthalene	---	---	---	---	---	---	39.5	88.4	198	---	Values for benzo(a)pyrene used as surrogates
Acenaphthene	---	---	---	---	---	---	39.5	88.4	198	---	Values for benzo(a)pyrene used as surrogates
Acenaphthylene	---	---	---	---	---	---	39.5	88.4	198	---	Values for benzo(a)pyrene used as surrogates
Anthracene	---	---	---	---	---	---	39.5	88.4	198	---	Values for benzo(a)pyrene used as surrogates
Benzo(a)anthracene	---	---	---	---	---	---	39.5	88.4	198	---	Values for benzo(a)pyrene used as surrogates
Benzo(a)pyrene	White leghorn chicken	1.50	35 days	Oral in diet	Reproduction	Not Applicable	39.5	88.4	198 [5]	Rigdon and Neal 1963	---
Benzo(b)fluoranthene	---	---	---	---	---	---	39.5	88.4	198	---	Values for benzo(a)pyrene used as surrogates
Benzo(g,h,i)perylene	---	---	---	---	---	---	39.5	88.4	198	---	Values for benzo(a)pyrene used as surrogates
Benzo(k)fluoranthene	---	---	---	---	---	---	39.5	88.4	198	---	Values for benzo(a)pyrene used as surrogates
Chrysene	---	---	---	---	---	---	39.5	88.4	198	---	Values for benzo(a)pyrene used as surrogates
Dibenz(a,h)anthracene	---	---	---	---	---	---	39.5	88.4	198	---	Values for benzo(a)pyrene used as surrogates
Fluoranthene	---	---	---	---	---	---	39.5	88.4	198	---	Values for benzo(a)pyrene used as surrogates
Fluorene	---	---	---	---	---	---	39.5	88.4	198	---	Values for benzo(a)pyrene used as surrogates
Indeno(1,2,3-cd)pyrene	---	---	---	---	---	---	39.5	88.4	198	---	Values for benzo(a)pyrene used as surrogates
Naphthalene	---	---	---	---	---	---	39.5	88.4	198	---	Values for benzo(a)pyrene used as surrogates
Phenanthrene	---	---	---	---	---	---	39.5	88.4	198	---	Values for benzo(a)pyrene used as surrogates
Pyrene	---	---	---	---	---	---	39.5	88.4	198	---	Values for benzo(a)pyrene used as surrogates
Organochlorine Pesticides:											
4,4'-DDD	---	---	---	---	---	---	0.227	0.72	2.27	---	Values for 4,4'-DDT used as surrogates
4,4'-DDE	---	---	---	---	---	---	0.227	0.72	2.27	---	Values for 4,4'-DDT used as surrogates
4,4'-DDT	Chicken	2.204	30 days	Oral in diet	Growth	Not Applicable	0.227 [7]	2.27	2.27	USEPA 2007d [13]	---
Aldrin	Ring-necked pheasant	1.14	5 days	Oral indiet	Mortality	Not Applicable	0.07 [3]	0.16	0.35 [4]	Hill et al. 1975	---
alpha-BHC	Japanese quail	0.15	90 days	Oral in diet	Reproduction	Not Applicable	0.563	1.13	2.25	Sample et al. 1996 [13]	Values based on a study using mixed BHC isomers
alpha-Chlordane	Red-winged blackbird	0.064	84 days	Oral in diet	Mortality	Not Applicable	2.14	4.79	10.7	Sample et al. 1996 [13]	Values based on a study using chlordane
beta-BHC	Japanese quail	0.15	90 days	Oral in diet	Reproduction	Not Applicable	0.563	1.13	2.25	Sample et al. 1996 [13]	Values based on a study using mixed BHC isomers
Chlorobenzilate	Bobwhite quail	Unknown	14 days	Oral (gavage)	Mortality	Not Applicable	9.73 [3]	13.9	19.73	USEPA 2005a [13]	---
delta-BHC	Japanese quail	0.15	90 days	Oral in diet	Reproduction	Not Applicable	0.563	1.13	2.25	Sample et al. 1996 [13]	Values based on a study using mixed BHC isomers
Dieldrin	Mallard duck	0.334	24 days	Oral in diet	Growth	Not Applicable	0.709 [7]	1.64	3.78	USEPA 2005b [13]	---
Endosulfan I	Grey partridge	0.40	4 weeks	Oral in diet	Reproduction	Not Applicable	10.0	22.4	50.0 [4]	Sample et al. 1996 [13]	NOAEL value based on a study using endosulfan
Endosulfan II	Grey partridge	0.40	4 weeks	Oral in diet	Reproduction	Not Applicable	10.0	22.4	50.0 [4]	Sample et al. 1996 [13]	NOAEL value based on a study using endosulfan
Endosulfan sulfate	Grey partridge	0.40	4 weeks	Oral in diet	Reproduction	Not Applicable	10.0	22.4	50.0 [4]	Sample et al. 1996 [13]	NOAEL value based on a study using endosulfan
Endrin	Screech owl	0.181	>83 days	Oral in diet	Reproduction	Not Applicable	0.021 [5]	0.047	0.104	Sample et al. 1996 [9]	---
Endrin aldehyde	---	---	---	---	---	---	0.021	0.047	0.104	---	Values for endrin used as surrogates
gamma-BHC (Lindane)	Mallard duck	1.00	8 weeks	Oral (intubation)	Reproduction	Not Applicable	4.0 [5]	8.94	20.0	Sample et al. 1996 [13]	Values based on a study using mixed BHC isomers
gamma-Chlordane	Red-winged blackbird	0.064	84 days	Oral in diet	Mortality	Not Applicable	2.14	4.79	10.7	Sample et al. 1996 [13]	Values based on a study using chlordane
Heptachlor	American woodcock	0.20	76 days	Oral in diet	Mortality	Not Applicable	0.49	1.03	2.17	Stickel et al. 1965	
Heptachlor epoxide	---	---	---	---	---	---	0.49	1.03	2.17	---	Values for heptachlor used as surrogates
Isodrin	---	---	---	---	---	---	NA	NA	NA	---	---
Kepone	Mallard duck	Unknown	14 days	Oral (gavage)	Mortality	Not Applicable	1.67 [3]	3.73	8.35 [4]	USEPA 2005a [13]	---
Methoxychlor	Chicken	1.5	16 weeks	Oral in diet	Reproduction	Not Applicable	355	794	1,775 [4]	Wiemeyer 1996	---
Toxaphene	American black duck	1.0	2 seasons	Oral in diet	Reproduction	Not Applicable	1.0	2.24	5.0	Wiemeyer 1996	---
Metals:											
Antimony	Northern bobwhite	0.19	6 weeks	Oral	Unknown	Unknown	4,740	14,989	47,400	Opresko et al. 1993	---
Arsenic	Chicken	1.6	19 days	Oral in diet	Growth	Arsenic oxide	2.24 [6]	3.18	4.51 [7]	USEPA 2005c [13]	---
Barium	One-day old chicks	0.121	4 weeks	Oral in diet	Mortality	Barium hydroxide	20.8	29.5	41.7	Sample et al. 1996 [13]	---
Beryllium	---	---	---	---	---	---	NA	NA	NA	---	---

TABLE 7-9
TOXICITY REFERENCE VALUES FOR BIRDS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Test Organism	Body Weight (kg)	Duration	Exposure Route	Effect/Endpoint	Test Material	NOAEL (mg/kg/d)	MATC [1] (mg/kg/d)	LOAEL (mg/kg/d)	Source Document [2]	Comments
Metals:											
Cadmium	Multiple species	Various	Various	Oral in diet/water	Reproduction/growth	Cadmium, cadmium sulfate, and cadmium chloride	1.47 [8]	3.06	6.36 [9]	USEPA 2005d	---
Chromium, total	Multiple species	Various	Various	Oral in diet	Reproduction/growth	Sodium and potassium dichromate	2.66 [8][10]	6.44	15.6 [9]	USEPA 2008	---
Cobalt	Multiple species	Various	Various	Oral in diet	Growth	Cobalt, cobalt chloride, and cobalt carbonate	7.61 [8]	11.8	18.3 [9]	USEPA 2005e [13]	---
Copper	Chicken	1.52	84 days	Oral in diet	Reproduction	Copper	4.05 [11]	7.00	12.1	USEPA 2007e [13]	---
Lead	Chicken	1.81	4 weeks	Oral in diet	Reproduction	Lead acetate	1.63 [11]	2.31	3.26	USEPA 2005f [13]	---
Mercury	Mallard duck	1.00	3 generations	Oral in diet	Reproduction	Methyl mercury dicyandiamide	0.026	0.045	0.078	USEPA 1997a [13]	---
Nickel	Multiple species	Various	Various	Oral in diet	Reproduction/growth	Nickel acetate, chloride, and sulfate	6.71 [8]	11.2	18.6 [9]	USEPA 2007f	---
Selenium	Chicken	0.328	2 weeks	Oral in diet	Mortality	Sodium selenite	0.29 [11]	0.410	0.579	USEPA 2007g [13]	---
Silver	Turkey	0.662	5 weeks	Oral in diet	Growth	Silver acetate	2.02 [12]	6.39	20.2	USEPA 2006	---
Thallium	European starling	Unknown	acute	Oral	Survival	Unknown	0.35 [3]	0.78	1.75 [4]	USEPA 1999 [13]	---
Tin	Japanese quail	0.15	6 weeks	Oral in diet	Reproduction	bis(Tributyltin)-oxide	6.80	11	16.9	Sample et al. 1996 [13]	---
Vanadium	Chicken	1.042	5 weeks	Oral in diet	Growth	Sodium metavanadate	0.344 [11]	0.486	0.688	USEPA 2005g [13]	---
Zinc	Multiple species	Various	Various	Oral in diet	Reproduction/growth	Zinc carbonate, oxide, and sulfate	66.1 [8]	106	171 [9]	USEPA 2007h	---

Notes:

PAH = Polynuclear Aromatic Hydrocarbon
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
USEPA = United States Environmental Protection Agency
mg/kg/d = milligram per kilogram-body weight per day
NA = Not Available
kg = kilogram

(1) MATC values were derived by calculating the geometric mean of the NOAEL and LOAEL values (values were calculated by Baker Environmental, Inc.).
(2) Source documents for NOAEL and LOAEL values represent primary data sources (as reported by original authors) unless otherwise noted.
(3) The chronic NOAEL value was estimated by applying a safety factor of 100 to a LD_{50} value (Wentsel et al., 1996 and USEPA, 1997b).
(4) A chronic LOAEL value was not available from the study used as the source of the chronic NOAEL value. Therefore, a chronic LOAEL value was estimated by applying a safety factor of 5 to the chronic NOAEL value (Wentsel et al., 1996).
(5) A chronic NOAEL value was not available from the study used as the source of the chronic LOAEL value. Therefore, the chronic NOAEL value shown was estimated by applying a safety factor of 5 to the chronic LOAEL value (Wentsel et al., 1996).
(6) The NOAEL value represents the lowest value of all reproduction, growth, and survival-based NOAEL values listed in the cited ecological soil screening levels document that meet the required data evaluation score. The value was used by the USEPA to derive the avian ecological soil screening level. It is noted that a geometric mean of NOAEL values for growth and reproduction could not be calculated by the USEPA because insufficient NOAEL values meeting the minimum required data evaluation score were identified from the literature.
(7) A LOAEL value was not available from the study chosen by the USEPA as the source of the NOAEL value selected as the ecological soil screening level. Therefore, the LOAEL value represents a geometric mean of all reproduction- and growth-based LOAEL values listed within the cited ecological soil screening level document that meet the minimum required data evaluation score (value was calculated by Michael Baker Jr., Inc.).
(8) The NOAEL value represents the geometric mean of all reproduction and growth-based NOAEL values listed within the cited ecological soil screening level document that meet the minimum required data evaluation score. Because this value is lower than the lowest bounded LOAEL for reproduction, growth, or survival, it was selected by the USEPA as the toxicity reference value for avian ecological soil screening level development.
(9) The NOAEL value selected by the USEPA as the ecological soil screening level represents a geometric mean of all reproduction and growth-based NOAEL values that meet the minimum required data evaluation score. Therefore, the LOAEL value shown represents a geometric mean of all reproduction and growth-based LOAEL values listed within the cited ecological soil screening level document that meet the minimum required data evaluation score (value was calculated by Michael Baker Jr., Inc.).
(10) The NOAEL value shown is for trivalent chromium.
(11) The NOAEL value shown represents the highest bounded NOAEL below the lowest bounded LOAEL for reproduction, growth, or survival listed within the cited ecological soil screening levels that meet the minimum required data evaluation score. The value was used by the USEPA as the toxicity reference value for avian ecological soil screening value development. It is noted that a geometric mean of available NOAEL values for growth and reproduction was not used as the toxicity reference value by the USEPA for ecological soil screening value development since the geometric mean is higher than the lowest bounded LOAEL for reproduction, growth, and survival.
(12) The NOAEL is equal to the lowest value of all reproduction- and growth-based LOAELs listed in the cited ecological soil screening levels document that meet the minimum required data evaluation score divided by ten. The value was used by the USEPA to derive the avian ecological soil screening level. It is noted that a geometric mean of NOAEL values for growth and reproduction could not be calculated by the USEPA based on the lack of NOAEL values for reproduction and growth.
(13) The data reference represents a secondary data source.

TABLE 7-9
TOXICITY REFERENCE VALUES FOR BIRDS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

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USEPA. 2005c. Ecological Soil Screening Levels for Cadmium (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-65.

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TABLE 7-10
TOXICITY REFERENCE VALUES FOR MAMMALS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Test Organism	Body Weight (kg)	Duration	Exposure Route	Effect/Endpoint	Test Material	NOAEL (mg/kg/d)	MATC [1] (mg/kg/d)	LOAEL (mg/kg/d)	Source Document [2]
Volatile Organics:										
1,1,1,2-Tetrachloroethane	---	---	---	---	---	---	NA	NA	NA	---
Carbon tetrachloride	Rat	0.35	2 years	Oral in diet	Reproduction	Not Applicable	16	35.8	80 [3]	Sample et al. 1996 [23]
Chlorobenzene	Dog	12.7	13 weeks	Oral	Liver toxicity	Not Applicable	27.25	38.5	54.5	USEPA 2013 [23]
Chloroform	Rat	0.35	13 weeks	Oral (intubation)	Liver toxicity	Not Applicable	15 [4]	33.5	75 [3]	Sample et al. 1996 [23]
Ethylbenzene	Rat	0.35	182 days	Oral (gavage)	Liver/kidney toxicity	Not Applicable	136	236	408	USEPA 2013 [23]
Pentachloroethane	---	---	---	---	---	---	NA	NA	NA	---
Styrene	Rat	0.35	90 days	Oral in water	Reproduction	Not Applicable	35	78.3	175 [3]	Beliles et al. 1985
Toluene	Mouse	0.03	Days 6-12 of gestation	Oral (gavage)	Reproduction	Not Applicable	52 [4]	116	260	Sample et al. 1996 [23]
Trichloroethene	Mouse	0.03	6 weeks	Oral (gavage)	hepatotoxicity	Not Applicable	5.0 [5]	3.5	2.5 [3]	Sample et al. 1996 [23]
Xylene, m/p-							2.06 [6]	2.31 [6]	2.58 [6]	---
Xylene, o-							2.06 [6]	2.31 [6]	2.58 [6]	---
Xylenes, total	Mouse	0.03	Days 6-15 of gestation	Oral (gavage)	Reproduction	Not Applicable	2.06	2.31	2.58	Sample et al. 1996 [23]
Semi-Volatile Organics:										
1,2,4,5-Tetrachlorobenzene	---	---	---	---	---	---	NA	NA	NA	---
1,2,4-Trichlorobenzene	Rat	0.35	3 generations	Oral in water	Reproduction	Not Applicable	53	80	106	Coulston and Kolbye 1994
1,1-Biphenyl	---	---	---	---	---	---	NA	NA	NA	---
1,2-Dichlorobenzene	Rat	0.35	chronic	Oral (gavage)	Liver/kidney toxicity	Not Applicable	171 [5]	383	857	Coulston and Kolbye 1994
1,3-Dichlorobenzene	---	0.35	---	---	---	---	171 [7]	383 [7]	857 [7]	---
1,4-Dichlorobenzene	Rat	0.35	Days 6-15 of gestation	Oral (gavage)	Reproduction (fetal development)	Not Applicable	250	354.0	500	Coulston and Kolbye 1994
2,3,4,6-Tetrachlorophenol	---	---	---	---	---	---	NA	NA	NA	---
2,4,5-Trichlorophenol	Rat	0.35	98 days	Oral in diet	Liver/kidney toxicity	Not Applicable	160 [5]	358	800	McCollister et al. 1961
2,4,6-Trichlorophenol	---	---	---	---	---	---	160 [8]	358 [8]	800 [8]	---
2,4-Dichlorophenol	Rat	0.35	103 weeks	Oral in diet	Reproduction	Not Applicable	88 [5]	198	440	NTP 1989
2-Acetylaminofluorene	---	---	---	---	---	---	NA	NA	NA	---
2-Chloronaphthalene	---	---	---	---	---	---	NA	NA	NA	---
3,3'-Dichlorobenzidine	---	---	---	---	---	---	NA	NA	NA	---
3,3-Dimethylbenzidine	---	---	---	---	---	---	NA	NA	NA	---
3-Methylcholanthrene	---	---	---	---	---	---	NA	NA	NA	---
4-Bromophenyl phenyl ether	---	---	---	---	---	---	NA	NA	NA	---
4-Chloro-3-methylphenol	---	---	---	---	---	---	NA	NA	NA	---
4-Chlorophenyl phenyl ether	---	---	---	---	---	---	NA	NA	NA	---
7-12-Dimethylbenz(a)anthracene	House mouse	0.038	65 weeks	Oral in diet	Mortality	Benzo(a)pyrene	0.615 [13]	1.36	3.01	USEPA 2007a [23]
Aramite, total	---	---	---	---	---	---	NA	NA	NA	---
bis(2-Ethylhexyl) phthalate	Mouse	0.03	105 days	Oral in diet	Reproduction	Not Applicable	18.3	57.9	183.3	Sample et al. 1996 [23]
Butyl benzyl phthalate	Rat	0.35	2 years	Oral in diet	Liver toxicity	Not Applicable	480 [5]	1,073	2,400	NTP 1997
Diallate	---	---	---	---	---	---	NA	NA	NA	---
cis-Diallate	---	---	---	---	---	---	NA	NA	NA	---
trans-Diallate	---	---	---	---	---	---	NA	NA	NA	---
Dibenzofuran	---	---	---	---	---	---	NA	NA	NA	---

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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Test Organism	Body Weight (kg)	Duration	Exposure Route	Effect/Endpoint	Test Material	NOAEL (mg/kg/d)	MATC [1] (mg/kg/d)	LOAEL (mg/kg/d)	Source Document [2]
Semi-Volatile Organics:										
Diethyl phthalate	Mouse	0.03	105 days	Oral in diet	Reproduction	Not Applicable	4,583	10,248	22,915 [3]	Sample et al. 1996 [23]
Di-n-butyl phthalate	Mouse	0.03	105 days	Oral in diet	Reproduction (litter size and offspring mortality)	Not Applicable	550	1,004	1,833	Sample et al. 1996 [23]
Di-n-octyl phthalate	Mouse	0.03	105 days	Oral in diet	Reproduction	Not Applicable	55 [9]	174	550 [9]	Sample et al. 1996 [23]
Dinoseb	---	---	---	---	---	---	NA	NA	NA	---
Hexachlorobenzene	Rat	0.35	4 generations	Oral	Reproduction (decreased fertility)	Not Applicable	8	11.3	16	ATSDR 2002 [23]
Hexachlorobutadiene	Rat	0.35	90 days +	Oral	Reproduction	Not Applicable	4.0 [5]	8.9	20	IPCS 1994 [23]
Hexachlorocyclopentadiene	Rat	0.35	Days 6-15 of gestation	Oral	Reproduction	Not Applicable	10	17.3	30	USEPA 1984 [23]
Hexachloroethane	---	---	---	---	---	---	NA	NA	NA	---
Hexachlorophene	Rat	0.35	Not reported	Oral	Mortality	Not Applicable	5.6 [10]	13	28 [3]	USEPA 1999 [23]
Hexachloropropene	---	---	---	---	---	---	NA	NA	NA	---
Isosafrole	---	---	---	---	---	---	NA	NA	NA	---
N-Nitrosodiphenylamine	Rat	0.35	8 to 11 weeks	Oral in diet	Systemic toxicity	Not Applicable	300 [5]	671	1,500	ATSDR 1993 [23]
p-Dimethylamino azobenzene	---	---	---	---	---	---	NA	NA	NA	---
Pentachlorobenzene	Rat	0.35	180 days	Oral	Not reported	Not Applicable	7.25	16.21	36.25 [3]	USEPA 1999 [23]
Pentachloronitrobenzene	---	---	---	---	---	---	NA	NA	NA	---
Pentachlorophenol	Various	Various	Various	Oral in diet or gavage	Reproduction/growth	Pentachlorophenol (purified, technical, or purity not specified)	8.42 [11]	13.81	22.65 [12]	USEPA 2007b
Pronamide	---	---	---	---	---	---	NA	NA	NA	---
PAHs:										
2-Methylnaphthalene	Norway rat	0.247	6 weeks	Oral in diet	Growth (body weight)	1-Naphthaleneacetic acid	65.6 [13]	147	328	USEPA 2007a [23]
Acenaphthene	Norway rat	0.247	6 weeks	Oral in diet	Growth (body weight)	1-Naphthaleneacetic acid	65.6 [13]	147	328	USEPA 2007a [23]
Acenaphthylene	Norway rat	0.247	6 weeks	Oral in diet	Growth (body weight)	1-Naphthaleneacetic acid	65.6 [13]	147	328	USEPA 2007a [23]
Anthracene	Norway rat	0.247	6 weeks	Oral in diet	Growth (body weight)	1-Naphthaleneacetic acid	65.6 [13]	147	328	USEPA 2007a [23]
Benzo(a)anthracene	House mouse	0.038	65 weeks	Oral in diet	Mortality	Benzo(a)pyrene	0.615 [13]	1.36	3.01	USEPA 2007a [23]
Benzo(a)pyrene	House mouse	0.038	65 weeks	Oral in diet	Mortality	Benzo(a)pyrene	0.615 [13]	1.36	3.01	USEPA 2007a [23]
Benzo(b)fluoranthene	House mouse	0.038	65 weeks	Oral in diet	Mortality	Benzo(a)pyrene	0.615 [13]	1.36	3.01	USEPA 2007a [23]
Benzo(g,h,i)perylene	House mouse	0.038	65 weeks	Oral in diet	Mortality	Benzo(a)pyrene	0.615 [13]	1.36	3.01	USEPA 2007a [23]
Benzo(k)fluoranthene	House mouse	0.038	65 weeks	Oral in diet	Mortality	Benzo(a)pyrene	0.615 [13]	1.36	3.01	USEPA 2007a [23]
Chrysene	House mouse	0.038	65 weeks	Oral in diet	Mortality	Benzo(a)pyrene	0.615 [13]	1.36	3.01	USEPA 2007a [23]
Dibenz(a,h)anthracene	House mouse	0.038	65 weeks	Oral in diet	Mortality	Benzo(a)pyrene	0.615 [13]	1.36	3.01	USEPA 2007a [23]
Fluoranthene	Norway rat	0.247	6 weeks	Oral in diet	Growth (body weight)	1-Naphthaleneacetic acid	65.6 [13]	147	328	USEPA 2007a [23]
Fluorene	Norway rat	0.247	6 weeks	Oral in diet	Growth (body weight)	1-Naphthaleneacetic acid	65.6 [13]	147	328	USEPA 2007a [23]
Indeno(1,2,3-cd)pyrene	House mouse	0.038	65 weeks	Oral in diet	Mortality	Benzo(a)pyrene	0.615 [13]	1.36	3.01	USEPA 2007a [23]
Naphthalene	Norway rat	0.247	6 weeks	Oral in diet	Growth (body weight)	1-Naphthaleneacetic acid	65.6 [13]	147	328	USEPA 2007a [23]
Phenanthrene	Norway rat	0.247	6 weeks	Oral in diet	Growth (body weight)	1-Naphthaleneacetic acid	65.6 [13]	147	328	USEPA 2007a [23]
Pyrene	House mouse	0.038	65 weeks	Oral in diet	Mortality	Benzo(a)pyrene	0.615 [13]	1.36	3.01	USEPA 2007a [23]

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Chemical	Test Organism	Body Weight (kg)	Duration	Exposure Route	Effect/Endpoint	Test Material	NOAEL (mg/kg/d)	MATC [1] (mg/kg/d)	LOAEL (mg/kg/d)	Source Document [2]
Organochlorine Pesticides:										
4,4'-DDD	---	---	---	---	---	---	0.147 [14]	0.329 [14]	0.735 [14]	---
4,4'-DDE	---	---	---	---	---	---	0.147 [14]	0.329 [14]	0.735 [14]	---
4,4'-DDT	Norway rat	0.068	15 days	Oral (gavage)	Reproduction	Not Applicable	0.147 [13]	0.329	0.735	USEPA 2007c [23]
Aldrin	Rat	0.35	3 generations (>1 year)	Oral in diet	Reproduction (number of litters)	Not Applicable	0.2	0.4	1.0	Sample et al. 1996 [23]
alpha-BHC	Mink	1.0	331 days	Oral in diet	Reproduction (kit mortality/body weight)	Mixed isomers	0.0137	0.0433	0.137	Sample et al. 1996 [23]
alpha-Chlordane	Mouse	Not reported	104 weeks	Oral in diet	Liver toxicity	Technical chlordane	0.15	0.34	0.75	USEPA 2013 [23]
Organochlorine Pesticides:										
beta-BHC	Rat	0.35	13 weeks	Oral in diet	Reproduction	Not Applicable	0.4	0.9	2.0	USEPA 2013 [23]
Chlorobenzilate	Rabbit	Not reported	Days 7-19 of gestation	Oral (intubation)	Maternal food consumption and body weight	Technical grade	5.0	10.0	20.0	USEPA 2013 [23]
delta-BHC	Mink	1.0	331 days	Oral in diet	Reproduction (kit mortality/body weight)	Mixed BHC isomers	0.0137	0.043	0.137	Sample et al. 1996 [23]
Dieldrin	Norway rat	0.156	750 days	Oral in diet	Reproduction (progeny numbers/counts)	Not Applicable	0.015 [13]	0.021	0.030	USEPA 2007d [23]
Endosulfan 1	Rat	0.35	30	Oral (intubation)	Reproduction	Endosulfan	0.15	0.34	0.75 [3]	Sample et al. 1996 [23]
Endosulfan 11	Rat	0.35	30	Oral (intubation)	Reproduction	Endosulfan	0.15	0.34	0.75 [3]	Sample et al. 1996 [23]
Endosulfan sulfate	---	---	---	---	---	---	0.15 [15]	0.34 [15]	0.75 [15]	Sample et al. 1996 [23]
Endrin	Mouse	0.03	120 days	Oral in diet	Reproduction (litter size and number of young/day	Not Applicable	0.092	0.29	0.92	Sample et al. 1996 [23]
Endrin aldehyde	---	---	---	---	---	---	0.092 [16]	0.29 [16]	0.92 [16]	Sample et al. 1996 [23]
gamma-BHC (Lindane)	Mink	1.0	331 days	Oral in diet	Reproduction (kit mortality/body weight)	Mixed BHC isomers	0.0137	0.043	0.137	Sample et al. 1996 [23]
gamma-Chlordane	Mouse	Not reported	104 weeks	Oral in diet	Liver toxicity	Technical chlordane	0.15	0.34	0.75	USEPA 2013 [23]
Heptachlor	Rat	Not reported	2 years	Oral in diet	Liver toxicity		0.15	0.19	0.25	USEPA 2013 [23]
Heptachlor epoxide	---	---	---	---	---	---	0.15 [17]	0.19 [17]	0.25 [17]	---
Isodrin	---	---	---	---	---	---	NA	NA	NA	---
Kepone	Rat	0.35	2 years	Oral in diet	Survival and growth	Not Applicable	0.08	0.19	0.4	Sample et al. 1996 [23]
Methoxychlor	Rabbit	Not reported	Days 7-19 of gestation	Not reported	Reproduction (litter loss) and maternal weight loss	Not Applicable	5.01	13.3	35.5	USEPA 2013 [23]
Toxaphene	Rat	0.4	3 generations	Oral in diet	Reproduction	Not Applicable	8.0	17.9	40 [3]	Sample et al. 1996 [23]
Metals:										
Antimony	Norway rat	0.33	31 days	Oral in water	Reproduction (progeny weight)	Antimony trichloride	0.059 [13]	0.19	0.59	USEPA 2005a [23]
Arsenic	Dog	10.1	8 weeks	Oral in diet	Growth (body weight)	Sodium arsenite	1.04 [13]	1.31	1.66	USEPA 2005b [23]
Barium	House mouse/Norway rat	Various	Various	Oral in diet/water or gavage	Reproduction/Growth	Barium acetate, barium chloride, and barium chloride dihydrate	51.8 [11]	65.5	82.7 [12]	USEPA 2005c
Beryllium	Norway rat	0.486	4 years	Oral in diet	Mortality (life span)	Beryllium sulfate	0.532 [18]	0.549	0.567 [19]	USEPA 2005d [23]
Cadmium	Norway rat	0.43	57 days	Oral in water	Growth (body weight)	Cadmium acetate	0.77 [13]	2.43	7.7	USEPA 2005e [23]

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Chemical	Test Organism	Body Weight (kg)	Duration	Exposure Route	Effect/Endpoint	Test Material	NOAEL (mg/kg/d)	MATC [1] (mg/kg/d)	LOAEL (mg/kg/d)	Source Document [2]
Metals:										
Chromium, total	Various	Various	Various	Oral in diet/water	Reproduction/growth	Various	2.4 [20][21]	11.85	58.53 [12]	USEPA 2005f
Cobalt	Various	Various	Various	Oral in diet/water or gavage	Reproduction/growth	Various	7.33 [11]	11.77	18.9 [12]	USEPA 2005g
Copper	Pig	100	4 weeks	Oral in diet	Growth (body weight)	Copper sulfate pentahydrate	5.6 [13]	7.23	9.34	USEPA 2007e [23]
Lead	Noway rat	0.3	7 weeks	Oral in water	Growth (body weight)	Lead acetate	4.7 [13]	6.47	8.90	USEPA 2005h [23]
Mercury	Rat	0.35	3 generations	Oral in diet	Reproduction (pup viability)	Methyl mercury chloride	0.032	0.072	0.16	Sample et al. 1996 [23]
Nickel	House mouse	0.025	35 days	Oral	Reproduction (sperm cell counts)	Nickelous chloride	1.7 [13]	2.40	3.40	USEPA 2007f [23]
Selenium	Pig	17.800	37 days	Oral in diet	Growth (body weight)	Sodium selenite	0.143 [13]	0.175	0.215	USEPA 2007g [23]
Silver	Pig	8.86	40 days	Oral in diet	Growth (body weight)	Silver acetate	6.02 [22]	19.04	60.2	USEPA 2006 [23]
Thallium	Rat	0.365	60 days	Oral in water	Reproduction (male testicular function)	Tallium sufate	0.0074	0.023	0.074	Sample et al. 1996 [23]
Tin	Mouse	0.03	Days 6-15 of gestation	Oral (intubation)	Reproduction (fetal weight and survival)	bis(Tributyltin) oxide	23.4	28.6	35.0	Sample et al. 1996 [23]
Vanadium	House mouse	0.0471	12 days	Oral (gavage)	Reproduction (offspring development)	Sodium orthovanadate	4.16 [13]	5.88	8.31	USEPA 2005i [23]
Zinc	Various	Various	Various	Oral in diet or gavage	Reproduction/growth	Various	75.4 [11]	26.96	82.3 [12]	USEPA 2007h

Notes:

PAH = Polynuclear Aromatic Hydrocarbon
ATSDR = Agency for Toxic Substances and Disease Registry
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
USEPA = United States Environmental Protection Agency
mg/kg/d = milligram per kilogram-body weight per day
IPCS = International Programme on Chemical Safety
NTP = National Toxicology Program
NA = Not Available
kg = kilogram

[1] MATC values were derived by calculating the geometric mean of the NOAEL and LOAEL values (values were calculated by Baker Environmental, Inc.).
[2] Source documents for NOAEL and LOAEL values represent primary data sources (as reported by original authors) unless otherwise noted.
[3] A chronic LOAEL value was not available from the study used as the source of the chronic NOAEL value. Therefore, a chronic LOAEL value was estimated by applying a safety factor of 5 to the chronic NOAEL value (Wentsel et al., 1996).
[4] A chronic NOAEL value was not available from the study used as the source of the chronic LOAEL value. Therefore, the chronic NOAEL value shown was estimated by applying a safety factor of 10 to the subchronic NOAEL value (Wentsel et al., 1996).
[5] A chronic NOAEL value was not available from the study used as the source of the chronic LOAEL value. Therefore, the chronic NOAEL value shown was estimated by applying a safety factor of 5 to the chronic LOAEL value (Wentsel et al., 1996).
[6] Value for total xylene used as a surrogate.
[7] Value for 1,2-dichlorobenzene used as a surrogate.
[8] Value for 2,4,5-trichlorophenol used as a surrogate
[9] Value for di-n-hexylphthalate reported in Sample et al. (1996) used as a surrogate (value based on a 105-day reproductive study using mice).
[10] The chronic NOAEL value was estimated by applying a safety factor of 100 to a LD_{50} value (Wentsel et al., 1996 and USEPA, 1997).
[11] The NOAEL value represents the geometric mean of all reproduction and growth-based NOAEL values listed within the cited ecological soil screening level document that meet the minimum required data evaluation score. Because this value is lower than the lowest bounded LOAEL for reproduction, growth, or survival, it was selected by the USEPA as the toxicity reference value for mammalian ecological soil screening level development.
[12] The NOAEL value selected by the USEPA as the ecological soil screening level represents a geometric mean of all reproduction and growth-based NOAEL values that meet the minimum required data evaluation score. Therefore, the LOAEL value shown represents a geometric mean of all reproduction and growth-based LOAEL values listed within the cited ecological soil screening level document that meet the minimum required data evaluation score (value was calculated by Michael Baker Jr., Inc.).

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Notes (continued):

(13) The NOAEL value shown represents the highest bounded NOAEL below the lowest bounded LOAEL for reproduction, growth, or survival listed within the cited ecological soil screening levels that meet the minimum required data evaluation score. The value was was used by the USEPA as the toxicity reference value for mammalian ecological soil screening value development. It is noted that a geometric mean of available NOAEL values for growth and reproduction was not used as the toxicity reference value by the USEPA for ecological soil screening value development since the geometric mean is higher than the lowest bounded LOAEL for reproduction, growth, and survival.

(14) Value for 4,4'-DDT used as a surrogate.

(15) Value for endosulfan I and endosulfan II used as a surrogate.

(16) Value for endrin used as a surrogate.

(17) Value for heptachlor used as a surrogate.

(18) The NOAEL value represents the lowest value of all reproduction, growth, and survival-based NOAEL values listed in the cited ecological soil screening levels document that meet the required data evaluation score. The value was used by the USEPA to derive the mammalian ecological soil screening level. It is noted that a geometric mean of NOAEL values for growth and reproduction could not be calculated by the USEPA because insufficient NOAEL values meeting the minimum required data evaluation score were identified from the literature.

(19) A LOAEL value was not available from the study chosen by the USEPA as the source of the NOAEL value selected as the ecological soil screening level. Therefore, the LOAEL value represents a geometric mean of all reproduction- and growth-based LOAEL values listed within the cited ecological soil screening level document that meet the minimum required data evaluation score (value was calculated by Michael Baker Jr., Inc.).

(20) The NOAEL value represents the geometric mean of all reproduction and growth-based NOAEL values listed within the cited ecological soil screening level document that meet the minimum required data evaluation score. It is noted that there were no bounded LOAEL values for reproduction, growth, or mortality for comparison.

(21) The NOAEL value shown is for trivalent chromium.

(22) The NOAEL is equal to the lowest value of all reproduction- and growth-based LOAELs listed in the cited ecological soil screening levels document that meet the minimum required data evaluation score divided by ten. The value was used by the USEPA to derive the mammalina ecological soil screening level. It is noted that a geometric mean of NOAEL values for growth and reproduction could not be calculated by the USEPA based on the lack of NOAEL values for reproduction and growth.

(23) The data reference represents a secondary data source.

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TABLE 7-11
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	BAF Value/Uptake Equation	Source Document	Description	BAF Value/Uptake Equation	Source Document	Description
Volatile Organics:						
1,1,1,2-Tetrachloroethane	5.176	USEPA 2007	Regression-based BAF (1)	3.151	USEPA 2007	Modeled BAF (9)
Carbon tetrachloride	4.715	USEPA 2007	Regression-based BAF (1)	3.070	USEPA 2007	Modeled BAF (9)
Chlorobenzene	4.175	USEPA 2007	Regression-based BAF (1)	2.968	USEPA 2007	Modeled BAF (9)
Chloroform	10.047	USEPA 2007	Regression-based BAF (1)	3.790	USEPA 2007	Modeled BAF (9)
Ethylbenzene	3.214	USEPA 2007	Regression-based BAF (1)	2.759	USEPA 2007	Modeled BAF (9)
Pentachloroethane	2.983	USEPA 2007	Regression-based BAF (1)	2.702	USEPA 2007	Modeled BAF (9)
Styrene	3.875	USEPA 2007	Regression-based BAF (1)	2.907	USEPA 2007	Modeled BAF (9)
Toluene	4.627	USEPA 2007	Regression-based BAF (1)	3.054	USEPA 2007	Modeled BAF (9)
Trichloroethene	4.803	USEPA 2007	Regression-based BAF (1)	3.086	USEPA 2007	Modeled BAF (9)
Xylenes (total)	3.245	USEPA 2007	Regression-based BAF (1)	2.766	USEPA 2007	Modeled BAF (9)
Semi-Volatile Organics:						
1,1-Biphenyl	1.467	USEPA 2007	Regression-based BAF (1)	2.218	USEPA 2007	Modeled BAF (9)
1,2,4,5-Tetrachlorobenzene	0.792	USEPA 2007	Regression-based BAF (1)	1.868	USEPA 2007	Modeled BAF (9)
1,2,4-Trichlorobenzene	1.426	USEPA 2007	Regression-based BAF (1)	2.200	USEPA 2007	Modeled BAF (9)
1,2-Dichlorobenzene	2.452	USEPA 2007	Regression-based BAF (1)	2.559	USEPA 2007	Modeled BAF (9)
1,3-Dichlorobenzene	2.233	USEPA 2007	Regression-based BAF (1)	2.493	USEPA 2007	Modeled BAF (9)
1,4,-Dichlorobenzene	2.475	USEPA 2007	Regression-based BAF (1)	2.565	USEPA 2007	Modeled BAF (9)
2,3,4,6-Tetrachlorophenol	0.945	USEPA 2007	Regression-based BAF (1)	1.962	USEPA 2007	Modeled BAF (9)
2,4,5-Trichlorophenol	1.870	USEPA 2007	Regression-based BAF (1)	2.373	USEPA 2007	Modeled BAF (9)
2,4,6-Trichlorophenol	1.905	USEPA 2007	Regression-based BAF (1)	2.385	USEPA 2007	Modeled BAF (9)
2,4-Dichlorophenol	3.400	USEPA 2007	Regression-based BAF (1)	2.803	USEPA 2007	Modeled BAF (9)
2-Acetylaminofluorene	3.275	USEPA 2007	Regression-based BAF (1)	2.774	USEPA 2007	Modeled BAF (9)
2-Chloronaphthalene	1.580	USEPA 2007	Regression-based BAF (1)	2.264	USEPA 2007	Modeled BAF (9)
3,3'-Dichlorobenzidine	2.275	USEPA 2007	Regression-based BAF (1)	2.506	USEPA 2007	Modeled BAF (9)
3,3'-Dimethylbenzidine	4.940	USEPA 2007	Regression-based BAF (1)	3.110	USEPA 2007	Modeled BAF (9)
3-Methylcholanthrene	0.150	USEPA 2007	Regression-based BAF (1)	1.175	USEPA 2007	Modeled BAF (9)
4-Bromophenyl phenyl ether	0.566	USEPA 2007	Regression-based BAF (1)	1.701	USEPA 2007	Modeled BAF (9)
4-Chloro-3-methylphenol	3.337	USEPA 2007	Regression-based BAF (1)	2.788	USEPA 2007	Modeled BAF (9)
4-Chlorophenyl phenyl ether	0.593	USEPA 2007	Regression-based BAF (1)	1.723	USEPA 2007	Modeled BAF (9)
7,12-Dimethylbenz(a)anthracene	0.125	USEPA 2007	Regression-based BAF (1)	1.116	USEPA 2007	Modeled BAF (9)
Aramite, total	0.669	USEPA 2007	Regression-based BAF (1)	1.782	USEPA 2007	Modeled BAF (9)
Bis(2-ethylhexyl)phthalate	0.066	USEPA 2007	Regression-based BAF (1)	0.935	USEPA 2007	Modeled BAF (9)
Butyl benzyl phthalate	0.657	USEPA 2007	Regression-based BAF (1)	1.773	USEPA 2007	Modeled BAF (9)
Diallate	0.911	USEPA 2007	Regression-based BAF (1)	1.942	USEPA 2007	Modeled BAF (9)
Dibenzofuran	1.287	USEPA 2007	Regression-based BAF (1)	2.138	USEPA 2007	Modeled BAF (9)

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	BAF Value/Uptake Equation	Source Document	Description	BAF Value/Uptake Equation	Source Document	Description
Semi-Volatile Organics:						
Diethyl phthalate	5.845	USEPA 2007	Regression-based BAF (1)	3.259	USEPA 2007	Modeled BAF (9)
Di-n-butyl phthalate	0.814	USEPA 2007	Regression-based BAF (1)	1.882	USEPA 2007	Modeled BAF (9)
Di-n-octyl phthalate	0.032	USEPA 2007	Regression-based BAF (1)	0.767	USEPA 2007	Modeled BAF (9)
Dinoseb	2.171	USEPA 2007	Regression-based BAF (1)	2.474	USEPA 2007	Modeled BAF (9)
Hexachlorobenzene	0.246	USEPA 2007	Regression-based BAF (1)	1.349	USEPA 2007	Modeled BAF (9)
Hexachlorobutadiene	0.675	USEPA 2007	Regression-based BAF (1)	1.787	USEPA 2007	Modeled BAF (9)
Hexachlorocyclopentadiene	0.393	USEPA 2007	Regression-based BAF (1)	1.536	USEPA 2007	Modeled BAF (9)
Hexachloroethane	1.439	USEPA 2007	Regression-based BAF (1)	2.206	USEPA 2007	Modeled BAF (9)
Hexachlorophene	0.053	USEPA 2007	Regression-based BAF (1)	0.878	USEPA 2007	Modeled BAF (9)
Hexachloropropene	1.009	USEPA 2007	Regression-based BAF (1)	1.998	USEPA 2007	Modeled BAF (9)
Isosafrole	2.593	USEPA 2007	Regression-based BAF (1)	2.599	USEPA 2007	Modeled BAF (9)
n-Nitrosodiphenylamine	3.155	USEPA 2007	Regression-based BAF (1)	2.745	USEPA 2007	Modeled BAF (9)
p-Dimethylamino azobenzene	0.837	USEPA 2007	Regression-based BAF (1)	1.897	USEPA 2007	Modeled BAF (9)
Pentachlorobenzene	0.444	USEPA 2007	Regression-based BAF (1)	1.589	USEPA 2007	Modeled BAF (9)
Pentachloronitrobenzene	0.792	USEPA 2007	Regression-based BAF (1)	1.868	USEPA 2007	Modeled BAF (9)
Pentachlorophenol	46.02	USEPA 2007	Maximum BAF (2)	88.12	USEPA 2007	90th percentile BAF (10)
Pronamide	2.275	USEPA 2007	Regression-based BAF (1)	2.506	USEPA 2007	Modeled BAF (9)
PAHs:						
2-Methylnaphthalene	1.641	USEPA 2007	Regression-based BAF (1)	2.288	USEPA 2007	Modeled BAF (9)
Acenaphthene	$In(C_p) = -0.8556[ln[C_s]) - 5.562$	USEPA 2007	Uptake equation (2)	2.252	USEPA 2007	Modeled BAF (9)
Acenaphthylene	1.522	USEPA 2007	Regression-based BAF (1)	2.241	USEPA 2007	Modeled BAF (9)
Anthracene	$ln(C_p) = 0.7784[ln(C_s)] - 0.9887$	USEPA 2007	Uptake equation (2)	1.912	USEPA 2007	Modeled BAF (9)
Benzo(a)anthracene	$In(C_p) = 0.5944[In(C_s)] - 2.7078$	USEPA 2007	Uptake equation (2)	1.417	USEPA 2007	Modeled BAF (9)
Benzo(a)pyrene	$ln(C_p) = 0.975[ln(C_s)] - 2.0615$	USEPA 2007	Uptake equation (2)	1.274	USEPA 2007	Modeled BAF (9)
Benzo(b)fluoranthene	0.48	USEPA 2007	Maximum BAF (3)	1.245	USEPA 2007	Modeled BAF (9)
Benzo(g,h,i)perylene	$ln(C_p) = 1.1829[ln(C_s)] - 0.9313$	USEPA 2007	Uptake equation (2)	1.093	USEPA 2007	Modeled BAF (9)
Benzo(k)fluoranthene	$ln(C_p) = 0.8595[ln(C_s)] - 2.1579$	USEPA 2007	Uptake equation (2)	1.245	USEPA 2007	Modeled BAF (9)
Chrysene	$In(C_p) = 0.5944[In(C_s)] - 2.7078$	USEPA 2007	Uptake equation (2)	1.417	USEPA 2007	Modeled BAF (9)
Dibenzo(a,h)anthracene	0.23	USEPA 2007	Maximum BAF (3)	1.096	USEPA 2007	Modeled BAF (9)
Fluoranthene	6.0	USEPA 2007	Maximum BAF (3)	1.648	USEPA 2007	Modeled BAF (9)
Fluorene	$In(C_p) = -0.8556[ln[C_s]) - 5.562$	USEPA 2007	Uptake equation (2)	2.089	USEPA 2007	Modeled BAF (9)
Indeno(1,2,3-cd)pyrene	0.15	USEPA 2007	Maximum BAF (3)	1.107	USEPA 2007	Modeled BAF (9)
Naphthalene	48	USEPA 2007	Maximum BAF (3)	2.606	USEPA 2007	Modeled BAF (9)
Phenanthrene	$ln(C_p) = 0.6203[ln(C_s)] - 0.1665$	USEPA 2007	Uptake equation (2)	1.912	USEPA 2007	Modeled BAF (9)
Pyrene	3.7	USEPA 2007	Maximum BAF (3)	1.653	USEPA 2007	Modeled BAF (9)

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	BAF Value/Uptake Equation	Source Document	Description	BAF Value/Uptake Equation	Source Document	Description
Organochlorine Pesticides:						
4,4'-DDD	0.202	USEPA 2007	Regression-based BAF (1)	$In(C_e) = 0.6975[In(C_s)] + 1.1613$	USEPA 2007	Uptake equation (12)
4,4'-DDE	0.14	USEPA 2007	Maximum BAF (4)	$In(C_e) = 0.8804[In(C_s)] + 2.4771$	USEPA 2007	Uptake equation (12)
4,4'-DDT	0.079	USEPA 2007	Maximum BAF (4)	$In(C_e) = 0.8689[In(C_s)] + 2.1247$	USEPA 2007	Uptake equation (12)
Aldrin	0.139	USEPA 2007	Regression-based BAF (1)	3.30	Edwards and Bohlen 1992	Mean BAF
alpha-BHC	1.735	USEPA 2007	Regression-based BAF (1)	2.324	USEPA 2007	Modeled BAF (10)
alpha-Chlordane	0.165	USEPA 2007	Regression-based BAF (1)	4.00	Edwards and Bohlen 1992	Mean BAF
beta-BHC	1.719	USEPA 2007	Regression-based BAF (1)	2.318	USEPA 2007	Modeled BAF (10)
Chlorobenzilate	0.721	USEPA 2007	Regression-based BAF (1)	1.820	USEPA 2007	Modeled BAF (10)
delta-BHC	1.263	USEPA 2007	Regression-based BAF (1)	2.127	USEPA 2007	Modeled BAF (10)
Dieldrin	2.222	USEPA 2007	Maximum BAF (4)	49.67	USEPA 2007	90th percentile BAF (13)
Endosulfan I	1.687	USEPA 2007	Regression-based BAF (1)	2.306	USEPA 2007	Modeled BAF (10)
Endosulfan II	1.687	USEPA 2007	Regression-based BAF (1)	2.306	USEPA 2007	Modeled BAF (10)
Endosulfan sulfate	1.978	USEPA 2007	Regression-based BAF (1)	2.410	USEPA 2007	Modeled BAF (10)
Endrin	0.535	USEPA 2007	Regression-based BAF (1)	3.60	Edwards and Bohlen 1992	Mean BAF
Endrin aldehyde	1.439	USEPA 2007	Regression-based BAF (1)	2.206	USEPA 2007	Modeled BAF (10)
gamma-BHC (lindane)	1.852	USEPA 2007	Regression-based BAF (1)	26.60	Romijn et al. 1994	Maximum BAF
gamma-Chlordane	0.165	USEPA 2007	Regression-based BAF (1)	4.00	Edwards and Bohlen 1992	Mean BAF
Heptachlor	0.174	USEPA 2007	Regression-based BAF (1)	3.00	Edwards and Bohlen 1992	Mean BAF
Heptachlor epoxide	0.566	USEPA 2007	Regression-based BAF (1)	10.00	Beyer and Gish 1980	Mean BAF
Isodrin	0.139	USEPA 2007	Regression-based BAF (1)	1.151	USEPA 2007	Modeled BAF (10)
Kepone	0.427	USEPA 2007	Regression-based BAF (1)	1.573	USEPA 2007	Modeled BAF (10)
Methoxychlor	0.525	USEPA 2007	Regression-based BAF (1)	1.666	USEPA 2007	Modeled BAF (10)
Toxaphene	0.355	USEPA 2007	Regression-based BAF (1)	1.493	USEPA 2007	Modeled BAF (10)
Metals:						
Antimony	$ln(C_p) = 0.938[ln(C_s)] - 3.233$	USEPA 2007	Uptake equation (4)	1.00	USEPA 2007	Assumed BAF
Arsenic	$In(C_p) = 0.564[ln[C_s]) - 1.992$	Bechtel Jacobs 1998	Uptake equation (5)	$ln(C_e) = 0.706[ln(C_s)] - 1.421$	USEPA 2007	Uptake equation (12)
Barium	0.447	Bechtel Jacobs 1998	90th percentile BAF (6)	0.16	Sample et al. 1998	90th percentile BAF (13)
Beryllium	$In(C_p) = 0.7345[ln[C_s]) - 0.5361$	USEPA 2007	Uptake equation (7)	1.182	Sample et al. 1998	90th percentile BAF (13)
Cadmium	$ln(C_p) = 0.546[ln(C_s)] - 0.475$	USEPA 2007	Uptake equation (8)	$ln(C_e) = 0.795[ln(C_s)] + 2.114$	USEPA 2007	Uptake equation (12)
Chromium, total	0.0839	Bechtel Jacobs 1998	90th percentile BAF (6)	3.162	Sample et al. 1998	90th percentile BAF (11)
Cobalt	0.0248	Bechtel Jacobs 1998	90th percentile BAF (6)	0.291	Sample et al. 1998	90th percentileBAF (13)
Copper	$ln(C_p) = 0.394[ln(C_s)] + 0.668$	USEPA 2007	Uptake equation (8)	$ln(C_e) = 0.264[ln(C_s)] + 1.675$	Sample et al. 1998	Uptake equation (14)
Lead	$ln(C_p) = 0.561[ln(C_s)] - 1.328$	USEPA 2007	Uptake equation (8)	$ln(C_e) = 0.807[ln(C_s)] - 2.18$	USEPA 2007	Uptake equation (12)
Mercury	$In(C_p) = 0.544[ln[C_s]) - 0.996$	Bechtel Jacobs 1998	Uptake equation (6)	20.63	Sample et al. 1998	90th percentile BAF (11)
Nickel	$ln(C_p) = 0.748[ln(C_s)] - 2.224$	USEPA 2007	Uptake equation (8)	4.73	Sample et al. 1998	90th percentile BAF (11)

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	BAF Value/Uptake Equation	Source Document	Description	BAF Value/Uptake Equation	Source Document	Description
Metals:						
Selenium	$\ln(C_p) = 1.104[\ln(C_s)] - 0.678$	USEPA 2007	Uptake equation [8]	$\ln(C_e) = 0.733[\ln(C_s)] - 0.075$	USEPA 2007	Uptake equation [12]
Silver	0.0367	Bechtel Jacobs 1998	90th percentile BAF [6]	15.338	Sample et al. 1998	90th percentile BAF [13]
Thallium	0.004	Baes et al. 1984	Geometric mean BAF	1.00	---	Assumed BAF
Tin	0.03	Baes et al. 1984	Geometric mean BAF	1.00	---	Assumed BAF
Vanadium	0.0097	Bechtel Jacobs 1998	90th percentile BAF [6]	0.088	Sample et al. 1998	90th percentile BAF [13]
Zinc	$\ln(C_p) = 0.554[\ln(C_s)] + 1.575$	USEPA 2007	Uptake equation [8]	$\ln(C_e) = 0.328[\ln(C_s)] + 4.449$	USEPA 2007	Uptake equation [12]

Notes:

USEPA = United States Environmental Protection Agency
BAF = Bioaccumulation Factor (unitless)
PAH = Polynuclear Aromatic Hydrocarbon
C_e = Concentration in earthworm tissue (mg/kg - dry weight)
C_p = Concentration in plant tissue (mg/kg - dry weight)
C_s = Maximum concentration in soil (mg/kg - dry weight)
ln = natural logarithm

(1) BAF value was estimated using an inter-chemical regression equation for non-ionic organics based on rinsed plant foliage BAF data: $\log BAF = -0.4057(\log K_{ow}) + 1.781$, where BAF is the bioaccumulation factor and K_{ow} is the octanol-water partition coefficient (see Figure 5, Panel B in USEPA, 2007). The K_{ow} value used in the estimation of the BAF value is listed in Table 7-3.

(2) The concentration in plant tissue was estimated using a chemical-specific bioaccumulation uptake equation (i.e., regression equation) based on rinsed plant foliage BAF data (see Appendix C in USEPA, 2007).

(3) Maximum BAF value for rinsed plant foliage data listed in Appendix C of USEPA (2007).

(4) The concentration in plant tissue was estimated using a chemical-specific bioaccumulation uptake equation (i.e., regression equation; see Table 4a of USEPA[2007]) derived from measured BAF data (see Appendix A, Table A-1 of USEPA, 2007).

(5) The concentration in plant tissue was estimated using a chemical-specific bioaccumulation uptake equation (i.e., regression equation) listed in Table 7 of Bechtel Jacobs (1998).

(6) 90th percentile BAF value listed in Appendix D, Table D-1 of Bechtel Jacobs (1998).

(7) The concentration in plant tissue was estimated using a chemical-specific bioaccumulation uptake equation (i.e., regression equation; see Table 4a of USEPA, 2007) derived from measured BAF data (see Appendix A, Table A-2 of USEPA, 2007).

(8) The concentration in plant tissue was estimated using a chemical-specific bioaccumulation uptake equation (i.e., regression equation) developed by Bechtel Jacobs (1998) and cited in Table 4a of USEPA (2007).

(9) BAF value was estimated using the relationship $BAF = K_{ww}/K_d$ where K_{ww} is the biota to soil pore water partition coefficient (L soil pore water/kg ww tissue; converted to L soil pore water/kg dw tissue by assuming 16 percent soilds [USEPA, 1993] and dividing by 0.16) and K_d is the soil to pore water partition coefficient (L soil pore water/kg dw soil) (relationship developed by Jager, 1998 and cited in USEPA, 2007). Chemical-specific values for K_{ww} and K_d were derived using the following relationships:

$\log(K_{ww}) = 0.87(\log K_{ow}) - 2.0$ where K_{ow} is the octanol-water partition coefficient (K_{ow} value listed in Table 7-3)

$K_d = (f_{oc})(K_{oc})$ where f_{oc} is the fraction of organic carbon in soil (assumed to be 0.01 [one percent]) and K_{oc} is the organic carbon partition coefficient (K_{oc} value listed in Table 7-3)

(10) 90th percentile BAF calculated from individual BAF values listed in Appendix F-2 of USEPA (2007).

(11) 90th percentile BAF value listed in Table 11 of Sample et al. (1998).

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Notes (continued):

(12) The concentration in earthworm tissue was estimated using a chemical-specific bioaccumulation uptake equation (i.e., regression equation) developed by Sample et al. (1998 and 1999) and cited in Table 4a of USEPA (2007).

(13) 90th percentile BAF listed in Appendix C, Table C.1 of Sample et al. (1998).

(14) The concentration in earthworm tissue was estimated using a chemical-specific bioaccumulation uptake equation (i.e., regression equation) listed in Table 12 of Sample et al. (1998).

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TABLE 7-12
SOIL BIOACCUMULATION FACTORS AND BIOACCUMULATION UPTAKE EQUATIONS USED TO ESTIMATE CHEMICAL CONCENTRATIONS IN SMALL MAMMAL TISSUE: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical	Soil-Small Mammal BAF (dry weight)		
	BAF Value/Uptake Equation	Source Document	Description
Volatile Organics:			
1,1,1,2-Tetrachloroethane	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
Carbon tetrachloride	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
Chlorobenzene	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
Chloroform	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
Ethylbenzene	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
Pentachloroethane	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
Styrene	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
Toluene	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
Trichloroethene	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
Xylenes (total)	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
Semi-Volatile Organics:			
1,2,4,5-Tetrachlorobenzene	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
1,2,4-Trichlorobenzene	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
1,2-Dichlorobenzene	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
1,3-Dichlorobenzene	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
1,4,-Dichlorobenzene	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
2,3,4,6-Tetrachlorophenol	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
2,4,5-Trichlorophenol	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
2,4,6-Trichlorophenol	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
2,4-Dichlorophenol	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
2-Acetylaminofluorene	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
2-Chloronaphthalene	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
3,3'-Dichlorobenzidine	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
3,3'-Dimethylbenzidine	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
3-Methylcholanthrene	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
4-Bromophenyl phenyl ether	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)

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Chemical	Soil-Small Mammal BAF (dry weight)		
	BAF Value/Uptake Equation	Source Document	Description
Semi-Volatile Organics:			
4-Chloro-3-methylphenol	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
4-Chlorophenyl phenyl ether	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
7,12-Dimethylbenz(a)anthracene	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
Aramite, total	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
Bis(2-ethylhexyl)phthalate	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
Butyl benzyl phthalate	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
Diallate, cis-	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
Diallate, trans-	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
Diallate	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
Dibenzofuran	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
Diethyl phthalate	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
Di-n-butyl phthalate	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
Di-n-octyl phthalate	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
Dinoseb	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
Hexachlorobenzene	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
Hexachlorobutadiene	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
Hexachlorocyclopentadiene	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
Hexachloroethane	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
Hexachlorophene	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
Hexachloropropene	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
Isosafrole	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
n-Nitrosodiphenylamine	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
p-Dimethylamino azobenzene	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
Pentachlorobenzene	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
Pentachloronitrobenzene	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
Pentachlorophenol	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)

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Chemical	Soil-Small Mammal BAF (dry weight)		
	BAF Value/Uptake Equation	Source Document	Description
Semi-Volatile Organics:			
Pronamide	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 (1)
PAHs:			
2-Methylnaphthalene	0.000	---	BAF value for other PAH compounds used as a surrogate
Acenaphthene	0.000	USEPA 2007	Bioaccumulation is assumed to be negligible
Acenaphthylene	0.000	USEPA 2007	Bioaccumulation is assumed to be negligible
Anthracene	0.000	USEPA 2007	Bioaccumulation is assumed to be negligible
Benzo(a)anthracene	0.000	USEPA 2007	Bioaccumulation is assumed to be negligible
Benzo(a)pyrene	0.000	USEPA 2007	Bioaccumulation is assumed to be negligible
Benzo(b)fluoranthene	0.000	USEPA 2007	Bioaccumulation is assumed to be negligible
Benzo(g,h,i)perylene	0.000	USEPA 2007	Bioaccumulation is assumed to be negligible
Benzo(k)fluoranthene	0.000	USEPA 2007	Bioaccumulation is assumed to be negligible
Chrysene	0.000	USEPA 2007	Bioaccumulation is assumed to be negligible
Dibenzo(a,h)anthracene	0.000	USEPA 2007	Bioaccumulation is assumed to be negligible
Fluoranthene	0.000	USEPA 2007	Bioaccumulation is assumed to be negligible
Fluorene	0.000	USEPA 2007	Bioaccumulation is assumed to be negligible
Indeno(1,2,3-cd)pyrene	0.000	USEPA 2007	Bioaccumulation is assumed to be negligible
Naphthalene	0.000	USEPA 2007	Bioaccumulation is assumed to be negligible
Phenanthrene	0.000	USEPA 2007	Bioaccumulation is assumed to be negligible
Pyrene	0.000	USEPA 2007	Bioaccumulation is assumed to be negligible
Organochlorine Pesticides:			
4,4'-DDD	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1
4,4'-DDE	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1
4,4'-DDT	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1
Aldrin	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1
alpha-BHC	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1
alpha-Chlordane	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1
beta-BHC	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1
Chlorobenzilate	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1
delta-BHC	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1
Dieldrin	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1

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Chemical	Soil-Small Mammal BAF (dry weight)		
	BAF Value/Uptake Equation	**Source Document**	**Description**
Organochlorine Pesticides:			
Endosulfan 1	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1
Endosulfan 11	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1
Endosulfan sulfate	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1
Endrin	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1
Endrin aldehyde	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1
gamma-BHC (lindane)	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1
gamma-Chlordane	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1
Heptachlor	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1
Heptachlor epoxide	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1
Isodrin	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1
Kepone	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1
Chemical	**Soil-Small Mammal BAF (dry weight)**		
	BAF Value/Uptake Equation	**Source Document**	**Description**
Organochlorine Pesticides:			
Methoxychlor	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1
Toxaphene	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1
Metals:			
Antimony	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1
Arsenic	$\ln(C_m) = 0.8188[\ln(C_s)] - 4.8471$	USEPA 2007	Regression-based uptake equation for all small mammals (2)
Barium	0.1121	Sample et al. 1998	90th percentile BAF for all small mammals (3)
Beryllium	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1
Cadmium	$\ln(C_m) = 0.4865[\mathrm{In}(C_s)] - 0.4306$	Sample et al. 1998	Regression-based uptake equation for all small mammals (4)
Chromium, total	$\ln(C_m) = 0.7338[\ln(C_s)] - 1.4599$	USEPA 2007	Regression-based uptake equation for all small mammals (2)
Cobalt	$\ln(C_m) = 1.3070[\ln(C_s)] - 4.4669$	USEPA 2007	Regression-based uptake equation for all small mammals (2)
Copper	$\ln(C_m) = 0.1444[\ln(C_s)] + 0.2042$	USEPA 2007	Regression-based uptake equation for all small mammals (2)
Lead	$\ln(C_m) = 0.4422[\ln(C_s)] + 0.0761$	USEPA 2007	Regression-based uptake equation for all small mammals (2)
Mercury	0.192	Sample et al. 1998	90th percentile BAF for all small mammals (5)

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SOIL BIOACCUMULATION FACTORS AND BIOACCUMULATION UPTAKE EQUATIONS USED TO ESTIMATE CHEMICAL CONCENTRATIONS IN SMALL MAMMAL TISSUE: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical	Soil-Small Mammal BAF (dry weight)		
	BAF Value/Uptake Equation	Source Document	Description
Metals:			
Nickel	$\ln(C_m) = 0.4658[\ln(C_s)] - 0.2462$	USEPA 2007	Regression-based uptake equation for all small mammals [(2)]
Selenium	$\ln(C_m) = 0.3764[\ln(C_s)] - 0.4158$	USEPA 2007	Regression-based uptake equation for all small mammals [(2)]
Silver	0.5013	Sample et al. 1998	90th percentile BAF for all small mammals [(3)]
Thallium	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1
Tin	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1
Vanadium	0.0179	Sample et al. 1998	90th percentile BAF for all small mammals [(3)]
Zinc	$\ln(C_m) = 0.0738[\ln(C_s)] + 4.4713$	Sample et al. 1998	Regression-based uptake equation for all small mammals [(4)]

Notes:

USEPA = United States Environmental Protection Agency
PAH = Polynuclear Aromatic Hydrocarbon
BAF = Bioaccumulation Factor
C_m = Concentration in small mammal tissue (mg/kg - dry weight)
C_s = Maximum concentration in soil (mg/kg - dry weight)
BAF_d = diet-to-small mammal bioaccumulation factor (wet weight)
DI = Small mammal dietary intake (mg/kg-BW/day)

(1) Most chemical exposure for small mammals is via the diet. Therefore, it is assumed that the concentration of the chemical in small mammal tissue is equal to the chemical concentration in its diet multiplied by a diet to whole-body BAF (BAF_d - wet weight basis). In the absence of literature-based diet to whole-body BAF, a value of 1.0 was assumed. The resulting tissue concentration was converted to a dry weight basis using an estimated solids content for small mammals of 0.32 (USEPA, 1993). Additional explanation is provided in Section 7.5.2.2.1.

(2) The concentration in small mammal tissue was estimated using a chemical-specific bioaccumulation uptake equation for all small mammals (i.e., regression (equation) developed by Sample et al. (1998) and cited in Table 4a of USEPA (2007).

(3) 90th percentile BAF value for all small mammals listed in Appendix C, Table C-1 of Sample et al. (1998).

(4) The concentration in small mammal tissue was estimated using a chemical-specific bioaccumulation uptake equation for all small mammals (i.e., regression equation) listed in Table 8 of Sample et al. (1998).

(5) 90th percentile BAF value for all small mammals listed in Table 7 of Sample et al. (1998).

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Table References:

Sample, B.E., J.J. Beauchamp, R.A. Efroymson, and G.W. Suter II. 1998. Development and Validation of Bioaccumulation Models for Small Mammals. Oak Ridge National Laboratory, Environmental Restoration Division, ORNL Environmental Restoration Program. ES/ER/TM-219.

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USEPA. 1993. Wildlife Exposure Factors Handbook. Office of Research and Development, Washington, D.C. EPA/600/R-93/187a.

TABLE 7-13
BIOACCUMULATION FACTORS FOR THE ESTIMATION OF CHEMICAL CONCENTRATIONS IN FISH: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical	Sediment-Fish BAF (dry weight)		
	Value	Source Document	Description
Volatile Organics:			
1,1,1,2-Tetrachloroethane	1.00	---	Assumed BAF
Carbon tetrachloride	1.00	---	Assumed BAF
Chlorobenzene	1.00	---	Assumed BAF
Chloroform	1.00	---	Assumed BAF
Ethylbenzene	1.00	---	Assumed BAF
Pentachloroethane	1.00	---	Assumed BAF
Styrene	1.00	---	Assumed BAF
Toluene	1.00	---	Assumed BAF
Trichloroethene	1.00	---	Assumed BAF
Xylene, o-	1.00	---	Assumed BAF
Xylene, m,p-	1.00	---	Assumed BAF
Xylene, total	1.00	---	Assumed BAF
Semi-Volatile Organics:			
1,1-Biphenyl	0.726		BAF derived from 90th percentile BSAF value listed in Table7-14 (1)
1,2,4,5-Tetrachlorobenzene	1.00	---	Assumed BAF
1,2,4-Trichlorobenzene	1.968	---	BAF derived from the single BSAF value listed in Table 7-14 (1)
1,2-Dichlorobenzene	1.258	---	BAF derived from the single BSAF value listed in Table 7-14 (1)
1,3-Dichlorobenzene	0.227	---	BAF derived from the single BSAF value listed in Table 7-14 (1)
1,4,-Dichlorobenzene	1.00	---	Assumed BAF
2,3,4,6-Tetrachlorophenol	1.00	---	Assumed BAF
2,4,5-Trichlorophenol	1.00	---	Assumed BAF
2,4,6-Trichlorophenol	1.00	---	Assumed BAF
2,4-Dichlorophenol	1.00	---	Assumed BAF
2-Acetylaminofluorene	1.00	---	Assumed BAF
2-Chloronaphthalene	1.00	---	Assumed BAF
3,3'-Dichlorobenzidine	1.00	---	Assumed BAF
3,3'-Dimethylbenzidine	1.00	---	Assumed BAF
3-Methylcholanthrene	1.00	---	Assumed BAF
4-Bromophenyl phenyl ether	1.00	---	Assumed BAF
4-Chloro-3-methylphenol	1.00	---	Assumed BAF
4-Chlorophenyl phenyl ether	1.00	---	Assumed BAF
7,12-Dimethylbenz(a)anthracene	1.00	---	Assumed BAF
Aramite, total	1.00	---	Assumed BAF
Bis(2-ethylhexyl)phthalate	34.679	---	BAF derived from 90th percentile BSAF value listed in Table 7-14 (1)

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BIOACCUMULATION FACTORS FOR THE ESTIMATION OF CHEMICAL CONCENTRATIONS IN FISH: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical	Sediment-Fish BAF (dry weight)		
	Value	Source Document	Description
Semi-Volatile Organics:			
Butyl benzyl phthalate	1.00	---	Assumed BAF
Diallate, total	1.00	---	Assumed BAF
Daillate, cis-	1.00	---	Assumed BAF
Diallate, trans-	1.00	---	Assumed BAF
Dibenzofuran	0.401	---	BAF derived from 90th percentile BSAF value listed in Table 7-14 (1)
Diethyl phthalate	1.00	---	Assumed BAF
Di-n-butyl phthalate	1.00	---	Assumed BAF
Di-n-octyl phthalate	1.00	---	Assumed BAF
Dinoseb	1.00	---	Assumed BAF
Hexachlorobenzene	1.011	---	BAF derived from the single BSAF value listed in Table 7-14 (1)
Hexachlorobutadiene	1.00	---	Assumed BAF
Hexachlorocyclopentadiene	1.00	---	Assumed BAF
Hexachloroethane	1.00	---	Assumed BAF
Hexachlorophene	1.00	---	Assumed BAF
Hexachloropropene	1.00	---	Assumed BAF
Isosafrole	1.00	---	Assumed BAF
n-Nitrosodiphenylamine	1.00	---	Assumed BAF
p-Dimethylamino azobenzene	1.00	---	Assumed BAF
Pentachlorobenzene	0.450	---	BAF derived from the single BSAF value listed in Table 7-14 (1)
Pentachloronitrobenzene	1.00	---	Assumed BAF
Pentachlorophenol	1.00	---	Assumed BAF
Pronamide	1.00	---	Assumed BAF
PAHs:			
2-Methylnaphthalene	2.049	---	BAF derived from 90th percentile BSAF value listed in Table 7-14 (1)
Acenaphthene	0.481	---	BAF derived from 90th percentile BSAF value listed in Table 7-14 (1)
Acenaphthylene	0.299	---	BAF derived from 90th percentile BSAF value listed in Table 7-14 (1)
Anthracene	0.147	---	BAF derived from 90th percentile BSAF value listed in Table 7-14 (1)
Benzo(a)anthracene	0.349	---	BAF derived from 90th percentile BSAF value listed in Table 7-14 (1)
Benzo(a)pyrene	0.040	---	BAF derived from 90th percentile BSAF value listed in Table 7-14 (1)
Benzo(b)fluoranthene	0.044	---	BAF derived from 90th percentile BSAF value listed in Table 7-14 (1)
Benzo(g,h,i)perylene	0.638	---	BAF derived from 90th percentile BSAF value listed in Table 7-14 (1)
Benzo(k)fluoranthene	0.041	---	BAF derived from 90th percentile BSAF value listed in Table 7-14 (1)

TABLE 7-13
BIOACCUMULATION FACTORS FOR THE ESTIMATION OF CHEMICAL CONCENTRATIONS IN FISH: STEP 2 SCREENING LEVEL RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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Chemical	Sediment-Fish BAF (dry weight)		
	Value	Source Document	Description
PAHs:			
Chrysene	0.251	---	BAF derived from 90th percentile BSAF value listed in Table 7-14 (1)
Dibenzo(a,h)anthracene	0.041	---	BAF derived from 90th percentile BSAF value listed in Table 7-14 (1)
Fluoranthene	0.108	---	BAF derived from 90th percentile BSAF value listed in Table 7-14 (1)
Fluorene	1.398	---	BAF derived from 90th percentile BSAF value listed in Table 7-14 (1)
Indeno(1,2,3-cd)pyrene	0.449	---	BAF derived from 90th percentile BSAF value listed in Table 7-14 (1)
Naphthalene	2.828	---	BAF derived from 90th percentile BSAF value listed in Table 7-14 (1)
Phenanthrene	0.702	---	BAF derived from 90th percentile BSAF value listed in Table 7-14 (1)
Pyrene	0.520	---	BAF derived from 90th percentile BSAF value listed in Table 7-14 (1)
Organochlorine Pesticides:			
4,4'-DDD	17.242	---	BAF derived from 90th percentile BSAF value listed in Table 7-14 (1)
4,4'-DDE	229.288	---	BAF derived from 90th percentile BSAF value listed in Table 7-14 (1)
4,4'-DDT	15.014	---	BAF derived from 90th percentile BSAF value listed in Table 7-14 (1)
Aldrin	20.229	---	BAF derived from the single BSAF value listed in Table 7-14 (1)
alpha-BHC	20.229	---	BAF derived from the single BSAF value listed in Table 7-14 (1)
alpha-Chlordane	20.554	---	BAF derived from 90th percentile BSAF value listed in Table 7-14 (1)
beta-BHC	20.229	---	BAF derived from the single BSAF value listed in Table 7-14 (1)
Chlorobenzilate	20.229	---	BAF value based on an assumed BSAF of 1.8 (2)
delta-BHC	20.229	---	BAF derived from the single BSAF value listed in Table 7-14 (1)
Dieldrin	105.488	---	BAF derived from 90th percentile BSAF value listed in Table 7-14 (1)
Endosulfan 1	20.229	---	BAF derived from the single BSAF value listed in Table 7-14 (1)
Endosulfan 11	20.229	---	BAF derived from the single BSAF value listed in Table 7-14 (1)
Endosulfan sulfate	20.229	---	BAF value based on an assumed BSAF of 1.8 (2)
Endrin	20.229	---	BAF derived from the single BSAF value listed in Table 7-14 (1)
Endrin aldehyde	20.229	---	BAF value based on an assumed BSAF of 1.8 (2)
gamma-BHC (lindane)	20.229	---	BAF derived from the single BSAF value listed in Table 7-14 (1)
gamma-Chlordane	18.898	---	BAF derived from the single BSAF value listed in Table 7-14 (1)
Heptachlor	20.229	---	BAF derived from the single BSAF value listed in Table 7-14 (1)
Heptachlor epoxide	20.229	---	BAF derived from the single BSAF value listed in Table 7-14 (1)
Isodrin	20.229	---	BAF value based on an assumed BSAF of 1.8 (2)

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Chemical	Sediment-Fish BAF (dry weight)		
	Value	Source Document	Description
Organochlorine Pesticides:			
Kepone	20.229	---	BAF value based on an assumed BSAF of 1.8 [(2)]
Methoxychlor	20.229	---	BAF derived from the single BSAF value listed in Table 7-14 (1)
Toxaphene	20.229	---	BAF derived from the single BSAF value listed in Table 7-14 (1)
Metals:			
Antimony	1.00	---	Assumed BAF
Arsenic	1.00	---	Assumed BAF
Barium	1.00	---	Assumed BAF
Beryllium	1.00	---	Assumed BAF
Cadmium	2.00	PTI 1995	95th percentile BAF
Chromium, total	1.00	---	Assumed BAF
Cobalt	1.00	---	Assumed BAF
Copper	1.00	---	Assumed BAF
Lead	0.39	PTI 1995	95th percentile BAF
Mercury	4.58	Cope et al. 1990	Maximum BAF
Nickel	1.00	---	Assumed BAF
Selenium	1.00	---	Assumed BAF
Silver	1.00	---	Assumed BAF
Thallium	1.00	---	Assumed BAF
Tin	1.00	---	Assumed BAF
Vanadium	1.00	---	Assumed BAF
Zinc	4.82	PTI 1995	95th percentile BAF

Notes:

BAF = Bioaccumulation Factor
PAH = Polynuclear Aromatic Hydrocarbon
PCB = Polychlorinated Biphenyl
BSAF = Biota-Sediment Accumulation Factor

(1) The single/90th percentile BSAF value (wet weight) listed in Table 7-13 was converted to a sediment-to-fish BAF value (dry weight) using a lipid content of 5.90 percent, solids content of 25 percent, and a minimum sediment organic carbon content (f_{oc}) of 0.021 for drainage ditch sediment.

(2) BSAF value listed in Table 7-13 for other pesticides (aldrin, alpha-BHC, beta-BHC, delta-BHC, endosulfan I, endofulfan II, endrin, gamma-BHC [lindane], gamma-chlordane, heptachlor, heptachlor epoxide, methoxychlor, and toxaphene) was used to derive the BAF value.

Table References:

Cope, W.G., J.G. Wiener, and R.G. Rada. 1990. Mercury Accumulation in Yellow Perch in Wisconsin Seepage Lakes: Relation to Lake Characteristics. Environ. Toxicol. Chem. 9:931-940.

PTI Environmental Services. 1995. Bioaccumulation Factor Approach Analysis for Metals and Polar Organic Compounds. Bellevue, Washington. 45 pp.

TABLE 7-14
LITERATURE-BASED BIOTA-SEDIMENT ACCUMULATION FACTORS USED TO DERIVE SEDIMENT-TO-FISH BIOACCUMULATION FACTORS
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Chemical	Organism	BSAF (wet weight)	Reference	90th Percentile BSAF (wet weight)	Median BSAF (wet weight)
PAHs:					
2-Methylnaphthalene	American eel (*Anguilla rostrata*)	0.0284	USEPA 2010	0.1823	0.0788
		0.0109	USEPA 2010		
		0.0518	USEPA 2010		
	White sucker (*Catostomus commersoni*)	0.0721	USEPA 2010		
		0.0832	USEPA 2010		
		0.0703	USEPA 2010		
		0.0743	USEPA 2010		
		0.0267	USEPA 2010		
		0.1031	USEPA 2010		
		0.1190	USEPA 2010		
		0.0895	USEPA 2010		
	Killifish (*Fundulus* sp.)	0.9717	USEPA 2010		
		0.1935	USEPA 2010		
	Largemouth bass (*Micropterus salmoides*)	0.1561	USEPA 2010		
Acenaphthene	American eel (*Anguilla rostrata*)	0.0293	USEPA 2010	0.0428	0.0351
		0.0048	USEPA 2010		
		0.0145	USEPA 2010		
	White sucker (*Catostomus commersoni*)	0.0365	USEPA 2010		
		0.0428	USEPA 2010		
		0.0417	USEPA 2010		
		0.0602	USEPA 2010		
		0.0089	USEPA 2010		
		0.0306	USEPA 2010		
		0.0401	USEPA 2010		
		0.0351	USEPA 2010		
Acenaphthylene	American eel (*Anguilla rostrata*)	0.0037	USEPA 2010	0.0266	0.0138
		0.0024	USEPA 2010		
		0.0003	USEPA 2010		
	White sucker (*Catostomus commersoni*)	0.0150	USEPA 2010		
		0.0149	USEPA 2010		
		0.0136	USEPA 2010		
		0.0138	USEPA 2010		
		0.0085	USEPA 2010		
		0.0266	USEPA 2010		
		0.0287	USEPA 2010		
		0.0244	USEPA 2010		

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Chemical	Organism	BSAF (wet weight)	Reference	90th Percentile BSAF (wet weight)	Median BSAF (wet weight)
PAHs:					
Anthracene	American eel (*Anguilla rostrata*)	0.0031	USEPA 2010	0.0131	0.0084
		0.0008	USEPA 2010		
		0.0002	USEPA 2010		
	White sucker (*Catostomus commersoni*)	0.0119	USEPA 2010		
		0.0106	USEPA 2010		
		0.0099	USEPA 2010		
		0.0105	USEPA 2010		
		0.0032	USEPA 2010		
		0.0139	USEPA 2010		
		0.0109	USEPA 2010		
		0.0148	USEPA 2010		
	Largemouth bass (*Micropterus salmoides*)	0.0072	USEPA 2010		
		0.0062	USEPA 2010		
	Mummichog (*Fundulus heteroclitus*)	0.0084	USEPA 2010		
	Cunner (*Tautogolabrus adspersus*)	0.0061	USEPA 2010		
Benzo(a)anthracene	White sucker (*Catostomus commersoni*)	0.0021	USEPA 2010	0.0310	0.0024
		0.0040	USEPA 2010		
		0.0029	USEPA 2010		
		0.0026	USEPA 2010		
		0.0003	USEPA 2010		
		0.0014	USEPA 2010		
		0.0009	USEPA 2010		
	Killifish (*Fundulus* sp.)	0.0941	USEPA 2010		
Benzo(a)pyrene	White sucker (*Catostomus commersoni*)	0.0018	USEPA 2010	0.00353	0.0021
		0.0023	USEPA 2010		
		0.0040	USEPA 2010		
		0.0002	USEPA 2010		
Benzo(b)fluoranthene	White sucker (*Catostomus commersoni*)	0.0043	USEPA 2010	0.00395	0.0025
		0.0034	USEPA 2010		
		0.0019	USEPA 2010		
		0.0025	USEPA 2010		
		0.0002	USEPA 2010		

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Chemical	Organism	BSAF (wet weight)	Reference	90th Percentile BSAF (wet weight)	Median BSAF (wet weight)
PAHs:					
Benzo(g,h,i)perylene	White sucker (*Catostomus commersoni*)	0.0040	USEPA 2010	0.0567	0.0040
		0.0012	USEPA 2010		
		0.0699	USEPA 2010		
Benzo(k)fluoranthene	White sucker (*Catostomus commersoni*)	0.0018	USEPA 2010	0.0036	0.0024
		0.0024	USEPA 2010		
		0.0030	USEPA 2010		
		0.0041	USEPA 2010		
		0.0002	USEPA 2010		
Chrysene	White sucker (*Catostomus commersoni*)	0.0046	USEPA 2010	0.0223	0.0027
		0.0029	USEPA 2010		
		0.0024	USEPA 2010		
		0.0034	USEPA 2010		
		0.0003	USEPA 2010		
		0.0010	USEPA 2010		
		0.0017	USEPA 2010		
		0.0636	USEPA 2010		
Dibenzo(a,h)anthracene	White sucker (*Catostomus commersoni*)	0.0022	USEPA 2010	0.0036	0.0022
		0.0014	USEPA 2010		
		0.0027	USEPA 2010		
		0.0043	USEPA 2010		
		0.0003	USEPA 2010		
Fluoranthene	American eel (*Anguilla rostrata*)	0.0011	USEPA 2010	0.0096	0.0029
		0.0003	USEPA 2010		
		0.0001	USEPA 2010		
	White sucker (*Catostomus commersoni*)	0.0045	USEPA 2010		
		0.0048	USEPA 2010		
		0.0065	USEPA 2010		
		0.0040	USEPA 2010		
		0.0007	USEPA 2010		
		0.0027	USEPA 2010		
		0.0035	USEPA 2010		
		0.0026	USEPA 2010		
	Cunner (*Tautogolabrus adspersus*)	0.0117	USEPA 2010		
		0.0029	USEPA 2010		
		0.0001	USEPA 2010		
	Killifish (*Fundulus* sp.)	0.0383	USEPA 2010		

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Chemical	Organism	BSAF (wet weight)	Reference	90th Percentile BSAF (wet weight)	Median BSAF (wet weight)
PAHs:					
Fluorene	American eel (*Anguilla rostrata*)	0.0063	USEPA 2010	0.1244	0.0237
		0.0016	USEPA 2010		
		0.0006	USEPA 2010		
		0.0039	USEPA 2010		
	White sucker (*Catostomus commersoni*)	0.0415	USEPA 2010		
		0.0238	USEPA 2010		
		0.0236	USEPA 2010		
		0.0225	USEPA 2010		
		0.0081	USEPA 2010		
		0.0324	USEPA 2010		
		0.0280	USEPA 2010		
		0.0280	USEPA 2010		
	Largemouth bass (*Micropterus salmoides*)	0.0302	USEPA 2010		
		0.0189	USEPA 2010		
	Mummichog (*Fundulus heteroclitus*)	0.5256	USEPA 2010		
	Cunner (*Tautogolabrus adspersus*)	0.2073	USEPA 2010		
Naphthalene	American eel (*Anguilla rostrata*)	0.0265	USEPA 2010	0.2517	0.0408
		0.0123	USEPA 2010		
	White sucker (*Catostomus commersoni*)	0.0408	USEPA 2010		
		0.0430	USEPA 2010		
		0.0428	USEPA 2010		
		0.0387	USEPA 2010		
		0.0170	USEPA 2010		
	Killifish (*Fundulus* sp.)	0.8125	USEPA 2010		
		0.1575	USEPA 2010		
		0.0366	USEPA 2010		
	White perch (*Morone americana*)	0.2517	USEPA 2010		

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Chemical	Organism	BSAF (wet weight)	Reference	90th Percentile BSAF (wet weight)	Median BSAF (wet weight)
PAHs:					
Phenanthrene	American eel (*Anguilla rostrata*)	0.0027	USEPA 2010	0.0625	0.0083
		0.0006	USEPA 2010		
		0.0002	USEPA 2010		
	White sucker (*Catostomus commersoni*)	0.0055	USEPA 2010		
		0.0109	USEPA 2010		
		0.0068	USEPA 2010		
		0.0072	USEPA 2010		
		0.0016	USEPA 2010		
		0.0083	USEPA 2010		
		0.0099	USEPA 2010		
		0.0085	USEPA 2010		
	Killifish (*Fundulus* sp.)	0.1128	USEPA 2010		
		0.1611	USEPA 2010		
	Cunner (*Tautogolabrus adspersus*)	0.0289	USEPA 2010		
		0.0135	USEPA 2010		
	Largemouth bass (*Micropterus salmoides*)	0.0064	USEPA 2010		
	Mummichog (*Fundulus heteroclitus*)	0.0184	USEPA 2010		
Pyrene	White sucker (*Catostomus commersoni*)	0.0022	USEPA 2010	0.0462	0.0034
		0.0027	USEPA 2010		
		0.0041	USEPA 2010		
		0.0026	USEPA 2010		
		0.0003	USEPA 2010		
	Mummichog (*Fundulus heteroclitus*)	0.0387	USEPA 2010		
	Cunner (*Tautogolabrus adspersus*)	0.0122	USEPA 2010		
	Killifish (*Fundulus* sp.)	0.0638	USEPA 2010		

TABLE 7-14
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Chemical	Organism	BSAF (wet weight)	Reference	90th Percentile BSAF (wet weight)	Median BSAF (wet weight)
PAHs:					
Indeno(1,2,3-cd)pyrene	White sucker (*Catostomus commersoni*)	0.0043	USEPA 2010	0.0400	0.0025
		0.0020	USEPA 2010		
		0.0013	USEPA 2010		
		0.0029	USEPA 2010		
		0.0002	USEPA 2010		
	Killifish (*Fundulus* sp.)	0.0756	USEPA 2010		
Organochlorine Pesticides:					
4,4'-DDT	White sucker (*Catostomus commersoni*)	0.9585	USEPA 2010	1.3360	0.6814
		0.6270	USEPA 2010		
		0.4678	USEPA 2010		
		0.7359	USEPA 2010		
	Largemouth bass (*Micropterus salmoides*)	1.7134	USEPA 2010		
	Cunner (*Tautogolabrus adspersus*)	0.2320	USEPA 2010		
4,4'-DDD	American eel (*Anguilla rostrata*)	0.2044	USEPA 2010	1.5342	1.1196
		0.1077	USEPA 2010		
		0.6946	USEPA 2010		
	White sucker (*Catostomus commersoni*)	1.4395	USEPA 2010		
		1.2702	USEPA 2010		
		1.1092	USEPA 2010		
		2.2362	USEPA 2010		
		0.2380	USEPA 2010		
		1.4602	USEPA 2010		
		1.5347	USEPA 2010		
		1.1300	USEPA 2010		
	Largemouth bass (*Micropterus salmoides*)	0.8150	USEPA 2010		
		1.5323	USEPA 2010		
	Cunner (*Tautogolabrus adspersus*)	0.2548	USEPA 2010		

TABLE 7-14
LITERATURE-BASED BIOTA-SEDIMENT ACCUMULATION FACTORS USED TO DERIVE SEDIMENT-TO-FISH BIOACCUMULATION FACTORS
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Chemical	Organism	BSAF (wet weight)	Reference	90th Percentile BSAF (wet weight)	Median BSAF (wet weight)
Organochlorine Pesticides:					
4,4'-DDE	American eel (*Anguilla rostrata*)	0.8158	USEPA 2010	20.4027	5.6214
		0.7514	USEPA 2010		
		1.1633	USEPA 2010		
	White sucker (*Catostomus commersoni*)	5.8285	USEPA 2010		
		8.2411	USEPA 2010		
		5.7078	USEPA 2010		
		5.6214	USEPA 2010		
		2.0276	USEPA 2010		
		2.1681	USEPA 2010		
		2.2127	USEPA 2010		
		3.8183	USEPA 2010		
	Killifish (*Fundulus* sp.)	5.7143	USEPA 2010		
		20.6833	USEPA 2010		
		0.9367	USEPA 2010		
	Largemouth bass (*Micropterus salmoides*)	10.3861	USEPA 2010		
		20.2167	USEPA 2010		
	Cunner (*Tautogolabrus adspersus*)	8.4328	USEPA 2010		
		34.7724	USEPA 2010		
	Bluegill (*Lepomis macrochirus*)	4.1949	USEPA 2010		
	Spot (*Leiostomus xanthurus*)	0.1114	USEPA 2010		
	Mummichog (*Fundulus heteroclitus*)	20.4027	USEPA 2010		
Aldrin	Not reported	1.8000	USEPA 2004	Not applicable	Not applicable
alpha-BHC	Not reported	1.8000	USEPA 2004	Not applicable	Not applicable
beta-BHC	Not reported	1.8000	USEPA 2004	Not applicable	Not applicable
delta-BHC	Not reported	1.8000	USEPA 2004	Not applicable	Not applicable

TABLE 7-14
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Chemical	Organism	BSAF (wet weight)	Reference	90th Percentile BSAF (wet weight)	Median BSAF (wet weight)
Organochlorine Pesticides:					
alpha-Chlordane	American eel (*Anguilla rostrata*)	0.1459	USEPA 2010	1.8290	0.8232
		0.3550	USEPA 2010		
		0.7662	USEPA 2010		
	White sucker (*Catostomus commersoni*)	0.6327	USEPA 2010		
		0.8802	USEPA 2010		
		1.1314	USEPA 2010		
		0.6116	USEPA 2010		
		0.7051	USEPA 2010		
		1.6644	USEPA 2010		
		1.8995	USEPA 2010		
		1.6206	USEPA 2010		
	Largemouth bass (*Micropterus salmoides*)	0.4099	USEPA 2010		
		1.2316	USEPA 2010		
	Bluegill (*Lepomis macrochirus*)	5.3575	USEPA 2010		
Dieldrin	American eel (*Anguilla rostrata*)	0.6369	USEPA 2010	9.3867	1.0965
		0.1267	USEPA 2010		
		0.6054	USEPA 2010		
	White sucker (*Catostomus commersoni*)	1.1887	USEPA 2010		
		1.3458	USEPA 2010		
		0.7671	USEPA 2010		
		1.0904	USEPA 2010		
		0.1899	USEPA 2010		
	Killifish (*Fundulus* sp.)	17.9341	USEPA 2010		
		1.5686	USEPA 2010		
	Bluegill (*Lepomis macrochirus*)	10.2554	USEPA 2010		
	Largemouth bass (*Micropterus salmoides*)	1.1026	USEPA 2010		
Endosulfan I	Not reported	1.8000	USEPA 2004	Not applicable	Not applicable
Endosulfan II	Not reported	1.8000	USEPA 2004	Not applicable	Not applicable

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Chemical	Organism	BSAF (wet weight)	Reference	90th Percentile BSAF (wet weight)	Median BSAF (wet weight)
Organochlorine Pesticides:					
Endrin	Not reported	1.8000	USEPA 2004	Not applicable	Not applicable
gamma-BHC	Not reported	1.8000	USEPA 2004	Not applicable	Not applicable
Heptachlor	Not reported	1.8000	USEPA 2004	Not applicable	Not applicable
Heptachlor epoxide	Not reported	1.8000	USEPA 2004	Not applicable	Not applicable
Methoxychlor	Not reported	1.8000	USEPA 2004	Not applicable	Not applicable
Toxaphene	Not reported	1.8000	USEPA 2004	Not applicable	Not applicable
gamma-Chlordane	American eel (*Anguilla rostrata*)	0.4868	USEPA 2010	1.6816	1.2960
	White sucker (*Catostomus commersoni*)	1.2960	USEPA 2010		
		1.7671	USEPA 2010		
		1.5533	USEPA 2010		
	Bluegill (*Lepomis macrochirus*)	0.6495	USEPA 2010		
Semi-Volatile Organics:					
1,2,4-Trichlorobenzene	Killifish (*Fundulus* sp.)	0.0770	USEPA 2010	0.1752	0.1315
		0.1861	USEPA 2010		
1,2-Dichlorobenzene	killifish (*Fundulus* sp.)	0.1119	USEPA 2010	Not Applicable	Not Applicable
1,3-Dichlorobenzene	killifish (*Fundulus* sp.)	0.0202	USEPA 2010	Not Applicable	Not Applicable
1,4-Dichlorobenzene	killifish (*Fundulus* sp.)	0.0136	USEPA 2010	Not Applicable	Not Applicable
Hexachlorobenzene	Not reported	0.0900	USEPA 2004	Not Applicable	Not Applicable

TABLE 7-14
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Chemical	Organism	BSAF (wet weight)	Reference	90th Percentile BSAF (wet weight)	Median BSAF (wet weight)
Semi-Volatile Organics:					
Dibenzofuran	American eel (*Anguilla rostrata*)	0.0021	USEPA 2010	0.0357	0.0317
		0.0067	USEPA 2010		
	White sucker (*Catostomus commersoni*)	0.0093	USEPA 2010		
		0.0320	USEPA 2010		
		0.0359	USEPA 2010		
		0.0333	USEPA 2010		
		0.0305	USEPA 2010		
		0.0327	USEPA 2010		
		0.0338	USEPA 2010		
		0.0496	USEPA 2010		
	Largemouth bass (*Micropterus salmoides*)	0.0138	USEPA 2010		
		0.0315	USEPA 2010		
Bis(2-ethylhexyl)phthalate	Killifish (*Fundulus* sp.)	2.8785	USEPA 2010	3.0859	1.1577
		3.2242	USEPA 2010		
		1.1577	USEPA 2010		
	Largescale sucker (*Catostomus macrocheilus*)	0.2988	USEPA 2010		
		0.1175	USEPA 2010		
Pentachlorobenzene	Not reported	0.0400	USEPA 2004	Not Applicable	Not Applicable
1,1-Biphenyl	White sucker (*Catostomus commersoni*)	0.0138	USEPA 2010	0.06459	0.0384
		0.0642	USEPA 2010		
		0.0681	USEPA 2010		
		0.0582	USEPA 2010		
		0.0337	USEPA 2010		
		0.0357	USEPA 2010		
		0.0347	USEPA 2010		
		0.0410	USEPA 2010		
	Largmouth Bass (*Micropterus salmoides*)	0.0519	USEPA 2010		
	Anerican eel (*Anguilla rostrata*)	0.0106	USEPA 2010		

TABLE 7-14
LITERATURE-BASED BIOTA-SEDIMENT ACCUMULATION FACTORS USED TO DERIVE SEDIMENT-TO-FISH BIOACCUMULATION FACTORS
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Notes:

PAH = Polynuclear Aromatic Hydrocarbon
BSAF = Biota-Sediment Accumulation Factor
USEPA = United States Environmental Protection Agency

Table References:

United States Environmental Protection Agency (USEPA). 2010. Biota-Sediment Accumulation Factor (BSAF) Database http://www.epa.gov/med/Prods_Pubs/bsaf.htm Accessed May 30, 2010.

USEPA. 2004. The Incidence and Severity of Sediment Contamination in Surface Waters of the United States. National Sediment Quality Survey: Second Edition EPA-823-R-04-007. November, 2004.

TABLE 7-15
PERCENT LIPID CONTENT OF FISH
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Organism [(1)]	**Percent Lipid (wet weight)** [(2)]	**Reference**
Bridgelip sucker (*Catostomus columbianus*)	12.22	USACE 2010
White sucker (*Catostomus commersoni*)	5.995	USACE 2010
Largescale sucker (*Catostomus macrocheilus*)	6.95	USACE 2010
Speckled sanddab (*Citharichthys stigmaeus*)	1.682 [(3)]	USACE 2010
Paiute sculpin (*Cottus beldingii*)	2.6	USACE 2010
Sculpin (*Cottus* spp.)	5.35	USACE 2010
Common carp (*Cyprinus carpio*)	6.314	USACE 2010
Channel catfish (*Ictalurus punctatus*)	3.3	USACE 2010
Flathead mullet (*Mugil cephalus*)	0.46	USACE 2010
Round goby (*Neogobius melanstomus*)	2.825 [(3)]	USACE 2010
Silver perch (*Bairdiella chrysoura*)	3.7	USACE 2010
Popeye lampfish (*Bolinichthys longipes*)	4.4	USACE 2010
Dogtooth lampfish (*Ceratoscopelus townsendi*)	8.6 [(3)]	USACE 2010
California headlightfish (*Diaphus theta*)	7.8 [(3)]	USACE 2010
Lanternfish (*Electrona antarctica*)	18.9	USACE 2010

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PERCENT LIPID CONTENT OF FISH
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Organism [(1)]	**Percent Lipid (wet weight)** [(2)]	**Reference**
Lanternfish (*Electrona carlsbergi*)	11.2	USACE 2010
Eastern mosquitofish (*Gambusia holbrooki*)	4.367	USACE 2010
Slendertail lanternfish (*Gonichthys tenuiculus*)	2.6	USACE 2010
Thickhead lanternfish (*Hygophum atratum*)	1.8	USACE 2010
Sunbeam lampfish (*Lampadena urophaos*)	8.9 [(3)]	USACE 2010
Northern lampfish (*Lampanyctus ingens*)	1.2	USACE 2010
Slimtail lampfish (*Lampanyctus parvicauda*)	12.3	USACE 2010
Pinpoint lanternfish (*Lampanyctus regalis*)	1.7	USACE 2010
Broadfin lampfish (*Lampanyctus ritteri*)	8.85 [(3)]	USACE 2010
Smallmouth bass (*Micropterus dolomieu*)	1.9	USACE 2010
Lanternfish (*Nannobrachium idostigma*)	5.8	USACE 2010
Patchwork lampfish (*Notoscopelus resplendens*)	5.6	USACE 2010
Columbia River redband trout (*Oncorhynchus mykiss gairdnerii*)	4.203 [(3)]	USACE 2010
Antarctic silverfish (*Pleuragramma antarcticum*)	4.3	USACE 2010
Japanese ricefish (*Oryzias latipes*)	4.765 [(3)]	USACE 2010

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PERCENT LIPID CONTENT OF FISH
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Organism [(1)]	**Percent Lipid (wet weight)** [(2)]	**Reference**
Rainbow smelt (*Osmerus mordax*)	7.0 [(3)]	USACE 2010
Fathead minnow (*Pimephales promelas*)	2.05 [(3)]	USACE 2010
Guppy (*Poecilia reticulata*)	9.7	USACE 2010
Bluefish (*Pomatomus saltatrix*)	1.8 [(3)]	USACE 2010
Lanternfish (*Protomyctophum bolini*)	8.5	USACE 2010
California flashlightfish (*Protomyctophum crockeri*)	5.2	USACE 2010
Brown trout (*Salmo trutta*)	4.8	USACE 2010
Deepwater lanternfish (*Taaningichthys bathyphilus*)	3.8	USACE 2010
Blue lanternfish (*Tarletonbeania crenularis*)	2.6	USACE 2010
Lake trout (*Salvelinus namaycush*)	13.60 [(3)]	USACE 2010
Pacific blackchin (*Scopelengys tristis*)	3.8	USACE 2010
California lanternfish (*Symbolophorus californiensis*)	5.76 [(3)]	USACE 2010
Mexican lampfish (*Triphoturus mexicanus*)	11.7 [(3)]	USACE 2010
Atlantic herring (*Clupea harengus*)	8.75	USACE 2010

Notes:

USACE = United States Army Corp of Engineers

TABLE 7-15
PERCENT LIPID CONTENT OF FISH
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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Notes (continued):

(1) The organisms listed include freshwater and marine species.

(2) Arithmetic average of the listed percent lipid data was used to convert biota-sediment accumulation factors to bioaccumulation factors (arithmetic average = 5.90 percent).

(3) The value shown represents an average of two or more percent lipid values.

Table References:

United States Army Corps of Engineers (USACE). 2010. BSAF Database. USACE Engineer Research and Development Center, Environmental Laboratory. Accessed May 30, 2010. http://el.erdc.usace.army.mil/bsafnew/bsaf.html.

TABLE 7-16
EXPOSURE PARAMETERS FOR UPPER TROPHIC LEVEL RECEPTORS: STEP 2 SCREENING LEVEL RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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Receptor	Habitat	Body Weight (kg)		Food Ingestion Rate (kg/day - dry)		Water Ingestion Rate (L/day)		Area Use
		Value	Reference	Value	Reference	Value	Reference	Factor
Birds:								
American robin	Terrestrial	0.056 [1]	Dunning 2008	0.01503	Allometric equation from Nagy (2001) for insectivorous birds[8]: $[0.540((BW*1000)^{0.705})]/1000$	0.01361	Allometric equation from Calder and Braun (1983) for all birds[8]: $0.059(BW)^{0.67}$	1.00
Mourning dove	Terrestrial	0.115 [2]	Dunning 2008	0.01723	Allometric equation from Nagy (2001) for all birds[8]: $[0.638((BW*1000)^{0.685})]/1000$	0.01449	Allometric equation from Calder and Braun (1983) for all birds[8]: $0.059(BW)^{0.67}$	1.00
Red-tailed hawk	Terrestrial	0.923 [3]	Dunning 2008	0.09679	Allometric equation from Nagy (2001) for carnivorous birds[8]: $[0.849((BW*1000)^{0.663})]/1000$	0.06910	Allometric equation from Calder and Braun (1983) for all birds[8]: $0.059(BW)^{0.67}$	1.00
Green heron	Aquatic	0.138 [4]	Dunning 2008	0.02567	Allometric equation from Nagy (2001) for all birds[8]: $[0.638((BW*1000)^{0.685})]/1000$	0.02139	Allometric equation from Calder and Braun (1983) for all birds[8]: $0.059(BW)^{0.67}$	1.00
Mammals:								
Brown flower bat	Terrestrial	0.016 [5]	Gannon et al. 2005	0.00277	Allometric equation from Nagy (2001) for bats[9]: $[0.365((BW*1000)^{0.671})]/1000$	0.00299	Allometric equation from Calder and Braun (1983) for all mammals[9]: $0.099(BW)^{0.90}$	1.00
Norway rat (prey item for red-tailed hawk)	Terrestrial	0.200 [6]	Jackson 1992	0.04075	Allometric equation from Nagy (2001) for rodents[10]: $[0.332((BW*1000)^{0.774})]/1000$	0.05305	Allometric equation from Calder and Braun (1983) for all mammals[10]: $0.099(BW)^{0.90}$	1.00

TABLE 7-16
EXPOSURE PARAMETERS FOR UPPER TROPHIC LEVEL RECEPTORS: STEP 2 SCREENING LEVEL RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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Notes:

BW = Body Weight
kg = kilogram
L/day = liter per day
kg/day - dry = kilogram per day - dry weight basis
USEPA = United States Environmental Protection Agency

(1) Minimum body weight for males and females from the western United States (n = 255).
(2) Minimum mean body weight for females from Illinois (n = 95)
(3) Minimum mean body weight for males from the western United States (n = 26)
(4) Minimum body weight for males and femals in the Caribbean (n = 70)
(5) Minimum body weight for males and females in Puerto Rico (n = 20)
(6) Minimum body weight within the range of reported values (sex and location not specified).
(8) Food and drinking water ingestion rates for avian receptors were calculated using maximum body weights: 0.123 kg for the mourning dove, 0.112 kg for the American robin, 1.266 kg for the red-tailed hawk, and 0.220 kg for the green heron (Dunning, 2008).
(9) Food and drinking water ingestion rate for the brown flower bat were calculated using a maximum body weight of 0.0205 kg (Gannon et al., 2005).
(10) Food and drinking water ingestion rate for the Norway rat were calculated using the maximum body weight within the range of reported values: 0.500 kg (Jackson, 1992).

Table References:

Calder, W.A. and E.J. Braun. 1983. Scaling of Osmotic Regulation in Mammals and Birds. Am. J. Physiol. 244:R601-R606.

Dunning, J.B., Jr. (ed.). 2008. CRC Handbook of Avian Body Masses, Second Edition. CRC Press, Boca Raton, FL. 655 pp.
Table References (continued):

Gannon, M.R., A. Kurta, A. Rodriguez-Durán, and M.R. Willig. 2005. Bats of Puerto Rico: An Island Focus and a Caribbean Perspective. Texas Tech University Press, Lubbock, TX. 239 pp.

Jackson, W.B. 1992. Norway Rat and Allies. Chapter 54 *In* Chapman, J.A. and G.A. Feldhamer (eds.), Wild Mammals of North America: Biology, Management, and Economics. The John Hopkins University Press, Baltimore, MD. pp. 1077-1088.

Nagy, K. A. 2001. Food Requirements of Wild Animals: Predictive Equations for Free-Living Mammals, Reptiles, and Birds. Nutr. Abstr. Rev. Series B. 71:21R-31R.

TABLE 7-17
DIETARY COMPOSITION FOR UPPER TROPHIC LEVEL RECEPTORS: STEP 2 SCREENING LEVEL RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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Receptor	Dietary Composition (percent)						Soil/Sediment Ingestion (percent)	
	Terrestrial Plants	Soil Invertebrates	Small Mammals	Aquatic Invertebrates	Fish	Reference	Value	Reference
Birds:								
American robin	0	89.5	0	0	0	Assumed [1]	10.5 [4]	Sample and Suter II 1994
Mourning dove	95.0	0	0	0	0	Tomlinson et al. 1994	5.0	Assumed
Red-tailed hawk	0	0	100	0	0	USEPA 1993; Sample and Suter II 1994	0	Sample and Suter II 1994
Green heron	0	0	0	0	100	Assumed [2]	0	Sample et al. 1997
Mammals:								
Brown flower bat	100	0	0	0	0	Gannon et al. 2005	0 [5]	Assumed
Norway rat (prey item for red-tailed hawk)	0	98.0	0	0	0	Assumed [3]	2.0	Assumed

Notes:

USEPA = United States Environmental Protection Agency

[1] Although the American robin is omnivorous (USEPA, 1993, Sample et al., 1997, Wheelwright et al., 1986, and Martin et al., 1951), an exclusive diet of terrestrial invertebrates (i.e., earthworms) is assumed for the screening level risk calculation.

[2] Although the green heron consumes aquatic invertebrates and fish (Sample et al., 1997), an exclusive diet of fish is assumed for the screening level risk calculation.

[3] Although the Norway rat is omnivorous (Jackson, 1992), an exclusive diet of terrestrial invertebrates (i.e., earthworms) is assumed for the screening level risk calculation.

[4] The percentage of soil in the diet of the American robin was estimated using the relationship presented in Sample and Sutter II (1994). An exclusive diet of earthworms extrapolates to a soil contribution of 10.5 percent to the total diet.

[5] Soil ingestion is considered negligible based on the arboreal feeding behavior of nectivorous bats.

Table References:

Gannon, M.R., A. Kurta, A. Rodriguez-Durán, and M.R. Willig. 2005. Bats of Puerto Rico: An Island Focus and a Caribbean Perspective. Texas Tech University Press, Lubbock, TX. 239 pp.

Jackson, W.B. 1992. Norway Rat and Allies. Chapter 54 *In* Chapman, J.A. and G.A. Feldhamer (eds.), Wild Mammals of North America: Biology, Management, and Economics. The John Hopkins University Press, Baltimore, MD. pp. 1077-1088.

TABLE 7-17
DIETARY COMPOSITION FOR UPPER TROPHIC LEVEL RECEPTORS: STEP 2 SCREENING LEVEL RISK CALCULATION
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Table References (continued):

Martin, A. C., H.S. Zim, and A.L. Nelson. 1951. American Wildlife and Plants: A Guide to Wildlife Food Habits. Dover Publications, Inc. New York, NY. 500 pp.

Sample, B.E., M.S. Aplin, R.A. Efroymson, G.W. Suter II, and C.J.E. Welsh. 1997. Methods and Tools for Estimation of the Exposure of Terrestrial Wildlife to Contaminants. Environmental Sciences Division, Oak Ridge National Laboratory. ORNL/TM-13391.

Sample, B.E. and G.W. Suter II. 1994. Estimating Exposure of Terrestrial Wildlife to Contaminants. Environmental Restoration Division, ORNL Environmental Restoration Program. ES/ER/TM-125.

Tomlinson, R.E., D.D. Dolton, R.R. George, and R.R. Mirarchi. 1994. Mourning Dove. In T.C. Tacha and C.E. Braun (eds), Migratory Shore and Upland Game Bird Management in North America. Int. Assoc. Fish and Wildlife Agencies, Washington, D.C. pp. 1-26.

USEPA. 1993. Wildlife Exposure Factors Handbook. Office of Research and Development, Washington, D.C. EPA/600/R-93/187a.

Wheelwright, N. T. 1986. The Diet of American Robins: An Analysis of U.S. Biological Survey Records. Auk. 103: 710-725.

TABLE 7-18
FREQUENCY AND RANGE OF ANALYTICAL DATA FOR SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION COMPARED TO TERRESTRIAL PLANT AND INVERTEBRATE-BASED SOIL SCREENING VALUES: STEP 2 SCREENING LEVEL RISK CALCULATION
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Analyte [1]	Contaminant Frequency/Range					Soil Screening Value (SSV)	Reference [3]	Maximum HQ [4]	Ecological COPC?	Comments
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	Value used in Step 2 Screen [2]					
Volatile Organics (µg/kg)										
1,1,1,2-Tetrachloroethane	0/19	ND	3.8U - 5.6U	2.221	5.6	100	CCME 2007	0.06	No	HQ < 1.0
1,1,1-Trichloroethane	0/19	ND	3.8U - 5.6U	2.221	5.6	100	CCME 2007	0.06	No	HQ < 1.0
1,1,2,2-Tetrachloroethane	0/19	ND	3.8U - 5.6U	2.221	5.6	100	CCME 2007	0.06	No	HQ < 1.0
1,1,2-Trichloroethane	0/19	ND	3.8U - 5.6U	2.221	5.6	100	CCME 2007	0.06	No	HQ < 1.0
1,1-Dichloroethane	0/19	ND	3.8U - 5.6U	2.221	5.6	100	CCME 2007	0.06	No	HQ < 1.0
1,1-Dichloroethene	0/19	ND	3.8U - 5.6U	2.221	5.6	100	CCME 2007	0.06	No	HQ < 1.0
1,2,3-Trichloropropane	0/19	ND	3.8U - 5.6U	2.221	5.6	NE	---	NA	Yes	No SSV
1,2-Dibromo-3-chloropropane (DBCP)	0/19	ND	3.8U - 5.6U	2.221	5.6	NE	---	NA	Yes	No SSV
1,2-Dibromoethane (EDB)	0/19	ND	3.8U - 5.6U	2.221	5.6	300	CCME 2007	0.02	No	HQ < 1.0
1,2-Dichloroethane	0/19	ND	3.8U - 5.6U	2.221	5.6	402	MHSPE 2000	0.01	No	HQ < 1.0
1,2-Dichloroethene (trans)	0/19	ND	3.8U - 5.6U	2.221	5.6	100	CCME 2007	0.06	No	HQ < 1.0
1,2-Dichloropropane	0/19	ND	3.8U - 5.6U	2.221	5.6	700,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
1,3-Dichloropropene (cis)	0/19	ND	3.8U - 5.6U	2.221	5.6	100	CCME 2007	0.06	No	HQ < 1.0
1,3-Dichloropropene (trans)	0/19	ND	3.8U - 5.6U	2.221	5.6	100	CCME 2007	0.06	No	HQ < 1.0
1,4-Dichloro-2-butene (trans)	0/19	ND	15U - 22U	8.842	22	1,000,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
2-Butanone (MEK)	0/19	ND	9.4UJ - 16U	5.737	16	NE	---	NA	Yes	No SSV
2-Chloro-1,3-butadiene (Chloroprene)	0/19	ND	3.8U - 5.6U	2.221	5.6	NE	---	NA	Yes	No SSV
2-Hexanone (MBK)	1/19	4.8J - 4.8J	9.4UJ - 14UJ	5.490	4.8	NE	---	NA	Yes	No SSV
3-Chloropropene (Allyl Chloride)	0/19	ND	3.8U - 5.6U	2.221	5.6	NE	---	NA	Yes	No SSV
4-Methyl-2-pentanone (MIBK)	0/19	ND	9.4UJ - 14UJ	5.526	14	NE	---	NA	Yes	No SSV
Acetone	13/19	24J - 190	9.6UJ - 17UJ	48.147	190	NE	---	NA	Yes	No SSV
Acetonitrile	0/19	ND	3.8U - 5.6U	2.221	5.6	NE	---	NA	Yes	No SSV
Acrylonitrile	1/19	3.4J - 3.4J	38U - 56U	21.205	3.4	1,000,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
Benzene	4/19	0.37J - 0.73J	3.8U - 5.6U	1.867	0.73	101	MHSPE 2000	<0.01	No	HQ < 1.0
Bromodichloromethane	0/19	ND	3.8U - 5.6U	2.221	5.6	NE	---	NA	Yes	No SSV
Bromoform	0/19	ND	3.8U - 5.6U	2.221	5.6	NE	---	NA	Yes	No SSV
Bromomethane	3/19	2.4J - 6.3	3.8UJ - 5.6UJ	2.511	6.3	NE	---	NA	Yes	No SSV
Carbon Disulfide	2/19	0.52J - 1J	3.8U - 5.6U	2.064	1	NE	---	NA	Yes	No SSV
Carbon Tetrachloride	0/19	ND	3.8U - 5.6U	2.221	5.6	1,000,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
Chlorobenzene	0/19	ND	3.8U - 5.6U	2.221	5.6	40,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
Chloroethane	0/19	ND	3.8U - 5.6U	2.221	5.6	NE	---	NA	Yes	No SSV
Chloroform	0/19	ND	3.8U - 5.6U	2.221	5.6	1,002	MHSPE 2000	<0.01	No	HQ < 1.0
Chloromethane	5/19	0.35J - 0.99J	3.8U - 5.6U	1.793	0.99	NE	---	NA	Yes	No SSV
Dibromochloromethane	0/19	ND	3.8U - 5.6U	2.221	5.6	NE	---	NA	Yes	No SSV
Dibromomethane	0/19	ND	3.8U - 5.6U	2.221	5.6	NE	---	NA	Yes	No SSV
Ethyl Methacrylate	0/19	ND	38U - 56U	22.211	56	NE	---	NA	Yes	No SSV
Ethylbenzene	0/19	ND	3.8U - 5.6U	2.221	5.6	5,003	MHSPE 2000	<0.01	No	HQ < 1.0
Trichlorofluoromethane	0/19	ND	3.8U - 5.6U	2.221	5.6	NE	---	NA	Yes	No SSV
Dichlorodifluoromethane	0/19	ND	3.8U - 5.6U	2.221	5.6	NE	---	NA	Yes	No SSV
Methyl Acrylonitrile	1/19	3.3J - 3.3J	38U - 56U	21.200	3.3	NE	---	NA	Yes	No SSV

TABLE 7-18
FREQUENCY AND RANGE OF ANALYTICAL DATA FOR SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION COMPARED TO TERRESTRIAL PLANT AND INVERTEBRATE-BASED SOIL SCREENING VALUES: STEP 2 SCREENING LEVEL RISK CALCULATION
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte [1]	Contaminant Frequency/Range					Soil Screening Value (SSV)	Reference [3]	Maximum HQ [4]	Ecological COPC?	Comments
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	Value used in Step 2 Screen [2]					
Volatile Organics (µg/kg)										
Methyl Iodide	4/19	0.97J - 12	3.8U - 5.6U	2.654	12	NE	---	NA	Yes	No SSV
Methylene Chloride	0/19	ND	3.8U - 5.6U	2.221	5.6	1,040	MHSPE 2000	<0.01	No	HQ < 1.0
Pentachloroethane	0/19	ND	3.8U - 5.6U	2.221	5.6	NE	---	NA	Yes	No SSV
Propionitrile (Ethyl Cyanide)	1/1	8.1J - 8.1J	ND	8.100	8.1	NE	---	NA	Yes	No SSV
Styrene (Ethenylbenzene)	0/19	ND	3.8U - 5.6U	2.221	5.6	10,030	MHSPE 2000	<0.01	No	HQ < 1.0
Tetrachloroethene (PCE)	0/19	ND	3.8U - 5.6U	2.221	5.6	400	MHSPE 2000	0.01	No	HQ < 1.0
Toluene	0/19	ND	3.8U - 5.6U	2.221	5.6	13,001	MHSPE 2000	<0.01	No	HQ < 1.0
Trichloroethene (TCE)	0/19	ND	3.8U - 5.6U	2.221	5.6	6,010	MHSPE 2000	<0.01	No	HQ < 1.0
Vinyl Acetate	0/19	ND	3.8U - 5.6U	2.221	5.6	NE	---	NA	Yes	No SSV
Vinyl Chloride	0/19	ND	3.8U - 5.6U	2.221	5.6	11.0	MHSPE 2000	0.51	No	HQ < 1.0
Xylene, m/p-	3/19	0.14J - 0.32J	8U - 11U	3.782	0.32	1,000	---	<0.01	No	HQ < 1.0
Xylene, o-	0/19	ND	3.8U - 5.6U	2.221	5.6	1,000	---	<0.01	No	HQ < 1.0
Xylenes, total	3/19	0.14J - 0.32J	4U - 5.6U	1.914	0.32	1,000	USEPA 2003	<0.01	No	HQ < 1.0
Semi-Volatile Organics (µg/kg)										
1,2,4,5-Tetrachlorobenzene	0/19	ND	180U - 240U	100.790	240	50.0	CCME 2007	4.80	Yes	HQ > 1.0
1,2,4-Trichlorobenzene	0/19	ND	180U - 240U	100.790	240	20,000	Efroymson et al. 1997a	0.01	No	HQ < 1.0
1,2-Dichlorobenzene (o-)	0/19	ND	180U - 240U	100.790	240	3,003	MHSPE 2000	0.08	No	HQ < 1.0
1,3,5-Trinitrobenzene (TNB)	0/19	ND	180U - 240UJ	100.790	240	40,000	---	<0.01	No	HQ < 1.0
1,3-Dichlorobenzene (m-)	0/19	ND	180U - 240U	100.790	240	3,003	MHSPE 2000	0.08	No	HQ < 1.0
1,3-Dinitrobenzene (m-)	0/19	ND	180U - 240U	100.790	240	40,000	---	<0.01	No	HQ < 1.0
1,4-Dichlorobenzene (p-)	0/19	ND	180U - 240U	100.790	240	20,000	Efroymson et al. 1997a	0.01	No	HQ < 1.0
1,4-Naphthoquinone	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
1-Naphthylamine	0/18	ND	180U - 240U	100.278	240	NE	---	NA	Yes	No SSV
2,2'-Oxybis[1-chloropropane]	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
2,3,4,6-Tetrachlorophenol	0/19	ND	360U - 460U	195.263	460	1,001	MHSPE 2000	0.46	No	HQ < 1.0
2,4,5-Trichlorophenol	0/19	ND	360U - 460U	195.263	460	4,000	Efroymson et al. 1997b	0.12	No	HQ < 1.0
2,4,6-Trichlorophenol	0/19	ND	360U - 460U	195.263	460	10,000	Efroymson et al. 1997a	0.05	No	HQ < 1.0
2,4-Dichlorophenol	0/19	ND	360U - 460U	195.263	460	1,001	MHSPE 2000	0.46	No	HQ < 1.0
2,4-Dimethylphenol	0/19	ND	360U - 460U	195.263	460	10	USEPA 2003	46.00	Yes	HQ > 1.0
2,4-Dinitrophenol	0/19	ND	360U - 460UJ	195.263	460	20,000	Efroymson et al. 1997b	0.02	No	HQ < 1.0
2,4-Dinitrotoluene (DNT)	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
2,6-Dichlorophenol	0/19	ND	360U - 460U	195.263	460	1,001	MHSPE 2000	0.46	No	HQ < 1.0
2,6-Dinitrotoluene (DNT)	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
2-Acetylaminofluorene	0/19	ND	180UJ - 240U	100.790	240	NE	---	NA	Yes	No SSV
2-Chloronaphthalene	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
2-Chlorophenol	0/19	ND	360U - 460U	195.263	460	1,001	MHSPE 2000	0.46	No	HQ < 1.0
2-Methyl-5-nitroaniline	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
2-Methylphenol (o-Cresol)	0/19	ND	360U - 460U	195.263	460	100	CCME 2007	4.60	Yes	HQ > 1.0
2-Naphthylamine	0/18	ND	180U - 240U	100.278	240	NE	---	NA	Yes	No SSV
2-Nitroaniline	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV

TABLE 7-18
FREQUENCY AND RANGE OF ANALYTICAL DATA FOR SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION COMPARED TO TERRESTRIAL PLANT AND INVERTEBRATE-BASED SOIL SCREENING VALUES: STEP 2 SCREENING LEVEL RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte [1]	Contaminant Frequency/Range					Soil Screening Value (SSV)	Reference [3]	Maximum HQ [4]	Ecological COPC?	Comments
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	Value used in Step 2 Screen [2]					
Semi-Volatile Organics (µg/kg)										
2-Nitrophenol	0/19	ND	360U - 460U	195.263	460	7,000	---	0.07	No	HQ < 1.0
2-Picoline	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
3,3'-Dichlorobenzidine	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
3,3'-Dimethylbenzidine	0/18	ND	180UJ - 240U	100.278	240	NE	---	NA	Yes	No SSV
3-Methylcholanthrene	0/19	ND	180UJ - 240U	100.790	240	NE	---	NA	Yes	No SSV
3-Methylphenol (m-Cresol)	0/19	ND	270U - 350U	147.368	350	100	CCME 2007	3.50	Yes	HQ > 1.0
3-Nitroaniline	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
4,6-Dinitro-2-methylphenol	0/19	ND	360U - 460U	195.263	460	NE	---	NA	Yes	No SSV
4-Aminobiphenyl	0/18	ND	180U - 240U	100.278	240	NE	---	NA	Yes	No SSV
4-Bromophenyl-phenylether	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
4-Chloro-3-methylphenol	0/19	ND	360U - 460U	195.263	460	NE	---	NA	Yes	No SSV
4-Chloroaniline	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
4-Chlorophenyl-phenylether	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
4-Dimethylaminoazobenzene (p-)	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
4-Methylphenol (p-Cresol)	0/19	ND	270U - 350U	147.368	350	100	CCME 2007	3.50	Yes	HQ > 1.0
4-Nitroaniline	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
4-Nitrophenol	0/19	ND	360U - 460U	195.263	460	7,000	Efroymson et al. 1997a	0.07	No	HQ < 1.0
4-Nitroquinoline-1-oxide	0/19	ND	180U - 240UJ	100.790	240	NE	---	NA	Yes	No SSV
7,12-Dimethylbenz(a)anthracene	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
a,a-Dimethylphenethylamine	0/19	ND	360UJ - 590U	242.368	590	NE	---	NA	Yes	No SSV
Acetophenone	0/19	ND	92U - 120U	50.237	120	NE	---	NA	Yes	No SSV
Aniline	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
Aramite	0/19	ND	180U - 240UJ	100.790	240	NE	---	NA	Yes	No SSV
Benzyl Alcohol	0/19	ND	180U - 240UJ	100.790	240	NE	---	NA	Yes	No SSV
Bis(2-chloroethoxy)methane	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
Bis(2-chloroethyl)ether	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
Bis(2-ethylhexyl) Phthalate (BEHP)	6/19	48J - 630J	180U - 210UJ	154.000	630	6,010	MHSPE 2000	0.10	No	HQ < 1.0
Butyl Benzyl Phthalate	1/19	170J - 170J	180U - 240U	104.737	170	6,010	MHSPE 2000	0.03	No	HQ < 1.0
Chlorobenzilate	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
Diallate (cis)	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
Diallate (trans)	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
Dibenzofuran	1/19	750 - 750	180U - 240U	135.000	750	NE	---	NA	Yes	No SSV
Diethyl Phthalate (DEP)	0/19	ND	180U - 240U	100.790	240	100,000	Efroymson et al. 1997b	<0.01	No	HQ < 1.0
Dimethyl Phthalate	0/19	ND	180U - 240U	100.790	240	200,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
Di-n-butyl Phthalate (DBP)	0/19	ND	180U - 240U	100.790	240	200,000	Efroymson et al. 1997b	<0.01	No	HQ < 1.0
Di-n-octyl Phthalate	0/19	ND	180U - 240U	100.790	240	6,010	MHSPE 2000	0.04	No	HQ < 1.0
Dinoseb	0/11	ND	180U - 210U	99.546	210	NE	---	NA	Yes	No SSV
Ethyl Methane Sulfonate (EMS)	0/19	ND	180UJ - 240UJ	100.790	240	NE	---	NA	Yes	No SSV
Hexachloro-1,3-butadiene	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
Hexachlorobenzene	0/19	ND	180U - 240U	100.790	240	1,000,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0

TABLE 7-18
FREQUENCY AND RANGE OF ANALYTICAL DATA FOR SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION COMPARED TO TERRESTRIAL PLANT AND INVERTEBRATE-BASED SOIL SCREENING VALUES: STEP 2 SCREENING LEVEL RISK CALCULATION
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte [1]	Contaminant Frequency/Range					Soil Screening Value (SSV)	Reference [3]	Maximum HQ [4]	Ecological COPC?	Comments
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	Value used in Step 2 Screen [2]					
Semi-Volatile Organics (µg/kg)										
Hexachlorocyclopentadiene	0/19	ND	180U - 240U	100.790	240	10,000	Efroymson et al. 1997b	0.02	No	HQ < 1.0
Hexachloroethane	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
Hexachloropropene	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
Isophorone	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
Isosafrole	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
Methapyrilene	0/17	ND	180U - 240UJ	100.000	240	NE	---	NA	Yes	No SSV
Methyl Methane Sulfonate	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
Nitrobenzene	0/19	ND	180U - 240U	100.790	240	40,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
n-Nitrosodiethylamine	0/19	ND	180U - 240U	100.790	240	20,000	---	0.01	No	HQ < 1.0
n-Nitrosodimethylamine (NDMA)	0/19	ND	180U - 240U	100.790	240	20,000	---	0.01	No	HQ < 1.0
n-Nitroso-di-n-butylamine	0/19	ND	180UJ - 240U	100.790	240	20,000	---	0.01	No	HQ < 1.0
n-Nitrosodi-n-propylamine	0/19	ND	180U - 240U	100.790	240	20,000	---	0.01	No	HQ < 1.0
n-Nitrosodiphenylamine	0/19	ND	180U - 240U	100.790	240	20,000	Efroymson et al. 1997a	0.01	No	HQ < 1.0
n-Nitrosomethylethylamine	0/19	ND	180U - 240U	100.790	240	20,000	---	0.01	No	HQ < 1.0
n-Nitrosomorpholine	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
n-Nitrosopiperidine	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
n-Nitrosopyrrolidine	0/19	ND	180UJ - 240U	100.790	240	NE	---	NA	Yes	No SSV
o-Toluidine	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
Pentachlorobenzene	0/19	ND	180U - 240U	100.790	240	1,150	USEPA 1999	0.21	No	HQ < 1.0
Pentachloronitrobenzene	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
Pentachlorophenol	0/19	ND	360U - 460U	195.000	460	5,000	USEPA 2007a	0.09	No	HQ < 1.0
Phenacetin	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
Phenol	0/19	ND	360U - 460U	195.263	460	30,000	Efroymson et al. 1997a	0.02	No	HQ < 1.0
Pronamide	0/19	ND	180U - 240U	100.790	240	13.6	USEPA 2003	17.65	Yes	HQ > 1.0
Pyridine	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
Safrole	0/19	ND	180U - 240U	100.790	240	NE	---	NA	Yes	No SSV
PAHs (µg/kg)										
Low molecular weight PAHs [5]	NA	NA	NA	NA	13,410	29,000	USEPA 2007b	0.46	No	HQ < 1.0
High molecular weight PAHs [6]	NA	NA	NA	NA	6,706	18,000	USEPA 2007b	0.37	No	HQ < 1.0
Organochlorine Pesticides (µg/kg)										
4,4'-DDD	4/19	0.6J - 8.1J	3.6U - 19UJ	2.573	8.1	401	MHSPE 2000	0.02	No	HQ < 1.0
4,4'-DDE	10/19	0.46J - 160	3.6U - 19UJ	13.824	160	401	MHSPE 2000	0.40	No	HQ < 1.0
4,4'-DDT	9/19	0.66J - 160	3.6U - 19UJ	11.322	160	401	MHSPE 2000	0.40	No	HQ < 1.0
Aldrin	0/19	ND	1.8U - 19U	1.655	19	401	MHSPE 2000	0.05	No	HQ < 1.0
BHC, alpha-	0/19	ND	1.8U - 19U	1.655	19	201	MHSPE 2000	0.09	No	HQ < 1.0
BHC, beta-	5/18	0.47J - 9.2NJ	0.95U - 4.8UJ	1.836	9.2	3.98	USEPA 2003	2.31	Yes	HQ > 1.0
BHC, delta-	0/19	ND	1.8U - 19U	1.655	19	201	MHSPE 2000	0.09	No	HQ < 1.0
BHC, gamma- (Lindane)	0/19	ND	1.8U - 19U	1.655	19	5.0	USEPA 2003	3.80	Yes	HQ > 1.0
Chlordane, alpha-	7/19	0.25J - 1.9J	1.8U - 19U	1.513	1.9	224	USEPA 2003	<0.01	No	HQ < 1.0

TABLE 7-18
FREQUENCY AND RANGE OF ANALYTICAL DATA FOR SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION COMPARED TO TERRESTRIAL PLANT AND INVERTEBRATE-BASED SOIL SCREENING VALUES: STEP 2 SCREENING LEVEL RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte [1]	Contaminant Frequency/Range					Soil Screening Value (SSV)	Reference [3]	Maximum HQ [4]	Ecological COPC?	Comments
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	Value used in Step 2 Screen [2]					
Organochlorine Pesticides (µg/kg)										
Chlordane, gamma-	2/19	0.57J - 3.5J	1.8U - 9.7UJ	1.320	3.5	224	USEPA 2003	0.02	No	HQ < 1.0
Dieldrin	0/19	ND	3.6U - 37U	3.229	37	400	MHSPE 2000	0.09	No	HQ < 1.0
Endosulfan I	0/19	ND	1.8U - 19U	1.655	19	100	Friday 1998	0.19	No	HQ < 1.0
Endosulfan II	0/19	ND	3.6U - 37U	3.229	37	100	Friday 1998	0.37	No	HQ < 1.0
Endosulfan Sulfate	3/19	0.52J - 0.72J	3.6U - 37U	3.026	0.72	100	Friday 1998	<0.01	No	HQ < 1.0
Endrin	0/19	ND	3.6U - 37U	3.229	37	401	MHSPE 2000	0.09	No	HQ < 1.0
Endrin Aldehyde	1/12	1.8J - 1.8J	3.6U - 37U	3.942	1.8	100	Friday 1998	0.02	No	HQ < 1.0
Heptachlor	0/19	ND	1.8U - 19U	1.655	19	400	MHSPE 2000	0.05	No	HQ < 1.0
Heptachlor Epoxide	0/19	ND	1.8U - 19U	1.655	19	400	MHSPE 2000	0.05	No	HQ < 1.0
Isodrin	0/19	ND	180U - 240U	100.790	240	3.32	USEPA 2003	72.29	Yes	HQ > 1.0
Kepone (Chlordecone)	0/14	ND	180UJ - 240UJ	101.429	240	100	Friday 1998	2.40	Yes	HQ > 1.0
Methoxychlor	1/19	26NJ - 26NJ	18U - 190U	15.368	26	100	Friday 1998	0.26	No	HQ < 1.0
Toxaphene	0/19	ND	90U - 920U	80.500	920	100	Friday 1998	9.20	Yes	HQ > 1.0
Inorganics (mg/kg)										
Antimony	7/19	0.17J - 8.5J	1.1UJ - 6.5UJ	1.736	8.5	78.0	USEPA 2005a	0.11	No	HQ < 1.0
Arsenic	9/19	0.29J - 5.5	0.53U - 2.9U	1.149	5.5	18.0	USEPA 2005b	0.31	No	HQ < 1.0
Barium	19/19	33.4 - 267J	ND	103.600	267	330	USEPA 2005c	0.81	No	HQ < 1.0
Beryllium	16/19	0.14J - 0.62J	2.8U - 2.9U	0.459	0.62	40.0	USEPA 2005d	0.02	No	HQ < 1.0
Cadmium	19/19	0.071J - 2.6	ND	0.629	2.6	32.0	USEPA 2005e	0.08	No	HQ < 1.0
Chromium	19/19	5.3J - 54.4	ND	31.090	54.4	57.0	USEPA 2008	0.95	No	HQ < 1.0
Cobalt	19/19	10.4J - 45.2	ND	22.753	45.2	13.0	USEPA 2005f	3.48	Yes	HQ > 1.0
Copper	19/19	24.8J - 291	ND	104.484	291	70.0	USEPA 2007c	4.16	Yes	HQ > 1.0
Lead	19/19	2.6J - 654J	ND	82.979	654	120	USEPA 2005g	5.45	Yes	HQ > 1.0
Mercury	15/19	0.009J - 0.095	0.038U - 0.041U	0.027	0.095	0.10	Efroymson et al. 1997a	0.95	No	HQ < 1.0
Nickel	19/19	6.1 - 27.5	ND	15.290	27.5	38.0	USEPA 2007d	0.72	No	HQ < 1.0
Selenium	15/19	0.21J - 2.4J	13.9U - 14.7U	2.020	2.4	0.52	USEPA 2007e	4.62	Yes	HQ > 1.0
Silver	5/19	0.093J - 2.6	0.53U - 3.3U	0.762	2.6	560	USEPA 2006	<0.01	No	HQ < 1.0
Thallium	6/19	0.027J - 0.37J	0.53U - 3.3U	0.599	0.37	1.00	Efroymson et al. 1997b	0.37	No	HQ < 1.0
Tin	11/19	3J - 36.5	5.1UJ - 6.3UJ	6.108	36.5	50.0	Efroymson et al. 1997b	0.73	No	HQ < 1.0
Vanadium	19/19	72.8J - 260J	ND	143.037	260	20.0	USEPA 2005h	13.00	Yes	HQ > 1.0
Zinc	19/19	34.1J - 747	ND	140.990	747	120	USEPA 2007f	6.23	Yes	HQ > 1.0

Notes:

CCME = Canadian Council of Ministries of the Environment
COPC = Chemical of Potential Concern
HQ = Hazard Quotient
SSV = Soil Screening Value
µg/kg = microgram per kilogram
mg/kg = milligram per kilogram
MHSPE = Dutch Ministry of Housing, Spatial Planning and Environment
USEPA = United States Environmental Protection Agency
PAH = Polynuclear Aromatic Hydrocarbon
NJ = Estimated value (tentative identification)
J = Estimated value
U = Not detected
UJ = Not detected, estimated value
ND = Not Detected
NE = Not Established
NA = Not Applicable

TABLE 7-18
FREQUENCY AND RANGE OF ANALYTICAL DATA FOR SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION COMPARED TO TERRESTRIAL PLANT AND INVERTEBRATE-BASED SOIL SCREENING VALUES: STEP 2 SCREENING LEVEL RISK CALCULATION
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Notes (continued):

(1) All surface soil analytical data for four VOCs (1,4-dioxane, acrolein, isobutyl alchohol, and methyl methacrylate) and one SVOC (1,4-phenylenediamine) were rejected during data validation activities. Although these five orga analytes are not listed below (see Appendix D for all rejected surface soil analytical data), they are identified as ecological COPCs based on the lack of any useable analytical data.

(2) Maximum detected concentration (or maximum reporting limit for non-detected chemicals).

(3) See Table 7-4 for reference citations.

(4) For a given chemical, the Hazard Quotient (HQ) is the maximum detected concentration (or maximum reporting limit for non-detected chemicals) divided by the soil screening value.

(5) Low molecular weight PAHs are defined by the USEPA (2007b) as PAH compounds composed of fewer than four rings. The low molecular weight PAH compounds analyzed for in SWMU 59 soil were 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, fluoranthene, fluorene, naphthalene, and phenanthrene. Value was calculated by summing maximum detected concentrations in site soil for each chemical. Maximum reporting limits limit were used for non-detected PAHs.

(6) High molecular weight PAHs are defined by the USEPA (2007b) as PAH compounds composed of four or more rings. The high molecular weight PAH compounds analyzed for in SWMU 59 soil were benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, and pyrene. Value was calculated by summing maximum detected concentrations in soil for each chemical. Maximum reporting limits were used for non-detected PAHs.

TABLE 7-19
FREQUENCY AND RANGE OF ANALYTICAL DATA FOR SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION COMPARED TO TERRESTRIAL PLANT AND INVERTEBRATE-BASED SOIL SCREENING VALUES: STEP 2 SCREENING LEVEL RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

	Contaminant Frequency/Range									
Analyte [1]	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	Value used in Step 2 Screen [2]	Soil Screening Value (SSV)	Reference [3]	Maximum HQ [4]	Ecological COPC?	Comments
Volatile Organics (µg/kg)										
1,1,1,2-Tetrachloroethane	0/10	ND	1.7U - 2.6U	1.120	2.6	100	CCME 2007	0.03	No	HQ < 1.0
1,1,1-Trichloroethane	0/10	ND	0.71U - 1.1U	0.465	1.1	100	CCME 2007	0.01	No	HQ < 1.0
1,1,2,2-Tetrachloroethane	0/10	ND	1.1U - 1.7U	0.740	1.7	100	CCME 2007	0.02	No	HQ < 1.0
1,1,2-Trichloroethane	0/10	ND	0.93U - 1.4U	0.602	1.4	100	CCME 2007	0.01	No	HQ < 1.0
1,1-Dichloroethane	0/10	ND	0.79U - 1.2U	0.512	1.2	100	CCME 2007	0.01	No	HQ < 1.0
1,1-Dichloroethene	0/10	ND	1.1U - 1.6U	0.695	1.6	100	CCME 2007	0.02	No	HQ < 1.0
1,2,3-Trichloropropane	0/10	ND	1.7U - 2.6U	1.120	2.6	NE	---	NA	Yes	No SSV
1,2-Dibromo-3-Chloropropane	0/10	ND	3.1U - 4.7U	2.050	4.7	NE	---	NA	Yes	No SSV
1,2-Dibromoethane	0/10	ND	1.1U - 1.6U	0.695	1.6	300	CCME 2007	<0.01	No	HQ < 1.0
1,2-Dichloroethane	0/10	ND	0.79U - 1.2U	0.512	1.2	402	MHSPE 2000	<0.01	No	HQ < 1.0
1,2-Dichloropropane	0/10	ND	0.71U - 1.1U	0.465	1.1	700,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
2-Butanone	0/10	ND	1.7U - 2.6U	1.120	2.6	NE	---	NA	Yes	No SSV
2-Hexanone	0/10	ND	2.4U - 3.5U	1.540	3.5	NE	---	NA	Yes	No SSV
4-Methyl-2-pentanone	0/10	ND	3U - 4.5U	1.960	4.5	NE	---	NA	Yes	No SSV
Acetone	4/10	15J - 45J	7.9U - 11U	14.730	45	NE	---	NA	Yes	No SSV
Acetonitrile	0/10	ND	29UJ - 44UJ	19.100	44	NE	---	NA	Yes	No SSV
Acrolein	0/10	ND	17UJ - 26UJ	11.200	26	NE	---	NA	Yes	No SSV
Acrylonitrile	0/10	ND	24UJ - 36UJ	15.800	36	1,000,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
Allyl chloride	0/10	ND	1.6U - 2.4U	1.030	2.4	NE	---	NA	Yes	No SSV
Benzene	0/10	ND	0.71U - 1.1U	0.465	1.1	101	MHSPE 2000	0.01	No	HQ < 1.0
Bromodichloromethane	0/10	ND	0.71U - 1.1U	0.465	1.1	NE	---	NA	Yes	No SSV
Bromoform	0/10	ND	1.1U - 1.6U	0.695	1.6	NE	---	NA	Yes	No SSV
Bromomethane	0/10	ND	1.1U - 1.6U	0.695	1.6	NE	---	NA	Yes	No SSV
Carbon disulfide	0/10	ND	0.79U - 1.2U	0.512	1.2	NE	---	NA	Yes	No SSV
Carbon tetrachloride	0/10	ND	0.71U - 1.1U	0.465	1.1	1,000,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
Chlorobenzene	0/10	ND	0.71U - 1.1U	0.465	1.1	40000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
Chloroethane	0/10	ND	1.9U - 2.9U	1.260	2.9	NE	---	NA	Yes	No SSV
Chloroform	0/10	ND	0.79U - 1.2U	0.512	1.2	1,002	MHSPE 2000	<0.01	No	HQ < 1.0
Chloromethane	0/10	ND	1.4U - 2.1U	0.930	2.1	NE	---	NA	Yes	No SSV
Chloroprene	0/10	ND	1.5U - 2.2U	0.975	2.2	NE	---	NA	Yes	No SSV
cis-1,3-Dichloropropene	0/10	ND	0.71U - 1.1U	0.465	1.1	100	CCME 2007	0.01	No	HQ < 1.0
Dibromochloromethane	0/10	ND	1.2U - 1.8U	0.790	1.8	NE	---	NA	Yes	No SSV
Dibromomethane	0/10	ND	1.2U - 1.8U	0.790	1.8	NE	---	NA	Yes	No SSV
Dichlorodifluoromethane	0/10	ND	0.71U - 1.1U	0.465	1.1	NE	---	NA	Yes	No SSV
Ethyl methacrylate	0/10	ND	2.4U - 3.6U	1.580	3.6	NE	---	NA	Yes	No SSV
Ethylbenzene	0/10	ND	0.93U - 1.4U	0.602	1.4	5,003	MHSPE 2000	<0.01	No	HQ < 1.0
Hexachlorobutadiene	0/10	ND	2.2U - 3.3U	1.445	3.3	NE	---	NA	Yes	No SSV
Iodomethane	0/10	ND	1.3UJ - 1.9UJ	0.835	1.9	NE	---	NA	Yes	No SSV
Methacrylonitrile	0/10	ND	16UJ - 25UJ	10.700	25	NE	---	NA	Yes	No SSV
Methyl methacrylate	0/10	ND	3.2U - 4.8U	2.095	4.8	NE	---	NA	Yes	No SSV
Methylene Chloride	0/10	ND	0.71U - 1.1U	0.465	1.1	1,040	MHSPE 2000	<0.01	No	HQ < 1.0
Pentachloroethane	0/10	ND	4.5U - 6.7U	2.930	6.7	NE	---	NA	Yes	No SSV
Propionitrile	0/10	ND	19UJ - 28UJ	12.150	28	NE	---	NA	Yes	No SSV

TABLE 7-19
FREQUENCY AND RANGE OF ANALYTICAL DATA FOR SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION COMPARED TO TERRESTRIAL PLANT AND INVERTEBRATE-BASED SOIL SCREENING VALUES: STEP 2 SCREENING LEVEL RISK CALCULATION
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CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte [1]	Contaminant Frequency/Range					Soil Screening Value (SSV)	Reference [3]	Maximum HQ [4]	Ecological COPC?	Comments
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	Value used in Step 2 Screen [2]					
Volatile Organics (µg/kg)										
Styrene	0/10	ND	0.71U - 1.1U	0.465	1.1	10,030	MHSPE 2000	<0.01	No	HQ < 1.0
Tetrachloroethene	0/10	ND	1.4U - 2U	0.885	2	400	MHSPE 2000	<0.01	No	HQ < 1.0
Toluene	0/10	ND	0.71U - 1.1U	0.465	1.1	13,001	MHSPE 2000	<0.01	No	HQ < 1.0
trans-1,2-Dichloroethene	0/10	ND	0.71U - 1.1U	0.465	1.1	100	CCME 2007	0.01	No	HQ < 1.0
trans-1,3-Dichloropropene	0/10	ND	0.71U - 1.1U	0.465	1.1	100	CCME 2007	0.01	No	HQ < 1.0
trans-1,4-Dichloro-2-butene	0/10	ND	2.1U - 3.1U	1.350	3.1	1,000,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
Trichloroethene	0/10	ND	0.93U - 1.4U	0.602	1.4	6,010	MHSPE 2000	<0.01	No	HQ < 1.0
Trichlorofluoromethane	0/10	ND	0.86U - 1.3U	0.561	1.3	NE	---	NA	Yes	No SSV
Vinyl acetate	0/10	ND	1.8U - 2.7U	1.165	2.7	NE	---	NA	Yes	No SSV
Vinyl chloride	0/10	ND	1.1U - 1.6U	0.695	1.6	11	MHSPE 2000	0.15	No	HQ < 1.0
Xylenes, Total	0/10	ND	0.79U - 1.2U	0.512	1.2	1,000	USEPA 2003	<0.01	No	HQ < 1.0
Semi-Volatile Organics (µg/kg)										
1,2,4,5-Tetrachlorobenzene	0/10	ND	4.1U - 46U	6.505	46	50	CCME 2007	0.92	No	HQ < 1.0
1,2,4-Trichlorobenzene	0/10	ND	0.71U - 1.1U	0.465	1.1	20,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
1,2-Dichlorobenzene	0/10	ND	0.93U - 1.4U	0.602	1.4	3,003	MHSPE 2000	<0.01	No	HQ < 1.0
1,3,5-Trinitrobenzene	0/10	ND	21U - 240UJ	33.500	240	40,000	---	<0.01	No	HQ < 1.0
1,3-Dichlorobenzene	0/10	ND	1.1U - 1.7U	0.740	1.7	3,003	MHSPE 2000	<0.01	No	HQ < 1.0
1,3-Dinitrobenzene	0/10	ND	21U - 240U	33.500	240	40,000	---	<0.01	No	HQ < 1.0
1,4-Dichlorobenzene	0/10	ND	0.71U - 1.1U	0.465	1.1	20,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
1,4-Dioxane	0/10	ND	8.3U - 93U	13.140	93	NE	---	NA	Yes	No SSV
1,4-Naphthoquinone	0/10	ND	4.1UJ - 46UJ	6.505	46	NE	---	NA	Yes	No SSV
1-Naphthylamine	0/10	ND	21U - 240U	33.500	240	NE	---	NA	Yes	No SSV
2,2'-oxybis[1-chloropropane]	0/10	ND	9U - 100U	14.145	100	NE	---	NA	Yes	No SSV
2,3,4,6-Tetrachlorophenol	0/10	ND	4.1U - 46U	6.505	46	1,001	MHSPE 2000	0.05	No	HQ < 1.0
2,4,5-Trichlorophenol	0/10	ND	9.5U - 110U	15.165	110	4,000	Efroymson et al. 1997b	0.03	No	HQ < 1.0
2,4,6-Trichlorophenol	0/10	ND	9.8U - 110U	15.490	110	10,000	Efroymson et al. 1997a	0.01	No	HQ < 1.0
2,4-Dichlorophenol	0/10	ND	9U - 100U	14.145	100	1001	MHSPE 2000	0.10	No	HQ < 1.0
2,4-Dimethylphenol	0/10	ND	9.5U - 110U	15.165	110	10	USEPA 2003	11.00	Yes	HQ > 1.0
2,4-Dinitrophenol	0/10	ND	52U - 590UJ	83.000	590	20,000	Efroymson et al. 1997b	0.03	No	HQ < 1.0
2,4-Dinitrotoluene	0/10	ND	9.3U - 100U	14.440	100	NE	---	NA	Yes	No SSV
2,6-Dichlorophenol	0/10	ND	4.1U - 46U	6.505	46	1,001	MHSPE 2000	0.05	No	HQ < 1.0
2,6-Dinitrotoluene	0/10	ND	9.8U - 110U	15.490	110	NE	---	NA	Yes	No SSV
2-Acetylaminofluorene	0/10	ND	41U - 460U	65.050	460	NE	---	NA	Yes	No SSV
2-Chloronaphthalene	0/10	ND	7.5U - 84U	11.815	84	NE	---	NA	Yes	No SSV
2-Chlorophenol	0/10	ND	6.6U - 74U	10.390	74	1,001	MHSPE 2000	0.07	No	HQ < 1.0
2-Methylphenol	0/10	ND	7.8U - 88U	12.330	88	100	CCME 2007	0.88	No	HQ < 1.0
2-Naphthylamine	0/10	ND	21U - 240U	33.500	240	NE	---	NA	Yes	No SSV
2-Nitroaniline	0/10	ND	8.7U - 98U	13.710	98	NE	---	NA	Yes	No SSV
2-Nitrophenol	0/10	ND	7.2U - 81U	11.390	81	7,000	---	0.01	No	HQ < 1.0
2-Picoline	0/10	ND	4.1U - 46U	6.505	46	NE	---	NA	Yes	No SSV
2-Toluidine	0/10	ND	4.1U - 46U	6.505	46	NE	---	NA	Yes	No SSV
3,4-Methylphenol	0/10	ND	9.1U - 100U	14.225	100	100	CCME 2007	1.00	No	HQ = 1.0

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FREQUENCY AND RANGE OF ANALYTICAL DATA FOR SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION COMPARED TO TERRESTRIAL PLANT AND INVERTEBRATE-BASED SOIL SCREENING VALUES: STEP 2 SCREENING LEVEL RISK CALCULATION
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte [1]	Contaminant Frequency/Range					Soil Screening Value (SSV)	Reference [3]	Maximum HQ [4]	Ecological COPC?	Comments
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	Value used in Step 2 Screen [2]					
Semi-Volatile Organics (µg/kg):										
3,3'-Dichlorobenzidine	0/10	ND	21U - 240U	33.500	240	NE	---	NA	Yes	No SSV
3,3'-Dimethylbenzidine	0/10	ND	82U - 920UJ	129.500	920	NE	---	NA	Yes	No SSV
3-Methylcholanthrene	0/10	ND	41U - 460U	65.050	460	NE	---	NA	Yes	No SSV
3-Nitroaniline	0/10	ND	8.3U - 93U	13.140	93	NE	---	NA	Yes	No SSV
4,6-Dinitro-2-methylphenol	0/10	ND	21U - 240U	33.500	240	NE	---	NA	Yes	No SSV
4-Aminobiphenyl	0/10	ND	21UJ - 240U	33.500	240	NE	---	NA	Yes	No SSV
4-Bromophenyl phenyl ether	0/10	ND	8.6U - 96U	13.575	96	NE	---	NA	Yes	No SSV
4-Chloro-3-methylphenol	0/10	ND	8.7U - 98U	13.710	98	NE	---	NA	Yes	No SSV
4-Chloroaniline	0/10	ND	6.5U - 73U	10.255	73	NE	---	NA	Yes	No SSV
4-Chlorophenyl phenyl ether	0/10	ND	8U - 89U	12.585	89	NE	---	NA	Yes	No SSV
4-Nitroaniline	0/10	ND	21U - 240U	33.500	240	NE	---	NA	Yes	No SSV
4-Nitrophenol	0/10	ND	91U - 1,000U	142.250	1000	7,000	Efroymson et al. 1997a	0.14	No	HQ < 1.0
4-Nitroquinoline-1-oxide	0/10	ND	52U - 590U	83.000	590	NE	---	NA	Yes	No SSV
7,12-Dimethylbenz(a)anthracene	0/10	ND	21U - 240U	33.500	240	NE	---	NA	Yes	No SSV
Acetophenone	0/10	ND	8.5U - 95U	13.340	95	NE	---	NA	Yes	No SSV
alpha,alpha-Dimethyl phenethylamine	0/10	ND	410UJ - 4,600UJ	650.500	4600	NE	---	NA	Yes	No SSV
Aniline	0/10	ND	10U - 110U	15.900	110	NE	---	NA	Yes	No SSV
Aramite, Total	0/10	ND	6U - 67U	9.390	67	NE	---	NA	Yes	No SSV
Benzyl alcohol	0/10	ND	7.6U - 85U	11.960	85	NE	---	NA	Yes	No SSV
Bis(2-chloroethoxy)methane	0/10	ND	8.1U - 91U	12.770	91	NE	---	NA	Yes	No SSV
Bis(2-chloroethyl)ether	0/10	ND	8.1U - 91U	12.770	91	NE	---	NA	Yes	No SSV
Bis(2-ethylhexyl) phthalate	5/10	11J - 78J	7.5U - 84U	27.090	78	6,010	MHSPE 2000	0.01	No	HQ < 1.0
Butyl benzyl phthalate	0/10	ND	8.3U - 93U	13.140	93	6,010	MHSPE 2000	0.02	No	HQ < 1.0
Diallate	0/10	ND	7U - 78U	11.015	78	NE	---	NA	Yes	No SSV
Dibenzofuran	0/10	ND	8.3U - 93U	13.140	93	NE	---	NA	Yes	No SSV
Diethyl phthalate	0/10	ND	9.2U - 100U	14.405	100	100,000	Efroymson et al. 1997b	<0.01	No	HQ < 1.0
Dimethyl phthalate	0/10	ND	9.3U - 100U	14.440	100	200,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
Di-n-butyl phthalate	0/10	ND	21U - 240U	33.500	240	200,000	Efroymson et al. 1997b	<0.01	No	HQ < 1.0
Di-n-octyl phthalate	0/10	ND	8.3U - 93U	13.140	93	6,010	MHSPE 2000	0.02	No	HQ < 1.0
Dinoseb	0/10	ND	8.3U - 93UJ	13.140	93	NE	---	NA	Yes	No SSV
Ethyl methanesulfonate	0/10	ND	9.7U - 110U	15.335	110	NE	---	NA	Yes	No SSV
Hexachlorobenzene	0/10	ND	9.5U - 110U	15.165	110	1,000,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
Hexachlorobutadiene	0/10	ND	2.2U - 3.3U	1.445	3.3	NE	---	NA	Yes	No SSV
Hexachlorocyclopentadiene	0/10	ND	4.6U - 52U	7.315	52	10,000	Efroymson et al. 1997b	<0.01	No	HQ < 1.0
Hexachloroethane	0/10	ND	7.2U - 81U	11.390	81	NE	---	NA	Yes	No SSV
Hexachlorophene	0/10	ND	3,000U - 33,000UJ	4700.000	33000	NE	---	NA	Yes	No SSV
Hexachloropropene	0/10	ND	6.6U - 74U	10.390	74	NE	---	NA	Yes	No SSV
Isophorone	0/10	ND	8.7U - 98U	13.710	98	NE	---	NA	Yes	No SSV
Isosafrole	0/10	ND	4.1U - 46U	6.505	46	NE	---	NA	Yes	No SSV
Methapyrilene	0/10	ND	83UJ - 930UJ	131.400	930	NE	---	NA	Yes	No SSV
Methyl methanesulfonate	0/10	ND	4.7UJ - 53UJ	7.400	53	NE	---	NA	Yes	No SSV
Nitrobenzene	0/10	ND	8.2U - 92U	12.950	92	40,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0

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Analyte [1]	Contaminant Frequency/Range					Soil Screening Value (SSV)	Reference [3]	Maximum HQ [4]	Ecological COPC?	Comments
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	Value used in Step 2 Screen [2]					
Semi-Volatile Organics (µg/kg):										
N-Nitro-o-toluidine	0/10	ND	21U - 240U	33.500	240	NE	---	NA	Yes	No SSV
N-Nitrosodiethylamine	0/10	ND	4.1U - 46U	6.505	46	20,000	---	<0.01	No	HQ < 1.0
N-Nitrosodimethylamine	0/10	ND	24U - 270U	37.500	270	20,000	---	0.01	No	HQ < 1.0
N-Nitrosodi-n-butylamine	0/10	ND	21U - 240U	33.500	240	20,000	---	0.01	No	HQ < 1.0
N-Nitrosodi-n-propylamine	0/10	ND	9.3U - 100U	14.440	100	20,000	---	<0.01	No	HQ < 1.0
N-Nitrosodiphenylamine	0/10	ND	7.6U - 85U	11.960	85	20,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
N-Nitrosomethylethylamine	0/10	ND	4.1U - 46U	6.505	46	20,000	---	<0.01	No	HQ < 1.0
N-Nitrosomorpholine	0/10	ND	5.6U - 63U	8.870	63	NE	---	NA	Yes	No SSV
N-Nitrosopiperidine	0/10	ND	4.2U - 47U	6.645	47	NE	---	NA	Yes	No SSV
N-Nitrosopyrrolidine	0/10	ND	4.5U - 50U	7.020	50	NE	---	NA	Yes	No SSV
p-Dimethylamino azobenzene	0/10	ND	21U - 240U	33.500	240	NE	---	NA	Yes	No SSV
Pentachlorobenzene	0/10	ND	4.1U - 46U	6.505	46	1,150	USEPA 1999	0.04	No	HQ < 1.0
Pentachloronitrobenzene	0/10	ND	21U - 240U	33.500	240	NE	---	NA	Yes	No SSV
Pentachlorophenol	0/10	ND	21U - 240U	33.500	240	5,000	USEPA 2007a	0.05	No	HQ < 1.0
Phenacetin	0/10	ND	21U - 240U	33.500	240	NE	---	NA	Yes	No SSV
Phenol	0/10	ND	8.1U - 91U	12.770	91	30,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
p-Phenylenediamine	0/10	ND	1,000U - 12,000UJ	1650.000	12,000	NE	---	NA	Yes	No SSV
Pronamide	0/10	ND	5.2U - 59U	8.300	59	13.6	USEPA 2003	4.34	Yes	HQ > 1.0
Pyridine	0/10	ND	25U - 280U	39.400	280	NE	---	NA	Yes	No SSV
Safrole, Total	0/10	ND	4.1U - 46U	6.505	46	NE	---	NA	Yes	No SSV
PAH Totals (µg/kg)										
Low Molecular Weight PAHs [5]	NA	NA	NA	NA	288.4	29,000	USEPA 2007b	0.01	No	HQ < 1.0
High Molecular Weight PAHs [6]	NA	NA	NA	NA	461	18,000	USEPA 2007b	0.03	No	HQ < 1.0
Metals (mg/kg)										
Antimony	0/10	ND	0.57U - 0.69U	0.318	0.69	78	USEPA 2005a	<0.01	No	HQ < 1.0
Arsenic	10/10	0.46 - 1.8	ND	1.091	1.8	18	USEPA 2005b	0.10	No	HQ < 1.0
Barium	10/10	24 - 210J	ND	121.400	210	330	USEPA 2005c	0.64	No	HQ < 1.0
Beryllium	10/10	0.097 - 0.63J	ND	0.286	0.63	40	USEPA 2005d	0.02	No	HQ < 1.0
Cadmium	10/10	0.047J - 0.47	ND	0.133	0.47	32	USEPA 2005e	0.01	No	HQ < 1.0
Chromium	10/10	32 - 150	ND	64.500	150	57	USEPA 2008	2.63	Yes	HQ > 1.0
Cobalt	10/10	6J - 36J	ND	20.100	36	13	USEPA 2005f	2.77	Yes	HQ > 1.0
Copper	10/10	50 - 260J	ND	108.900	260	70	USEPA 2007c	3.71	Yes	HQ > 1.0
Mercury	4/10	0.014J - 0.069	0.0093U - 0.012U	0.017	0.069	0.1	Efroymson et al. 1997a	0.69	No	HQ < 1.0
Nickel	10/10	15 - 47	ND	26.100	47	38	USEPA 2007d	1.24	Yes	HQ > 1.0
Selenium	3/10	0.47J - 1.2	0.29U - 0.35U	0.352	1.2	0.52	USEPA 2007e	2.31	Yes	HQ > 1.0
Silver	3/10	0.088J - 0.35	0.057U - 0.069U	0.081	0.35	560	USEPA 2006	<0.01	No	HQ < 1.0
Thallium	3/10	0.039J - 0.073J	0.029U - 0.035U	0.027	0.073	1	Efroymson et al. 1997b	0.07	No	HQ < 1.0
Tin	1/10	8.3J - 8.3J	2.9U - 3.5U	2.280	8.3	50	Efroymson et al. 1997b	0.17	No	HQ < 1.0
Vanadium	10/10	110 - 330	ND	206.000	330	20.0	USEPA 2005h	16.50	Yes	HQ > 1.0
Zinc	10/10	42 - 100J	ND	63.400	100	120	USEPA 2007f	0.83	No	HQ < 1.0

TABLE 7-19
FREQUENCY AND RANGE OF ANALYTICAL DATA FOR SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION COMPARED TO TERRESTRIAL PLANT AND INVERTEBRATE-BASED SOIL SCREENING VALUES: STEP 2 SCREENING LEVEL RISK CALCULATION
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Notes:

MHSPE = Dutch Ministry of Housing, Spatial Planning and Environment
CCME = Canadian Council of Ministries of the Environment
USEPA = United States Environmental Protection Agency
COPC = Chemical of Potential Concern
SSV = Soil Screening Value
PAH = Polynuclear Aromatic Hydrocarbon
µg/kg = microgram per kilogram
mg/kg = milligram per kilogram
HQ = Hazard Quotient
U = Not detected
UJ = Not detected, estimated value
J = Estimated value
NA = Not Applicable
NE = Not Established
ND = Not Detected

(1) All surface soil analytical data for isobutanol (isobutyl alcohol) and lead were rejected during data validation activities. Although these two analytes are not listed below (see Appendix D for all rejected surface soil analytical data), they are identified as ecological COPCs based on the lack of any useable analytical data.
(2) Maximum detected concentration (or maximum limit of detection for non-detected chemicals).
(3) See Table 7-4 for reference citations.
(4) For a given chemical, the Hazard Quotient (HQ) is the maximum detected concentration (or maximum limit of detection for non-detected chemicals) divided by the screening value.
(5) Low molecular weight PAHs are defined by the USEPA (2007b) as PAH compounds composed of fewer than four rings. The low molecular weight PAH compounds analyzed for in SWMU 59 soil were 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, fluoranthene, fluorene, naphthalene, and phenanthrene. Value was calculated by summing maximum detected concentrations in site soil for each chemical. Maximum limits of detection were used for non-detected PAHs.
(6) High molecular weight PAHs are defined by the USEPA (2007b) as PAH compounds composed of four or more rings. The high molecular weight PAH compounds analyzed for in SWMU 59 soil were benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, and pyrene. Value was calculated by summing maximum detected concentrations in site soil for each chemical. Maximum limits of detection were used for non-detected PAHs.

TABLE 7-20
FREQUENCY AND RANGE OF ANALYTICAL DATA FOR SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION COMPARED TC
TERRESTRIAL PLANT AND INVERTEBRATE-BASED SOIL SCREENING VALUES: STEP 2 SCREENING LEVEL RISK CALCULATION
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Analyte [1]	Contaminant Frequency/Range					Soil Screening Value (SSV)	Reference [3]	Maximum HQ [4]	Ecological COPC?	Comments
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	Value used in Step 2 Screen [2]					
Volatile Organics (µg/kg)										
1,1,1,2-Tetrachloroethane	0/23	ND	3.8U - 5.5U	2.283	5.5	100	CCME 2007	0.06	No	HQ < 1.0
1,1,1-Trichloroethane	0/23	ND	3.8U - 5.5U	2.283	5.5	100	CCME 2007	0.06	No	HQ < 1.0
1,1,2,2-Tetrachloroethane	0/23	ND	3.8U - 5.5U	2.283	5.5	100	CCME 2007	0.06	No	HQ < 1.0
1,1,2-Trichloroethane	0/23	ND	3.8U - 5.5U	2.283	5.5	100	CCME 2007	0.06	No	HQ < 1.0
1,1-Dichloroethane	0/23	ND	3.8U - 5.5U	2.283	5.5	100	CCME 2007	0.06	No	HQ < 1.0
1,1-Dichloroethene	0/23	ND	3.8U - 5.5U	2.283	5.5	100	CCME 2007	0.06	No	HQ < 1.0
1,2,3-Trichloropropane	0/23	ND	3.8U - 5.5U	2.283	5.5	NE	---	NA	Yes	No SSV
1,2-Dibromo-3-chloropropane (DBCP)	0/23	ND	3.8U - 5.5U	2.283	5.5	NE	---	NA	Yes	No SSV
1,2-Dibromoethane (EDB)	0/23	ND	3.8U - 5.5U	2.283	5.5	300	CCME 2007	0.02	No	HQ < 1.0
1,2-Dichloroethane	0/23	ND	3.8U - 5.5U	2.283	5.5	402	MHSPE 2000	0.01	No	HQ < 1.0
1,2-Dichloroethene (trans)	0/23	ND	3.8U - 5.5U	2.283	5.5	100	CCME 2007	0.06	No	HQ < 1.0
1,2-Dichloropropane	0/23	ND	3.8U - 5.5U	2.283	5.5	700,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
1,3-Dichloropropene (cis)	0/23	ND	3.8U - 5.5U	2.283	5.5	100	CCME 2007	0.06	No	HQ < 1.0
1,3-Dichloropropene (trans)	0/23	ND	3.8U - 5.5U	2.283	5.5	100	CCME 2007	0.06	No	HQ < 1.0
1,4-Dichloro-2-butene (trans)	0/23	ND	15UJ - 22U	9.109	22	1,000,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
2-Butanone (MEK)	0/23	ND	9.4U - 14U	5.646	14	NE	---	NA	Yes	No SSV
2-Chloro-1,3-butadiene (Chloroprene)	0/23	ND	3.8U - 5.5U	2.283	5.5	NE	---	NA	Yes	No SSV
2-Hexanone (MBK)	0/23	ND	9.4UJ - 14U	5.646	14	NE	---	NA	Yes	No SSV
3-Chloropropene (Allyl Chloride)	0/23	ND	3.8U - 5.5U	2.283	5.5	NE	---	NA	Yes	No SSV
4-Methyl-2-pentanone (MIBK)	0/23	ND	9.4U - 14U	5.646	14	NE	---	NA	Yes	No SSV
Acetone	4/23	26 - 150	9.4U - 27U	16.783	150	NE	---	NA	Yes	No SSV
Acetonitrile	0/23	ND	3.8U - 5.5U	2.283	5.5	NE	---	NA	Yes	No SSV
Acrylonitrile	0/23	ND	38U - 55U	22.826	55	1,000,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
Benzene	2/23	0.4J - 0.71J	3.8U - 5.5U	2.124	0.71	101	MHSPE 2000	<0.01	No	HQ < 1.0
Bromodichloromethane	0/23	ND	3.8U - 5.5U	2.283	5.5	NE	---	NA	Yes	No SSV
Bromoform	0/23	ND	3.8U - 5.5U	2.283	5.5	NE	---	NA	Yes	No SSV
Bromomethane	3/23	1.2J - 1.6J	3.8U - 5.5UJ	2.172	1.6	NE	---	NA	Yes	No SSV
Carbon Disulfide	2/23	0.54J - 0.76J	3.8U - 5.5U	2.150	0.76	NE	---	NA	Yes	No SSV
Carbon Tetrachloride	0/23	ND	3.8U - 5.5U	2.283	5.5	1,000,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
Chlorobenzene	0/23	ND	3.8U - 5.5U	2.283	5.5	40,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
Chloroethane	0/23	ND	3.8U - 5.5U	2.283	5.5	NE	---	NA	Yes	No SSV
Chloroform	0/23	ND	3.8U - 5.5U	2.283	5.5	1,002	MHSPE 2000	<0.01	No	HQ < 1.0
Chloromethane	4/23	0.37J - 1.1J	3.8UJ - 5.5U	1.989	1.1	NE	---	NA	Yes	No SSV
Dibromochloromethane	0/23	ND	3.8U - 5.5U	2.283	5.5	NE	---	NA	Yes	No SSV
Dibromomethane	0/23	ND	3.8UJ - 5.5U	2.283	5.5	NE	---	NA	Yes	No SSV
Ethyl Methacrylate	0/23	ND	38U - 55U	22.826	55	NE	---	NA	Yes	No SSV
Ethylbenzene	0/23	ND	3.8U - 5.5U	2.283	5.5	5,003	MHSPE 2000	<0.01	No	HQ < 1.0
Trichlorofluoromethane	0/23	ND	3.8U - 5.5U	2.283	5.5	NE	---	NA	Yes	No SSV
Dichlorodifluoromethane	0/23	ND	3.8U - 5.5U	2.283	5.5	NE	---	NA	Yes	No SSV
Methyl Acrylonitrile	0/23	ND	38U - 55U	22.826	55	NE	---	NA	Yes	No SSV
Methyl Iodide	3/23	1.3J - 30J	3.8UJ - 5.5U	3.428	30	NE	---	NA	Yes	No SSV

TABLE 7-20
FREQUENCY AND RANGE OF ANALYTICAL DATA FOR SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION COMPARED TC
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Analyte [1]	Contaminant Frequency/Range					Soil Screening Value (SSV)	Reference [3]	Maximum HQ [4]	Ecological COPC?	Comments
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	Value used in Step 2 Screen [2]					
Volatile Organics (µg/kg)										
Methylene Chloride	0/23	ND	3.8U - 5.5U	2.283	5.5	1,040	MHSPE 2000	<0.01	No	HQ < 1.0
Pentachloroethane	0/23	ND	3.8U - 5.5U	2.283	5.5	NE	---	NA	Yes	No SSV
Styrene (Ethenylbenzene)	0/23	ND	3.8U - 5.5U	2.283	5.5	10,030	MHSPE 2000	<0.01	No	HQ < 1.0
Tetrachloroethene (PCE)	0/23	ND	3.8U - 5.5U	2.283	5.5	400	MHSPE 2000	0.01	No	HQ < 1.0
Toluene	0/23	ND	3.8U - 5.5U	2.283	5.5	13,001	MHSPE 2000	<0.01	No	HQ < 1.0
Trichloroethene (TCE)	0/23	ND	3.8U - 5.5U	2.283	5.5	6,010	MHSPE 2000	<0.01	No	HQ < 1.0
Vinyl Acetate	0/23	ND	3.8UJ - 5.5U	2.283	5.5	NE	---	NA	Yes	No SSV
Vinyl Chloride	0/23	ND	3.8U - 5.5U	2.283	5.5	11.0	MHSPE 2000	0.50	No	HQ < 1.0
Xylene, m/p-	8/23	0.12J - 0.19J	7.8U - 11U	3.043	0.19	1,000	---	<0.01	No	HQ < 1.0
Xylene, o-	0/23	ND	3.8U - 5.5U	2.283	5.5	1,000	---	<0.01	No	HQ < 1.0
Xylenes, total	8/23	0.12J - 0.19J	3.9U - 5.5U	1.556	0.19	1,000	USEPA 2003	<0.01	No	HQ < 1.0
Semi-Volatile Organics (µg/kg)										
1,2,4,5-Tetrachlorobenzene	0/23	ND	180U - 250U	102.174	250	50.0	CCME 2007	5.00	Yes	HQ > 1.0
1,2,4-Trichlorobenzene	0/23	ND	180U - 250U	102.174	250	20,000	Efroymson et al. 1997a	0.01	No	HQ < 1.0
1,2-Dichlorobenzene (o-)	0/23	ND	180U - 250U	102.174	250	3,003	MHSPE 2000	0.08	No	HQ < 1.0
1,3,5-Trinitrobenzene (TNB)	0/23	ND	180U - 250UJ	102.174	250	40,000	---	<0.01	No	HQ < 1.0
1,3-Dichlorobenzene (m-)	0/23	ND	180U - 250U	102.174	250	3,003	MHSPE 2000	0.08	No	HQ < 1.0
1,3-Dinitrobenzene (m-)	0/23	ND	180U - 250U	102.174	250	40,000	---	<0.01	No	HQ < 1.0
1,4-Dichlorobenzene (p-)	0/23	ND	180U - 250U	102.174	250	20,000	Efroymson et al. 1997a	0.01	No	HQ < 1.0
1,4-Naphthoquinone	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
1-Naphthylamine	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
2,2'-Oxybis[1-chloropropane]	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
2,3,4,6-Tetrachlorophenol	0/23	ND	350U - 480U	198.478	480	1,001	MHSPE 2000	0.48	No	HQ < 1.0
2,4,5-Trichlorophenol	0/23	ND	350U - 480U	198.478	480	4,000	Efroymson et al. 1997b	0.12	No	HQ < 1.0
2,4,6-Trichlorophenol	0/23	ND	350U - 480U	198.478	480	10,000	Efroymson et al. 1997a	0.05	No	HQ < 1.0
2,4-Dichlorophenol	0/23	ND	350U - 480U	198.478	480	1,001	MHSPE 2000	0.48	No	HQ < 1.0
2,4-Dimethylphenol	0/23	ND	350U - 480U	198.478	480	10	USEPA 2003	48.00	Yes	HQ > 1.0
2,4-Dinitrophenol	0/23	ND	350U - 480UJ	198.478	480	20,000	Efroymson et al. 1997b	0.02	No	HQ < 1.0
2,4-Dinitrotoluene (DNT)	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
2,6-Dichlorophenol	0/23	ND	350U - 480U	198.478	480	1,001	MHSPE 2000	0.48	No	HQ < 1.0
2,6-Dinitrotoluene (DNT)	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
2-Acetylaminofluorene	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
2-Chloronaphthalene	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
2-Chlorophenol	0/23	ND	350U - 480U	198.478	480	1,001	MHSPE 2000	0.48	No	HQ < 1.0
2-Methyl-5-nitroaniline	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
2-Methylphenol (o-Cresol)	0/23	ND	350U - 480U	198.478	480	100	CCME 2007	4.80	Yes	HQ > 1.0
2-Naphthylamine	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
2-Nitroaniline	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
2-Nitrophenol	0/23	ND	350U - 480U	198.478	480	7,000	---	0.07	No	HQ < 1.0
2-Picoline	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
3,3'-Dichlorobenzidine	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV

TABLE 7-20
FREQUENCY AND RANGE OF ANALYTICAL DATA FOR SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION COMPARED TC
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Analyte [1]	Contaminant Frequency/Range					Soil Screening Value (SSV)	Reference [3]	Maximum HQ [4]	Ecological COPC?	Comments
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	Value used in Step 2 Screen [2]					
Semi-volatile Organics (µg/kg)										
3,3'-Dimethylbenzidine	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
3-Methylcholanthrene	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
3-Methylphenol (m-Cresol)	0/23	ND	260U - 370U	149.783	370	100	CCME 2007	3.70	Yes	HQ > 1.0
3-Nitroaniline	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
4,6-Dinitro-2-methylphenol	0/23	ND	350U - 480U	198.478	480	NE	---	NA	Yes	No SSV
4-Aminobiphenyl	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
4-Bromophenyl-phenylether	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
4-Chloro-3-methylphenol	0/23	ND	350U - 480U	198.478	480	NE	---	NA	Yes	No SSV
4-Chloroaniline	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
4-Chlorophenyl-phenylether	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
4-Dimethylaminoazobenzene (p-)	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
4-Methylphenol (p-Cresol)	0/23	ND	260U - 370U	149.783	370	100	CCME 2007	3.70	Yes	HQ > 1.0
4-Nitroaniline	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
4-Nitrophenol	0/23	ND	350U - 480U	198.478	480	7,000	Efroymson et al. 1997a	0.07	No	HQ < 1.0
4-Nitroquinoline-1-oxide	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
7,12-Dimethylbenz(a)anthracene	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
a,a-Dimethylphenethylamine	0/23	ND	360UJ - 610U	244.783	610	NE	---	NA	Yes	No SSV
Acetophenone	0/23	ND	90U - 120U	50.783	120	NE	---	NA	Yes	No SSV
Aniline	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
Aramite	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
Benzyl Alcohol	0/23	ND	180UJ - 250UJ	102.174	250	NE	---	NA	Yes	No SSV
Bis(2-chloroethoxy)methane	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
Bis(2-chloroethyl)ether	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
Bis(2-ethylhexyl) Phthalate (BEHP)	2/23	58J - 83J	180U - 250U	99.609	83	6,010	MHSPE 2000	0.01	No	HQ < 1.0
Butyl Benzyl Phthalate	0/23	ND	180U - 250U	102.174	250	6,010	MHSPE 2000	0.04	No	HQ < 1.0
Chlorobenzilate	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
Diallate (cis)	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
Diallate (trans)	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
Dibenzofuran	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
Diethyl Phthalate (DEP)	0/23	ND	180U - 250U	102.174	250	100,000	Efroymson et al. 1997b	<0.01	No	HQ < 1.0
Dimethyl Phthalate	0/23	ND	180U - 250U	102.174	250	200,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
Di-n-butyl Phthalate (DBP)	0/23	ND	180U - 250U	102.174	250	200,000	Efroymson et al. 1997b	<0.01	No	HQ < 1.0
Di-n-octyl Phthalate	1/23	55J - 55J	180U - 250U	100.217	55	6,010	MHSPE 2000	<0.01	No	HQ < 1.0
Dinoseb	0/13	ND	180U - 220U	100.000	220	NE	---	NA	Yes	No SSV
Ethyl Methane Sulfonate (EMS)	0/23	ND	180UJ - 250U	102.174	250	NE	---	NA	Yes	No SSV
Hexachloro-1,3-butadiene	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
Hexachlorobenzene	0/23	ND	180U - 250U	102.174	250	1,000,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
Hexachlorocyclopentadiene	0/23	ND	180U - 250U	102.174	250	10,000	Efroymson et al. 1997b	0.03	No	HQ < 1.0
Hexachloroethane	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
Hexachloropropene	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
Isophorone	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV

TABLE 7-20
FREQUENCY AND RANGE OF ANALYTICAL DATA FOR SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION COMPARED TO TERRESTRIAL PLANT AND INVERTEBRATE-BASED SOIL SCREENING VALUES: STEP 2 SCREENING LEVEL RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte [1]	Contaminant Frequency/Range					Soil Screening Value (SSV)	Reference [3]	Maximum HQ [4]	Ecological COPC?	Comments
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	Value used in Step 2 Screen [2]					
Semi-Volatile Organics (µg/kg)										
Isosafrole	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
Methapyrilene	0/21	ND	180U - 250U	101.905	250	NE	---	NA	Yes	No SSV
Methyl Methane Sulfonate	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
Nitrobenzene	0/23	ND	180U - 250U	102.174	250	40,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
n-Nitrosodiethylamine	0/23	ND	180U - 250U	102.174	250	20,000	---	0.01	No	HQ < 1.0
n-Nitrosodimethylamine (NDMA)	0/23	ND	180U - 250U	102.174	250	20,000	---	0.01	No	HQ < 1.0
n-Nitroso-di-n-butylamine	0/23	ND	180UJ - 250UJ	102.174	250	20,000	---	0.01	No	HQ < 1.0
n-Nitrosodi-n-propylamine	0/23	ND	180U - 250U	102.174	250	20,000	---	0.01	No	HQ < 1.0
n-Nitrosodiphenylamine	0/23	ND	180U - 250U	102.174	250	20,000	Efroymson et al. 1997a	0.01	No	HQ < 1.0
n-Nitrosomethylethylamine	0/23	ND	180U - 250U	102.174	250	20,000	---	0.01	No	HQ < 1.0
n-Nitrosomorpholine	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
n-Nitrosopiperidine	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
n-Nitrosopyrrolidine	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
o-Toluidine	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
Pentachlorobenzene	0/23	ND	180U - 250U	102.174	250	1,150	USEPA 1999	0.22	No	HQ < 1.0
Pentachloronitrobenzene	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
Pentachlorophenol	0/23	ND	350U - 480U	198.478	480	5,000	USEPA 2007a	0.10	No	HQ < 1.0
Phenacetin	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
Phenol	0/23	ND	350U - 480U	198.478	480	30,000	Efroymson et al. 1997a	0.02	No	HQ < 1.0
Pronamide	0/23	ND	180U - 480U	140.435	480	13.6	USEPA 2003	35.29	Yes	HQ > 1.0
Pyridine	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
Safrole	0/23	ND	180U - 250U	102.174	250	NE	---	NA	Yes	No SSV
PAHs (µg/kg)										
Low molecular weight PAHs [5]	NA	NA	NA	NA	67.45	29,000	USEPA 2007b	<0.01	No	HQ < 1.0
High molecular weight PAHs [6]	NA	NA	NA	NA	65.99	18,000	USEPA 2007b	<0.01	No	HQ < 1.0
Organochlorine Pesticides (µg/kg)										
4,4'-DDD	1/23	0.39J - 0.39J	3.6U - 4.9U	1.928	0.39	401	MHSPE 2000	<0.01	No	HQ < 1.0
4,4'-DDE	4/23	0.66J - 3.5J	3.6U - 4.9U	2.027	3.5	401	MHSPE 2000	<0.01	No	HQ < 1.0
4,4'-DDT	3/23	0.63J - 1.3J	3.6U - 4.9U	1.865	1.3	401	MHSPE 2000	<0.01	No	HQ < 1.0
Aldrin	0/23	ND	1.8U - 2.5U	1.022	2.5	401	MHSPE 2000	<0.01	No	HQ < 1.0
BHC, alpha-	0/23	ND	1.8U - 2.5U	1.022	2.5	201	MHSPE 2000	0.01	No	HQ < 1.0
BHC, beta-	4/23	0.84J - 8.9NJ	1U - 2.5U	1.210	8.9	3.98	USEPA 2003	2.24	Yes	HQ > 1.0
BHC, delta-	0/23	ND	1.8U - 2.5U	1.022	2.5	201	MHSPE 2000	0.01	No	HQ < 1.0
BHC, gamma- (Lindane)	0/23	ND	1.8U - 2.5U	1.022	2.5	5.0	USEPA 2003	0.50	No	HQ < 1.0
Chlordane, alpha-	0/23	ND	1.8U - 2.5U	1.022	2.5	224	USEPA 2003	<0.01	No	HQ < 1.0
Chlordane, gamma-	0/23	ND	1.8U - 2.5U	1.022	2.5	224	USEPA 2003	<0.01	No	HQ < 1.0
Dieldrin	0/23	ND	3.5U - 4.9U	1.987	4.9	400	MHSPE 2000	0.01	No	HQ < 1.0
Endosulfan I	0/23	ND	1.8U - 2.5U	1.022	2.5	100	Friday 1998	0.03	No	HQ < 1.0
Endosulfan II	0/23	ND	3.5U - 4.9U	1.987	4.9	100	Friday 1998	0.05	No	HQ < 1.0
Endosulfan Sulfate	0/23	ND	3.5U - 4.9U	1.987	4.9	100	Friday 1998	0.05	No	HQ < 1.0
Endrin	1/23	0.56J - 0.56J	3.5U - 4.9U	1.916	0.56	401	MHSPE 2000	<0.01	No	HQ < 1.0

TABLE 7-20
FREQUENCY AND RANGE OF ANALYTICAL DATA FOR SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION COMPARED TC
TERRESTRIAL PLANT AND INVERTEBRATE-BASED SOIL SCREENING VALUES: STEP 2 SCREENING LEVEL RISK CALCULATION
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CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte [1]	Contaminant Frequency/Range					Soil Screening Value (SSV)	Reference [3]	Maximum HQ [4]	Ecological COPC?	Comments
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	Value used in Step 2 Screen [2]					
Organochlorine Pesticides (µg/kg)										
Endrin Aldehyde	3/22	0.46J - 0.54J	3.6U - 4.9U	1.786	0.54	100	Friday 1998	<0.01	No	HQ < 1.0
Heptachlor	1/23	0.22J - 0.22J	1.8U - 2.5U	0.984	0.22	400	MHSPE 2000	<0.01	No	HQ < 1.0
Heptachlor Epoxide	0/23	ND	1.8U - 2.5U	1.022	2.5	400	MHSPE 2000	<0.01	No	HQ < 1.0
Isodrin	0/23	ND	180U - 250U	102.174	250	3.32	USEPA 2003	75.30	Yes	HQ > 1.0
Kepone (Chlordecone)	0/8	ND	180UJ - 230UJ	100.000	230	100	Friday 1998	2.30	Yes	HQ > 1.0
Methoxychlor	0/23	ND	18U - 25U	10.217	25	100	Friday 1998	0.25	No	HQ < 1.0
Toxaphene	0/23	ND	88U - 120U	49.978	120	100	Friday 1998	1.20	Yes	HQ > 1.0
Inorganics (mg/kg)										
Antimony	5/23	0.15J - 1.2J	1.1UJ - 7.1UJ	2.089	1.2	78.0	USEPA 2005a	0.02	No	HQ < 1.0
Arsenic	8/23	0.19J - 1.8	0.54U - 3.5UJ	1.125	1.8	18.0	USEPA 2005b	0.10	No	HQ < 1.0
Barium	14/14	29.5 - 267J	ND	108.893	267	330	USEPA 2005c	0.81	No	HQ < 1.0
Beryllium	15/23	0.091J - 0.96	2.6U - 3.5U	0.765	0.96	40.0	USEPA 2005d	0.02	No	HQ < 1.0
Cadmium	20/23	0.12J - 0.77	3.1U - 3.5U	0.570	0.77	32.0	USEPA 2005e	0.02	No	HQ < 1.0
Chromium	23/23	8 - 79.3J	ND	35.361	79.3	57.0	USEPA 2008	1.39	Yes	HQ > 1.0
Cobalt	23/23	9.6J - 72.1J	ND	28.883	72.1	13.0	USEPA 2005f	5.55	Yes	HQ > 1.0
Copper	23/23	5.1J - 270	ND	88.283	270	70.0	USEPA 2007c	3.86	Yes	HQ > 1.0
Lead	17/22	1J - 33J	2.9U - 3.5UJ	8.027	33	120	USEPA 2005g	0.28	No	HQ < 1.0
Mercury	10/23	0.009J - 0.1	0.036U - 0.048U	0.021	0.1	0.10	Efroymson et al. 1997a	1.00	No	HQ = 1.0
Nickel	23/23	6.3 - 47.3	ND	17.348	47.3	38.0	USEPA 2007d	1.24	Yes	HQ > 1.0
Selenium	13/23	0.2J - 2.6J	13.2U - 17.7UJ	3.790	2.6	0.52	USEPA 2007e	5.00	Yes	HQ > 1.0
Silver	5/23	0.1J - 0.57J	0.55U - 3.5U	0.969	0.57	560	USEPA 2006	<0.01	No	HQ < 1.0
Thallium	8/23	0.029J - 0.5J	0.54U - 3.5U	0.864	0.5	1.00	Efroymson et al. 1997b	0.50	No	HQ < 1.0
Tin	11/23	1.9J - 26	5.1UJ - 6.5UJ	3.715	26	50.0	Efroymson et al. 1997b	0.52	No	HQ < 1.0
Vanadium	23/23	43.5J - 282J	ND	134.078	282	20.0	USEPA 2005h	14.10	Yes	HQ > 1.0
Zinc	23/23	39.3 - 242J	ND	87.817	242	120	USEPA 2007f	2.02	Yes	HQ > 1.0

Notes:

CCME = Canadian Council of Ministries of the Environment
COPC = Chemical of Potential Concern
HQ = Hazard Quotient
SSV = Soil Screening Value
µg/kg = microgram per kilogram
mg/kg = milligram per kilogram
MHSPE = Dutch Ministry of Housing, Spatial Planning and Environment
USEPA = United States Environmental Protection Agency
PAH = Polynuclear Aromatic Hydrocarbon
NJ = Estimated value (tentative identification)
J = Estimated value
U = Not detected
UJ = Not detected, estimated value
ND = Not Detected
NE = Not Established
NA = Not Applicable

(1) All subsurface soil analytical data for five VOCs (1,4-dioxane, acrolein, isobutyl alchohol, methyl methacrylate, and propionitrile) and one SVOC (1,4-phenylenediamine) were rejected during data validation activities. Although these six organic analytes are not listed below (see Appendix D for all rejected subsurface soil analytical data), they are identified as ecological COPCs based on the lack of any useable analytical data.

(2) Maximum detected concentration (or maximum reporting limit for non-detected chemicals).

(3) See Table 7-4 for reference citations.

(4) For a given chemical, the Hazard Quotient (HQ) is the maximum detected concentration (or maximum reporting limit for non-detected chemicals) divided by the soil screening value.

(5) Low molecular weight PAHs are defined by the USEPA (2007b) as PAH compounds composed of fewer than four rings. The low molecular weight PAH compounds analyzed for in SWMU 59 soil were 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, fluoranthene, fluorene, naphthalene, and phenanthrene. Value was calculated by summing maximum detected concentrations in site soil for each chemical. Maximum reporting limits were used for non-detected PAHs.

(6) High molecular weight PAHs are defined by the USEPA (2007b) as PAH compounds composed of four or more rings. The high molecular weight PAH compounds analyzed for in SWMU 59 soil were benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, and pyrene. Value was calculated by summing maximum detected concentrations in si soil for each chemical. Maximum reporting limits were used for non-detected PAHs.

TABLE 7-21
FREQUENCY AND RANGE OF ANALYTICAL DATA FOR SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION COMPARED TO TERRESTRIAL PLANT AND INVERTEBRATE-BASED SOIL SCREENING VALUES: STEP 2 SCREENING LEVEL RISK CALCULATION
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte [1]	Contaminant Frequency/Range					Soil Screening Value (SSV)	Reference [3]	Maximum HQ [4]	Ecological COPC?	Comments
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	Value used in Step 2 Screen [2]					
Volatile Organics (µg/kg)										
1,1,1,2-Tetrachloroethane	0/10	ND	2U - 3.4U	1.215	3.4	100	CCME 2007	0.03	No	HQ < 1.0
1,1,1-Trichloroethane	0/10	ND	0.83U - 1.4U	0.505	1.4	100	CCME 2007	0.01	No	HQ < 1.0
1,1,2,2-Tetrachloroethane	0/10	ND	1.3U - 2.3U	0.810	2.3	100	CCME 2007	0.02	No	HQ < 1.0
1,1,2-Trichloroethane	0/10	ND	1.1U - 1.8U	0.660	1.8	100	CCME 2007	0.02	No	HQ < 1.0
1,1-Dichloroethane	0/10	ND	0.91U - 1.5U	0.553	1.5	100	CCME 2007	0.02	No	HQ < 1.0
1,1-Dichloroethene	0/10	ND	1.2U - 2.1U	0.755	2.1	100	CCME 2007	0.02	No	HQ < 1.0
1,2,3-Trichloropropane	0/10	ND	2U - 3.4U	1.215	3.4	NE	---	NA	Yes	No SSV
1,2-Dibromo-3-Chloropropane	0/10	ND	3.6U - 6.2U	2.225	6.2	NE	---	NA	Yes	No SSV
1,2-Dibromoethane	0/10	ND	1.2U - 2.1U	0.755	2.1	300	CCME 2007	<0.01	No	HQ < 1.0
1,2-Dichloroethane	0/10	ND	0.91U - 1.5U	0.553	1.5	402	MHSPE 2000	<0.01	No	HQ < 1.0
1,2-Dichloropropane	0/10	ND	0.83U - 1.4U	0.505	1.4	700,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
2-Butanone	0/10	ND	2U - 3.4U	1.215	3.4	NE	---	NA	Yes	No SSV
2-Hexanone	0/10	ND	2.7U - 4.6U	1.660	4.6	NE	---	NA	Yes	No SSV
4-Methyl-2-pentanone	0/10	ND	3.5U - 5.9U	2.125	5.9	NE	---	NA	Yes	No SSV
Acetone	3/10	14J - 40J	9.1U - 15U	10.980	40	NE	---	NA	Yes	No SSV
Acetonitrile	0/10	ND	34UJ - 58U	20.800	58	NE	---	NA	Yes	No SSV
Acrolein	0/10	ND	20UJ - 34UJ	12.150	34	NE	---	NA	Yes	No SSV
Acrylonitrile	0/10	ND	28UJ - 48UJ	17.150	48	1,000,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
Allyl chloride	0/10	ND	1.8U - 3.1U	1.110	3.1	NE	---	NA	Yes	No SSV
Benzene	0/10	ND	0.83U - 1.4U	0.505	1.4	101	MHSPE 2000	0.01	No	HQ < 1.0
Bromodichloromethane	0/10	ND	0.83U - 1.4U	0.505	1.4	NE	---	NA	Yes	No SSV
Bromoform	0/10	ND	1.2U - 2.1U	0.755	2.1	NE	---	NA	Yes	No SSV
Bromomethane	0/10	ND	1.2U - 2.1U	0.755	2.1	NE	---	NA	Yes	No SSV
Carbon disulfide	0/10	ND	0.91U - 1.5U	0.553	1.5	NE	---	NA	Yes	No SSV
Carbon tetrachloride	0/10	ND	0.83U - 1.4U	0.505	1.4	1,000,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
Chlorobenzene	0/10	ND	0.83U - 1.4U	0.505	1.4	40,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
Chloroethane	0/10	ND	2.2U - 3.8U	1.360	3.8	NE	---	NA	Yes	No SSV
Chloroform	0/10	ND	0.91U - 1.5U	0.553	1.5	1,002	MHSPE 2000	<0.01	No	HQ < 1.0
Chloromethane	0/10	ND	1.7U - 2.8U	1.005	2.8	NE	---	NA	Yes	No SSV
Chloroprene	0/10	ND	1.7U - 3U	1.060	3	NE	---	NA	Yes	No SSV
cis-1,3-Dichloropropene	0/10	ND	0.83U - 1.4U	0.505	1.4	100	CCME 2007	0.01	No	HQ < 1.0
Dibromochloromethane	0/10	ND	1.4U - 2.4U	0.860	2.4	NE	---	NA	Yes	No SSV
Dibromomethane	0/10	ND	1.4U - 2.4U	0.860	2.4	NE	---	NA	Yes	No SSV
Dichlorodifluoromethane	0/10	ND	0.83U - 1.4U	0.505	1.4	NE	---	NA	Yes	No SSV
Ethyl methacrylate	0/10	ND	2.8U - 4.8U	1.715	4.8	NE	---	NA	Yes	No SSV
Ethylbenzene	0/10	ND	1.1U - 1.8U	0.660	1.8	5,003	MHSPE 2000	<0.01	No	HQ < 1.0
Hexachlorobutadiene	0/10	ND	2.6U - 4.4U	1.570	4.4	NE	---	NA	Yes	No SSV
Iodomethane	0/10	ND	1.5UJ - 2.5UJ	0.905	2.5	NE	---	NA	Yes	No SSV
Methacrylonitrile	0/10	ND	19UJ - 32U	11.600	32	NE	---	NA	Yes	No SSV
Methyl Methacrylate	0/10	ND	3.7U - 6.3U	2.275	6.3	NE	---	NA	Yes	No SSV
Methylene Chloride	1/10	7.2 - 7.2	0.83U - 1.1U	1.155	7.2	1,040	MHSPE 2000	<0.01	No	HQ < 1.0

TABLE 7-21
FREQUENCY AND RANGE OF ANALYTICAL DATA FOR SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION COMPARED TO TERRESTRIAL PLANT AND INVERTEBRATE-BASED SOIL SCREENING VALUES: STEP 2 SCREENING LEVEL RISK CALCULATION
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte [1]	Contaminant Frequency/Range					Soil Screening Value (SSV)	Reference [3]	Maximum HQ [4]	Ecological COPC?	Comments
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	Value used in Step 2 Screen [2]					
Volatile Organics (µg/kg)										
Pentachloroethane	0/10	ND	5.2U - 8.9U	3.180	8.9	NE	---	NA	Yes	No SSV
Propionitrile	0/10	ND	22UJ - 37U	13.200	37	NE	---	NA	Yes	No SSV
Styrene	0/10	ND	0.83U - 1.4U	0.505	1.4	10,030	MHSPE 2000	<0.01	No	HQ < 1.0
Tetrachloroethene	0/10	ND	1.6U - 2.7U	0.955	2.7	400	MHSPE 2000	<0.01	No	HQ < 1.0
Toluene	0/10	ND	0.83U - 1.4U	0.505	1.4	13,001	MHSPE 2000	<0.01	No	HQ < 1.0
trans-1,2-Dichloroethene	0/10	ND	0.83U - 1.4U	0.505	1.4	100	CCME 2007	0.01	No	HQ < 1.0
trans-1,3-Dichloropropene	0/10	ND	0.83U - 1.4U	0.505	1.4	100	CCME 2007	0.01	No	HQ < 1.0
trans-1,4-Dichloro-2-butene	0/10	ND	2.4U - 4.1U	1.470	4.1	1,000,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
Trichloroethene	0/10	ND	1.1U - 1.8U	0.660	1.8	6,010	MHSPE 2000	<0.01	No	HQ < 1.0
Trichlorofluoromethane	0/10	ND	0.99U - 1.7U	0.605	1.7	NE	---	NA	Yes	No SSV
Vinyl acetate	0/10	ND	2.1U - 3.5U	1.270	3.5	NE	---	NA	Yes	No SSV
Vinyl chloride	0/10	ND	1.2U - 2.1U	0.755	2.1	11	MHSPE 2000	0.19	No	HQ < 1.0
Xylenes, Total	0/10	ND	0.91U - 1.5U	0.553	1.5	1,000	USEPA 2003	<0.01	No	HQ < 1.0
Semivolatile Organics (µg/kg)										
1,2,4,5-Tetrachlorobenzene	0/10	ND	3.7U - 4.7U	2.185	4.7	50	CCME 2007	0.09	No	HQ < 1.0
1,2,4-Trichlorobenzene	0/10	ND	0.83U - 1.4U	0.505	1.4	20,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
1,2-Dichlorobenzene	0/10	ND	1.1U - 1.8U	0.660	1.8	3,003	MHSPE 2000	<0.01	No	HQ < 1.0
1,3,5-Trinitrobenzene	0/10	ND	19U - 24U	11.150	24	40,000	---	<0.01	No	HQ < 1.0
1,3-Dichlorobenzene	0/10	ND	1.3U - 2.3U	0.810	2.3	3,003	MHSPE 2000	<0.01	No	HQ < 1.0
1,3-Dinitrobenzene	0/10	ND	19U - 24U	11.150	24	40,000	---	<0.01	No	HQ < 1.0
1,4-Dichlorobenzene	0/10	ND	0.83U - 1.4U	0.505	1.4	20,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
1,4-Dioxane	0/10	ND	7.6U - 9.5U	4.435	9.5	NE	---	NA	Yes	No SSV
1,4-Naphthoquinone	0/10	ND	3.7UJ - 4.7UJ	2.185	4.7	NE	---	NA	Yes	No SSV
1-Naphthylamine	0/10	ND	19U - 24U	11.150	24	NE	---	NA	Yes	No SSV
2,2'-oxybis[1-chloropropane]	0/10	ND	8.1U - 10U	4.750	10	NE	---	NA	Yes	No SSV
2,3,4,6-Tetrachlorophenol	0/10	ND	3.7U - 4.7U	2.185	4.7	1,001	MHSPE 2000	<0.01	No	HQ < 1.0
2,4,5-Trichlorophenol	0/10	ND	8.6U - 11U	4.995	11	4,000	Efroymson et al. 1997b	<0.01	No	HQ < 1.0
2,4,6-Trichlorophenol	0/10	ND	8.9U - 11U	5.195	11	10,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
2,4-Dichlorophenol	0/10	ND	8.1U - 10U	4.750	10	1,001	MHSPE 2000	<0.01	No	HQ < 1.0
2,4-Dimethylphenol	1/10	17J - 17J	8.6U - 11U	6.195	17	10	CCME 2007	1.70	Yes	HQ > 1.0
2,4-Dinitrophenol	0/10	ND	47U - 60U	27.850	60	20,000	Efroymson et al. 1997b	<0.01	No	HQ < 1.0
2,4-Dinitrotoluene	0/10	ND	8.5U - 11U	4.970	11	NE	---	NA	Yes	No SSV
2,6-Dichlorophenol	0/10	ND	3.7U - 4.7U	2.185	4.7	1,001	MHSPE 2000	<0.01	No	HQ < 1.0
2,6-Dinitrotoluene	0/10	ND	8.9U - 11U	5.195	11	NE	---	NA	Yes	No SSV
2-Acetylaminofluorene	0/10	ND	37U - 47U	21.850	47	NE	---	NA	Yes	No SSV
2-Chloronaphthalene	0/10	ND	6.8U - 8.5U	3.980	8.5	NE	---	NA	Yes	No SSV
2-Chlorophenol	0/10	ND	6U - 7.5U	3.515	7.5	1,001	MHSPE 2000	<0.01	No	HQ < 1.0
2-Methylphenol	0/10	ND	7.1U - 9U	4.180	9	100	CCME 2007	0.09	No	HQ < 1.0
2-Naphthylamine	0/10	ND	19U - 24U	11.150	24	NE	---	NA	Yes	No SSV
2-Nitroaniline	0/10	ND	7.9U - 10U	4.635	10	NE	---	NA	Yes	No SSV
2-Nitrophenol	0/10	ND	6.5U - 8.3U	3.845	8.3	7,000	---	<0.01	No	HQ < 1.0

TABLE 7-21
FREQUENCY AND RANGE OF ANALYTICAL DATA FOR SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION COMPARED TO TERRESTRIAL PLANT AND INVERTEBRATE-BASED SOIL SCREENING VALUES: STEP 2 SCREENING LEVEL RISK CALCULATION
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte [1]	Contaminant Frequency/Range					Soil Screening Value (SSV)	Reference [3]	Maximum HQ [4]	Ecological COPC?	Comments
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	Value used in Step 2 Screen [2]					
Semi-Volatile Organics (µg/kg)										
2-Picoline	0/10	ND	3.7U - 4.7U	2.185	4.7	NE	---	NA	Yes	No SSV
2-Toluidine	0/10	ND	3.7U - 4.7U	2.185	4.7	NE	---	NA	Yes	No SSV
3,4 Methylphenol	0/10	ND	8.2U - 10U	4.795	10	100	CCME 2007	0.10	No	HQ < 1.0
3,3'-Dichlorobenzidine	0/10	ND	19U - 24U	11.150	24	NE	---	NA	Yes	No SSV
3,3'-Dimethylbenzidine	0/10	ND	74U - 94U	43.800	94	NE	---	NA	Yes	No SSV
3-Methylcholanthrene	0/10	ND	37U - 47U	21.850	47	NE	---	NA	Yes	No SSV
3-Nitroaniline	0/10	ND	7.6U - 9.5U	4.435	9.5	NE	---	NA	Yes	No SSV
4,6-Dinitro-2-methylphenol	0/10	ND	19U - 24U	11.150	24	NE	---	NA	Yes	No SSV
4-Aminobiphenyl	0/10	ND	19UJ - 24UJ	11.150	24	NE	---	NA	Yes	No SSV
4-Bromophenyl phenyl ether	0/10	ND	7.8U - 9.8U	4.575	9.8	NE	---	NA	Yes	No SSV
4-Chloro-3-methylphenol	0/10	ND	7.9U - 10U	4.635	10	NE	---	NA	Yes	No SSV
4-Chloroaniline	0/10	ND	5.9U - 7.4U	3.460	7.4	NE	---	NA	Yes	No SSV
4-Chlorophenyl phenyl ether	0/10	ND	7.2U - 9.1U	4.240	9.1	NE	---	NA	Yes	No SSV
4-Nitroaniline	0/10	ND	19U - 24U	11.150	24	NE	---	NA	Yes	No SSV
4-Nitrophenol	0/10	ND	82U - 100U	47.950	100	7000	Efroymson et al. 1997a	0.01	No	HQ < 1.0
4-Nitroquinoline-1-oxide	0/10	ND	47U - 60U	27.850	60	NE	---	NA	Yes	No SSV
7,12-Dimethylbenz(a)anthracene	0/10	ND	19U - 24U	11.150	24	NE	---	NA	Yes	No SSV
Acetophenone	0/10	ND	7.7U - 9.7U	4.510	9.7	NE	---	NA	Yes	No SSV
alpha,alpha-Dimethyl phenethylamine	0/10	ND	370UJ - 470UJ	218.500	470	NE	---	NA	Yes	No SSV
Aniline	0/10	ND	9.3U - 12U	5.465	12	NE	---	NA	Yes	No SSV
Aramite, Total	0/10	ND	5.4U - 6.8U	3.180	6.8	NE	---	NA	Yes	No SSV
Benzyl alcohol	0/10	ND	6.9U - 8.7U	4.045	8.7	NE	---	NA	Yes	No SSV
Bis(2-chloroethoxy)methane	0/10	ND	7.3U - 9.3U	4.305	9.3	NE	---	NA	Yes	No SSV
Bis(2-chloroethyl)ether	0/10	ND	7.3U - 9.3U	4.305	9.3	NE	---	NA	Yes	No SSV
Bis(2-ethylhexyl) phthalate	8/10	8.5J - 59J	7.9U - 8.3U	18.620	59	6,010	MHSPE 2000	<0.01	No	HQ < 1.0
Butyl benzyl phthalate	0/10	ND	7.6U - 9.5U	4.435	9.5	6,010	MHSPE 2000	<0.01	No	HQ < 1.0
Diallate	0/10	ND	6.3U - 8U	3.715	8	NE	---	NA	Yes	No SSV
Dibenzofuran	0/10	ND	7.6U - 9.5U	4.435	9.5	NE	---	NA	Yes	No SSV
Diethyl phthalate	0/10	ND	8.4U - 11U	4.885	11	100,000	Efroymson et al. 1997b	<0.01	No	HQ < 1.0
Dimethyl phthalate	0/10	ND	8.5U - 11U	4.970	11	200,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
Di-n-butyl phthalate	0/10	ND	19U - 24U	11.150	24	200,000	Efroymson et al. 1997b	<0.01	No	HQ < 1.0
Di-n-octyl phthalate	0/10	ND	7.6U - 9.5U	4.435	9.5	6,010	MHSPE 2000	<0.01	No	HQ < 1.0
Dinoseb	0/10	ND	7.6U - 9.5U	4.435	9.5	NE	---	NA	Yes	No SSV
Ethyl methanesulfonate	0/10	ND	8.8U - 11U	5.180	11	NE	---	NA	Yes	No SSV
Hexachlorobenzene	0/10	ND	8.6U - 11U	4.995	11	1,000,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
Hexachlorobutadiene	0/10	ND	2.6U - 4.4U	1.570	4.4	NE	---	NA	Yes	No SSV
Hexachlorocyclopentadiene	0/10	ND	4.2U - 5.3U	2.455	5.3	10,000	Efroymson et al. 1997b	<0.01	No	HQ < 1.0
Hexachloroethane	0/10	ND	6.5U - 8.3U	3.845	8.3	NE	---	NA	Yes	No SSV
Hexachlorophene	0/10	ND	2700U - 3400U	1595.000	3400	NE	---	NA	Yes	No SSV
Hexachloropropene	0/10	ND	6U - 7.5U	3.515	7.5	NE	---	NA	Yes	No SSV
Isophorone	0/10	ND	7.9U - 10U	4.635	10	NE	---	NA	Yes	No SSV

TABLE 7-21
FREQUENCY AND RANGE OF ANALYTICAL DATA FOR SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION COMPARED TO TERRESTRIAL PLANT AND INVERTEBRATE-BASED SOIL SCREENING VALUES: STEP 2 SCREENING LEVEL RISK CALCULATION
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Analyte [1]	Contaminant Frequency/Range					Soil Screening Value (SSV)	Reference [3]	Maximum HQ [4]	Ecological COPC?	Comments
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	Value used in Step 2 Screen [2]					
Semi-Volatile Organics (µg/kg)										
Isosafrole	0/10	ND	3.7U - 4.7U	2.185	4.7	NE	---	NA	Yes	No SSV
Methapyrilene	0/10	ND	76UJ - 95UJ	44.350	95	NE	---	NA	Yes	No SSV
Methyl methanesulfonate	0/10	ND	4.3UJ - 5.4UJ	2.520	5.4	NE	---	NA	Yes	No SSV
Nitrobenzene	0/10	ND	7.4U - 9.4U	4.380	9.4	40,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
N-Nitro-o-toluidine	0/10	ND	19U - 24U	11.150	24	NE	---	NA	Yes	No SSV
N-Nitrosodiethylamine	0/10	ND	3.7U - 4.7U	2.185	4.7	20,000	---	<0.01	No	HQ < 1.0
N-Nitrosodimethylamine	0/10	ND	21U - 27U	12.550	27	20,000	---	<0.01	No	HQ < 1.0
N-Nitrosodi-n-butylamine	0/10	ND	19U - 24U	11.150	24	20,000	---	<0.01	No	HQ < 1.0
N-Nitrosodi-n-propylamine	0/10	ND	8.5U - 11U	4.970	11	20,000	---	<0.01	No	HQ < 1.0
N-Nitrosodiphenylamine	0/10	ND	6.9U - 8.7U	4.045	8.7	20,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
N-Nitrosomethylethylamine	0/10	ND	3.7U - 4.7U	2.185	4.7	20,000	---	<0.01	No	HQ < 1.0
N-Nitrosomorpholine	0/10	ND	5.1U - 6.4U	2.985	6.4	NE	---	NA	Yes	No SSV
N-Nitrosopiperidine	0/10	ND	3.8U - 4.8U	2.255	4.8	NE	---	NA	Yes	No SSV
N-Nitrosopyrrolidine	0/10	ND	4.1U - 5.1U	2.385	5.1	NE	---	NA	Yes	No SSV
p-Dimethylamino azobenzene	0/10	ND	19U - 24U	11.150	24	NE	---	NA	Yes	No SSV
Pentachlorobenzene	1/10	5.6J - 5.6J	3.7U - 4.7U	2.535	5.6	1,150	USEPA 1999	<0.01	No	HQ < 1.0
Pentachloronitrobenzene	0/10	ND	19U - 24U	11.150	24	NE	---	NA	Yes	No SSV
Pentachlorophenol	0/10	ND	19U - 24U	11.150	24	5,000	USEPA 2007a	<0.01	No	HQ < 1.0
Phenacetin	0/10	ND	19U - 24U	11.150	24	NE	---	NA	Yes	No SSV
Phenol	0/10	ND	7.3U - 9.3U	4.305	9.3	30,000	Efroymson et al. 1997a	<0.01	No	HQ < 1.0
p-Phenylen diamine	0/10	ND	940U - 1200U	547.000	1200	NE	---	NA	Yes	No SSV
Pronamide	0/10	ND	4.7U - 6U	2.785	6	13.6	USEPA 2003	0.44	No	HQ < 1.0
Pyridine	0/10	ND	23U - 28U	13.250	28	NE	---	NA	Yes	No SSV
Safrole, Total	0/10	ND	3.7U - 4.7U	2.185	4.7	NE	---	NA	Yes	No SSV
PAH Totals (µg/kg)										
Low Molecular Weight PAHs [5]	NA	NA	NA	NA	37.5	29,000	USEPA 2007b	<0.01	No	HQ < 1.0
High Molecular Weight PAHs [6]	NA	NA	NA	NA	47.1	18,000	USEPA 2007b	<0.01	No	HQ < 1.0
Metals (mg/kg)										
Antimony	0/10	ND	0.55U - 0.7U	0.328	0.7	78	USEPA 2005a	<0.01	No	HQ < 1.0
Arsenic	10/10	0.7 - 1.2	ND	0.975	1.2	18	USEPA 2005b	0.07	No	HQ < 1.0
Barium	10/10	30 - 120	ND	87.200	120	330	USEPA 2005c	0.36	No	HQ < 1.0
Beryllium	10/10	0.12 - 0.5	ND	0.259	0.5	40	USEPA 2005d	0.01	No	HQ < 1.0
Cadmium	9/10	0.016J - 0.45	0.034U - 0.034U	0.106	0.45	32	USEPA 2005e	0.01	No	HQ < 1.0
Chromium	10/10	16 - 120	ND	59.600	120	57	USEPA 2008	2.11	Yes	HQ > 1.0
Cobalt	10/10	3.5J - 24J	ND	14.020	24	13	USEPA 2005f	1.85	Yes	HQ > 1.0
Copper	10/10	48 - 210	ND	102.700	210	70	USEPA 2007c	3.00	Yes	HQ > 1.0
Mercury	4/10	0.011J - 0.083	0.0091U - 0.011U	0.021	0.083	0.1	Efroymson et al. 1997a	0.83	No	HQ < 1.0
Nickel	10/10	5.7 - 44	ND	25.370	44	38	USEPA 2007d	1.16	Yes	HQ > 1.0
Selenium	4/10	0.49J - 0.69	0.28U - 0.35U	0.331	0.69	0.52	USEPA 2007e	1.33	Yes	HQ > 1.0
Silver	1/10	0.26 - 0.26	0.055U - 0.07U	0.055	0.26	560	USEPA 2006	<0.01	No	HQ < 1.0
Thallium	1/10	0.037J - 0.037J	0.028U - 0.035U	0.019	0.037	1	Efroymson et al. 1997b	0.04	No	HQ < 1.0

TABLE 7-21
FREQUENCY AND RANGE OF ANALYTICAL DATA FOR SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION COMPARED TO TERRESTRIAL PLANT AND INVERTEBRATE-BASED SOIL SCREENING VALUES: STEP 2 SCREENING LEVEL RISK CALCULATION
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Analyte [1]	Contaminant Frequency/Range					Soil Screening Value (SSV)	Reference [3]	Maximum HQ [4]	Ecological COPC?	Comments
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	Value used in Step 2 Screen [2]					
Metals (mg/kg)										
Tin	0/10	ND	2.8U - 3.6U	1.675	3.6	50	Efroymson et al. 1997b	0.07	No	HQ < 1.0
Vanadium	10/10	110 - 400	ND	223.000	400	20	USEPA 2005h	20.00	Yes	HQ > 1.0
Zinc	10/10	35 - 77	ND	53.300	77	120	USEPA 2007f	0.64	No	HQ < 1.0

Notes:

MHSPE = Dutch Ministry of Housing, Spatial Planning and Environment
CCME = Canadian Council of Ministries of the Environment
USEPA = United States Environmental Protection Agency
COPC = Chemical of Potential Concern
SSV = Soil Screening Value
PAH = Polynuclear Aromatic Hydrocarbon
µg/kg = microgram per kilogram
mg/kg = milligram per kilogram
HQ = Hazard Quotient
U = Not detected
UJ = Not detected, estimated value
J = Estimated value
NA = Not Applicable
NE = Not Established
ND = Not Detected

(1) All subsurface soil analytical data for isobutanol (isobutyl alcohol) and lead were rejected during data validation activities. Although these two analytes are not listed below (see Appendix D for all rejected surface soil analytical data), they are identified as ecological COPCs based on the lack of any useable analytical data.
(2) Maximum detected concentration (or maximum limit of detection for non-detected chemicals).
(3) See Table 7-4 for reference citations.
(4) For a given chemical, the Hazard Quotient (HQ) is the maximum detected concentration (or maximum limit of detection for non-detected chemicals) divided by the screening value.
(5) Low molecular weight PAHs are defined by the USEPA (2007b) as PAH compounds composed of fewer than four rings. The low molecular weight PAH compounds analyzed for in SWMU 59 soil were 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, fluoranthene, fluorene, naphthalene, and phenanthrene. Value was calculated by summing maximum detected concentrations in site soil for each chemical. Maximum limits of detection were used for non-detected PAHs.
(6) High molecular weight PAHs are defined by the USEPA (2007b) as PAH compounds composed of four or more rings. The high molecular weight PAH compounds analyzed for in SWMU 59 soil were benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, and pyrene. Value was calculated by summing maximum detected concentrations in site soil for each chemical. Maximum limits of detection were used for non-detected PAHs.

TABLE 7-22
FREQUENCY AND RANGE OF GROUNDWATER DATA COMPARED TO GROUNDWATER SCREENING VALUES: STEP 2 SCREENING LEVEL RISK CALCULATION
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	Contaminant Frequency/Range									
Analyte [1]	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	Value used in Step 2 Screen [2]	Groundwater Screening Value (GWSV)	Reference [3]	Maximum HQ [4]	Ecological COPC?	Comments
Volatile Organics (µg/L)										
1,1,1,2-Tetrachloroethane	0/10	ND	0.5U - 0.5U	0.250	0.5	200	USEPA 2007	<0.01	No	HQ < 1.0
1,1,1-Trichloroethane	0/10	ND	0.5U - 0.5U	0.250	0.5	312	USEPA 2001	<0.01	No	HQ < 1.0
1,1,2,2-Tetrachloroethane	0/10	ND	0.5U - 0.5U	0.250	0.5	90.2	USEPA 2001	<0.01	No	HQ < 1.0
1,1,2-Trichloroethane	0/10	ND	0.5U - 0.5U	0.250	0.5	340	USEPA 2007	<0.01	No	HQ < 1.0
1,1-Dichloroethane	0/10	ND	0.5U - 0.5U	0.250	0.5	47.0	USEPA 2003	0.01	No	HQ < 1.0
1,1-Dichloroethene	0/10	ND	0.5U - 0.5U	0.250	0.5	2,240	USEPA 2001	<0.01	No	HQ < 1.0
1,2,3-Trichloropropane	0/10	ND	0.5U - 0.5U	0.250	0.5	274	USEPA 2007	<0.01	No	HQ < 1.0
1,2-Dibromo-3-chloropropane (DBCP)	0/10	ND	0.5U - 0.5U	0.250	0.5	100	USEPA 2007	<0.01	No	HQ < 1.0
1,2-Dibromoethane (EDB)	0/10	ND	0.5U - 0.5U	0.250	0.5	48.0	USEPA 2007	0.01	No	HQ < 1.0
1,2-Dichloroethane	0/10	ND	0.5U - 0.5U	0.250	0.5	1,130	USEPA 2001	<0.01	No	HQ < 1.0
1,2-Dichloroethene (trans)	0/10	ND	0.5U - 0.5U	0.250	0.5	4,480	Buchman 2008	<0.01	No	HQ < 1.0
1,2-Dichloropropane	0/10	ND	0.5U - 0.5U	0.250	0.5	2,400	USEPA 2001	<0.01	No	HQ < 1.0
1,3-Dichloropropene (cis)	0/10	ND	0.5U - 0.5U	0.250	0.5	7.90	USEPA 2001	0.06	No	HQ < 1.0
1,3-Dichloropropene (trans)	0/10	ND	0.5U - 0.5U	0.250	0.5	7.90	USEPA 2001	0.06	No	HQ < 1.0
1,4-Dichloro-2-butene (trans)	0/10	ND	2U - 2U	1.000	2	NE	---	NA	Yes	No GWSV
2-Chloro-1,3-butadiene (Chloroprene)	0/10	ND	0.5U - 0.5U	0.250	0.5	NE	---	NA	Yes	No GWSV
2-Hexanone (MBK)	0/10	ND	2.5U - 2.5U	1.250	2.5	99.0	USEPA 2003	0.03	No	HQ < 1.0
3-Chloropropene (Allyl Chloride)	0/10	ND	0.5UJ - 0.5UJ	0.250	0.5	3.40	USEPA 2007	0.15	No	HQ < 1.0
4-Methyl-2-pentanone (MIBK)	0/10	ND	2.5U - 2.5U	1.250	2.5	170	USEPA 2003	0.01	No	HQ < 1.0
Acetonitrile	0/10	ND	0.5U - 0.5U	0.250	0.5	12,000	USEPA 2003	<0.01	No	HQ < 1.0
Benzene	4/10	0.036J - 0.1J	0.5U - 0.5U	0.176	0.1	109	USEPA 2001	<0.01	No	HQ < 1.0
Bromodichloromethane	0/10	ND	0.5U - 0.5U	0.250	0.5	2,400	USEPA 2007	<0.01	No	HQ < 1.0
Bromoform	0/10	ND	0.5U - 0.5U	0.250	0.5	640	USEPA 2001	<0.01	No	HQ < 1.0
Bromomethane	0/10	ND	0.5UJ - 0.5UJ	0.250	0.5	120	USEPA 2007	<0.01	No	HQ < 1.0
Carbon Disulfide	3/10	0.05J - 0.15J	0.5U - 0.5U	0.201	0.15	15.0	USEPA 2003	0.01	No	HQ < 1.0
Carbon Tetrachloride	0/10	ND	0.5U - 0.5U	0.250	0.5	1,500	USEPA 2001	<0.01	No	HQ < 1.0
Chlorobenzene	0/10	ND	0.5U - 0.5U	0.250	0.5	105	USEPA 2001	<0.01	No	HQ < 1.0
Chloroethane	0/10	ND	0.5U - 0.5U	0.250	0.5	NE	---	NA	Yes	No GWSV
Chloroform	0/10	ND	0.5U - 0.5U	0.250	0.5	815	USEPA 2001	<0.01	No	HQ < 1.0
Chloromethane	0/10	ND	0.5U - 0.5U	0.250	0.5	2,700	USEPA 2007	<0.01	No	HQ < 1.0
Dibromochloromethane	0/10	ND	0.5U - 0.5U	0.250	0.5	340	USEPA 2007	<0.01	No	HQ < 1.0
Dibromomethane	0/10	ND	0.5U - 0.5U	0.250	0.5	1,280	Buchman 2008	<0.01	No	HQ < 1.0
Ethyl Methacrylate	0/10	ND	5U - 5U	2.500	5	18,000	USEPA 2007	<0.01	No	HQ < 1.0
Ethylbenzene	0/10	ND	0.5U - 0.5U	0.250	0.5	4.30	USEPA 2001	0.12	No	HQ < 1.0
Trichlorofluoromethane	0/10	ND	0.5UJ - 0.5UJ	0.250	0.5	1,280	Buchman 2008	<0.01	No	HQ < 1.0
Dichlorodifluoromethane	0/10	ND	0.5UJ - 0.5UJ	0.250	0.5	1,280	---	<0.01	No	HQ < 1.0
Methyl Acrylonitrile	0/10	ND	5U - 5U	2.500	5	NE	---	NA	Yes	No GWSV
Methyl Iodide	0/10	ND	0.5UJ - 0.5UJ	0.250	0.5	NE	---	NA	Yes	No GWSV
Methyl Methacrylate	0/10	ND	5U - 5U	2.500	5	2,800	USEPA 2003	<0.01	No	HQ < 1.0
Methylene Chloride	0/10	ND	0.5U - 0.5U	0.250	0.5	2,560	USEPA 2001	<0.01	No	HQ < 1.0
Pentachloroethane	0/10	ND	0.5U - 0.5U	0.250	0.5	56.2	Buchman 2008	<0.01	No	HQ < 1.0

TABLE 7-22
FREQUENCY AND RANGE OF GROUNDWATER DATA COMPARED TO GROUNDWATER SCREENING VALUES: STEP 2 SCREENING LEVEL RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

	Contaminant Frequency/Range									
Analyte	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	Value used in Step 2 Screen (1)	Groundwater Screening Value (GWSV)	Reference (2)	Maximum HQ (4)	Ecological COPC?	Comments
Volatile Organics (µg/L)										
Styrene (Ethenylbenzene)	0/10	ND	0.5U - 0.5U	0.250	0.5	170	USEPA 2007	<0.01	No	HQ < 1.0
Tetrachloroethene (PCE)	0/10	ND	0.5U - 0.5U	0.250	0.5	45.0	USEPA 2001	0.01	No	HQ < 1.0
Toluene	0/10	ND	0.5U - 0.5U	0.250	0.5	37.0	USEPA 2001	0.01	No	HQ < 1.0
Trichloroethene (TCE)	0/10	ND	0.5U - 0.5U	0.250	0.5	40.0	Buchman 2008	0.01	No	HQ < 1.0
Vinyl Acetate	0/10	ND	1U - 1U	0.500	1	100	USEPA 2007	0.01	No	HQ < 1.0
Vinyl Chloride	0/10	ND	0.5U - 0.5U	0.250	0.5	930	USEPA 2003	<0.01	No	HQ < 1.0
Xylene, m/p-	0/10	ND	1U - 1U	0.500	1	27.0	USEPA 2003	0.04	No	HQ < 1.0
Xylene, o-	0/10	ND	0.5U - 0.5U	0.250	0.5	27.0	USEPA 2003	0.02	No	HQ < 1.0
Xylenes, total	0/10	ND	0.5U - 0.5U	0.250	0.5	27.0	USEPA 2003	0.02	No	HQ < 1.0
Semi-Volatile Organics (µg/L)										
1,2,4,5-Tetrachlorobenzene	0/10	ND	5UJ - 5.3UJ	2.520	5.3	10.0	USEPA 2007	0.53	No	HQ < 1.0
1,2,4-Trichlorobenzene	0/10	ND	5UJ - 5.3UJ	2.520	5.3	4.50	USEPA 2001	1.18	Yes	HQ > 1.0
1,2-Dichlorobenzene (o-)	0/10	ND	5UJ - 5.3UJ	2.520	5.3	19.7	USEPA 2001	0.27	No	HQ < 1.0
1,3,5-Trinitrobenzene (TNB)	0/10	ND	5UJ - 5.3UJ	2.520	5.3	80.0	USEPA 2007	0.07	No	HQ < 1.0
1,3-Dichlorobenzene (m-)	0/10	ND	5UJ - 5.3UJ	2.520	5.3	28.5	USEPA 2001	0.19	No	HQ < 1.0
1,3-Dinitrobenzene (m-)	0/10	ND	5UJ - 5.3UJ	2.520	5.3	22.0	USEPA 2003	0.24	No	HQ < 1.0
1,4-Dichlorobenzene (p-)	0/10	ND	5UJ - 5.3UJ	2.520	5.3	19.9	USEPA 2001	0.27	No	HQ < 1.0
1,4-Naphthoquinone	0/10	ND	5UJ - 5.3UJ	2.520	5.3	NE	---	NA	Yes	No GWSV
1-Naphthylamine	0/10	ND	5UJ - 5.3UJ	2.520	5.3	70.0	USEPA 2007	0.08	No	HQ < 1.0
2,2'-Oxybis[1-chloropropane]	0/10	ND	5UJ - 5.3UJ	2.520	5.3	NE	---	NA	Yes	No GWSV
2,3,4,6-Tetrachlorophenol	0/10	ND	10UJ - 10UJ	5.000	10	8.80	Buchman 2008	1.14	Yes	HQ > 1.0
2,4,5-Trichlorophenol	0/10	ND	10UJ - 10UJ	5.000	10	11.0	Buchman 2008	0.91	No	HQ < 1.0
2,4,6-Trichlorophenol	0/10	ND	10UJ - 10UJ	5.000	10	12.1	USEPA 2007	0.83	No	HQ < 1.0
2,4-Dichlorophenol	0/10	ND	10UJ - 10UJ	5.000	10	1.67	USEPA 2007	5.99	Yes	HQ > 1.0
2,4-Dimethylphenol	0/10	ND	10UJ - 10UJ	5.000	10	131	USEPA 2007	0.08	No	HQ < 1.0
2,4-Dinitrophenol	0/10	ND	10UJ - 10UJ	5.000	10	48.5	USEPA 2001	0.21	No	HQ < 1.0
2,4-Dinitrotoluene (DNT)	0/10	ND	5UJ - 5.3UJ	2.520	5.3	44.0	USEPA 2003	0.12	No	HQ < 1.0
2,6-Dichlorophenol	0/10	ND	10UJ - 10UJ	5.000	10	54.0	USEPA 2007	0.19	No	HQ < 1.0
2,6-Dinitrotoluene (DNT)	0/10	ND	5UJ - 5.3UJ	2.520	5.3	81.0	USEPA 2003	0.07	No	HQ < 1.0
2-Acetylaminofluorene	0/10	ND	5UJ - 5.3UJ	2.520	5.3	20.0	USEPA 2007	0.27	No	HQ < 1.0
2-Chloronaphthalene	0/10	ND	5UJ - 5.3UJ	2.520	5.3	0.15	Buchman 2008	35.33	Yes	HQ > 1.0
2-Chlorophenol	0/10	ND	10UJ - 10UJ	5.000	10	53.0	USEPA 2007	0.19	No	HQ < 1.0
2-Methyl-5-nitroaniline	0/10	ND	5UJ - 5.3UJ	2.520	5.3	220	USEPA 2007	0.02	No	HQ < 1.0
2-Methylnaphthalene	0/10	ND	0.2UJ - 0.21UJ	0.101	0.21	6.00	USEPA 2007	0.04	No	HQ < 1.0
2-Methylphenol (o-Cresol)	0/10	ND	10UJ - 10UJ	5.000	10	102	USEPA 2007	0.10	No	HQ < 1.0
2-Naphthylamine	0/10	ND	5UJ - 5.3UJ	2.520	5.3	NE	---	NA	Yes	No GWSV
2-Nitroaniline	0/10	ND	5UJ - 5.3UJ	2.520	5.3	48.9	USEPA 2007	0.11	No	HQ < 1.0
2-Nitrophenol	0/10	ND	10UJ - 10UJ	5.000	10	10,000	USEPA 2007	<0.01	No	HQ < 1.0
2-Picoline	0/10	ND	5UJ - 5.3UJ	2.520	5.3	8,979	USEPA 2007	<0.01	No	HQ < 1.0
3,3'-Dichlorobenzidine	0/10	ND	5UJ - 5.3UJ	2.520	5.3	4.50	USEPA 2003	1.18	Yes	HQ > 1.0
3,3'-Dimethylbenzidine	0/10	ND	5UJ - 5.3UJ	2.520	5.3	160	USEPA 2007	0.03	No	HQ < 1.0

TABLE 7-22
FREQUENCY AND RANGE OF GROUNDWATER DATA COMPARED TO GROUNDWATER SCREENING VALUES: STEP 2 SCREENING LEVEL RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

	Contaminant Frequency/Range									
Analyte	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	Value used in Step 2 Screen [1]	Groundwater Screening Value (GWSV)	Reference [2]	Maximum HQ [4]	Ecological COPC?	Comments
Semi-Volatile Organics (µg/L)										
3-Methylcholanthrene	0/10	ND	5UJ - 5.3UJ	2.520	5.3	NE	---	NA	Yes	No GWSV
3-Methylphenol (m-Cresol)	0/10	ND	8UJ - 8.4UJ	4.030	8.4	300	USEPA 2007	0.03	No	HQ < 1.0
3-Nitroaniline	0/10	ND	5UJ - 5.3UJ	2.520	5.3	9.80	USEPA 2007	0.54	No	HQ < 1.0
4,6-Dinitro-2-methylphenol	0/10	ND	10UJ - 10UJ	5.000	10	23.0	USEPA 2003	0.43	No	HQ < 1.0
4-Aminobiphenyl	0/10	ND	5UJ - 5.3UJ	2.520	5.3	NE	---	NA	Yes	No GWSV
4-Bromophenyl-phenylether	0/10	ND	5UJ - 5.3UJ	2.520	5.3	1.50	USEPA 2003	3.53	Yes	HQ > 1.0
4-Chloro-3-methylphenol	0/10	ND	10UJ - 10UJ	5.000	10	0.30	USEPA 2003	33.33	Yes	HQ > 1.0
4-Chloroaniline	0/10	ND	5UJ - 5.3UJ	2.520	5.3	10.0	USEPA 2007	0.53	No	HQ < 1.0
4-Chlorophenyl-phenylether	0/10	ND	5UJ - 5.3UJ	2.520	5.3	7.30	USEPA 2007	0.73	No	HQ < 1.0
4-Dimethylaminoazobenzene (p-)	0/10	ND	5UJ - 5.3UJ	2.520	5.3	NE	---	NA	Yes	No GWSV
4-Methylphenol (p-Cresol)	0/10	ND	8UJ - 8.4UJ	4.030	8.4	33.6	USEPA 2007	0.25	No	HQ < 1.0
4-Nitroaniline	0/10	ND	5UJ - 5.3UJ	2.520	5.3	170	USEPA 2007	0.03	No	HQ < 1.0
4-Nitrophenol	0/10	ND	10UJ - 10UJ	5.000	10	71.7	USEPA 2001	0.14	No	HQ < 1.0
4-Nitroquinoline-1-oxide	0/1	ND	5UJ - 5UJ	2.500	5	NE	---	NA	Yes	No GWSV
7,12-Dimethylbenz(a)anthracene	0/10	ND	5UJ - 5.3UJ	2.520	5.3	6.00	Buchman 2008	0.88	No	HQ < 1.0
a,a-Dimethylphenethylamine	0/10	ND	50UJ - 53UJ	25.200	53	NE	---	NA	Yes	No GWSV
Acenaphthene	0/10	ND	0.2UJ - 0.21UJ	0.101	0.21	9.70	USEPA 2001	0.02	No	HQ < 1.0
Acenaphthylene	0/10	ND	0.2UJ - 0.21UJ	0.101	0.21	6.00	Buchman 2008	0.04	No	HQ < 1.0
Acetophenone	0/10	ND	2.5UJ - 2.6UJ	1.260	2.6	1,550	USEPA 2007	<0.01	No	HQ < 1.0
Aniline	0/10	ND	5UJ - 5.3UJ	2.520	5.3	294	USEPA 2007	0.02	No	HQ < 1.0
Anthracene	0/10	ND	0.2UJ - 0.21UJ	0.101	0.21	5.35	USEPA 2007	0.04	No	HQ < 1.0
Aramite	0/10	ND	5UJ - 5.3UJ	2.520	5.3	3.09	USEPA 2003	1.72	Yes	HQ > 1.0
Benzo(a)anthracene	0/10	ND	0.2UJ - 0.21UJ	0.101	0.21	0.025	USEPA 2003	8.40	Yes	HQ > 1.0
Benzo(a)pyrene (BaP)	0/10	ND	0.2UJ - 0.21UJ	0.101	0.21	10.0	USEPA 2004	0.02	No	HQ < 1.0
Benzo(b)fluoranthene	0/10	ND	0.2UJ - 0.21UJ	0.101	0.21	6.00	Buchman 2008	0.04	No	HQ < 1.0
Benzo(g,h,i)perylene	0/10	ND	0.2UJ - 0.21UJ	0.101	0.21	6.00	Buchman 2008	0.04	No	HQ < 1.0
Benzo(k)fluoranthene	0/10	ND	0.2UJ - 0.21UJ	0.101	0.21	6.00	Buchman 2008	0.04	No	HQ < 1.0
Benzyl Alcohol	0/10	ND	5UJ - 5.3UJ	2.520	5.3	150	USEPA 2007	0.04	No	HQ < 1.0
Bis(2-chloroethoxy)methane	0/10	ND	5UJ - 5.3UJ	2.520	5.3	1,840	USEPA 2007	<0.01	No	HQ < 1.0
Bis(2-chloroethyl)ether	0/10	ND	5UJ - 5.3UJ	2.520	5.3	2,380	USEPA 2001	<0.01	No	HQ < 1.0
Bis(2-ethylhexyl) Phthalate (BEHP)	1/10	2.4J - 2.4J	5UJ - 5.3UJ	2.510	2.4	360	Buchman 2008	<0.01	No	HQ < 1.0
Butyl Benzyl Phthalate	0/10	ND	5UJ - 5.3UJ	2.520	5.3	29.4	USEPA 2001	0.18	No	HQ < 1.0
Chlorobenzilate	0/10	ND	5UJ - 5.3UJ	2.520	5.3	NE	---	NA	Yes	No GWSV
Chrysene	0/10	ND	0.2UJ - 0.21UJ	0.101	0.21	10.0	USEPA 2004	0.02	No	HQ < 1.0
Diallate (cis)	0/10	ND	5UJ - 5.3UJ	2.520	5.3	82.0	USEPA 2007	0.06	No	HQ < 1.0
Diallate (trans)	0/10	ND	5UJ - 5.3UJ	2.520	5.3	82.0	USEPA 2007	0.06	No	HQ < 1.0
Dibenz(a,h)anthracene	0/10	ND	0.2UJ - 0.21UJ	0.101	0.21	6.00	Buchman 2008	0.04	No	HQ < 1.0
Dibenzofuran	0/10	ND	5UJ - 5.3UJ	2.520	5.3	33.3	USEPA 2007	0.16	No	HQ < 1.0
Diethyl Phthalate (DEP)	0/10	ND	5UJ - 5.3UJ	2.520	5.3	75.9	USEPA 2001	0.07	No	HQ < 1.0
Dimethyl Phthalate	0/10	ND	5UJ - 5.3UJ	2.520	5.3	580	USEPA 2001	<0.01	No	HQ < 1.0
Di-n-butyl Phthalate (DBP)	0/10	ND	5UJ - 5.3UJ	2.520	5.3	3.40	USEPA 2001	1.56	Yes	HQ > 1.0

TABLE 7-22
FREQUENCY AND RANGE OF GROUNDWATER DATA COMPARED TO GROUNDWATER SCREENING VALUES: STEP 2 SCREENING LEVEL RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

	Contaminant Frequency/Range									
Analyte	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	Value used in Step 2 Screen (1)	Groundwater Screening Value (GWSV)	Reference (2)	Maximum HQ (4)	Ecological COPC?	Comments
Semi-Volatile Organics (µg/L)										
Di-n-octyl Phthalate	0/10	ND	5UJ - 5.3UJ	2.520	5.3	1,150	USEPA 2007	<0.01	No	HQ < 1.0
Dinoseb	0/10	ND	5UJ - 5.3UJ	2.520	5.3	1.70	USEPA 2007	3.12	Yes	HQ > 1.0
Ethyl Methane Sulfonate (EMS)	0/10	ND	5UJ - 5.3UJ	2.520	5.3	40.0	USEPA 2007	0.13	No	HQ < 1.0
Fluoranthene	0/10	ND	0.2UJ - 0.21UJ	0.101	0.21	11.0	USEPA 1996	0.02	No	HQ < 1.0
Fluorene	0/10	ND	0.2UJ - 0.21UJ	0.101	0.21	10.0	USEPA 2007	0.02	No	HQ < 1.0
Hexachloro-1,3-butadiene	0/10	ND	5UJ - 5.3UJ	2.520	5.3	0.32	USEPA 2001	16.56	Yes	HQ > 1.0
Hexachlorobenzene	0/10	ND	5UJ - 5.3UJ	2.520	5.3	0.077	USEPA 2007	68.83	Yes	HQ < 1.0
Hexachlorocyclopentadiene	0/10	ND	5UJ - 5.3UJ	2.520	5.3	0.07	USEPA 2001	75.71	Yes	HQ > 1.0
Hexachloroethane	0/10	ND	5UJ - 5.3UJ	2.520	5.3	9.40	USEPA 2001	0.56	No	HQ < 1.0
Hexachloropropene	0/10	ND	5UJ - 5.3UJ	2.520	5.3	NE	---	NA	Yes	No GWSV
Indeno(1,2,3-cd)pyrene	0/10	ND	0.2UJ - 0.21UJ	0.101	0.21	6.00	Buchman 2008	0.04	No	HQ < 1.0
Isophorone	0/10	ND	5UJ - 5.3UJ	2.520	5.3	129	USEPA 2001	0.04	No	HQ < 1.0
Isosafrole	0/10	ND	5UJ - 5.3UJ	2.520	5.3	NE	---	NA	Yes	No GWSV
Methapyrilene	0/10	ND	5UJ - 5.3UJ	2.520	5.3	NE	---	NA	Yes	No GWSV
Methyl Methane Sulfonate	0/10	ND	5UJ - 5.3UJ	2.520	5.3	NE	---	NA	Yes	No GWSV
Naphthalene	1/10	1.3J - 1.3J	0.2UJ - 0.21UJ	0.221	1.3	23.5	USEPA 2001	0.06	No	HQ < 1.0
Nitrobenzene	0/10	ND	5UJ - 5.3UJ	2.520	5.3	66.8	USEPA 2001	0.08	No	HQ < 1.0
n-Nitrosodiethylamine	0/10	ND	5UJ - 5.3UJ	2.520	5.3	768	USEPA 2003	<0.01	No	HQ < 1.0
n-Nitrosodimethylamine (NDMA)	0/10	ND	5UJ - 5.3UJ	2.520	5.3	25.0	---	0.21	No	HQ < 1.0
n-Nitroso-di-n-butylamine	0/10	ND	5UJ - 5.3UJ	2.520	5.3	25.0	---	0.21	No	HQ < 1.0
n-Nitrosodi-n-propylamine	0/10	ND	5UJ - 5.3UJ	2.520	5.3	25.0	---	0.21	No	HQ < 1.0
n-Nitrosodiphenylamine	0/10	ND	5UJ - 5.3UJ	2.520	5.3	25.0	USEPA 2011	0.21	No	HQ < 1.0
n-Nitrosomethylethylamine	0/10	ND	5UJ - 5.3UJ	2.520	5.3	25.0	---	0.21	No	HQ < 1.0
n-Nitrosomorpholine	0/10	ND	5UJ - 5.3UJ	2.520	5.3	NE	---	NA	Yes	No GWSV
n-Nitrosopiperidine	0/10	ND	5UJ - 5.3UJ	2.520	5.3	NE	---	NA	Yes	No GWSV
n-Nitrosopyrrolidine	0/10	ND	5UJ - 5.3UJ	2.520	5.3	NE	---	NA	Yes	No GWSV
o-Toluidine	0/10	ND	5UJ - 5.3UJ	2.520	5.3	5.20	USEPA 2007	1.02	Yes	HQ > 1.0
Pentachlorobenzene	0/10	ND	5UJ - 5.3UJ	2.520	5.3	129	USEPA 2001	0.04	No	HQ < 1.0
Pentachloronitrobenzene	0/10	ND	5UJ - 5.3UJ	2.520	5.3	0.12	USEPA 2007	44.17	Yes	HQ > 1.0
Pentachlorophenol	0/10	ND	10UJ - 10UJ	5.000	10	7.90	USEPA 2013	1.27	Yes	HQ > 1.0
Phenacetin	0/10	ND	5UJ - 5.3UJ	2.520	5.3	NE	---	NA	Yes	No GWSV
Phenanthrene	1/10	0.054J - 0.054J	0.2UJ - 0.21UJ	0.096	0.054	8.30	USEPA 1996	<0.01	No	HQ < 1.0
Phenol	0/10	ND	10UJ - 10UJ	5.000	10	58.0	USEPA 2001	0.17	No	HQ < 1.0
Pronamide	0/9	ND	5UJ - 5.1UJ	2.506	5.1	35.0	USEPA 2007	0.15	No	HQ < 1.0
Pyrene	2/10	0.01J - 0.012J	0.2UJ - 0.21UJ	0.083	0.012	0.248	USEPA 2007	0.05	No	HQ < 1.0
Pyridine	0/10	ND	5UJ - 5.3UJ	2.520	5.3	500	USEPA 2007	0.01	No	HQ < 1.0
Safrole	0/10	ND	5UJ - 5.3UJ	2.520	5.3	NE	---	NA	Yes	No GWSV
Organochlorine Pesticides (µg/L)										
4,4'-DDD	0/10	ND	0.1U - 0.11U	0.053	0.11	0.001	PREQB 2010	110.00	Yes	HQ > 1.0
4,4'-DDE	0/10	ND	0.1U - 0.11U	0.053	0.11	0.001	PREQB 2010	110.00	Yes	HQ > 1.0
4,4'-DDT	0/10	ND	0.1U - 0.11U	0.053	0.11	0.001	PREQB 2010	110.00	Yes	HQ > 1.0

TABLE 7-22
FREQUENCY AND RANGE OF GROUNDWATER DATA COMPARED TO GROUNDWATER SCREENING VALUES: STEP 2 SCREENING LEVEL RISK CALCULATION
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

	Contaminant Frequency/Range									
Analyte	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	Value used in Step 2 Screen [1]	Groundwater Screening Value (GWSV)	Reference [2]	Maximum HQ [4]	Ecological COPC?	Comments
Organochlorine Pesticides (µg/L)										
Aldrin	0/10	ND	0.05U - 0.056U	0.026	0.056	0.13	USEPA 2001	0.43	No	HQ < 1.0
BHC, alpha-	0/10	ND	0.05U - 0.056U	0.026	0.056	2.30	USEPA 2007	0.02	No	HQ < 1.0
BHC, beta-	0/10	ND	0.05U - 0.056U	0.026	0.056	32.0	USEPA 2007	<0.01	No	HQ < 1.0
BHC, delta-	0/10	ND	0.05U - 0.056U	0.026	0.056	0.125	USEPA 2007	0.45	No	HQ < 1.0
BHC, gamma- (Lindane)	0/10	ND	0.05U - 0.056U	0.026	0.056	0.016	PREQB 2010	3.50	Yes	HQ > 1.0
Chlordane, alpha-	1/10	0.016NJ - 0.016NJ	0.05U - 0.056U	0.026	0.016	0.004	PREQB 2010	4.00	Yes	HQ > 1.0
Chlordane, gamma-	0/10	ND	0.05U - 0.056U	0.026	0.056	0.004	PREQB 2010	14.00	Yes	HQ > 1.0
Dieldrin	0/10	ND	0.1U - 0.11U	0.053	0.11	0.0019	USEPA 2013	57.89	Yes	HQ > 1.0
Endosulfan I	0/10	ND	0.05U - 0.056U	0.026	0.056	0.0087	PREQB 2010	6.44	Yes	HQ > 1.0
Endosulfan II	0/10	ND	0.1U - 0.11U	0.053	0.11	0.0087	PREQB 2010	12.64	Yes	HQ > 1.0
Endosulfan Sulfate	0/10	ND	0.1U - 0.11U	0.053	0.11	0.92	USEPA 2007	0.12	No	HQ < 1.0
Endrin	0/10	ND	0.1U - 0.11U	0.053	0.11	0.0023	PREQB 2010	47.83	Yes	HQ > 1.0
Endrin Aldehyde	0/10	ND	0.1U - 0.11U	0.053	0.11	0.0023	---	47.83	Yes	HQ > 1.0
Heptachlor	0/10	ND	0.05U - 0.056U	0.026	0.056	0.0036	USEPA 2013	15.56	Yes	HQ > 1.0
Heptachlor Epoxide	0/10	ND	0.05U - 0.056U	0.026	0.056	0.0036	PREQB 2010	15.56	Yes	HQ > 1.0
Isodrin	0/10	ND	5UJ - 5.3UJ	2.520	5.3	0.12	USEPA 2007	44.17	Yes	HQ > 1.0
Kepone (Chlordecone)	0/10	ND	5UJ - 5.3UJ	2.520	5.3	0.094	USEPA 2007	56.38	Yes	HQ > 1.0
Methoxychlor	0/10	ND	0.5U - 0.56U	0.264	0.56	0.030	PREQB 2010	18.67	Yes	HQ > 1.0
Toxaphene	0/10	ND	2.5U - 2.8U	1.325	2.8	0.0002	PREQB 2010	14000.00	Yes	HQ > 1.0
Total Inorganics (µg/L)										
Antimony	6/10	0.26J - 0.54J	2U - 2U	0.644	0.54	500	Buchman 2008	<0.01	No	HQ < 1.0
Arsenic	10/10	0.94J - 6.2	NA	3.214	6.2	36.0	PREQB 2010	0.17	No	HQ < 1.0
Barium	10/10	6.5J - 49.1	NA	24.580	49.1	16,667	USEPA 2007	<0.01	No	HQ < 1.0
Beryllium	1/10	0.055J - 0.055J	1U - 1U	0.456	0.055	167	USEPA 2007	<0.01	No	HQ < 1.0
Cadmium	7/10	0.069J - 0.71J	1U - 1U	0.360	0.71	8.85	PREQB 2010	0.08	No	HQ < 1.0
Chromium	10/10	0.46J - 5.5	NA	1.379	5.5	50.4	PREQB 2010	0.11	No	HQ < 1.0
Cobalt	10/10	0.3J - 5.8	NA	2.308	5.8	45.0	USEPA 2007	0.13	No	HQ < 1.0
Copper	10/10	3.9 - 21.3	NA	9.510	21.3	3.73	PREQB 2010	5.71	Yes	HQ > 1.0
Lead	2/10	1.7 - 5	1U - 1U	1.070	5	8.52	PREQB 2010	0.59	No	HQ < 1.0
Nickel	9/10	1.2 - 8	1U - 1U	2.890	8	8.28	PREQB 2010	0.97	No	HQ < 1.0
Selenium	10/10	0.48J - 24.2	NA	10.248	24.2	71.1	PREQB 2010	0.34	No	HQ < 1.0
Silver	6/10	0.054J - 0.65J	1UJ - 1UJ	0.345	0.65	2.24	PREQB 2010	0.29	No	HQ < 1.0
Thallium	5/10	0.096J - 0.43J	1U - 1U	0.353	0.43	21.3	USEPA 2001	0.02	No	HQ < 1.0
Tin	0/10	ND	20U - 20U	10.000	20	180	USEPA 2003	0.11	No	HQ < 1.0
Vanadium	10/10	9.2 - 171	NA	63.290	171	12.0	USEPA 2003	14.25	Yes	HQ > 1.0

TABLE 7-22
FREQUENCY AND RANGE OF GROUNDWATER DATA COMPARED TO GROUNDWATER SCREENING VALUES: STEP 2 SCREENING LEVEL RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Notes:

COPC = Chemical of Potential Concern
USEPA = United States Environmental Protection Agency
GWSV = Groundwater Screening Value
PREQB = Puerto Rico Environmental quality Board
µg/L - microgram per liter
HQ = Hazard Quotient
ND = Not Detected
NA = Not Applicable
NE = Not Established
NJ = Estimated value (tentative identification)
J = Estimated value
U = Not detected
UJ = Not detected, estimated value

(1) All groundwater analytical data for seven VOCs (1,4-dioxane, 2-butanone, acetone, acrolein, acrylonitrile, isobutyl alchohol, and propionitrile), one SVOC (1,4-phenylenediamine), and two metals (mercury and zinc) were rejected during data validation activities. Although these analytes are not listed below (see Appendix D for all rejected groundwater analytical data), they are identified as ecological COPCs based on the lack of any useable analytical data.

(2) Maximum detected concentration (or maximum reporting limits for non-detected chemicals).

(3) See Table 7-6 for reference citations.

(4) For a given chemical, the hazard quotient (HQ) is the maximum detected concentration (or maximum reporting limit for non-detected chemicals) divided by the groundwater screening value.

TABLE 7-23
FREQUENCY AND RANGE OF DRAINAGE DITCH SURFACE WATER DATA COMPARED TO SURFACE WATER SCREENING VALUES: STEP 2 SCREENING LEVEL RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte [1]	Contaminant Frequency/Range					Surface Water Screening Value (SWSV)	Reference [3]	Maximum HQ [4]	Ecological COPC?	Comments
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half) Non-Detects)	Value used in Step 2 Screen [2]					
Volatile Organics (µg/L)										
1,1,1,2-Tetrachloroethane	0/3	ND	0.5U - 0.5U	0.250	0.5	200	USEPA 2007	<0.01	No	HQ < 1.0
1,1,1-Trichloroethane	0/3	ND	0.5U - 0.5U	0.250	0.5	76.0	USEPA 2003	<0.01	No	HQ < 1.0
1,1,2,2-Tetrachloroethane	0/3	ND	0.5U - 0.5U	0.250	0.5	240	USEPA 2001	<0.01	No	HQ < 1.0
1,1,2-Trichloroethane	0/3	ND	0.5U - 0.5U	0.250	0.5	500	USEPA 2003	<0.01	No	HQ < 1.0
1,1-Dichloroethane	0/3	ND	0.5U - 0.5U	0.250	0.5	47.0	USEPA 2003	0.01	No	HQ < 1.0
1,1-Dichloroethene	0/3	ND	0.5U - 0.5U	0.250	0.5	65.0	USEPA 2003	<0.01	No	HQ < 1.0
1,2,3-Trichloropropane	0/3	ND	0.5U - 0.5U	0.250	0.5	274	USEPA 2007	<0.01	No	HQ < 1.0
1,2-Dibromo-3-chloropropane (DBCP)	0/3	ND	0.5U - 0.5U	0.250	0.5	200	USEPA 2007	<0.01	No	HQ < 1.0
1,2-Dibromoethane (EDB)	0/3	ND	0.5U - 0.5U	0.250	0.5	150	USEPA 2007	<0.01	No	HQ < 1.0
1,2-Dichloroethane	0/3	ND	0.5U - 0.5U	0.250	0.5	910	USEPA 2003	<0.01	No	HQ < 1.0
1,2-Dichloroethene (trans)	0/3	ND	0.5U - 0.5U	0.250	0.5	970	USEPA 2003	<0.01	No	HQ < 1.0
1,2-Dichloropropane	0/3	ND	0.5U - 0.5U	0.250	0.5	360	USEPA 2003	<0.01	No	HQ < 1.0
1,3-Dichloropropene (cis)	0/3	ND	0.5U - 0.5U	0.250	0.5	24.4	USEPA 2001	0.02	No	HQ < 1.0
1,3-Dichloropropene (trans)	0/3	ND	0.5U - 0.5U	0.250	0.5	24.4	USEPA 2001	0.02	No	HQ < 1.0
1,4-Dichloro-2-butene (trans)	0/3	ND	2U - 2U	1.000	2	NE	---	NA	Yes	No SWSV
2-Chloro-1,3-butadiene (Chloroprene)	0/3	ND	0.5U - 0.5U	0.250	0.5	NE	---	NA	Yes	No SWSV
2-Hexanone (MBK)	0/3	ND	2.5U - 2.5U	1.250	2.5	99.0	USEPA 2003	0.03	No	HQ < 1.0
3-Chloropropene (Allyl Chloride)	0/3	ND	0.5U - 0.5U	0.250	0.5	3.40	USEPA 2007	0.15	No	HQ < 1.0
4-Methyl-2-pentanone (MIBK)	0/3	ND	2.5U - 2.5U	1.250	2.5	170	USEPA 2003	0.01	No	HQ < 1.0
Acetonitrile	0/3	ND	0.5U - 0.5U	0.250	0.5	12,000	USEPA 2003	<0.01	No	HQ < 1.0
Benzene	0/3	ND	0.5U - 0.5U	0.250	0.5	53.0	USEPA 2001	<0.01	No	HQ < 1.0
Bromodichloromethane	1/3	0.34J - 0.34J	0.5U - 0.5U	0.280	0.34	2,400	USEPA 2007	<0.01	No	HQ < 1.0
Bromoform	0/3	ND	0.5U - 0.5U	0.250	0.5	230	USEPA 2003	<0.01	No	HQ < 1.0
Bromomethane	0/3	ND	0.5U - 0.5U	0.250	0.5	16.0	USEPA 2003	0.03	No	HQ < 1.0
Carbon Disulfide	1/3	0.021J - 0.021J	0.5U - 0.5U	0.174	0.021	15.0	USEPA 2003	<0.01	No	HQ < 1.0
Carbon Tetrachloride	0/3	ND	0.5U - 0.5U	0.250	0.5	240	USEPA 2003	<0.01	No	HQ < 1.0
Chlorobenzene	0/3	ND	0.5U - 0.5U	0.250	0.5	47.0	USEPA 2003	0.01	No	HQ < 1.0
Chloroethane	0/3	ND	0.5U - 0.5U	0.250	0.5	NE	---	NA	Yes	No SWSV
Chloroform	1/3	1.2 - 1.2	0.5U - 0.5U	0.567	1.2	140	USEPA 2003	<0.01	No	HQ < 1.0
Chloromethane	0/3	ND	0.5U - 0.5U	0.250	0.5	5,500	USEPA 2001	<0.01	No	HQ < 1.0
Dibromochloromethane	1/3	0.16J - 0.16J	0.5U - 0.5U	0.220	0.16	340	USEPA 2007	<0.01	No	HQ < 1.0
Dibromomethane	0/3	ND	0.5U - 0.5U	0.250	0.5	220	Buchman 2008	<0.01	No	HQ < 1.0
Ethyl Methacrylate	0/3	ND	5U - 5U	2.500	5	18,000	USEPA 2007	<0.01	No	HQ < 1.0
Ethylbenzene	0/3	ND	0.5U - 0.5U	0.250	0.5	14.0	USEPA 2003	0.04	No	HQ < 1.0
Freon 11 (Trichlorofluoromethane)	0/3	ND	0.5UJ - 0.5UJ	0.250	0.5	220	Buchman 2008	<0.01	No	HQ < 1.0
Freon-12 (Dichlorodifluoromethane)	0/3	ND	0.5U - 0.5U	0.250	0.5	220	---	<0.01	No	HQ < 1.0
Methyl Acrylonitrile	0/3	ND	5U - 5U	2.500	5	NE	---	NA	Yes	No SWSV
Methyl Iodide	0/3	ND	0.5U - 0.5U	0.250	0.5	NE	---	NA	Yes	No SWSV
Methyl Methacrylate	0/3	ND	5U - 5U	2.500	5	2,800	USEPA 2003	<0.01	No	HQ < 1.0
Methylene Chloride	0/3	ND	0.5U - 0.5U	0.250	0.5	159	USEPA 2003	<0.01	No	HQ < 1.0
Pentachloroethane	0/3	ND	0.5U - 0.5U	0.250	0.5	56.4	USEPA 2003	<0.01	No	HQ < 1.0

TABLE 7-23
FREQUENCY AND RANGE OF DRAINAGE DITCH SURFACE WATER DATA COMPARED TO SURFACE WATER SCREENING VALUES: STEP 2 SCREENING LEVEL RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte [1]	Contaminant Frequency/Range					Surface Water Screening Value (SWSV)	Reference [3]	Maximum HQ [4]	Ecological COPC?	Comments
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half) Non-Detects)	Value used in Step 2 Screen [2]					
Volatile Organics (µg/L)										
Styrene (Ethenylbenzene)	0/3	ND	0.5U - 0.5U	0.250	0.5	32.0	USEPA 2003	0.02	No	HQ < 1.0
Tetrachloroethene (PCE)	0/3	ND	0.5U - 0.5U	0.250	0.5	45.0	USEPA 2003	0.01	No	HQ < 1.0
Toluene	0/3	ND	0.5U - 0.5U	0.250	0.5	175	USEPA 2001	<0.01	No	HQ < 1.0
Trichloroethene (TCE)	0/3	ND	0.5U - 0.5U	0.250	0.5	47.0	USEPA 2003	0.01	No	HQ < 1.0
Vinyl Acetate	0/3	ND	1U - 1U	0.500	1	248	USEPA 2003	<0.01	No	HQ < 1.0
Vinyl Chloride	0/3	ND	0.5U - 0.5U	0.250	0.5	930	USEPA 2003	<0.01	No	HQ < 1.0
Xylene, m/p-	0/3	ND	1U - 1U	0.500	1	27.0	USEPA 2003	0.04	No	HQ < 1.0
Xylene, o-	0/3	ND	0.5U - 0.5U	0.250	0.5	27.0	USEPA 2003	0.02	No	HQ < 1.0
Xylenes, total	0/3	ND	0.5U - 0.5U	0.250	0.5	27.0	USEPA 2003	0.02	No	HQ < 1.0
Semi-Volatile Organics (µg/L)										
1,2,4,5-Tetrachlorobenzene	0/3	ND	5UJ - 5.1UJ	2.517	5.1	3.00	USEPA 2003	1.70	Yes	HQ > 1.0
1,2,4-Trichlorobenzene	0/3	ND	5UJ - 5.1UJ	2.517	5.1	30.0	USEPA 2003	0.17	No	HQ < 1.0
1,2-Dichlorobenzene (o-)	0/3	ND	5UJ - 5.1UJ	2.517	5.1	14.0	USEPA 2003	0.36	No	HQ < 1.0
1,3,5-Trinitrobenzene (TNB)	0/3	ND	5UJ - 5.1UJ	2.517	5.1	80.0	USEPA 2007	0.06	No	HQ < 1.0
1,3-Dichlorobenzene (m-)	0/3	ND	5UJ - 5.1UJ	2.517	5.1	38.0	USEPA 2003	0.13	No	HQ < 1.0
1,3-Dinitrobenzene (m-)	0/3	ND	5UJ - 5.1UJ	2.517	5.1	22.0	USEPA 2003	0.23	No	HQ < 1.0
1,4-Dichlorobenzene (p-)	0/3	ND	5UJ - 5.1UJ	2.517	5.1	9.40	USEPA 2003	0.54	No	HQ < 1.0
1,4-Naphthoquinone	0/3	ND	5UJ - 5.1UJ	2.517	5.1	0.40	USEPA 2007	12.75	Yes	HQ > 1.0
1-Naphthylamine	0/3	ND	5UJ - 5.1UJ	2.517	5.1	70	USEPA 2007	0.07	No	HQ < 1.0
2,2'-Oxybis[1-chloropropane]	0/3	ND	5UJ - 5.1UJ	2.517	5.1	NE	---	NA	Yes	No SWSV
2,3,4,6-Tetrachlorophenol	0/3	ND	10UJ - 10UJ	5.000	10	1.20	USEPA 2003	8.33	Yes	HQ > 1.0
2,4,5-Trichlorophenol	0/3	ND	10UJ - 10UJ	5.000	10	62.5	USEPA 2007	0.16	No	HQ < 1.0
2,4,6-Trichlorophenol	0/3	ND	10UJ - 10UJ	5.000	10	4.90	USEPA 2003	2.04	Yes	HQ > 1.0
2,4-Dichlorophenol	0/3	ND	10UJ - 10UJ	5.000	10	11.0	USEPA 2003	0.91	No	HQ < 1.0
2,4-Dimethylphenol	0/3	ND	10UJ - 10UJ	5.000	10	21.2	USEPA 2001	0.47	No	HQ < 1.0
2,4-Dinitrophenol	0/3	ND	10UJ - 10UJ	5.000	10	6.20	USEPA 2001	1.61	Yes	HQ > 1.0
2,4-Dinitrotoluene (DNT)	0/3	ND	5UJ - 5.1UJ	2.517	5.1	44.0	USEPA 2003	0.12	No	HQ < 1.0
2,6-Dichlorophenol	0/3	ND	10UJ - 10UJ	5.000	10	34.0	USEPA 2007	0.29	No	HQ < 1.0
2,6-Dinitrotoluene (DNT)	0/3	ND	5UJ - 5.1UJ	2.517	5.1	81.0	USEPA 2003	0.06	No	HQ < 1.0
2-Acetylaminofluorene	0/3	ND	5UJ - 5.1UJ	2.517	5.1	20.0	USEPA 2007	0.26	No	HQ < 1.0
2-Chloronaphthalene	0/3	ND	5UJ - 5.1UJ	2.517	5.1	32.0	Buchman 2008	0.16	No	HQ < 1.0
2-Chlorophenol	0/3	ND	10UJ - 10UJ	5.000	10	24.0	USEPA 2003	0.42	No	HQ < 1.0
2-Methyl-5-nitroaniline	0/3	ND	5UJ - 5.1UJ	2.517	5.1	220	USEPA 2007	0.02	No	HQ < 1.0
2-Methylnaphthalene	0/3	ND	0.2UJ - 0.21UJ	0.102	0.21	14.56	USEPA 2007	0.01	No	HQ < 1.0
2-Methylphenol (o-Cresol)	0/3	ND	10UJ - 10UJ	5.000	10	67.0	USEPA 2003	0.15	No	HQ < 1.0
2-Naphthylamine	0/3	ND	5UJ - 5.1UJ	2.517	5.1	NE	---	NA	Yes	No SWSV
2-Nitroaniline	0/3	ND	5UJ - 5.1UJ	2.517	5.1	48.9	USEPA 2007	0.10	No	HQ < 1.0
2-Nitrophenol	0/3	ND	10UJ - 10UJ	5.000	10	3,500	USEPA 2001	<0.01	No	HQ < 1.0
2-Picoline	0/3	ND	5UJ - 5.1UJ	2.517	5.1	8.970	USEPA 2007	0.57	No	HQ < 1.0
3,3'-Dichlorobenzidine	0/3	ND	5UJ - 5.1UJ	2.517	5.1	4.50	USEPA 2003	1.13	Yes	HQ > 1.0
3,3'-Dimethylbenzidine	0/3	ND	5UJ - 5.1UJ	2.517	5.1	160	USEPA 2007	0.03	No	HQ < 1.0

TABLE 7-23
FREQUENCY AND RANGE OF DRAINAGE DITCH SURFACE WATER DATA COMPARED TO SURFACE WATER SCREENING VALUES: STEP 2 SCREENING LEVEL RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte [1]	Contaminant Frequency/Range					Surface Water Screening Value (SWSV)	Reference [3]	Maximum HQ [4]	Ecological COPC?	Comments
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half) Non-Detects)	Value used in Step 2 Screen [2]					
Semi-Volatile Organics (µg/L)										
3-Methylcholanthrene	0/3	ND	5UJ - 5.1UJ	2.517	5.1	NE	---	NA	Yes	No SWSV
3-Methylphenol (m-Cresol)	0/3	ND	8UJ - 8.2UJ	4.033	8.2	62.0	USEPA 2003	0.13	No	HQ < 1.0
3-Nitroaniline	0/3	ND	5UJ - 5.1UJ	2.517	5.1	9.80	USEPA 2007	0.52	No	HQ < 1.0
4,6-Dinitro-2-methylphenol	0/3	ND	10UJ - 10UJ	5.000	10	23.0	USEPA 2003	0.43	No	HQ < 1.0
4-Aminobiphenyl	0/3	ND	5UJ - 5.1UJ	2.517	5.1	NE	---	NA	Yes	No SWSV
4-Bromophenyl-phenylether	0/3	ND	5UJ - 5.1UJ	2.517	5.1	1.50	USEPA 2003	3.40	Yes	HQ > 1.0
4-Chloro-3-methylphenol	0/3	ND	10UJ - 10UJ	5.000	10	0.30	USEPA 2001	33.33	Yes	HQ > 1.0
4-Chloroaniline	0/3	ND	5UJ - 5.1UJ	2.517	5.1	232	USEPA 2003	0.02	No	HQ < 1.0
4-Chlorophenyl-phenylether	0/3	ND	5UJ - 5.1UJ	2.517	5.1	7.30	USEPA 2007	0.70	No	HQ < 1.0
4-Dimethylaminoazobenzene (p-)	0/3	ND	5UJ - 5.1UJ	2.517	5.1	NE	---	NA	Yes	No SWSV
4-Methylphenol (p-Cresol)	0/3	ND	8UJ - 8.2UJ	4.033	8.2	25.0	USEPA 2003	0.33	No	HQ < 1.0
4-Nitroaniline	0/3	ND	5UJ - 5.1UJ	2.517	5.1	170	USEPA 2007	0.03	No	HQ < 1.0
4-Nitrophenol	0/3	ND	10UJ - 10UJ	5.000	10	60.0	USEPA 2003	0.17	No	HQ < 1.0
4-Nitroquinoline-1-oxide	0/1	ND	5U - 5U	2.500	5	NE	---	NA	Yes	No SWSV
7,12-Dimethylbenz(a)anthracene	0/3	ND	5UJ - 5.1UJ	2.517	5.1	6.00	Buchman 2008	0.85	No	HQ < 1.0
a,a-Dimethylphenethylamine	0/3	ND	50UJ - 51UJ	25.167	51	NE	---	NA	Yes	No SWSV
Acenaphthene	0/3	ND	0.2UJ - 0.21UJ	0.102	0.21	23.0	USEPA 1996	<0.01	No	HQ < 1.0
Acenaphthylene	0/3	ND	0.2UJ - 0.21UJ	0.102	0.21	6.00	Buchman 2008	0.04	No	HQ < 1.0
Acetophenone	0/3	ND	2.5UJ - 2.6UJ	1.267	2.6	1,550	USEPA 2007	<0.01	No	HQ < 1.0
Aniline	0/3	ND	5UJ - 5.1UJ	2.517	5.1	4.10	USEPA 2003	1.24	Yes	HQ > 1.0
Anthracene	0/3	ND	0.2UJ - 0.21UJ	0.102	0.21	0.035	USEPA 2003	6.00	Yes	HQ > 1.0
Aramite	0/3	ND	5UJ - 5.1UJ	2.517	5.1	3.09	USEPA 2003	1.65	Yes	HQ > 1.0
Benzo(a)anthracene	0/3	ND	0.2UJ - 0.21UJ	0.102	0.21	0.025	USEPA 2003	8.40	Yes	HQ > 1.0
Benzo(a)pyrene (BaP)	0/3	ND	0.2UJ - 0.21UJ	0.102	0.21	0.014	USEPA 2003	15.00	Yes	HQ > 1.0
Benzo(b)fluoranthene	0/3	ND	0.2UJ - 0.21UJ	0.102	0.21	6.00	Buchman 2008	0.04	No	HQ < 1.0
Benzo(g,h,i)perylene	0/3	ND	0.2UJ - 0.21UJ	0.102	0.21	6.00	Buchman 2008	0.04	No	HQ < 1.0
Benzo(k)fluoranthene	0/3	ND	0.2UJ - 0.21UJ	0.102	0.21	6.00	Buchman 2008	0.04	No	HQ < 1.0
Benzyl Alcohol	0/3	ND	5UJ - 5.1UJ	2.517	5.1	8.60	USEPA 2003	0.59	No	HQ < 1.0
Bis(2-chloroethoxy)methane	0/3	ND	5UJ - 5.1UJ	2.517	5.1	1,840	USEPA 2007	<0.01	No	HQ < 1.0
Bis(2-chloroethyl)ether	0/3	ND	5UJ - 5.1UJ	2.517	5.1	2,380	USEPA 2001	<0.01	No	HQ < 1.0
Bis(2-ethylhexyl) Phthalate (BEHP)	0/3	ND	5UJ - 5.1UJ	2.517	5.1	0.30	USEPA 2003	17.00	Yes	HQ > 1.0
Butyl Benzyl Phthalate	0/3	ND	5UJ - 5.1UJ	2.517	5.1	22.0	USEPA 2001	0.23	No	HQ < 1.0
Chlorobenzilate	0/3	ND	5UJ - 5.1UJ	2.517	5.1	NE	---	NA	Yes	No SWSV
Chrysene	0/3	ND	0.2UJ - 0.21UJ	0.102	0.21	10.0	USEPA 2004	0.02	No	HQ < 1.0
Diallate (cis)	0/3	ND	5UJ - 5.1UJ	2.517	5.1	82.0	USEPA 2007	0.06	No	HQ < 1.0
Diallate (trans)	0/3	ND	5UJ - 5.1UJ	2.517	5.1	82.0	USEPA 2007	0.06	No	HQ < 1.0
Dibenz(a,h)anthracene	0/3	ND	0.2UJ - 0.21UJ	0.102	0.21	6.00	Buchman 2008	0.04	No	HQ < 1.0
Dibenzofuran	0/3	ND	5UJ - 5.1UJ	2.517	5.1	4.00	USEPA 2003	1.28	Yes	HQ > 1.0
Diethyl Phthalate (DEP)	0/3	ND	5UJ - 5.1UJ	2.517	5.1	110	USEPA 2003	0.05	No	HQ < 1.0
Dimethyl Phthalate	0/3	ND	5UJ - 5.1UJ	2.517	5.1	330	USEPA 2001	0.02	No	HQ < 1.0
Di-n-butyl Phthalate (DBP)	0/3	ND	5UJ - 5.1UJ	2.517	5.1	9.40	USEPA 2001	0.54	No	HQ < 1.0

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FREQUENCY AND RANGE OF DRAINAGE DITCH SURFACE WATER DATA COMPARED TO SURFACE WATER SCREENING VALUES: STEP 2 SCREENING LEVEL RISK CALCULATION
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Analyte [1]	Contaminant Frequency/Range					Surface Water Screening Value (SWSV)	Reference [3]	Maximum HQ [4]	Ecological COPC?	Comments
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half) Non-Detects)	Value used in Step 2 Screen [2]					
Semi-Volatile Organics (µg/L)										
Di-n-octyl Phthalate	0/3	ND	5UJ - 5.1UJ	2.517	5.1	30.0	USEPA 2003	0.17	No	HQ < 1.0
Dinoseb	0/2	ND	5UJ - 5.1UJ	2.525	5.1	0.48	USEPA 2003	10.63	Yes	HQ > 1.0
Ethyl Methane Sulfonate (EMS)	0/3	ND	5UJ - 5.1UJ	2.517	5.1	40.0	USEPA 2007	0.13	No	HQ < 1.0
Fluoranthene	2/3	0.017J - 0.019J	0.2U - 0.2U	0.045	0.019	8.10	USEPA 1996	<0.01	No	HQ < 1.0
Fluorene	0/3	ND	0.2UJ - 0.21UJ	0.102	0.21	19.0	USEPA 2003	0.01	No	HQ < 1.0
Hexachloro-1,3-butadiene	0/3	ND	5UJ - 5.1UJ	2.517	5.1	0.93	USEPA 2001	5.48	Yes	HQ > 1.0
Hexachlorobenzene	0/3	ND	5UJ - 5.1UJ	2.517	5.1	0.13	USEPA 2007	39.23	Yes	HQ > 1.0
Hexachlorocyclopentadiene	0/3	ND	5UJ - 5.1UJ	2.517	5.1	0.07	USEPA 2001	72.86	Yes	HQ > 1.0
Hexachloroethane	0/3	ND	5UJ - 5.1UJ	2.517	5.1	8.00	USEPA 2003	0.64	No	HQ < 1.0
Hexachloropropene	0/3	ND	5UJ - 5.1UJ	2.517	5.1	NE	---	NA	Yes	No SWSV
Indeno(1,2,3-cd)pyrene	0/3	ND	0.2UJ - 0.21UJ	0.102	0.21	6.00	Buchman 2008	0.04	No	HQ < 1.0
Isophorone	0/3	ND	5UJ - 5.1UJ	2.517	5.1	920	USEPA 2003	<0.01	No	HQ < 1.0
Isosafrole	0/3	ND	5UJ - 5.1UJ	2.517	5.1	NE	---	NA	Yes	No SWSV
Methapyrilene	0/3	ND	5UJ - 5.1UJ	2.517	5.1	NE	---	NA	Yes	No SWSV
Methyl Methane Sulfonate	0/3	ND	5UJ - 5.1UJ	2.517	5.1	NE	---	NA	Yes	No SWSV
Naphthalene	0/3	ND	0.2UJ - 0.21UJ	0.102	0.21	13.0	USEPA 2003	0.02	No	HQ < 1.0
Nitrobenzene	0/3	ND	5UJ - 5.1UJ	2.517	5.1	220	USEPA 2003	0.02	No	HQ < 1.0
n-Nitrosodiethylamine	0/3	ND	5UJ - 5.1UJ	2.517	5.1	768	USEPA 2003	<0.01	No	HQ < 1.0
n-Nitrosodimethylamine (NDMA)	0/3	ND	5UJ - 5.1UJ	2.517	5.1	25.0	---	0.20	No	HQ < 1.0
n-Nitroso-di-n-butylamine	0/3	ND	5UJ - 5.1UJ	2.517	5.1	25.0	---	0.20	No	HQ < 1.0
n-Nitrosodi-n-propylamine	0/3	ND	5UJ - 5.1UJ	2.517	5.1	25.0	---	0.20	No	HQ < 1.0
n-Nitrosodiphenylamine	0/3	ND	5UJ - 5.1UJ	2.517	5.1	25.0	USEPA 2011	0.20	No	HQ < 1.0
n-Nitrosomethylethylamine	0/3	ND	5UJ - 5.1UJ	2.517	5.1	25.0	---	0.20	No	HQ < 1.0
n-Nitrosomorpholine	0/3	ND	5UJ - 5.1UJ	2.517	5.1	NE	---	NA	Yes	No SWSV
n-Nitrosopiperidine	0/3	ND	5UJ - 5.1UJ	2.517	5.1	NE	---	NA	Yes	No SWSV
n-Nitrosopyrrolidine	0/3	ND	5UJ - 5.1UJ	2.517	5.1	NE	---	NA	Yes	No SWSV
o-Toluidine	0/3	ND	5UJ - 5.1UJ	2.517	5.1	5.20	USEPA 2007	0.98	No	HQ < 1.0
Pentachlorobenzene	0/3	ND	5UJ - 5.1UJ	2.517	5.1	0.019	USEPA 2003	268.42	Yes	HQ > 1.0
Pentachloronitrobenzene	0/3	ND	5UJ - 5.1UJ	2.517	5.1	1.00	USEPA 2007	5.10	Yes	HQ > 1.0
Pentachlorophenol	0/3	ND	10UJ - 10UJ	5.000	10	15.0	USEPA 2013	0.67	No	HQ < 1.0
Phenacetin	0/3	ND	5UJ - 5.1UJ	2.517	5.1	NE	---	NA	Yes	No SWSV
Phenanthrene	0/3	ND	0.2UJ - 0.21UJ	0.102	0.21	6.30	USEPA 1996	0.03	No	HQ < 1.0
Phenol	0/3	ND	10UJ - 10UJ	5.000	10	180	USEPA 2003	0.06	No	HQ < 1.0
Pronamide	0/3	ND	5UJ - 10U	3.350	10	7.60	USEPA 2007	1.32	Yes	HQ > 1.0
Pyrene	2/3	0.018J - 0.02J	0.2U - 0.2U	0.046	0.02	0.30	USEPA 2003	0.07	No	HQ < 1.0
Pyridine	0/3	ND	5UJ - 5.1UJ	2.517	5.1	2,380	USEPA 2003	<0.01	No	HQ < 1.0
Safrole	0/3	ND	5UJ - 5.1UJ	2.517	5.1	NE	---	NA	Yes	No SWSV
Organochlorine Pesticides (µg/L)										
4,4'-DDD	0/3	ND	0.1U - 0.1U	0.050	0.1	0.001	PREQB 2010	100.00	Yes	HQ > 1.0
4,4'-DDE	1/3	0.006J - 0.006J	0.1U - 0.1U	0.035	0.006	0.001	PREQB 2010	6.00	Yes	HQ > 1.0
4,4'-DDT	1/3	0.0065J - 0.0065J	0.1U - 0.1U	0.036	0.0065	0.001	PREQB 2010	6.50	Yes	HQ > 1.0

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	Contaminant Frequency/Range									
Analyte [1]	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half) Non-Detects)	Value used in Step 2 Screen [2]	Surface Water Screening Value (SWSV)	Reference [3]	Maximum HQ [4]	Ecological COPC?	Comments
Organochlorine Pesticides (µg/L)										
Aldrin	0/3	ND	0.05U - 0.051U	0.025	0.051	0.017	USEPA 2003	3.00	Yes	HQ > 1.0
BHC, alpha-	0/3	ND	0.05U - 0.051U	0.025	0.051	2.30	USEPA 2007	0.02	No	HQ < 1.0
BHC, beta-	0/3	ND	0.05U - 0.051U	0.025	0.051	32.0	USEPA 2007	<0.01	No	HQ < 1.0
BHC, delta-	0/3	ND	0.05U - 0.051U	0.025	0.051	1.20	USEPA 2007	0.04	No	HQ < 1.0
BHC, gamma- (Lindane)	0/3	ND	0.05U - 0.051U	0.025	0.051	0.026	USEPA 2003	1.96	Yes	HQ > 1.0
Chlordane, alpha-	0/3	ND	0.05U - 0.051U	0.025	0.051	0.0043	PREQB 2010	11.86	Yes	HQ > 1.0
Chlordane, gamma-	0/3	ND	0.05U - 0.051U	0.025	0.051	0.0043	PREQB 2010	11.86	Yes	HQ > 1.0
Dieldrin	0/3	ND	0.1U - 0.1U	0.050	0.1	0.056	USEPA 2013	1.79	Yes	HQ > 1.0
Endosulfan I	0/3	ND	0.05U - 0.051U	0.025	0.051	0.056	PREQB 2010	0.91	No	HQ < 1.0
Endosulfan II	0/3	ND	0.1U - 0.1U	0.050	0.1	0.056	PREQB 2010	1.79	Yes	HQ > 1.0
Endosulfan Sulfate	0/3	ND	0.1U - 0.1U	0.050	0.1	0.92	USEPA 2007	0.11	No	HQ < 1.0
Endrin	0/3	ND	0.1U - 0.1U	0.050	0.1	0.036	PREQB 2010	2.78	Yes	HQ > 1.0
Endrin Aldehyde	0/2	ND	0.1U - 0.1U	0.050	0.1	0.036	---	2.78	Yes	HQ > 1.0
Heptachlor	0/3	ND	0.05U - 0.051U	0.025	0.051	0.0038	USEPA 2013	13.42	Yes	HQ > 1.0
Heptachlor Epoxide	0/3	ND	0.05U - 0.051U	0.025	0.051	0.0038	PREQB 2010	13.42	Yes	HQ > 1.0
Isodrin	0/3	ND	5UJ - 5.1UJ	2.517	5.1	0.12	USEPA 2007	42.50	Yes	HQ > 1.0
Kepone (Chlordecone)	0/3	ND	5UJ - 5.1UJ	2.517	5.1	11.2	PREQB 2010	0.46	No	HQ < 1.0
Methoxychlor	0/3	ND	0.5U - 0.51U	0.252	0.51	0.03	PREQB 2010	17.00	Yes	HQ > 1.0
Toxaphene	0/3	ND	2.5U - 2.6U	1.267	2.6	0.0002	PREQB 2010	13000.00	Yes	HQ > 1.0
Total Inorganics (µg/L)										
Antimony	2/3	0.23J - 0.26J	2U - 2U	0.497	0.26	80.0	USEPA 2003	<0.01	No	HQ < 1.0
Arsenic	3/3	0.42J - 0.49J	NA	0.450	0.49	150	USEPA 2013	<0.01	No	HQ < 1.0
Barium	3/3	19.4 - 21.4	NA	20.233	21.4	220	USEPA 2003	0.10	No	HQ < 1.0
Beryllium	0/3	ND	1U - 1U	0.500	1	1.69	USEPA 2013	0.59	No	HQ < 1.0
Cadmium	0/3	ND	1U - 1U	0.500	1	0.11	PREQB 2010	8.73	Yes	HQ > 1.0
Chromium	3/3	0.68J - 0.76J	NA	0.730	0.76	33.3	PREQB 2010	0.02	No	HQ < 1.0
Cobalt	3/3	0.32J - 0.34J	NA	0.333	0.34	24.0	USEPA 2003	0.01	No	HQ < 1.0
Copper	3/3	3.8 - 4	NA	3.933	4	3.46	PREQB 2010	1.16	Yes	HQ > 1.0
Lead	0/3	ND	1U - 1U	0.500	1	0.73	PREQB 2010	1.38	Yes	HQ > 1.0
Mercury	0/1	ND	0.2U - 0.2U	0.100	0.2	0.91	USEPA 2013	0.22	No	HQ < 1.0
Nickel	0/3	ND	1U - 1U	0.500	1	19.55	PREQB 2010	0.05	No	HQ < 1.0
Selenium	3/3	0.47J - 0.75J	NA	0.580	0.75	5.00	PREQB 2010	0.15	No	HQ < 1.0
Silver	0/3	ND	1UJ - 1UJ	0.500	1	0.51	PREQB 2010	1.94	Yes	HQ > 1.0
Thallium	0/3	ND	1U - 1U	0.500	1	4.00	USEPA 2001	0.25	No	HQ < 1.0
Tin	0/3	ND	20U - 20U	10.000	20	180	USEPA 2003	0.11	No	HQ < 1.0
Vanadium	3/3	7 - 7.6	NA	7.300	7.6	12.0	USEPA 2003	0.63	No	HQ < 1.0
Zinc	1/1	7.9J - 7.9J	NA	7.900	7.9	44.8	PREQB 2010	0.18	No	HQ < 1.0

TABLE 7-23
FREQUENCY AND RANGE OF DRAINAGE DITCH SURFACE WATER DATA COMPARED TO SURFACE WATER SCREENING VALUES: STEP 2 SCREENING LEVEL RISK CALCULATION
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Notes:

COPC = Chemical of Potential Concern
USEPA = United States Environmental Protection Agency
SWSV = Surface Water Screening Value
PREQB = Puerto Rico Environmental Quality Board
HQ = Hazard Quotient
ug/L - microgram per liter
ND = Not Detected
NA = Not Applicable
NE = Not Established
J = Estimated value
U = Not detected
UJ = Not detected, estimated value

(1) All surface water analytical data for seven VOCs (1,4-dioxane, 2-butanone, acetone, acrolein, acrylonitrile, isobutyl alchohol, and propionitrile) and one SVOC (1,4-phenylenediamine) were rejected during data validation activities. Although these eight organic analytes are not listed below (see Appendix D for all rejected drainage ditch surface water analytical data), they are identified as ecological COPCs based on the lack of any useable analytical data.

(2) Maximum detected concentration (or maximum reporting limit for non-detected chemicals).

(3) See Table 7-7 for reference citations.

(4) For a given chemical, the hazard quotient (HQ) is the maximum detected concentration (or maximum reporting limit for non-detected chemicals) divided by the surface water screening value.

TABLE 7-24
FREQUENCY AND RANGE OF DRAINAGE DITCH SEDIMENT DATA COMPARED TO SEDIMENT SCREENING VALUES: STEP 2 SCREENING LEVEL RISK CALCULATION
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Analyte [1]	Contaminant Frequency/Range					Sediment Screeniing Value (SDSV)	Reference [3]	Maximum HQ [4]	Ecological COPC?	Comments
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	Value used in Step 2 Screen [2]					
Volatile Organics (µg/kg)										
1,1,1,2-Tetrachloroethane	0/3	ND	6.7U - 12UJ	4.950	12	1,617	USEPA 1993 and 1996	<0.01	No	HQ < 1.0
1,1,1-Trichloroethane	0/3	ND	6.7U - 12UJ	4.950	12	438	USEPA 1993 and 1996	0.03	No	HQ < 1.0
1,1,2,2-Tetrachloroethane	0/3	ND	6.7U - 12UJ	4.950	12	1,127	USEPA 1993 and 1996	0.01	No	HQ < 1.0
1,1,2-Trichloroethane	0/3	ND	6.7U - 12UJ	4.950	12	1,088	USEPA 1993 and 1996	0.01	No	HQ < 1.0
1,1-Dichloroethane	0/3	ND	6.7U - 12UJ	4.950	12	56.8	USEPA 1993 and 1996	0.21	No	HQ < 1.0
1,1-Dichloroethene	0/3	ND	6.7U - 12UJ	4.950	12	170	USEPA 1993 and 1996	0.07	No	HQ < 1.0
1,2,3-Trichloropropane	0/3	ND	6.7U - 12UJ	4.950	12	938	USEPA 1993 and 1996	0.01	No	HQ < 1.0
1,2-Dibromo-3-chloropropane (DBCP)	0/3	ND	6.7U - 12UJ	4.950	12	839	USEPA 1993 and 1996	0.01	No	HQ < 1.0
1,2-Dibromoethane (EDB)	0/3	ND	6.7U - 12UJ	4.950	12	291	USEPA 1993 and 1996	0.04	No	HQ < 1.0
1,2-Dichloroethane	0/3	ND	6.7U - 12UJ	4.950	12	533	USEPA 1993 and 1996	0.02	No	HQ < 1.0
1,2-Dichloroethene (trans)	0/3	ND	6.7U - 12UJ	4.950	12	2,208	USEPA 1993 and 1996	<0.01	No	HQ < 1.0
1,2-Dichloropropane	0/3	ND	6.7U - 12UJ	4.950	12	654	USEPA 1993 and 1996	0.02	No	HQ < 1.0
1,3-Dichloropropene (cis)	0/3	ND	6.7U - 12UJ	4.950	12	54.3	USEPA 1993 and 1996	0.22	No	HQ < 1.0
1,3-Dichloropropene (trans)	0/3	ND	6.7U - 12UJ	4.950	12	50.7	USEPA 1993 and 1996	0.24	No	HQ < 1.0
1,4-Dichloro-2-butene (trans)	0/3	ND	27U - 47UJ	19.333	47	NE	---	NA	Yes	No SDSV
2-Butanone (MEK)	0/3	ND	17U - 29UJ	12.000	29	87.1	USEPA 1993 and 1996	0.33	No	HQ < 1.0
2-Chloro-1,3-butadiene (Chloroprene)	0/3	ND	6.7U - 12UJ	4.950	12	NE	---	NA	Yes	No SDSV
2-Hexanone (MBK)	0/3	ND	17U - 29UJ	12.000	29	47.3	USEPA 1993 and 1996	0.61	No	HQ < 1.0
3-Chloropropene (Allyl Chloride)	0/3	ND	6.7U - 12UJ	4.950	12	5.64	USEPA 1993 and 1996	2.13	Yes	HQ > 1.0
4-Methyl-2-pentanone (MIBK)	0/3	ND	17U - 29UJ	12.000	29	69.3	USEPA 1993 and 1996	0.42	No	HQ < 1.0
Acetone	2/2	78 - 150J	NA	114.000	150	20.8	USEPA 1993 and 1996	7.23	Yes	HQ > 1.0
Acetonitrile	0/3	ND	6.7U - 12UJ	4.950	12	117	USEPA 1993 and 1996	0.10	No	HQ < 1.0
Acrylonitrile	0/2	ND	67U - 120UJ	46.750	120	2.44	USEPA 1993 and 1996	49.13	Yes	HQ > 1.0
Benzene	0/3	ND	6.7U - 12UJ	4.950	12	138	USEPA 1993 and 1996	0.09	No	HQ < 1.0
Bromodichloromethane	0/3	ND	6.7U - 12UJ	4.950	12	5,848	USEPA 1993 and 1996	<0.01	No	HQ < 1.0
Bromoform	0/3	ND	6.7U - 12UJ	4.950	12	987	USEPA 1993 and 1996	0.01	No	HQ < 1.0
Bromomethane	0/3	ND	6.7U - 12UJ	4.950	12	4.97	USEPA 1993 and 1996	2.41	Yes	HQ > 1.0
Carbon Disulfide	1/3	2.3J - 2.3J	6.7U - 12UJ	3.883	2.3	29.1	USEPA 1993 and 1996	0.08	No	HQ < 1.0
Carbon Tetrachloride	0/3	ND	6.7U - 12UJ	4.950	12	2,434	USEPA 1993 and 1996	<0.01	No	HQ < 1.0
Chlorobenzene	0/3	ND	6.7U - 12UJ	4.950	12	640	USEPA 1993 and 1996	0.02	No	HQ < 1.0
Chloroethane	0/3	ND	6.7U - 12UJ	4.950	12	6,070	Di Toro and McGrath 2000	<0.01	No	HQ < 1.0
Chloroform	0/3	ND	6.7U - 12UJ	4.950	12	227	USEPA 1993 and 1996	0.05	No	HQ < 1.0
Chloromethane	0/3	ND	6.7U - 12UJ	4.950	12	907	USEPA 1993 and 1996	0.01	No	HQ < 1.0
Dibromochloromethane	0/3	ND	6.7U - 12UJ	4.950	12	971	USEPA 1993 and 1996	0.01	No	HQ < 1.0
Dibromomethane	0/3	ND	6.7U - 12UJ	4.950	12	147	USEPA 1993 and 1996	0.08	No	HQ < 1.0
Ethyl Methacrylate	0/3	ND	67U - 120UJ	49.500	120	13,827	USEPA 1993 and 1996	<0.01	No	HQ < 1.0
Ethylbenzene	0/3	ND	6.7U - 12UJ	4.950	12	4.00	Buchman 2008	3.00	Yes	HQ > 1.0
Freon 11 (Trichlorofluoromethane)	0/3	ND	6.7U - 12UJ	4.950	12	1,419	USEPA 1993 and 1996	<0.01	No	HQ < 1.0
Freon-12 (Dichlorodifluoromethane)	0/3	ND	6.7U - 12UJ	4.950	12	614	USEPA 1993 and 1996	0.02	No	HQ < 1.0
Methyl Acrylonitrile	0/3	ND	67U - 120UJ	49.500	120	NE	---	NA	Yes	No SDSV
Methyl Iodide	0/3	ND	6.7U - 12UJ	4.950	12	NE	---	NA	Yes	No SDSV

TABLE 7-24
FREQUENCY AND RANGE OF DRAINAGE DITCH SEDIMENT DATA COMPARED TO SEDIMENT SCREENING VALUES: STEP 2 SCREENING LEVEL RISK CALCULATION
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Analyte [1]	Contaminant Frequency/Range					Sediment Screeniing Value (SDSV)	Reference [3]	Maximum HQ [4]	Ecological COPC?	Comments
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	Value used in Step 2 Screen [2]					
Volatile Organics (µg/kg)										
Methyl Methacrylate	0/1	ND	110UJ - 110UJ	55.000	110	1,337	USEPA 1993 and 1996	0.08	No	HQ < 1.0
Methylene Chloride	0/3	ND	6.7U - 12UJ	4.950	12	56.6	USEPA 1993 and 1996	0.21	No	HQ < 1.0
Pentachloroethane	0/3	ND	6.7U - 12UJ	4.950	12	1,207	USEPA 1993 and 1996	<0.01	No	HQ < 1.0
Styrene (Ethenylbenzene)	0/3	ND	6.7U - 12UJ	4.950	12	522	USEPA 1993 and 1996	0.02	No	HQ < 1.0
Tetrachloroethene (PCE)	0/3	ND	6.7U - 12UJ	4.950	12	57.0	Buchman 2008	0.21	No	HQ < 1.0
Toluene	0/3	ND	6.7U - 12UJ	4.950	12	1,857	USEPA 1993 and 1996	<0.01	No	HQ < 1.0
Trichloroethene (TCE)	0/3	ND	6.7U - 12UJ	4.950	12	456	USEPA 1993 and 1996	0.03	No	HQ < 1.0
Vinyl Acetate	0/3	ND	6.7U - 12UJ	4.950	12	27.2	USEPA 1993 and 1996	0.44	No	HQ < 1.0
Vinyl Chloride	0/3	ND	6.7U - 12UJ	4.950	12	583	USEPA 1993 and 1996	0.02	No	HQ < 1.0
Xylene, m/p-	1/3	0.79J - 0.79J	13U - 24UJ	6.430	0.79	4.00	Buchman 2008	0.20	No	HQ < 1.0
Xylene, o-	0/3	ND	6.7U - 12UJ	4.950	12	4.00	Buchman 2008	3.00	Yes	HQ > 1.0
Xylenes, total	1/3	0.79J - 0.79J	6.7U - 12UJ	3.380	0.79	4.00	Buchman 2008	0.20	No	HQ < 1.0
Semi-Volatile Organics (µg/kg)										
1,2,4,5-Tetrachlorobenzene	0/3	ND	310U - 360UJ	170.000	360	2,295	USEPA 1993 and 1996	0.16	No	HQ < 1.0
1,2,4-Trichlorobenzene	0/3	ND	310U - 360UJ	170.000	360	4.80	Buchman 2008	75.00	Yes	HQ > 1.0
1,2-Dichlorobenzene (o-)	0/3	ND	310U - 360UJ	170.000	360	13.0	Buchman 2008	27.69	Yes	HQ > 1.0
1,3,5-Trinitrobenzene (TNB)	0/3	ND	310U - 360UJ	170.000	360	24.3	USEPA 1993 and 1996	14.82	Yes	HQ > 1.0
1,3-Dichlorobenzene (m-)	0/3	ND	310U - 360UJ	170.000	360	2,761	USEPA 1993 and 1996	0.13	No	HQ < 1.0
1,3-Dinitrobenzene (m-)	0/3	ND	310U - 360UJ	170.000	360	13.8	USEPA 1993 and 1996	26.11	Yes	HQ > 1.0
1,4-Dichlorobenzene (p-)	0/3	ND	310U - 360UJ	170.000	360	110	Buchman 2008	3.27	Yes	HQ > 1.0
1,4-Naphthoquinone	0/3	ND	310U - 360UJ	170.000	360	0.40	USEPA 1993 and 1996	892.92	Yes	HQ > 1.0
1-Naphthylamine	0/3	ND	310U - 360UJ	170.000	360	234	USEPA 1993 and 1996	1.54	Yes	HQ > 1.0
2,2'-Oxybis[1-chloropropane]	0/3	ND	310U - 360UJ	170.000	360	NE	---	NA	Yes	No SDSV
2,3,4,6-Tetrachlorophenol	0/3	ND	600U - 700UJ	331.667	700	597	USEPA 1993 and 1996	1.17	Yes	HQ > 1.0
2,4,5-Trichlorophenol	0/3	ND	600U - 700UJ	331.667	700	3.00	Buchman 2008	233.33	Yes	HQ > 1.0
2,4,6-Trichlorophenol	0/3	ND	600U - 700UJ	331.667	700	6.00	Buchman 2008	116.67	Yes	HQ > 1.0
2,4-Dichlorophenol	0/3	ND	600U - 700UJ	331.667	700	0.21	Buchman 2008	3360.54	Yes	HQ > 1.0
2,4-Dimethylphenol	0/3	ND	600U - 700UJ	331.667	700	18.0	Buchman 2008	38.89	Yes	HQ > 1.0
2,4-Dinitrophenol	0/3	ND	600U - 700UJ	331.667	700	4.35	USEPA 1993 and 1996	160.90	Yes	HQ > 1.0
2,4-Dinitrotoluene (DNT)	0/3	ND	310U - 360UJ	170.000	360	87.5	USEPA 1993 and 1996	4.12	Yes	HQ > 1.0
2,6-Dichlorophenol	0/3	ND	600U - 700UJ	331.667	700	361	USEPA 1993 and 1996	1.94	Yes	HQ > 1.0
2,6-Dinitrotoluene (DNT)	0/3	ND	310U - 360UJ	170.000	360	117	USEPA 1993 and 1996	3.07	Yes	HQ > 1.0
2-Acetylaminofluorene	0/3	ND	310U - 360UJ	170.000	360	490	USEPA 1993 and 1996	0.73	No	HQ < 1.0
2-Chloronaphthalene	0/3	ND	310U - 360UJ	170.000	360	1,413	USEPA 1993 and 1996	0.25	No	HQ < 1.0
2-Chlorophenol	0/3	ND	600U - 700UJ	331.667	700	0.33	Buchman 2008	2102.10	Yes	HQ > 1.0
2-Methyl-5-nitroaniline	0/3	ND	310U - 360UJ	170.000	360	318	USEPA 1993 and 1996	1.13	Yes	HQ > 1.0
2-Methylnaphthalene	1/3	4.4J - 4.4J	310U - 360UJ	113.133	4.4	20.2	CCME 2002	0.22	No	HQ < 1.0
2-Methylphenol (o-Cresol)	0/3	ND	600UJ - 700UJ	331.667	700	8.00	Buchman 2008	87.50	Yes	HQ > 1.0
2-Naphthylamine	0/3	ND	310U - 360UJ	170.000	360	NE	---	NA	Yes	No SDSV
2-Nitroaniline	0/3	ND	310U - 360UJ	170.000	360	67.7	USEPA 1993 and 1996	5.32	Yes	HQ > 1.0
2-Nitrophenol	0/3	ND	600U - 700UJ	331.667	700	4,228	USEPA 1993 and 1996	0.17	No	HQ < 1.0

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Analyte [1]	Contaminant Frequency/Range					Sediment Screeniing Value (SDSV)	Reference [3]	Maximum HQ [4]	Ecological COPC?	Comments
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	Value used in Step 2 Screen [2]					
Semi-Volatile Organics (µg/kg)										
2-Picoline	0/3	ND	310U - 360UJ	170.000	360	2.32	USEPA 1993 and 1996	154.84	Yes	HQ > 1.0
3,3'-Dichlorobenzidine	0/3	ND	310U - 360UJ	170.000	360	267	USEPA 1993 and 1996	1.35	Yes	HQ > 1.0
3,3'-Dimethylbenzidine	0/3	ND	310U - 360UJ	170.000	360	1,449	USEPA 1993 and 1996	0.25	No	HQ < 1.0
3-Methylcholanthrene	0/3	ND	310U - 360UJ	170.000	360	NE	---	NA	Yes	No SDSV
3-Methylphenol (m-Cresol)	0/3	ND	450U - 530UJ	250.000	530	113	USEPA 1993 and 1996	4.71	Yes	HQ > 1.0
3-Nitroaniline	0/3	ND	310U - 360UJ	170.000	360	4.58	USEPA 1993 and 1996	78.68	Yes	HQ > 1.0
4,6-Dinitro-2-methylphenol	0/3	ND	600U - 700UJ	331.667	700	58.6	USEPA 1993 and 1996	11.94	Yes	HQ > 1.0
4-Aminobiphenyl	0/3	ND	310U - 360UJ	170.000	360	NE	---	NA	Yes	No SDSV
4-Bromophenyl-phenylether	0/3	ND	310U - 360UJ	170.000	360	656	Di Toro and McGrath 2000	0.55	No	HQ < 1.0
4-Chloro-3-methylphenol	0/3	ND	600U - 700UJ	331.667	700	7.03	USEPA 1993 and 1996	99.58	Yes	HQ > 1.0
4-Chloroaniline	0/3	ND	310U - 360UJ	170.000	360	321	USEPA 1993 and 1996	1.12	Yes	HQ > 1.0
4-Chlorophenyl-phenylether	0/3	ND	310U - 360UJ	170.000	360	602	Di Toro and McGrath 2000	0.60	No	HQ < 1.0
4-Dimethylaminoazobenzene (p-)	0/3	ND	310U - 360UJ	170.000	360	NE	---	NA	Yes	No SDSV
4-Methylphenol (p-Cresol)	0/3	ND	450U - 530UJ	250.000	530	100.0	Buchman 2008	5.30	Yes	HQ > 1.0
4-Nitroaniline	0/3	ND	310U - 360UJ	170.000	360	83.0	USEPA 1993 and 1996	4.33	Yes	HQ > 1.0
4-Nitrophenol	0/3	ND	600U - 700UJ	331.667	700	95.1	USEPA 1993 and 1996	7.36	Yes	HQ > 1.0
4-Nitroquinoline-1-oxide	0/3	ND	310U - 360UJ	170.000	360	NE	---	NA	Yes	No SDSV
7,12-Dimethylbenz(a)anthracene	0/3	ND	310UJ - 360UJ	170.000	360	405,612	USEPA 1993 and 1996	<0.01	No	HQ < 1.0
a,a-Dimethylphenethylamine	0/3	ND	690UJ - 1000UJ	423.333	1000	NE	---	NA	Yes	No SDSV
Acenaphthene	0/3	ND	17UJ - 360UJ	114.500	360	6.70	MacDonald et al. 2003/CCME 2002	53.73	Yes	HQ > 1.0
Acenaphthylene	1/3	1.6J - 1.6J	310U - 360UJ	112.200	1.6	5.90	MacDonald et al. 2003/CCME 2002	0.27	No	HQ < 1.0
Acetophenone	0/3	ND	150U - 180UJ	85.000	180	1,333	USEPA 1993 and 1996	0.13	No	HQ < 1.0
Aniline	0/3	ND	310U - 360UJ	170.000	360	0.79	USEPA 1993 and 1996	454.65	Yes	HQ > 1.0
Anthracene	1/3	4.6J - 4.6J	310U - 360UJ	113.200	4.6	57.2	MacDonald et al. 2000	0.08	No	HQ < 1.0
Aramite	0/3	ND	310U - 360UJ	170.000	360	3,552	USEPA 1993 and 1996	0.10	No	HQ < 1.0
Benzo(a)anthracene	1/3	5J - 5J	310U - 360UJ	113.333	5	108	MacDonald et al. 2000	0.05	No	HQ < 1.0
Benzo(a)pyrene (BaP)	0/3	ND	17UJ - 360UJ	114.500	360	150	MacDonald et al. 2000	2.40	Yes	HQ > 1.0
Benzo(b)fluoranthene	0/3	ND	17UJ - 360UJ	114.500	360	1,800	Buchman 2008	0.20	No	HQ < 1.0
Benzo(g,h,i)perylene	0/3	ND	17UJ - 360UJ	114.500	360	170	Persaud et al. 1993	2.12	Yes	HQ > 1.0
Benzo(k)fluoranthene	0/3	ND	17UJ - 360UJ	114.500	360	240	Persaud et al. 1993	1.50	Yes	HQ > 1.0
Benzyl Alcohol	0/3	ND	310U - 360UJ	170.000	360	52.0	Buchman 2008	6.92	Yes	HQ > 1.0
Bis(2-chloroethoxy)methane	0/3	ND	310U - 360UJ	170.000	360	211	USEPA 1993 and 1996	1.71	Yes	HQ > 1.0
Bis(2-chloroethyl)ether	0/3	ND	310U - 360UJ	170.000	360	774	USEPA 1993 and 1996	0.47	No	HQ < 1.0
Bis(2-ethylhexyl) Phthalate (BEHP)	3/3	110J - 730	NA	326.667	730	180	MacDonald et al. 2003	4.06	Yes	HQ > 1.0
Butyl Benzyl Phthalate	1/3	63J - 63J	310U - 360UJ	132.667	63	63.0	Buchman 2008	1.00	No	HQ = 1.0
Chlorobenzilate	0/3	ND	310U - 360UJ	170.000	360	NE	---	NA	Yes	No SDSV
Chrysene	1/3	6.9J - 6.9J	310U - 360UJ	113.967	6.9	166	MacDonald et al. 2000	0.04	No	HQ < 1.0
Diallate (cis)	0/3	ND	310U - 360UJ	170.000	360	44,667	USEPA 1993 and 1996	<0.01	No	HQ < 1.0
Diallate (trans)	0/3	ND	310UJ - 360UJ	170.000	360	44,667	USEPA 1993 and 1996	<0.01	No	HQ < 1.0
Dibenz(a,h)anthracene	0/3	ND	17UJ - 360UJ	114.500	360	33.0	MacDonald et al. 2000	10.91	Yes	HQ > 1.0
Dibenzofuran	0/3	ND	310U - 360UJ	170.000	360	110	Buchman 2008	3.27	Yes	HQ > 1.0

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Analyte [1]	Contaminant Frequency/Range					Sediment Screeniing Value (SDSV)	Reference [3]	Maximum HQ [4]	Ecological COPC?	Comments
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	Value used in Step 2 Screen [2]					
Semi-Volatile Organics (µg/kg)										
Diethyl Phthalate (DEP)	0/3	ND	310U - 360UJ	170.000	360	630	MacDonald et al. 2003	0.57	No	HQ < 1.0
Dimethyl Phthalate	0/3	ND	310U - 360UJ	170.000	360	6.00	Buchman 2008	60.00	Yes	HQ > 1.0
Di-n-butyl Phthalate (DBP)	0/3	ND	310U - 360UJ	170.000	360	58.0	Buchman 2008	6.21	Yes	HQ > 1.0
Di-n-octyl Phthalate	0/3	ND	310U - 360UJ	170.000	360	61.0	Buchman 2008	5.90	Yes	HQ > 1.0
Dinoseb	0/2	ND	310U - 360UJ	167.500	360	42.8	USEPA 1993 and 1996	8.42	Yes	HQ > 1.0
Ethyl Methane Sulfonate (EMS)	0/3	ND	310U - 360UJ	170.000	360	0.94	USEPA 1993 and 1996	382.47	Yes	HQ > 1.0
Fluoranthene	2/3	7.2J - 36J	360UJ - 360UJ	74.400	36	423	MacDonald et al. 2000	0.09	No	HQ < 1.0
Fluorene	1/3	2.3J - 2.3J	310U - 360UJ	112.433	2.3	77.4	MacDonald et al. 2000	0.03	No	HQ < 1.0
Hexachloro-1,3-butadiene	0/3	ND	310U - 360UJ	170.000	360	55.0	MacDonald et al. 2003	6.55	Yes	HQ > 1.0
Hexachlorobenzene	0/3	ND	310U - 360UJ	170.000	360	20.0	MacDoanld et al 2003/Persaud et al. 1993	18.00	Yes	HQ > 1.0
Hexachlorocyclopentadiene	0/3	ND	310U - 360UJ	170.000	360	292	USEPA 1993 and 1996	1.23	Yes	HQ > 1.0
Hexachloroethane	0/3	ND	310U - 360UJ	170.000	360	73.0	Buchman 2008	4.93	Yes	HQ > 1.0
Hexachloropropene	0/3	ND	310U - 360UJ	170.000	360	NE	---	NA	Yes	No SDSV
Indeno(1,2,3-cd)pyrene	1/3	8.3J - 8.3J	310U - 360UJ	114.433	8.3	200	Persaud et al. 1993	0.04	No	HQ < 1.0
Isophorone	0/3	ND	310U - 360UJ	170.000	360	907	USEPA 1993 and 1996	0.40	No	HQ < 1.0
Isosafrole	0/3	ND	310U - 360UJ	170.000	360	NE	---	NA	Yes	No SDSV
Methapyrilene	0/3	ND	310U - 360UJ	170.000	360	NE	---	NA	Yes	No SDSV
Methyl Methane Sulfonate	0/3	ND	310U - 360UJ	170.000	360	NE	---	NA	Yes	No SDSV
Naphthalene	0/3	ND	17UJ - 360UJ	114.500	360	176	MacDonald et al. 2000	2.05	Yes	HQ > 1.0
Nitrobenzene	0/3	ND	310U - 360UJ	170.000	360	21.0	Buchman 2008	17.14	Yes	HQ > 1.0
n-Nitrosodiethylamine	0/3	ND	310U - 360UJ	170.000	360	47.8	USEPA 1993 and 1996	7.53	Yes	HQ > 1.0
n-Nitrosodimethylamine (NDMA)	0/3	ND	310U - 360UJ	170.000	360	0.14	USEPA 1993 and 1996	2489.85	Yes	HQ > 1.0
n-Nitroso-di-n-butylamine	0/3	ND	310UJ - 360UJ	170.000	360	123	USEPA 1993 and 1996	2.93	Yes	HQ > 1.0
n-Nitrosodi-n-propylamine	0/3	ND	310U - 360UJ	170.000	360	12.5	USEPA 1993 and 1996	28.82	Yes	HQ > 1.0
n-Nitrosodiphenylamine	0/3	ND	310U - 360UJ	170.000	360	28.0	Buchman 2008	12.86	Yes	HQ > 1.0
n-Nitrosomethylethylamine	0/3	ND	310U - 360UJ	170.000	360	0.40	USEPA 1993 and 1996	899.13	Yes	HQ > 1.0
n-Nitrosomorpholine	0/3	ND	310U - 360UJ	170.000	360	NE	---	NA	Yes	No SDSV
n-Nitrosopiperidine	0/3	ND	310U - 360UJ	170.000	360	NE	---	NA	Yes	No SDSV
n-Nitrosopyrrolidine	0/3	ND	310U - 360UJ	170.000	360	NE	---	NA	Yes	No SDSV
o-Toluidine	0/3	ND	310U - 360UJ	170.000	360	2.17	USEPA 1993 and 1996	165.66	Yes	HQ > 1.0
Pentachlorobenzene	0/3	ND	310U - 360UJ	170.000	360	59.1	USEPA 1993 and 1996	6.09	Yes	HQ > 1.0
Pentachloronitrobenzene	0/3	ND	310U - 360UJ	170.000	360	765	USEPA 1993 and 1996	0.47	No	HQ < 1.0
Pentachlorophenol	0/3	ND	600U - 700UJ	331.667	700	17.0	Buchman 2008	41.18	Yes	HQ > 1.0
Phenacetin	0/3	ND	310U - 360UJ	170.000	360	NE	---	NA	Yes	No SDSV
Phenanthrene	1/3	6.3J - 6.3J	310U - 360UJ	113.767	6.3	204	MacDonald et al. 2000	0.03	No	HQ < 1.0
Phenol	0/3	ND	600U - 700UJ	331.667	700	130	Buchman 2008	5.38	Yes	HQ > 1.0
Pronamide	0/3	ND	310U - 690UJ	226.667	690	450	USEPA 1993 and 1996	1.53	Yes	HQ > 1.0
Pyrene	2/3	8.8J - 41J	360UJ - 360UJ	76.600	41	195	MacDonald et al. 2000	0.21	No	HQ < 1.0
Pyridine	0/3	ND	310U - 360UJ	170.000	360	228	USEPA 1993 and 1996	1.58	Yes	HQ > 1.0
Safrole	0/3	ND	310U - 360UJ	170.000	360	NE	---	NA	Yes	No SDSV

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Analyte [1]	Contaminant Frequency/Range					Sediment Screeniing Value (SDSV)	Reference [3]	Maximum HQ [4]	Ecological COPC?	Comments
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	Value used in Step 2 Screen [2]					
Organochlorine Pesticides (µg/kg)										
4,4'-DDD	3/3	1.6J - 5.9J	NA	3.367	5.9	4.88	MacDonald et al. 2000	1.21	Yes	HQ > 1.0
4,4'-DDE	3/3	32J - 160	NA	75.667	160	3.16	MacDonald et al. 2000	50.63	Yes	HQ > 1.0
4,4'-DDT	1/3	1.3J - 1.3J	6U - 7UJ	2.600	1.3	5.28	MacDonald et al. 2000	0.25	No	HQ < 1.0
Aldrin	1/3	0.66J - 0.66J	3.5UJ - 3.6UJ	1.403	0.66	2.00	Persaud et al. 1993	0.33	No	HQ < 1.0
BHC, alpha-	0/3	ND	3.1U - 3.6UJ	1.700	3.6	6.00	Persaud et al. 1993	0.60	No	HQ < 1.0
BHC, beta-	0/3	ND	1.5U - 1.8UJ	0.850	1.8	5.00	Persaud et al. 1993	0.36	No	HQ < 1.0
BHC, delta-	0/3	ND	3.1U - 3.6UJ	1.700	3.6	296	USEPA 1993 and 1996	0.01	No	HQ < 1.0
BHC, gamma- (Lindane)	0/3	ND	3.1U - 3.6UJ	1.700	3.6	2.37	MacDonald et al. 2000	1.52	Yes	HQ > 1.0
Chlordane, alpha-	2/3	2.1NJ - 25NJ	3.1U - 3.1U	9.550	25	3.24	---	7.72	Yes	HQ > 1.0
Chlordane, gamma-	2/3	18J - 31J	3.1U - 3.1U	16.850	31	3.24	---	9.57	Yes	HQ > 1.0
Dieldrin	1/3	0.9J - 0.9J	6U - 7UJ	2.467	0.9	1.90	MacDonald et al. 2000	0.47	No	HQ < 1.0
Endosulfan I	0/3	ND	3.1U - 3.6UJ	1.700	3.6	12.6	USEPA 1993 and 1996	0.29	No	HQ < 1.0
Endosulfan II	0/3	ND	6U - 7UJ	3.317	7	12.6	USEPA 1993 and 1996	0.55	No	HQ < 1.0
Endosulfan Sulfate	0/3	ND	6U - 7UJ	3.317	7	76.6	USEPA 1993 and 1996	0.09	No	HQ < 1.0
Endrin	0/3	ND	6U - 7UJ	3.317	7	2.22	MacDonald et al. 2000	3.15	Yes	HQ > 1.0
Endrin Aldehyde	2/3	0.87J - 1.1J	6U - 6U	1.657	1.1	2.22	---	0.50	No	HQ < 1.0
Heptachlor	1/3	1.2J - 1.2J	3.1U - 3.5UJ	1.500	1.2	0.30	Buchman 2008	4.00	Yes	HQ > 1.0
Heptachlor Epoxide	0/3	ND	3.1U - 3.6UJ	1.700	3.6	2.47	MacDonald et al. 2000	1.46	Yes	HQ > 1.0
Isodrin	0/3	ND	310U - 360UJ	170.000	360	6,183	USEPA 1993 and 1996	0.06	No	HQ < 1.0
Kepone (Chlordecone)	0/3	ND	310U - 360U	170.000	360	38,161	USEPA 1993 and 1996	<0.01	No	HQ < 1.0
Methoxychlor	0/3	ND	31U - 36UJ	17.000	36	62.1	USEPA 1993 and 1996	0.58	No	HQ < 1.0
Toxaphene	0/3	ND	150U - 180UJ	83.333	180	0.10	MacDonald et al. 2003/CCME 2002	1800.00	Yes	HQ > 1.0
Inorganics (mg/kg)										
Antimony	2/3	0.58J - 0.8J	2.1UJ - 2.1UJ	0.810	0.8	2.00	Long and Morgan 1991	0.40	No	HQ < 1.0
Arsenic	3/3	0.65J - 1.5	NA	1.043	1.5	9.79	MacDonald et al. 2000	0.15	No	HQ < 1.0
Barium	3/3	81.6J - 164J	NA	118.200	164	20.0	MacDonald et al. 2003	8.20	Yes	HQ > 1.0
Beryllium	3/3	0.35J - 0.45J	NA	0.393	0.45	NE	---	NA	Yes	No SDSV
Cadmium	3/3	0.69J - 0.99J	NA	0.860	0.99	0.99	MacDonald et al. 2000	1.00	No	HQ = 1.0
Chromium	3/3	37.3 - 42.1J	NA	39.500	42.1	43.4	MacDonald et al. 2000	0.97	No	HQ < 1.0
Cobalt	3/3	20.9J - 31.9J	NA	25.067	31.9	50.0	MacDonald et al. 2003	0.64	No	HQ < 1.0
Copper	12/12	36.2J - 187J	NA	113.600	187	31.6	MacDonald et al. 2000	5.20	Yes	HQ > 1.0
Lead	10/10	4.92J - 71.2J	NA	32.835	71.2	35.8	MacDonald et al. 2000	1.99	Yes	HQ > 1.0
Mercury	3/3	0.033J - 0.19	NA	0.103	0.19	0.18	MacDonald et al. 2000	1.06	Yes	HQ > 1.0
Nickel	3/3	18.7J - 28.1	NA	23.133	28.1	22.7	MacDonald et al. 2000	1.24	Yes	HQ > 1.0
Selenium	3/3	0.69J - 1J	NA	0.830	1	2.00	Lemley 2002 (as cited in USEPA 2007)	0.50	No	HQ < 1.0
Silver	3/3	0.17J - 0.23J	NA	0.190	0.23	1.00	MacDonald et al. 2003	0.23	No	HQ < 1.0
Thallium	2/3	0.053J - 0.14J	1UJ - 1UJ	0.231	0.14	NE	---	NA	Yes	No SDSV
Tin	0/3	ND	8.1U - 10.5UJ	4.833	10.5	3.40	Buchman 2008	3.09	Yes	HQ > 1.0
Vanadium	3/3	144J - 232J	NA	177.333	232	57.0	Buchman 2008	4.07	Yes	HQ > 1.0
Zinc	12/12	71.7J - 357J	NA	193.725	357	121.0	MacDonald et al. 2000	2.95	Yes	HQ > 1.0

TABLE 7-24
FREQUENCY AND RANGE OF DRAINAGE DITCH SEDIMENT DATA COMPARED TO SEDIMENT SCREENING VALUES: STEP 2 SCREENING LEVEL RISK CALCULATION
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Notes:

CCME = Canadian Council of Ministers of the Environment
COPC = Chemical of Potential Concern
USEPA = United States Environmental Protection Agency
Notes (continued):

SDSV = Sediment Screening Value
µg/kg - microgram per kilogram
mg/kg = milligran per kilogram
HQ = Hazard Quotient
NA = Not Applicable
ND = Not Detected
NE = Not Established
J = Estimated value
U = Not detected
UJ = Not detected, estimated value

(1) All sediment analytical data for four VOCs (1,4-dioxane, acrolein, isobutyl alchohol, and propionitrile) and one SVOC (1,4-phenylenediamine) were rejected during data validation activities. Although these five organic analytes are not listed below (see Appendix D for all rejected drainage ditch sediment analytical data), they are identified as ecological COPCs based on the lack of any useable analytical data.

(2) Maximum detected concentration (or maximum reporting limit for non-detected chemicals).

(3) See Table 7-8 for reference citations.

(4) For a given chemical, the hazard quotient (HQ) is the maximum detected concentration (or maximum reporting limit for non-detected chemicals) divided by the sediment screening value.

TABLE 7-25
HAZARD QUOTIENT VALUES FOR AVIAN AND MAMMALIAN DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Brown flower bat			American robin			Mourning dove			Red-tailed hawk		
	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC
Volatile Organics:												
1,1,1,2-Tetrachloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbon tetrachloride	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzene	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Toluene	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethene	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Xylene, m/p-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Xylene, o-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Xylenes, total	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Semi-Volatile Organics:												
1,2,4,5-Tetrachlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,3-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,4-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2,3,4,6-Tetrachlorophenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4,5-Trichlorophenol	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4,6-Trichlorophenol	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dichlorophenol	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Acetylaminofluorene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Chloronaphthalene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3,3'-Dichlorobenzidine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3,3'-Dimethylbenzidine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3-Methylcholanthrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Bromopheny phenyl ether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chloro-3-methylphenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chlorophenyl phenyl ether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7,12-Dimethylbenz(a)anthracene	NA	NA	NA	0.04	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

TABLE 7-25
HAZARD QUOTIENT VALUES FOR AVIAN AND MAMMALIAN DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Brown flower bat			American robin			Mourning dove			Red-tailed hawk		
	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC
Semi-Volatile Organics:												
Aramite, total	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	<0.01	<0.01	<0.01	0.14	0.03	0.06	0.01	<0.01	<0.01	0.04	<0.01	0.02
Butyl benzyl phthalate	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Diallate (cis)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Diallate (trans)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzofuran	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Diethyl phthalate	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-butyl phthalate	<0.01	<0.01	<0.01	0.52	0.10	0.23	0.14	0.03	0.06	0.14	0.03	0.06
Di-n-octyl phthalate	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dinoseb	NA	NA	NA	0.48	0.10	0.22	0.23	0.05	0.10	0.13	0.03	0.06
Hexachlorobenzene	<0.01	<0.01	<0.01	0.78	0.15	0.34	0.10	0.02	0.04	0.20	0.04	0.09
Hexachlorobutadiene	<0.01	<0.01	<0.01	0.03	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Hexachlorocyclopentadiene	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloropropene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Isosafrole	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
N-Nitrosodiphenylamine	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
p-Dimethylamino azobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorobenzene	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachloronitrobenzene	NA	NA	NA	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Pentachlorophenol	0.44	0.16	0.27	1.45	0.14	0.46	0.45	0.04	0.14	0.39	0.04	0.12
Pronamide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PAHs:												
2-Methylnaphthalene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthylene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Anthracene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(a)anthracene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(a)pyrene	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(b)fluoranthene	0.10	0.02	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(g,h,i)perylene	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

TABLE 7-25
HAZARD QUOTIENT VALUES FOR AVIAN AND MAMMALIAN DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical	Brown flower bat			American robin			Mourning dove			Red-tailed hawk		
	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC
PAHs:												
Benzo(k)fluoranthene	0.02	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chrysene	0.02	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dibenz(a,h)anthracene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fluoranthene	0.07	0.01	0.03	0.05	<0.01	0.02	0.10	0.02	0.04	<0.01	<0.01	<0.01
Fluorene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Naphthalene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Phenanthrene	<0.01	<0.01	<0.01	0.09	0.02	0.04	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Pyrene	3.12	0.64	1.41	0.03	<0.01	0.01	0.04	<0.01	0.02	<0.01	<0.01	<0.01
Organochlorine Pesticides:												
4,4'-DDD	<0.01	<0.01	<0.01	0.12	0.01	0.04	<0.01	<0.01	<0.01	0.03	<0.01	0.01
4,4'-DDE	0.03	<0.01	0.01	2.53	0.25	0.80	0.02	<0.01	<0.01	0.68	0.07	0.22
4,4'-DDT	0.01	<0.01	<0.01	1.82	0.18	0.58	0.01	<0.01	<0.01	0.49	0.05	0.16
Aldrin	<0.01	<0.01	<0.01	0.22	0.04	0.10	<0.01	<0.01	<0.01	0.06	0.01	0.03
alpha-BHC	0.42	0.04	0.13	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
alpha-Chlordane	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
beta-BHC	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chlorobenzilate	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
delta-BHC	0.30	0.03	0.10	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dieldrin	0.95	0.48	0.67	0.62	0.12	0.27	0.02	<0.01	<0.01	0.17	0.03	0.07
Endosulfan I	0.04	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan II	0.07	0.01	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan sulfate	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endrin	0.04	<0.01	0.02	1.57	0.32	0.71	0.15	0.03	0.07	0.42	0.08	0.19
Endrin aldehyde	<0.01	<0.01	<0.01	0.05	<0.01	0.02	0.02	<0.01	<0.01	0.01	<0.01	<0.01
gamma-BHC (Lindane)	0.45	0.04	0.14	0.03	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
gamma-Chlordane	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Heptachlor	<0.01	<0.01	<0.01	0.03	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Heptachlor epoxide	0.01	<0.01	<0.01	0.09	0.02	0.04	<0.01	<0.01	<0.01	0.03	<0.01	0.01
Isodrin	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kepone	0.23	0.05	0.10	0.06	0.01	0.03	0.01	<0.01	<0.01	0.02	<0.01	<0.01

TABLE 7-25
HAZARD QUOTIENT VALUES FOR AVIAN AND MAMMALIAN DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Brown flower bat			American robin			Mourning dove			Red-tailed hawk		
	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC
Organochlorine Pesticides:												
Methoxychlor	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Toxaphene	<0.01	<0.01	<0.01	0.36	0.07	0.16	0.05	0.01	0.02	0.09	0.02	0.04
Metals:												
Antimony	0.86	0.09	0.27	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic	0.06	0.04	0.05	0.16	0.08	0.11	0.04	0.02	0.03	<0.01	<0.01	<0.01
Barium	0.40	0.25	0.32	0.86	0.43	0.60	0.91	0.46	0.64	<0.01	<0.01	<0.01
Beryllium	0.13	0.13	0.13	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	0.24	0.02	0.07	2.94	0.68	1.42	0.11	0.03	0.06	0.07	0.02	0.04
Chromium, total	0.33	0.01	0.07	16.11	2.75	6.65	0.40	0.07	0.16	0.17	0.03	0.07
Cobalt	0.03	0.01	0.02	0.58	0.24	0.38	0.07	0.03	0.04	0.02	<0.01	0.01
Copper	0.56	0.34	0.44	3.44	1.15	1.99	1.18	0.39	0.68	0.45	0.15	0.26
Lead	0.37	0.20	0.27	14.43	7.21	10.20	3.89	1.94	2.75	1.22	0.61	0.86
Mercury	0.56	0.11	0.25	18.22	6.07	10.52	0.59	0.20	0.34	0.07	0.02	0.04
Nickel	0.13	0.07	0.09	4.77	1.72	2.87	0.06	0.02	0.03	0.06	0.02	0.03
Selenium	1.62	1.08	1.32	1.69	0.85	1.20	0.72	0.36	0.51	0.33	0.17	0.23
Silver	<0.01	<0.01	<0.01	4.78	0.48	1.51	0.02	<0.01	<0.01	0.07	<0.01	0.02
Thallium	0.06	<0.01	0.02	0.28	0.06	0.13	<0.01	<0.01	<0.01	0.07	0.01	0.03
Tin	<0.01	<0.01	<0.01	1.44	0.58	0.91	0.06	0.03	0.04	0.36	0.14	0.23
Vanadium	0.11	0.05	0.07	37.29	18.65	26.37	6.71	3.36	4.74	1.42	0.71	1.00
Zinc	0.43	0.40	0.41	3.04	1.18	1.89	0.49	0.19	0.31	0.23	0.09	0.14

Notes:

Shaded cells indicate a hazard quotient value greater than 1.0

NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
NA = Toxicity reference value not available (hazard quotient value could not be calculated)

TABLE 7-26
HAZARD QUOTIENT VALUES FOR AVIAN AND MAMMALIAN DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical [1]	Brown flower bat			American robin			Mourning dove			Red-tailed hawk		
	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC
Volatile Organics:												
1,1,1,2-Tetrachloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbon tetrachloride	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzene	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Toluene	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethene	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Xylenes, total	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Semi-Volatile Organics:												
1,2,4,5-Tetrachlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,3-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,4-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2,3,4,6-Tetrachlorophenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4,5-Trichlorophenol	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4,6-Trichlorophenol	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dichlorophenol	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Acetylaminofluorene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Chloronaphthalene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3,3'-Dichlorobenzidine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3,3'-Dimethylbenzidine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3-Methylcholanthrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Bromopheny phenyl ether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chloro-3-methylphenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chlorophenyl phenyl ether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7,12-Dimethylbenz(a)anthracene	NA	NA	NA	0.04	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aramite, total	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Butyl benzyl phthalate	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 7-26
HAZARD QUOTIENT VALUES FOR AVIAN AND MAMMALIAN DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical [1]	Brown flower bat			American robin			Mourning dove			Red-tailed hawk		
	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC
Semi-Volatile Organics:												
Diallate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzofuran	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Diethyl phthalate	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-butyl phthalate	<0.01	<0.01	<0.01	0.52	0.10	0.23	0.14	0.03	0.06	0.14	0.03	0.06
Di-n-octyl phthalate	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dinoseb	NA	NA	NA	0.22	0.04	0.10	0.11	0.02	0.05	0.06	0.01	0.03
Hexachlorobenzene	<0.01	<0.01	<0.01	0.36	0.07	0.16	0.05	<0.01	0.02	0.10	0.02	0.04
Hexachlorobutadiene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Hexachlorocyclopentadiene	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloropropene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Isosafrole	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
N-Nitrosodiphenylamine	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
p-Dimethylamino azobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorobenzene	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachloronitrobenzene	NA	NA	NA	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Pentachlorophenol	0.23	0.08	0.14	0.76	0.08	0.24	0.23	0.02	0.07	0.21	0.02	0.07
Pronamide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PAHs:												
2-Methylnaphthalene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthylene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Anthracene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(a)anthracene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(a)pyrene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(b)fluoranthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(g,h,i)perylene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(k)fluoranthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chrysene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dibenz(a,h)anthracene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fluoranthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

TABLE 7-26
HAZARD QUOTIENT VALUES FOR AVIAN AND MAMMALIAN DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical [1]	Brown flower bat			American robin			Mourning dove			Red-tailed hawk		
	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC
PAHs:												
Fluorene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Naphthalene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Phenanthrene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Pyrene	0.05	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Metals:												
Antimony	0.08	<0.01	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic	0.03	0.02	0.03	0.06	0.03	0.04	0.02	<0.01	0.01	<0.01	<0.01	<0.01
Barium	0.31	0.20	0.25	0.67	0.34	0.48	0.72	0.36	0.51	<0.01	<0.01	<0.01
Beryllium	0.14	0.13	0.13	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	0.09	<0.01	0.03	0.75	0.17	0.36	0.04	<0.01	0.02	0.03	<0.01	0.02
Chromium, total	0.91	0.04	0.18	44.43	7.58	18.35	1.10	0.19	0.45	0.36	0.06	0.15
Cobalt	0.02	<0.01	0.01	0.46	0.19	0.30	0.05	0.02	0.03	0.02	<0.01	0.01
Copper	0.54	0.32	0.42	3.18	1.07	1.84	1.09	0.37	0.63	0.45	0.15	0.26
Mercury	0.47	0.09	0.21	13.23	4.41	7.64	0.49	0.16	0.28	0.05	0.02	0.03
Nickel	0.20	0.10	0.14	8.16	2.94	4.90	0.09	0.03	0.06	0.07	0.03	0.04
Selenium	0.75	0.50	0.61	1.00	0.50	0.70	0.34	0.17	0.24	0.26	0.13	0.18
Silver	<0.01	<0.01	<0.01	0.64	0.06	0.20	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thallium	0.03	<0.01	0.01	0.06	0.01	0.03	<0.01	<0.01	<0.01	0.01	<0.01	<0.01
Tin	0.16	0.11	0.13	1.04	0.42	0.66	0.38	0.15	0.24	0.56	0.22	0.35
Vanadium	0.13	0.07	0.09	47.33	23.67	33.47	8.52	4.26	6.02	1.80	0.90	1.27
Zinc	0.14	0.13	0.14	1.45	0.56	0.90	0.14	0.06	0.09	0.19	0.08	0.12

Notes:

Shaded cells indicate a hazard quotient value greater than 1.0

NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
NA = Toxicity Reference Value not available (hazard quotient value could not be calculated)

[1] All surface soil analytical data for lead were rejected during data validation activities. Although lead is not listed below (see Appendix D for all rejected surface soil analytical data), this metal was identified as an ecological COPC based on the lack of any useable analytical data.

TABLE 7-27
HAZARD QUOTIENT VALUES FOR AVIAN AND MAMMALIAN DIETARY EXPOSURES TO CHEMICALS IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Brown flower bat			American robin			Mourning dove			Red-tailed hawk		
	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC
Volatile Organic:												
1,1,1,2-Tetrachloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbon tetrachloride	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzene	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Toluene	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethene	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Xylene, m/p-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Xylene, o-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Xylenes, total	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Semi-Volatile Organics:												
1,2,4,5-Tetrachlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,3-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,4-Dichlorobenzene	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2,3,4,6-Tetrachlorophenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4,5-Trichlorophenol	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4,6-Trichlorophenol	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dichlorophenol	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Acetylaminofluorene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Chloronaphthalene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3,3'-Dichlorobenzidine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3,3'-Dimethylbenzidine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3-Methylcholanthrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Bromopheny phenyl ether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chloro-3-methylphenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chlorophenyl phenyl ether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7,12-Dimethylbenz(a)anthracene	NA	NA	NA	0.04	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aramite, total	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 7-27
HAZARD QUOTIENT VALUES FOR AVIAN AND MAMMALIAN DIETARY EXPOSURES TO CHEMICALS IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Brown flower bat			American robin			Mourning dove			Red-tailed hawk		
	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC
Semi-Volatile Organics:												
bis(2-Ethylhexyl)phthalate	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Butyl benzyl phthalate	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Diallate (cis)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Diallate (trans)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzofuran	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Diethyl phthalate	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-butyl phthalate	<0.01	<0.01	<0.01	0.55	0.11	0.24	0.14	0.03	0.06	0.14	0.03	0.06
Di-n-octyl phthalate	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dinoseb	NA	NA	NA	0.52	0.10	0.23	0.27	0.05	0.12	0.14	0.03	0.06
Hexachlorobenzene	<0.01	<0.01	<0.01	0.81	0.16	0.36	0.10	0.02	0.05	0.21	0.04	0.09
Hexachlorobutadiene	<0.01	<0.01	<0.01	0.03	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Hexachlorocyclopentadiene	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloropropene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Isosafrole	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
N-Nitrosodiphenylamine	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
p-Dimethylamino azobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorobenzene	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachloronitrobenzene	NA	NA	NA	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Pentachlorophenol	0.45	0.17	0.28	1.51	0.15	0.48	0.47	0.05	0.15	0.41	0.04	0.13
Pronamide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PAHs:												
2-Methylnaphthalene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthylene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Anthracene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(a)anthracene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(a)pyrene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(b)fluoranthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(g,h,i)perylene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(k)fluoranthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chrysene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

TABLE 7-27
HAZARD QUOTIENT VALUES FOR AVIAN AND MAMMALIAN DIETARY EXPOSURES TO CHEMICALS IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Brown flower bat			American robin			Mourning dove			Red-tailed hawk		
	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC
PAHs:												
Dibenz(a,h)anthracene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fluoranthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fluorene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Naphthalene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Phenanthrene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Pyrene	0.03	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Organochlorine Pesticides:												
4,4'-DDD	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
4,4'-DDE	<0.01	<0.01	<0.01	0.09	<0.01	0.03	<0.01	<0.01	<0.01	0.02	<0.01	<0.01
4,4'-DDT	<0.01	<0.01	<0.01	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aldrin	<0.01	<0.01	<0.01	0.03	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
alpha-BHC	0.06	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
alpha-Chlordane	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
beta-BHC	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chlorobenzilate	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
delta-BHC	0.04	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dieldrin	0.13	0.06	0.09	0.08	0.02	0.04	<0.01	<0.01	<0.01	0.02	<0.01	<0.01
Endosulfan I	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan II	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan sulfate	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endrin	<0.01	<0.01	<0.01	0.02	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endrin aldehyde	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
gamma-BHC (Lindane)	0.06	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
gamma-Chlordane	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Heptachlor	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Heptachlor epoxide	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Isodrin	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kepone	0.22	0.04	0.10	0.06	0.01	0.03	<0.01	<0.01	<0.01	0.01	<0.01	<0.01
Methoxychlor	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Toxaphene	<0.01	<0.01	<0.01	0.05	<0.01	0.02	<0.01	<0.01	<0.01	0.01	<0.01	<0.01

TABLE 7-27
HAZARD QUOTIENT VALUES FOR AVIAN AND MAMMALIAN DIETARY EXPOSURES TO CHEMICALS IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Brown flower bat			American robin			Mourning dove			Red-tailed hawk		
	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC
Metals:												
Antimony	0.14	0.01	0.04	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic	0.03	0.02	0.03	0.06	0.03	0.04	0.02	<0.01	0.01	<0.01	<0.01	<0.01
Barium	0.40	0.25	0.32	0.86	0.43	0.60	0.91	0.46	0.64	<0.01	<0.01	<0.01
Beryllium	0.19	0.17	0.18	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	0.12	0.01	0.04	1.11	0.26	0.54	0.06	0.01	0.03	0.04	<0.01	0.02
Chromium, total	0.48	0.02	0.10	23.49	4.01	9.70	0.58	0.10	0.24	0.23	0.04	0.09
Cobalt	0.04	0.02	0.03	0.93	0.39	0.60	0.10	0.04	0.07	0.04	0.02	0.03
Copper	0.55	0.33	0.42	3.27	1.09	1.89	1.12	0.38	0.65	0.45	0.15	0.26
Lead	0.07	0.04	0.05	0.85	0.43	0.60	0.32	0.16	0.22	0.33	0.16	0.23
Mercury	0.57	0.11	0.26	19.18	6.39	11.07	0.61	0.20	0.35	0.08	0.03	0.05
Nickel	0.20	0.10	0.14	8.21	2.96	4.93	0.09	0.03	0.06	0.07	0.03	0.04
Selenium	1.77	1.17	1.44	1.80	0.90	1.28	0.78	0.39	0.55	0.34	0.17	0.24
Silver	<0.01	<0.01	<0.01	1.05	0.10	0.33	<0.01	<0.01	<0.01	0.01	<0.01	<0.01
Thallium	0.07	<0.01	0.02	0.38	0.08	0.17	0.01	<0.01	<0.01	0.10	0.02	0.04
Tin	<0.01	<0.01	<0.01	1.03	0.41	0.65	0.05	0.02	0.03	0.26	0.10	0.16
Vanadium	0.11	0.06	0.08	40.45	20.22	28.60	7.28	3.64	5.15	1.54	0.77	1.09
Zinc	0.23	0.21	0.22	1.99	0.77	1.23	0.25	0.09	0.15	0.21	0.08	0.13

Notes:

Shaded cells indicate a hazard quotient value greater than 1.0

NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
NA = Toxicity Reference Value not available (hazard quotient value could not be calculated)

TABLE 7-28
HAZARD QUOTIENT VALUES FOR AVIAN AND MAMMALIAN DIETARY EXPOSURES TO CHEMICALS IN SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical [1]	Brown flower bat			American robin			Mourning dove			Red-tailed hawk		
	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC
Volatile Organic:												
1,1,1,2-Tetrachloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzene	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Toluene	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethene	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Xylenes, total	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Semi-Volatile Organics:												
1,2,4,5-Tetrachlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,3-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,4-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2,3,4,6-Tetrachlorophenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4,5-Trichlorophenol	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4,6-Trichlorophenol	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dichlorophenol	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Acetylaminofluorene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Chloronaphthalene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3,3'-Dichlorobenzidine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3,3'-Dimethylbenzidine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3-Methylcholanthrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Bromopheny phenyl ether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chloro-3-methylphenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chlorophenyl phenyl ether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7,12-Dimethylbenz(a)anthracene	NA	NA	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aramite, total	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 7-28
HAZARD QUOTIENT VALUES FOR AVIAN AND MAMMALIAN DIETARY EXPOSURES TO CHEMICALS IN SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical [1]	Brown flower bat			American robin			Mourning dove			Red-tailed hawk		
	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC
Semi-Volatile Organics:												
bis(2-Ethylhexyl)phthalate	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Butyl benzyl phthalate	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Diallate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzofuran	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Diethyl phthalate	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-butyl phthalate	<0.01	<0.01	<0.01	0.06	0.01	0.03	0.02	<0.01	<0.01	0.02	<0.01	<0.01
Di-n-octyl phthalate	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dinoseb	NA	NA	NA	0.03	<0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Hexachlorobenzene	<0.01	<0.01	<0.01	0.05	<0.01	0.02	0.01	<0.01	<0.01	0.02	<0.01	<0.01
Hexachlorobutadiene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Hexachlorocyclopentadiene	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloropropene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Isosafrole	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
N-Nitrosodiphenylamine	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
p-Dimethylamino azobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorobenzene	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachloronitrobenzene	NA	NA	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Pentachlorophenol	0.02	<0.01	0.01	0.08	<0.01	0.02	0.02	<0.01	<0.01	0.02	<0.01	<0.01
Pronamide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PAHs:												
2-Methylnaphthalene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthylene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Anthracene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(a)anthracene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(a)pyrene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(b)fluoranthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(g,h,i)perylene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(k)fluoranthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chrysene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dibenz(a,h)anthracene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

TABLE 7-28
HAZARD QUOTIENT VALUES FOR AVIAN AND MAMMALIAN DIETARY EXPOSURES TO CHEMICALS IN SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical [1]	Brown flower bat			American robin			Mourning dove			Red-tailed hawk		
	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC
PAHs:												
Fluoranthene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fluorene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Naphthalene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Phenanthrene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Pyrene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Metals:												
Antimony	0.08	<0.01	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic	0.03	0.02	0.02	0.04	0.02	0.03	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Barium	0.18	0.11	0.14	0.38	0.19	0.27	0.41	0.20	0.29	<0.01	<0.01	<0.01
Beryllium	0.11	0.11	0.11	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	0.09	<0.01	0.03	0.73	0.17	0.35	0.04	<0.01	0.02	0.03	<0.01	0.02
Chromium, total	0.73	0.03	0.15	35.55	6.06	14.68	0.88	0.15	0.36	0.31	0.05	0.13
Cobalt	0.01	<0.01	<0.01	0.31	0.13	0.20	0.03	0.01	0.02	0.01	<0.01	<0.01
Copper	0.50	0.30	0.38	2.76	0.92	1.60	0.95	0.32	0.55	0.43	0.14	0.25
Mercury	0.52	0.10	0.23	15.92	5.31	9.19	0.55	0.18	0.32	0.06	0.02	0.04
Nickel	0.19	0.09	0.13	7.64	2.76	4.59	0.09	0.03	0.05	0.07	0.03	0.04
Selenium	0.41	0.27	0.33	0.65	0.33	0.46	0.18	0.09	0.13	0.21	0.10	0.15
Silver	<0.01	<0.01	<0.01	0.48	0.05	0.15	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thallium	0.03	<0.01	<0.01	0.03	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Tin	<0.01	<0.01	<0.01	0.14	0.06	0.09	<0.01	<0.01	<0.01	0.04	0.01	0.02
Vanadium	0.16	0.08	0.11	57.37	28.69	40.57	10.32	5.16	7.30	2.18	1.09	1.54
Zinc	0.12	0.11	0.12	1.33	0.51	0.82	0.12	0.05	0.08	0.19	0.07	0.12

Notes:

Shaded cells indicate a hazard quotient value greater than 1.0

NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
NA = Toxicity Reference Value not available (hazard quotient value could not be calculated)

[1] All subsurface soil analytical data for lead were rejected during data validation activities. Although lead is not listed below (see Appendix D for all rejected subsurface soil analytical data), this metal was identified as an ecological COPC based on the lack of any useable analytical data.

TABLE 7-29
HAZARD QUOTIENT VALUES FOR AVIAN DIETARY EXPOSURES TO CHEMICALS IN DRAINAGE DITCH SEDIMENT: STEP 2 SCREENING LEVEL RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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Chemical	Green heron		
	NOAEL	LOAEL	MATC
Volatile Organics:			
1,1,1,2-Tetrachloroethane	NA	NA	NA
Pentachloroethane	NA	NA	NA
Carbon tetrachloride	NA	NA	NA
Chlorobenzene	NA	NA	NA
Chloroform	NA	NA	NA
Ethylbenzene	NA	NA	NA
Styrene	NA	NA	NA
Toluene	NA	NA	NA
Trichloroethene	NA	NA	NA
Xylene, m/p-	<0.01	<0.01	<0.01
Xylene, o-	<0.01	<0.01	<0.01
Xylenes, total	<0.01	<0.01	<0.01
Semi-Volatile Organics:			
1,2,4,5-Tetrachlorobenzene	NA	NA	NA
1,2,4-Trichlorobenzene	NA	NA	NA
1,2-Dichlorobenzene	<0.01	<0.01	<0.01
1,3-Dichlorobenzene	<0.01	<0.01	<0.01
1,4-Dichlorobenzene	<0.01	<0.01	<0.01
2,3,4,6-Tetrachlorophenol	NA	NA	NA
2,4,5-Trichlorophenol	NA	NA	NA
2,4,6-Trichlorophenol	NA	NA	NA
2,4-Dichlorophenol	NA	NA	NA
2-Acetylaminofluorene	NA	NA	NA
2-Chloronaphthalene	NA	NA	NA
3,3'-Dichlorobenzidine	NA	NA	NA
3,3'-Dimethylbenzidine	NA	NA	NA
3-Methylcholanthrene	NA	NA	NA
4-Bromopheny phenyl ether	NA	NA	NA
4-Chloro-3-methylphenol	NA	NA	NA

TABLE 7-29
HAZARD QUOTIENT VALUES FOR AVIAN DIETARY EXPOSURES TO CHEMICALS IN DRAINAGE DITCH SEDIMENT: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical	Green heron		
	NOAEL	LOAEL	MATC
Semi-Volatile Organics:			
4-Chlorophenyl phenyl ether	NA	NA	NA
7,12-Dimethylbenz(a)anthracene	0.03	<0.01	0.01
Aramite, total	NA	NA	NA
bis(2-Ethylhexyl)phthalate	4.24	0.85	1.90
Butyl benzyl phthalate	NA	NA	NA
Diallate (cis)	NA	NA	NA
Diallate (trans)	NA	NA	NA
Dibenzofuran	NA	NA	NA
Diethyl phthalate	NA	NA	NA
Di-n-butyl phthalate	0.31	0.06	0.14
Di-n-octyl phthalate	<0.01	<0.01	<0.01
Dinoseb	0.26	0.05	0.11
Hexachlorobenzene	0.62	0.12	0.27
Hexachlorobutadiene	0.02	<0.01	<0.01
Hexachlorocyclopentadiene	NA	NA	NA
Hexachloroethane	NA	NA	NA
Hexachloropropene	NA	NA	NA
Isosafrole	NA	NA	NA
N-Nitrosodiphenylamine	NA	NA	NA
p-Dimethylamino azobenzene	NA	NA	NA
Pentachlorobenzene	NA	NA	NA
Pentachloronitrobenzene	<0.01	<0.01	<0.01
Pentachlorophenol	0.02	<0.01	<0.01
Pronamide	NA	NA	NA
PAHs:			
2-Methylnaphthalene	<0.01	<0.01	<0.01
Acenaphthene	<0.01	<0.01	<0.01
Acenaphthylene	<0.01	<0.01	<0.01
Anthracene	<0.01	<0.01	<0.01

TABLE 7-29
HAZARD QUOTIENT VALUES FOR AVIAN DIETARY EXPOSURES TO CHEMICALS IN DRAINAGE DITCH SEDIMENT: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical	Green heron		
	NOAEL	LOAEL	MATC
PAHs:			
Benzo(a)anthracene	<0.01	<0.01	<0.01
Benzo(a)pyrene	<0.01	<0.01	<0.01
Benzo(b)fluoranthene	<0.01	<0.01	<0.01
Benzo(g,h,i)perylene	<0.01	<0.01	<0.01
Benzo(k)fluoranthene	<0.01	<0.01	<0.01
Chrysene	<0.01	<0.01	<0.01
Dibenz(a,h)anthracene	<0.01	<0.01	<0.01
Fluoranthene	<0.01	<0.01	<0.01
Fluorene	<0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	<0.01	<0.01	<0.01
Naphthalene	0.01	<0.01	<0.01
Phenanthrene	<0.01	<0.01	<0.01
Pyrene	<0.01	<0.01	<0.01
Organochlorine Pesticides:			
4,4'-DDD	0.08	<0.01	0.03
4,4'-DDE	30.06	3.01	9.51
4,4'-DDT	0.02	<0.01	<0.01
Aldrin	0.04	<0.01	0.02
alpha-BHC	0.02	<0.01	0.01
alpha-Chlordane	0.04	<0.01	0.02
beta-BHC	0.01	<0.01	<0.01
Chlorobenzilate	<0.01	<0.01	<0.01
delta-BHC	0.02	<0.01	0.01
Dieldrin	0.02	<0.01	0.01
Endosulfan I	<0.01	<0.01	<0.01
Endosulfan II	<0.01	<0.01	<0.01
Endosulfan sulfate	<0.01	<0.01	<0.01
Endrin	1.25	0.25	0.56
Endrin aldehyde	0.20	0.04	0.09

TABLE 7-29
HAZARD QUOTIENT VALUES FOR AVIAN DIETARY EXPOSURES TO CHEMICALS IN DRAINAGE DITCH SEDIMENT: STEP 2 SCREENING LEVEL RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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Chemical	Green heron		
	NOAEL	LOAEL	MATC
Organochlorine Pesticides:			
gamma-BHC (Lindane)	<0.01	<0.01	<0.01
gamma-Chlordane	0.05	0.01	0.02
Heptachlor	<0.01	<0.01	<0.01
Heptachlor epoxide	0.03	<0.01	0.01
Isodrin	NA	NA	NA
Kepone	0.04	<0.01	0.02
Methoxychlor	<0.01	<0.01	<0.01
Toxaphene	0.68	0.14	0.30
Metals:			
Antimony	<0.01	<0.01	<0.01
Arsenic	0.12	0.06	0.09
Barium	1.47	0.73	1.04
Beryllium	NA	NA	NA
Cadmium	0.25	0.06	0.12
Chromium, total	2.94	0.50	1.22
Cobalt	0.78	0.32	0.50
Copper	8.59	2.87	4.97
Lead	3.17	1.58	2.24
Mercury	6.23	2.08	3.59
Nickel	0.78	0.28	0.47
Selenium	0.64	0.32	0.45
Silver	0.02	<0.01	<0.01
Thallium	0.07	0.01	0.03
Tin	0.29	0.12	0.18
Vanadium	125.44	62.72	88.70
Zinc	4.84	1.87	3.01

Shaded cells indicate a hazard quotient value greater than 1.0
Notes:

NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
NA = Toxicity Reference Value not available (hazard quotient value could not be calculated)

TABLE 7-30
EXPOSURE PARAMETERS FOR UPPER TROPHIC LEVEL RECEPTORS: STEP 3A RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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Receptor	Habitat	Body Weight (kg)		Food Ingestion Rate (kg/day - dry)		Water Ingestion Rate (L/day)		Area Use Factor
		Value	Reference	Value	Reference	Value	Reference	
Birds:								
American robin	Terrestrial	0.0785 (1)	Dunning 2008	0.01033	Allometric equation from Nagy (2001) for omnivorous birds (7): $[0.67((BW*1000)^{0.627})]/1000$	0.01073	Allometric equation from Calder and Braun (1983) for all birds (7): $0.059(BW)^{0.67}$	1.00
Mourning dove	Terrestrial	0.115 (2)	Dunning 2008	0.01646	Allometric equation from Nagy (2001) for all birds (7): $[0.638((BW*1000)^{0.685})]/1000$	0.01385	Allometric equation from Calder and Braun (1983) for all birds (7): $0.059(BW)^{0.67}$	1.00
Red-tailed hawk	Terrestrial	1.0945 (3)	Dunning 2008	0.08788	Allometric equation from Nagy (2001) for carnivorous birds (7): $[0.849((BW*1000)^{0.663})]/1000$	0.06268	Allometric equation from Calder and Braun (1983) for all birds (7): $0.059(BW)^{0.67}$	1.00
Green heron	Aquatic	0.187 (4)	Dunning 2008	0.02296	Allometric equation from Nagy (2001) for all birds(7): $[0.638((BW*1000)^{0.685})]/1000$	0.01919	Allometric equation from Calder and Braun (1983) for all birds(7): $0.059(BW)^{0.67}$	1.00
Mammals:								
Brown flower bat	Terrestrial	0.0183 (5)	Gannon et al. 2005	0.00257	Allometric equation from Nagy (2001) for bats (8): $[0.365((BW*1000)^{0.671})]/1000$	0.00270	Allometric equation from Calder and Braun (1983) for all mammals (8): $0.099(BW)^{0.90}$	1.00
Norway rat (prey item for red-tailed hawk)	Terrestrial	0.350 (6)	Jackson 1992	0.03092	Allometric equation from Nagy (2001) for rodents (9): $[0.332((BW*1000)^{0.774})]/1000$	0.03849	Allometric equation from Calder and Braun (1983) for all mammals (9): $0.099(BW)^{0.90}$	1.00

TABLE 7-30
EXPOSURE PARAMETERS FOR UPPER TROPHIC LEVEL RECEPTORS: STEP 3A RISK CALCULATION
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Notes:

BW = Body Weight
kg = kilogram
L/day = liter per day
kg/day - dry = kilogram per day - dry weight basis
USEPA = United States Environmental Protection Agency

(1) Mean body weight for males and females from the western United States (n = 255).
(2) Mean mean body weight for males and females from Illinois (n = 95).
(3) Mean body weight for males and females from the western United States (n = 50).
(4) Mean body weight for males and femals in the Caribbean (n = 70)
(5) Mean body weight for males and females in Puerto Rico (n = 20).
(6) The body weight shown represents the midpoint within the range of reported values (gender and location not specified).
(7) Food and drinking water ingestion rates for avian receptors were calculated using mean body weights: 0.115 kg for the mourning dove, 0.0785 kg for the American robin, 1.0945 kg for the red-tailed hawk, and 0.187 kg for the green heron (Dunning, 2008).
(8) Food and drinking water ingestion rate for the brown flower bat were calculated using a mean body weight of 0.0183 kg (Gannon et al., 2005).
(9) Food and drinking water ingestion rate for the Norway rat were calculated using the midpoint within the range of reported values: 0.350 kg (Jackson, 1992).

Table References:

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Gannon, M.R., A. Kurta, A. Rodriguez-Durán, and M.R. Willig. 2005. Bats of Puerto Rico: An Island Focus and a Caribbean Perspective. Texas Tech University Press, Lubbock, TX. 239 pp.

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Nagy, K. A. 2001. Food Requirements of Wild Animals: Predictive Equations for Free-Living Mammals, Reptiles, and Birds. Nutr. Abstr. Rev. Series B. 71:21R-31R.

TABLE 7-31
DIETARY COMPOSITION FOR UPPER TROPHIC LEVEL RECEPTORS: STEP 3A RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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Receptor	Dietary Composition (percent)						Soil/Sediment Ingestion (percent)	
	Terrestrial Plants	Soil Invertebrates	Small Mammals	Aquatic Invertebrates	Fish	Reference	Value	Reference
Birds:								
American robin	8.3	83.0 (1)	0	0	0	Wheelwright et al. 1986	8.7 (2)	Sample and Suter II 1994
Mourning dove	95.0	0	0	0	0	Tomlinson et al. 1994	5.0	Assumed
Red-tailed hawk	0	0	100	0	0	USEPA 1993; Sample and Suter II 1994	0	Sample and Suter II 1994
Green heron	0	0	0	29.0	71.0	Sample et al. 1997	0	Sample et al. 1997
Mammals:								
Brown flower bat	100	0	0	0	0	Gannon et al. 2005	0 (3)	Assumed
Norway rat (prey item for red-tailed hawk)	49.0	49.0	0	0	0	Assumed	2.0	Assumed

Notes:

USEPA = United States Environmental Protection Agency

(1) The value shown represents the highest seasonal percentage of invertebrates in the diet of the American robin as reported by Wheelwright et al. (1986

(2) The percentage of soil in the diet of the American robin was estimated using the relationship presented in Sample and Sutter II (1994). A diet of 83 percent earthworms extrapolates to a so contribution of 8.7 percent to the total diet.

(3) Soil ingestion is considered negligible based on the arboreal feeding behavior of nectivorous bats

Table References:

Gannon, M.R., A. Kurta, A. Rodriguez-Durán, and M.R. Willig. 2005. Bats of Puerto Rico: An Island Focus and a Caribbean Perspective. Texas Tech University Press, Lubbock, TX. 239 pp.

Sample, B.E. and G.W. Suter II. 1994. Estimating Exposure of Terrestrial Wildlife to Contaminants. Environmental Restoration Division, ORNL Environmental Restoration Program. ES/ER/TM-125

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TABLE 7-32
SOIL TO PLANT AND SOIL TO EARTHWORM BIOACCUMULATION FACTORS AND BIOACCUMULATION UPTAKE EQUATIONS USED TO ESTIMATE CHEMICAL CONCENTRATIONS IN TERRESTRIAL PLANT AND INVERTEBRATE TISSUE: STEP 3A RISK CALCULATION
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Chemical [1]	Soil-Plant BAF (dry weight) or Uptake Equation (dry weight)			Soil-Invertebrate BAF (dry weight) or Uptake Equation (dry weight)		
	BAF Value/Uptake Equation	Source Document	Description	BAF Value/Uptake Equation	Source Document	Description
Semi-Volatile Organics:						
Butyl benzyl phthalate	0.657	USEPA 2007	Regression-based BAF [2]	1.773	USEPA 2007	Modeled BAF [11]
Dibenzofuran	1.287	USEPA 2007	Regression-based BAF [2]	2.138	USEPA 2007	Modeled BAF [11]
Pentachlorophenol	5.93	USEPA 2007	Median BAF [3]	16.15	USEPA 2007	Median BAF [12]
PAHs:						
Pyrene	0.72	USEPA 2007	Median BAF [4]	NA [10]	---	---
Organochlorine Pesticides:						
4,4'-DDE	0.136	USEPA 2007	Median BAF [4]	$\ln(C_e) = 0.8804[\ln(C_s)] + 2.4771$	USEPA 2007	Uptake equation [13]
4,4'-DDT	0.037	USEPA 2007	Median BAF [4]	$\ln(C_e) = 0.8689[\ln(C_s)] + 2.1247$	USEPA 2007	Uptake equation [13]
Endrin	0.535	USEPA 2007	Regression-based BAF [2]	3.60	Edwards and Bohlen 1992	Mean BAF
Metals:						
Beryllium	$\ln(C_p) = 0.7345[\ln(C_s)] - 0.5361$	USEPA 2007	Uptake equation [5]	0.045	USEPA 2007	Median BAF [14]
Cadmium	$\ln(C_p) = 0.546[\ln(C_s)] - 0.475$	USEPA 2007	Uptake equation [6]	$\ln(C_e) = 0.795[\ln(C_s)] + 2.114$	USEPA 2007	Uptake equation [15]
Chromium, total	0.041	USEPA 2007	Median BAF [7]	0.306	USEPA 2007	Median BAF [16]
Copper	$\ln(C_p) = 0.394[\ln(C_s)] + 0.668$	USEPA 2007	Uptake equation [6]	$\ln(C_e) = 0.264[\ln(C_s)] + 1.675$	Sample et al. 1998	Uptake equation [17]
Lead	$\ln(C_p) = 0.561[\ln(C_s)] - 1.328$	USEPA 2007	Uptake equation [6]	$\ln(C_e) = 0.807[\ln(C_s)] - 2.18$	USEPA 2007	Uptake equation [15]
Mercury	$\ln(C_p) = 0.544[\ln[C_s]) - 0.996$	Bechtel Jacobs 1998	Uptake equation [8]	1.693	Sample et al. 1998	Median BAF [18]
Nickel	$\ln(C_p) = 0.748[\ln(C_s)] - 2.224$	USEPA 2007	Uptake equation [6]	1.059	Sample et al. 1998	Median BAF [18]
Selenium	$\ln(C_p) = 1.104[\ln(C_s)] - 0.678$	USEPA 2007	Uptake equation [6]	$\ln(C_e) = 0.733[\ln(C_s)] - 0.075$	USEPA 2007	Uptake equation [15]
Silver	0.014	USEPA 2007	Median BAF [6]	2.045	USEPA 2007	Median BAF [14]
Tin	0.03	Baes et al. 1984	Geometric mean	1.00	---	Assumed BAF
Vanadium	0.00485	USEPA 2007	Median BAF [9]	0.042	USEPA 2007	Median BAF [14]
Zinc	$\ln(C_p) = 0.554[\ln(C_s)] + 1.575$	USEPA 2007	Uptake equation [6]	$\ln(C_e) = 0.328[\ln(C_s)] + 4.449$	USEPA 2007	Uptake equation [15]

Notes:

USEPA = United States Environmental Protection Agency
BAF = Bioaccumulation Factor (unitless)
PAH = Polynuclear Aromatic Hydrocarbon
ln = natural logarithm
NA = Not Applicable
C_e = Concentration in earthworm tissue (mg/kg - dry weight)
C_p = Concentration in plant tissue (mg/kg - dry weight)
C_s = 95 percent UCL of the mean concentration in soil (mg/kg - dry weight) - for a given chemical, the 95 percent UCL of the mean concentration was used if there was a minimum of eight detected values and less than 70 percent non-detected results (if these conditions were not met, the maximum concentration was used)

TABLE 7-32
SOIL TO PLANT AND SOIL TO EARTHWORM BIOACCUMULATION FACTORS AND BIOACCUMULATION UPTAKE EQUATIONS USED TO ESTIMATE CHEMICAL CONCENTRATIONS IN TERRESTRIAL PLANT AND INVERTEBRATE TISSUE: STEP 3A RISK CALCULATION
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Notes (continued):

(1) The chemicals listed are those detected in surface soil and/or subsurface soil and identified as ecological COPCs for American robin, mourning dove, red-tailed hawk and/or brown flower bat dietary exposures because maximum doses exceed toxicity reference values or the chemical lacks a toxicity reference value. Non-detected chemicals identified as ecological COPCs because maximum exposure doses exceed toxicity reference values also are listed.

(2) BAF value was estimated using an inter-chemical regression equation for non-ionic organics based on rinsed plant foliage BAF data: $\log BAF = -0.4057(\log K_{ow}) + 1.781$, where BAF is the bioaccumulation factor and K_{ow} is the octanol-water partition coefficient (see Figure 5, Panel B in USEPA, 2007). The K_{ow} value used in the estimation of the BAF value is listed in Table 7-3.

(3) Median BAF value listed in Appendix F, Table F-1 of USEPA (2007).

(4) Median BAF value for rinsed plant foliage BAF data listed in Appendix C of USEPA (2007).

(5) The concentration in plant tissue was estimated using a chemical-specific bioaccumulation uptake equation (i.e., regression equation; see Table 4a of USEPA, 2007) derived from measured BAF data (see Appendix A, Table A-2 of USEPA, 2007).

(6) The concentration in plant tissue was estimated using a chemical-specific bioaccumulation uptake equation (i.e., regression equation; see Table 4a of USEPA[2007]) developed by Bechtel Jacobs (1998) and cited in Table 4a of USEPA (2007).

(7) Median BAF value listed in Table 4a of USEPA (2007). The value corresponds to the median BAF value listed in Appendix D, Table D-1 of Bechtel Jacobs (1998).

(8) The concentration in plant tissue was estimated using a chemical-specific bioaccumulation uptake equation (i.e., regression equation) listed in Table 7 of Bechtel Jacobs (1998).

(9) Median BAF value for rinsed plant foliage BAF data listed in Appendix C of USEPA (2007).

(10) Pyrene was not identified as an ecological COPC for an upper trophic level terrestrail receptor with a diet that includes soil invertebrates. As such, a soil-to-invertebrate BAF for this PAH is not shown.

(11) BAF value was estimated using the relationship $BAF = K_{ww}/K_d$ where K_{ww} is the biota to soil pore water partition coefficient (L soil pore water/kg ww tissue; converted to L soil pore water/kg dw tissue by assuming 16 percent solids [USEPA, 1993] and dividing by 0.16) and K_d is the soil to pore water partition coefficient (L soil pore water/kg dw soil) (relationship developed by Jager, 1998 and cited in USEPA, 2007). Chemical-specific values for K_{ww} and K_d were derived using the following relationships:

$\log(K_{ww}) = 0.87(\log K_{ow}) - 2.0$ where K_{ow} is the octanol-water partition coefficient (K_{ow} value listed in Table 7-3)

$K_d = (f_{oc})(K_{oc})$ where f_{oc} is the fraction of organic carbon in soil (assumed to be 0.01 [one percent]) and K_{oc} is the organic carbon partition coefficient (K_{oc} value listed in Table 7-3)

(12) Median BAF value calculated from individual earthworm BAF values listed in Appendix F-2 of USEPA (2007).

(13) The concentration in earthworm tissue was estimated using a chemical-specific bioaccumulation uptake equation (i.e., regression equation; see Table 4b of USEPA[2007]) derived from measured BAF data (see Appendix D, Table D-1 of USEPA, 2007).

(14) Median BAF value listed in Table 4a of USEPA (2007). The value corresponds to the median BAF value listed in Appendix C, Table C-1 of Sample et al. (1998).

(15) The concentration in earthworm tissue was estimated using a chemical-specific bioaccumulation uptake equation (i.e., regression equation) developed by Sample et al. (1998 and 1999) and cited in Table 4a of USEPA (2007).

(16) Median BAF value listed in Table 4a of USEPA (2007). The value corresponds to the median BAF value listed in Table 11 of Sample et al. (1998).

(17) The concentration in earthworm tissue was estimated using a chemical-specific bioaccumulation uptake equation (i.e., regression equation) listed in Table 12 of Sample et al. (1998).

(18) Median BAF value listed in Table 11 of Sample et al. (1998).

Table References:

Baes III, C.F., R.D. Scharp, A.L. Sjoreen, and R.W. Shor. 1984. A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides Through Agriculture. ORNL 5786. Oak Ridge National Laboratory, Oak Ridge, TN.

Bechtel Jacobs. 1998. Empirical Models for the Uptake of Inorganic Chemicals from Soil by Plants. Prepared for U.S. Department of Energy. BJC/OR-133. September 1998.

TABLE 7-32
SOIL TO PLANT AND SOIL TO EARTHWORM BIOACCUMULATION FACTORS AND BIOACCUMULATION UPTAKE EQUATIONS USED TO ESTIMATE CHEMICAL CONCENTRATIONS IN TERRESTRIAL PLANT AND INVERTEBRATE TISSUE: STEP 3A RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Table References (continued):

Edwards, C.A. and P.J. Bohlen. 1992. The Effects of Toxic Chemicals on Earthworms. Rev. Environ. Contam. Toxicol. 125:23-99.

Sample, B.E., J.J. Beauchamp, R.A. Efroymson, G.W. Suter II, and T.L. Ashwood. 1998. Development and Validation of Bioaccumulation Models for Earthworms. Oak Ridge National Laboratory, Environmental Restoration Division, ORNL Environmental Restoration Program. ES/ER/TM-220.

United States Environmental Protection Agency (USEPA). 2007. Attachemnt 4-1 of Guidance for Developing Ecological Soil Screening Levels (Eco-SSLs): Exposure Factors and Bioaccumulation Models for Derivation of Wildlife Eco-SSLs. Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-55.

TABLE 7-33
SOIL BIOACCUMULATION FACTORS AND BIOACCUMULATION UPTAKE EQUATIONS USED TO ESTIMATE CHEMICAL CONCENTRATIONS IN SMALL MAMMAL TISSUE: STEP 3A RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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Chemical [1]	Soil-Small Mammal BAF (dry weight) or Uptake Equation (dry weight)		
	BAF Value/Uptake Equation	Source Document	Description
Semi-Volatile Organics:			
Butyl benzyl phthalate	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 [2]
Dibenzofuran	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 [2]
Metals:			
Beryllium	$C_m = [(BAF_d)(DI)]/0.32$	---	See Section 7.5.2.2.1 [2]
Lead	0.0659	Sample et al. 1998	Median BAF for omnivores [3]
Vanadium	0.01037	Sample et al. 1998	Median BAF for omnivores [3]

Notes:

USEPA = United States Environmental Protection Agency
BAF = Bioaccumulation Factor
COPC = Chemical of Potential Concern
C_m = Concentration in small mammal tissue (mg/kg - dry weight)
BAF_d = diet-to-small mammal bioaccumulation factor (wet weight)
DI = Small mammal dietary intake (mg/kg-BW/day)

(1) The chemicals listed are those detected in surface and/or subsurface soil and identified as ecological COPCs in the Step 2 screening level risk calculation for the red-tailed hawk. Non-detected chemicals identified as ecological COPCs because maximum exposure doses exceed toxicity reference values also are listed.

(2) Most chemical exposure for small mammals is via the diet. Therefore, it is assumed that the concentration of the chemical in the tissue of small mammals is equal to the chemical concentration in its diet multiplied by a diet-to-whole body BAF (BAF_d - wet weight basis). In the absence of literature-based diet-to whole-body BAF, a value of 1.0 was assumed. The resulting tissue concentration was converted to a dry weight basis using an estimated solids content for small mammals of 0.32 (USEPA, 1993). Additional explanation if provided in Section 7.5.2.2.1.

(3) Median BAF value for omnivores listed in Appendix C, Table C-1 of Sample et al. (1998).

Table References:

Sample, B.E., J.J. Beauchamp, R.A. Efroymson, and G.W. Suter II. 1998. Development and Validation of Bioaccumulation Models for Small Mammals. Oak Ridge National Laboratory, Environmental Restoration Division, ORNL Environmental Restoration Program. ES/ER/TM-219.

United States Environmental Protection Agency (USEPA). 1993. Wildlife Exposure Factors Handbook. Office of Research and Development, Washington, D.C. EPA/600/R-93/187a.2007.

TABLE 7-34
BIOACCUMULATION FACTORS USED TO ESTIMATE CHEMICAL CONCENTRATIONS IN AQUATIC INVERTEBRATES AND FISH: STEP 3A RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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Chemical [1]	Sediment-Invertebrate BAF (dry weight)			Sediment-Fish BAF (dry weight)		
	Value	Source Document	Description	Value	Source Document	Description
Semi-Volatile Organics:						
Bis(2-ethylhexyl)phthalate	66.10	---	BAF derived from median BSAF value listed in Table 7-33 [2]	13.01	---	BAF derived from median BSAF value listed in Table 7-30 [5]
Butyl benzyl phthalate	1.00	---	Assumed BAF	1.00	---	Assumed BAF
Organochlorine Pesticides:						
4,4'-DDE	16.23	---	BAF derived from median BSAF value listed in Table 7-33 [2]	63.17	---	BAF derived from median BSAF value listed in Table 7-30 [5]
Endrin	1.00	---	Assumed BAF	20.23	---	BAF derived from the single BSAF value listed in Table 7-14 [5]
Metals:						
Barium	1.00	---	Assumed BAF	1.00	---	Assumed BAF
Beryllium	1.00	---	Assumed BAF	1.00	---	Assumed BAF
Chromium, total	0.10	Bechtel Jacobs 1998	Median BAF [3]	0.038	Krantzberg and Boyd 1992	Mean BAF
Copper	0.661	Bechtel Jacobs 1998	Median BAF [4]	0.10	Krantzberg and Boyd 1992	Mean BAF
Lead	0.08	Bechtel Jacobs 1998	Median BAF [4]	0.13	PTI 1995	Median BAF
Mercury	1.136	Bechtel Jacobs 1998	Median BAF [3]	3.25	Cope et al. 1990	Mean BAF
Vanadium	1.00	---	Assumed BAF	1.00	---	Assumed BAF
Zinc	0.840	Bechtel Jacobs 1998	Median BAF [4]	1.25	PTI 1995	Median BAF

Notes:
BAF = Bioaccumulation Factor
BSAF = Biota-Sediment Accumulation Factor

(1) The chemicals listed are those detected in drainage ditch sediment and identified as ecological chemicals of potential concern for the green heron because (1) maximum exposure doses exceed toxicity reference values or (2) the chemical lacks a toxicity reference value. Non-detected chemicals identified as ecological chemicals of potential concern because maximum exposure doses exceed toxicity reference values also are listed.
(2) The median BSAF value (wet weight) listed in Table 7-33 was converted to a sediment-to-invertebrate BAF value (dry weight) using a lipid content of 3.44 percent (see Table 7-31), a solids content of 21 percent, and a mean sediment organic carbon content (f_{oc}) of 0.021 for drainage ditch sediment.
(3) Median BAF value listed in Table 2 of Bechtel Jacobs (1998) for depurated and non-depurated organisms. A combined depurated/non-depurated data set was used as the source of the median BAF value due to the low number of data points for the depurated data set.
(4) Median BAF value listed in Table 2 of Bechtel Jacobs (1998) for depurated organisms.
(5) The median/single BSAF value (wet weight) listed in Table 7-14 was converted to a sediment-to-fish BAF value (dry weight) using a lipid content of 5.90 percent (see table 7-14), a solids content of 25 percent, and a sediment organic carbon content (f_{oc}) of 0.021 for drainage ditch sediment.

Table References:

Bechtel Jacobs. 1998. Biota Sediment Accumulation Factors for Invertebrates: Review and Recommendations for Oak Ridge Reservation. Prepared for U.S. Department of Energy. BJC/OR-112. August 1998.

Cope, W.G., J.G. Wiener, and R.G. Rada. 1990. Mercury Accumulation in Yellow Perch in Wisconsin Seepage Lakes: Relation to Lake Characteristics. Environ. Toxicol. Chem. 9:931-940.

PTI Environmental Services. 1995. Bioaccumulation Factor Approach Analysis for Metals and Polar Organic Compounds. Bellevue, Washington. October 1995. 45 pp.

Krantzberg, G. and D. Boyd. 1992. The Biological Significance of Contaminants in Sediment from Hamilton Harbor, Lake Ontario. Environ. Toxicol. Chem. 11:1527-1540.

TABLE 7-35
LITERATURE-BASED BIOTA-SEDIMENT ACCUMULATION FACTORS USED TO DERIVE SEDIMENT-TO-INVERTEBRATE BIOACCUMULATION FACTORS
SWMU 59 - NAVY OPERATIONS AREA ON CABRAS ISLAND
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Organism	BSAF (wet weight)	Reference
Organochlorine Pesticides:			
4,4'-DDE	Alewife Floater (*Anodonta implicata*)	0.4737	USEPA 2010
		0.1345	USEPA 2010
		0.5311	USEPA 2010
		0.2600	USEPA 2010
		0.3030	USEPA 2010
		0.0712	USEPA 2010
		0.0702	USEPA 2010
		0.3084	USEPA 2010
		1.2682	USEPA 2010
		0.1398	USEPA 2010
		1.0588	USEPA 2010
		0.1815	USEPA 2010
		0.9621	USEPA 2010
	Little-Neck Clam (*Mercenaria mercenaria*)	19.6516	USEPA 2010
		20.2121	USEPA 2010
		4.5984	USEPA 2010
		3.2567	USEPA 2010
		7.8571	USEPA 2010
		17.2097	USEPA 2010
		2.8981	USEPA 2010
		4.3780	USEPA 2010
		6.1827	USEPA 2010
		6.3333	USEPA 2010
	Little-Neck Clam (*Mercenaria mercenaria*) (continued)	0.5555	USEPA 2010
		2.0756	USEPA 2010
		1.5606	USEPA 2010
		0.5973	USEPA 2010
	Ribbed Mussel (*Geukensia demissa*)	10.4558	USEPA 2010
		4.4898	USEPA 2010
		5.4918	USEPA 2010
	Bent-Nosed Clam (*Macoma nasuta*)	0.5476	USEPA 2010
	Blue Mussel (*Mytilus edulis*)	3.3477	USEPA 2010
		3.4513	USEPA 2010
		0.9176	USEPA 2010
		2.6561	USEPA 2010
		2.0383	USEPA 2010
		2.1704	USEPA 2010

TABLE 7-35
LITERATURE-BASED BIOTA-SEDIMENT ACCUMULATION FACTORS USED TO DERIVE SEDIMENT-TO-INVERTEBRATE BIOACCUMULATION FACTORS
SWMU 59 - NAVY OPERATIONS AREA ON CABRAS ISLAND
PHASE I RCRA FACILITY INVESTIGATION REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Organism	BSAF (wet weight)	Reference
Organochlorine Pesticides:			
4,4'-DDE (continued)	Blue Mussel (Mytilus edulis) (continued)	4.1857	USEPA 2010
		10.6942	USEPA 2010
		8.3396	USEPA 2010
		1.5443	USEPA 2010
		4.5769	USEPA 2010
		3.5099	USEPA 2010
		24.4905	USEPA 2010
		23.7962	USEPA 2010
		1.4231	USEPA 2010
	Hard-Shell Clam (*Pitar morrhuana*)	2.0868	USEPA 2010
		1.4421	USEPA 2010
		4.8003	USEPA 2010
		1.3636	USEPA 2010
		39.6403	USEPA 2010
		1.6065	USEPA 2010
		4.3106	USEPA 2010
		8.6100	USEPA 2010
		10.5364	USEPA 2010
		7.7533	USEPA 2010
		21.4096	USEPA 2010
		0.8511	USEPA 2010
		0.8789	USEPA 2010
		1.0007	USEPA 2010
	Brackish Water Clam (*Rangia cuneata*)	7.1065	USEPA 2010
		6.1124	USEPA 2010
		3.8161	USEPA 2010
		2.7185	USEPA 2010
	Unidentified Crayfish	0.6859	USEPA 2010
		0.7381	USEPA 2010
		1.7638	USEPA 2010
		1.8954	USEPA 2010
		0.9144	USEPA 2010
		0.5429	USEPA 2010
		2.5387	USEPA 2010
		2.5122	USEPA 2010
		1.1784	USEPA 2010
		0.5888	USEPA 2010
		0.4140	USEPA 2010
		0.5446	USEPA 2010
		7.5294	USEPA 2010

TABLE 7-35
LITERATURE-BASED BIOTA-SEDIMENT ACCUMULATION FACTORS USED TO DERIVE SEDIMENT-TO-INVERTEBRATE BIOACCUMULATION FACTORS
SWMU 59 - NAVY OPERATIONS AREA ON CABRAS ISLAND
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Chemical	Organism	BSAF (wet weight)	Reference
4,4'-DDE (continued)	Unidentified Crayfish (continued)	0.9356	USEPA 2010
		5.4176	USEPA 2010
		1.8750	USEPA 2010
		2.0221	USEPA 2010
		11.2041	USEPA 2010
		2.2303	USEPA 2010
		1.1141	USEPA 2010
		0.3925	USEPA 2010
		2.4231	USEPA 2010
	4,4'-DDE Statistics: 90th Percentile BSAF (wet weight)	10.6153	
	Median BSAF (wet weight)	2.0812	
Semi-Volatile Organics:			
Bis(2-ethylexyl)phthalate	Unidentified Crayfish	0.8100	USEPA 2010
		13.9641	USEPA 2010
		8.4739	USEPA 2010
	Bis (2-ethylhexyl)phthalate Statistics: 90th Percentile BSAF (wet weight)	12.8661	
	Median BSAF (wet weight)	8.4739	

Notes:

BSAF = Biota-Sediment Accumulation Factor
USEPA = United States Environmental Protection Agency

Table References:

United States Army Corps of Engineers (USACE). 2010. BSAF Database. Engineering Research and Development Center, Engineering Laboratory. http://el.erdc.usace.army.mil/bsafnew/bsaf.html. Accessed May 30, 2010.

United States Environmental Protection Agency (USEPA). 2010. Biota-Sediment Accumulation Factor (BSAF) Database. http://www.epa.gov/med/Prods_Pubs/bsaf.htm. Accessed May 30, 2010.

TABLE 7-36
PERCENT LIPID CONTENT OF AQUATIC INVERTEBRATES
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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Organism [(1)]	**Percent Lipid (wet weight)** [(2)]	**Reference**
Amphipod (*Diporeia* spp.)	7.73 [(3)]	USACE 2010
Amphipod (*Hyalella azteca*)	1.265 [(3)]	USACE 2010
Crayfish (*Orconectes* spp.)	0.86	USACE 2010
Crayfish (*Procambarus* spp.)	2.985 [(3)]	USACE 2010
Mysid shrimp (*Antarctomysis ohlinii*)	3.2	USACE 2010
Copepod (*Calanoides acutus*)	10.6	USACE 2010
Asian paddle crab (*Charybdis japonica*)	1.9	USACE 2010
Burrowing crab (*Chasmagnathus granulata*)	4.118 [(3)]	USACE 2010
Amphipod (*Corophium colo*)	0.54 [(3)]	USACE 2010
Amphipod (*Corophium volutator*)	0.81 [(3)]	USACE 2010
Amphipod (*Cyphocaris richardii*)	6.6	USACE 2010
Krill (*Euphausia superba*)	5.675	USACE 2010
Amphipod (*Eurythenes gryllus*)	13.8	USACE 2010
Amphipod (*Eusirus propaperdentatus*)	5.1	USACE 2010
Amphipod (*Leptocheirus plumulosus*)	1.21	USACE 2010

TABLE 7-36
PERCENT LIPID CONTENT OF AQUATIC INVERTEBRATES
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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Organism [(1)]	**Percent Lipid (wet weight)** [(2)]	**Reference**
Indian brown shrimp (*Metapenaeus affinis*)	1.637 [(3)]	USACE 2010
Greasy-back shrimp (*Metapenaeus ensis*)	1.755 [(3)]	USACE 2010
Copepod (*Metridia gerlachei*)	5.0	USACE 2010
Mantis shrimp (*Oratosquilla oratoria*)	2.22 [(3)]	USACE 2010
Daggerblade grass shrimp (*Palaemonetes pugio*)	1.7	USACE 2010
Amphipod (*Parandania boecki*)	4.6	USACE 2010
Arrow worm (*Pseudosagitta gazellae*)	4.1	USACE 2010
Copepod (*Rhincalanus gigas*)	1.9	USACE 2010
Chinese marsh crab (*Sesarma denaani*)	3.87 [(3)]	USACE 2010
Krill (*Thysanoessa macrura*)	4.1	USACE 2010
Asian clam (*Corbicula fluminea*)	2.11 [(3)]	USACE 2010
Asian clam (*Corbicula manilensis*)	1.504	USACE 2010
Asian clam (*Corbicula* spp.)	1.25	USACE 2010
Zebra mussel (*Dreissena polymorpha*)	2.37 [(3)]	USACE 2010
Clam (*Dreissena* spp.)	1.22	USACE 2010

TABLE 7-36
PERCENT LIPID CONTENT OF AQUATIC INVERTEBRATES
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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Organism [1]	Percent Lipid (wet weight) [2]	Reference
Fatmucket (*Lampsilis siliquoidea*)	0.249 [3]	USACE 2010
Eastern oyster (*Crassostrea virginica*)	0.618 [3]	USACE 2010
Japanese cockle (*Fulvia mutica*)	0.5	USACE 2010
Bent nosed clam (*Macoma nasuta*)	1.663 [3]	USACE 2010
Hard clam (*Mercenaria* spp.)	0.88	USACE 2010
Blue muscle (*Mytilus edulis*)	3.634 [3]	USACE 2010
Asian clam (*Potamocorbula amurensis*)	0.40 [3]	USACE 2010
Razor clam (*Sinonovacula constricta*)	1.75 [3]	USACE 2010
Japanese littleneck clam (*Venerupis philippinarum*)	0.80 [3]	USACE 2010
Oligochaete (*Limnodrilus hoffmeisteri*)	13.0	USACE 2010
Oligochaete (*Lumbriculus variegatus*)	0.951 [3]	USACE 2010
Polychaete (*Abarenicola pacifica*)	20.9	USACE 2010
Milky ribbon worm (*Cerebratulus lacteus*)	3.696	USACE 2010
Polychaete (*Leitoscoloplos fragilis*)	1.52 [3]	USACE 2010
Polychaete (*Marenzelleria viridis*)	1.39 [3]	USACE 2010

TABLE 7-36
PERCENT LIPID CONTENT OF AQUATIC INVERTEBRATES
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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Organism [(1)]	**Percent Lipid (wet weight)** [(2)]	**Reference**
Polychaete (*Nephtys* spp.)	2.86	USACE 2010
Polychaete (*Nereis diversicolor*)	1.29 [(3)]	USACE 2010

Notes:

USACE = United States Army Corps of Engineers

(1) The organisms listed include freshwater and marine species

(2) Arithmetic average of the listed percent lipid data was used to convert biota-sediment accumulation factors to bioaccumulation factors (arithmetic average = 3.44 percent).

(3) The value shown represents an average of two or more percent lipid values.

Table References:

United States Army Corps of Engineers (USACE). 2010. BSAF Database. USACE Engineer Research and Development Center, Environmental Laboratory. Accessed May 30, 2010. http://el.erdc.usace.army.mil/bsafnew/bsaf.html.

TABLE 7-37
FREQUENCY AND RANGE OF SURFACE SOIL DATA COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION COMPARED TO SOIL SCREENING VALUES FOR TERRESTRIAL PLANTS AND INVERTEBRATES: STEP 3A RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte [1]	Contaminant Frequency/Range						Soil Screening Values (SSV)	Reference [4]	95% UCL of the Mean HQ [5]	Comments
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	95% UCL of the Mean [2]	Value used in Step 3a Screen [3]				
Volatiles (µg/kg)										
Acetone	13/19	24J - 190	9.6UJ - 17UJ	48.147	70.63	190	NE	---	NA	No SSV
Inorganics (mg/kg)										
Cobalt	19/19	10.4J - 45.2	NA	22.753	25.82	25.82	13	USEPA 2005f	1.99	HQ > 1.0
Copper	19/19	24.8J - 291	NA	104.484	136.00	136.00	70	USEPA 2007c	1.94	HQ > 1.0
Lead	19/19	2.6J - 654J	NA	82.979	537.10	537.10	120	USEPA 2005g	4.48	HQ > 1.0
Selenium	15/19	0.21J - 2.4J	13.9U - 14.7U	2.020	0.94	0.94	0.52	USEPA 2007e	1.81	HQ > 1.0
Vanadium	19/19	72.8J - 260J	NA	143.037	167.00	167.00	20	USEPA 2005h	8.35	HQ > 1.0
Zinc	19/19	34.1J - 747	NA	140.990	317.00	317.00	120	USEPA 2007f	2.64	HQ > 1.0

Notes:

µg/kg = microgram per kilogram
mg/kg = milligram per kilogram
USEPA = United States Environmental Protection Agency
UCL = Upper Confidence Limit
HQ = Hazard Quotient
SSV = Soil Screening Value
ND = Not Detected
NE = Not Established
J = Estimated value
U = Not detected

(1) The analytes shown are those chemicals detected in surface soil (minimum of eight detected values with less than seventy percent non-detected results) and identified as ecological chemicals of potential concern in Step 2 of the screening level risk calculation because maximum concentrations exceed soil screening values.
(2) 95% UCL of the mean concentrations were calculated using USEPA ProUCL Version 4.1.01 software (USEPA, 2010a and 2010b).
(3) Risk estimates were re-calculated in Step 3a using 95% UCL of the mean concentrations.
(4) See Table 7-4 for reference citations.
(5) The 95% UCL of the mean HQ is derived by dividing the 95% UCL of the mean concentration by the soil screening value.

Table References:

United States Environmental Protection Agency (USEPA). 2010a. ProUCL Version 4.1.00 User Guide (Draft). Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. Office of Research and Development. EPA/600/R-07/041. May 2010. http://www.epa.gov/osp/hstl/tsc/software.htm.

USEPA. 2010b. ProUCL Version 4.1.00 Technical Guide (Draft). Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. Office of Research and Development. EPA/600/R-07/041. http://www.epa.gov/osp/hstl/tsc/software.htm.

TABLE 7-38
SUMMARY OF DESCRIPTIVE AND DISTRIBUTIONAL STATISTICS FOR INORGANIC ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY INVESTIGATION
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Population [1]	Descriptive Statistics [2]							Test for Normality [6]	Test for Homogeneity of Variance [7]	Distributional Statistics		
		Frequency of Detection	Range of Detections	Range of Non-Detections	Mean [3]	SE	95% UCL [4]	ULM [5]			Mean/Median of the Distribution [8]	Right Tail of the Distribution [9]	
												Quantile Test	Slippage Test
Beryllium	SWMU 59	16/19	0.14J - 0.62J	2.8U - 2.9U	0.69	0.22	0.33	---	Test not performed [10]	Test not performed [11]	Gehan Test [13] Not elevated at α = 0.05 G(-0.518) < z(1.645)	Test not performed [17]	Not elevated at α = 0.05
	NAPR Background	16/18	0.085B - 0.58	0.04U - 0.1U	0.29	0.04	0.35	0.579	Test not performed [10]				
Cadmium	SWMU 59	19/19	0.071J - 2.6	ND	0.63	0.15	0.93	---	Test not performed [10]	Test not performed [11]	Test not performed [14]	Test not performed [14]	Test not performed [14]
	NAPR Background	7/20	0.18J - 0.92J	0.059U - 1.2U	0.38	0.07	NA	0.755	Test not performed [10]				
Chromium	SWMU 59	19/19	5.3J - 54.4	ND	31.09	3.20	36.65	---	Normal at α = 0.05	Variances are equal at α = 0.05 (p = 0.567)	Two Sample T-Test [15] Not elevated at α = 0.05 (p = 0.103)	Not elevated at α = 0.05	Not elevated at α = 0.05
	NAPR Background	20/20	5.9J - 47	ND	25.69	2.73	30.42	50.1	Normal at α = 0.05				
Cobalt	SWMU 59	19/19	10.4J - 45.2	ND	22.75	1.77	25.82	---	Normal at α = 0.05	Test not performed [12]	Wilcoxon Rank Sum Test [16] Not Elevated at α = 0.05 (p = 0.347)	Not elevated at α = 0.05	Not elevated at α = 0.05
	NAPR Background	19/19	9.5 - 50.2J	ND	22.84	2.68	27.99	46.2	Not normal at α = 0.05				
Copper	SWMU 59	19/19	24.8J - 291	ND	104.50	14.23	136.00	---	Not normal at α = 0.05	Test not performed [12]	Wilcoxon Rank Sum Test [16] Elevated at α = 0.05 (p = 0.049)	Not elevated at α = 0.05	Not elevated at α = 0.05
	NAPR Background	18/18	13N - 180	ND	77.11	11.01	96.27	170.6	Normal at α = 0.05				
Lead	SWMU 59	19/19	2.6J - 654J	ND	82.98	45.63	537.10	---	Not normal at α = 0.05	Test not performed [12]	Wilcoxon Rank Sum Test [16] Elevated at α = 0.05 (p = 0.013)	Elevated at α = 0.05	Elevated at α = 0.05
	NAPR Background	18/18	2 - 21J	ND	8.68	1.62	12.38	22.4	Not normal at α = 0.05				
Mercury	SWMU 59	15/19	0.009J - 0.095	0.038U - 0.041U	0.03	0.01	0.04	---	Test not performed [10]	Test not performed [11]	Gehan Test [16] Not Elevated at α = 0.05 G(-2.75) < z(1.645)	Not elevated at α = 0.05	Not elevated at α = 0.05
	NAPR Background	17/20	0.012B - 0.12J	0.02U - 0.04U	0.05	0.01	0.06	0.112	Test not performed [10]				
Nickel	SWMU 59	19/19	6.1 - 27.5	ND	15.29	1.49	17.87	---	Normal at α = 0.05	Test not performed [12]	Wilcoxon Rank Sum Test [16] Elevated at α = 0.05 (p = 0.019)	Elevated at α = 0.05	Elevated at α = 0.05
	NAPR Background	19/19	3.4B - 19	ND	10.54	1.20	13.08	21.2	Not normal at α = 0.05				
Selenium	SWMU 59	15/19	0.21J - 2.4J	13.9U - 14.7U	3.52	1.31	0.94	---	Test not performed [10]	Test not performed [11]	Test not performed [14]	Test not performed [14]	Test not performed [14]
	NAPR Background	5/20	0.45J - 1.2J	0.13UJ - 2.1UJ	0.84	0.10	NA	1.12	Test not performed [10]				
Silver	SWMU 59	5/19	0.093J - 2.6	0.53U - 3.3U	1.34	0.28	NA	--	Test not performed [10]	Test not performed [11]	Test not performed [14]	Test not performed [14]	Test not performed [14]
	NAPR Background	0/20	ND	0.067U - 1.2U	0.41	0.09	NA	0.603	Test not performed [10]				

TABLE 7-38
SUMMARY OF DESCRIPTIVE AND DISTRIBUTIONAL STATISTICS FOR INORGANIC ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY INVESTIGATION
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Population [1]	Descriptive Statistics [2]							Test for Normality [6]	Test for Homogeneity of Variance [7]	Distributional Statistics		
		Frequency of Detection	Range of Detections	Range of Non-Detections	Mean [3]	SE	95% UCL [4]	ULM [5]			Mean/Median of the Distribution [8]	Right Tail of the Distribution [9]	
												Quantile Test	Slippage Test
Tin	SWMU 59	11/19	3J - 36.5	5.1UJ - 6.3UJ	7.32	1.67	9.63	---	Test not performed [10]	Test not performed [11]	Gehan Test [13] Elevated at α = 0.05 G(3.633) > Z(1.645)	Test not performed [17]	Elevated at α = 0.05
	NAPR Background	12/19	1.4 - 4B	0.69U - 1.3U	1.83	0.20	2.34	2.83	Test not performed [10]				
Vanadium	SWMU 59	19/19	72.8J - 260J	ND	143.00	12.81	167.00	---	Not normal at α = 0.05	Test not performed [12]	Wilcoxon Rank Sum Test [16] Not elevated at α = 0.05 (p = 0.464)	Not elevated at α = 0.05	Not elevated at α = 0.05
	NAPR Background	18/18	35 - 230	ND	141.60	13.85	165.70	259.1	Normal at α = 0.05				
Zinc	SWMU 59	19/19	34.1J - 747	ND	141.00	40.38	317.00	---	Not normal at α = 0.05	Test not performed [12]	Wilcoxon Rank Sum Test [16] Elevated at α = 0.05 (p = 0.001)	Elevated at α = 0.05	Elevated at α = 0.05
	NAPR Background	18/18	6.2E - 120E	ND	52.48	7.62	65.73	117.1	Normal at α = 0.05				

Notes:

SE - Standard error
95% UCL - 95 Percent Upper Confidence Limit of the Mean
ULM - Upper Limit of the Mean
NA - Not applicable
ND - Not detected
J - Estimated value
U - Not detected
UJ - Not detected, estimated value
E - The reported concentrations is estimated due to the presence of matrix interferences
B - The reported concentration is less than the reporting limit but greater than method detection limit

(1) Basewide background surface soil analytical data taken from the Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds (Baker, 2010).
(2) Units in mg/kg.
(2) Arithmetic mean calculated using non-detected data at the reporting limit/limit of detection.
(4) 95% Upper Conficence Limit of the mean concentrations were calculated using USEPA ProUCL Version 4.1.01 software (USEPA, 2011). A value was calculated for those data sets with a minimum of eight detected values and less than 70 percent non-detected results.
(5) Upper limit of the mean concentration is equal to the mean plus two standard deviations.
(6) Normality verified by the Shapiro-Wilk test (NFESC, 2002 and USEPA, 2010).
(7) Homogeneity of variance verified by F test (NFESC, 2002 and USEPA, 2010).
(8) Parametric tests are used if: (a) the SWMU and background datasets do not contain non-detected results and (b) both data sets are normally distributed. Non-parametric tests are used if: (a) both data sets are not normally distributed or (b) the SWMU and/or background data sets contain non-detected resuts (USEPA, 2010).
(9) Quantile and slippage tests only determine if a particular inorganic chemical is likely present at equivalent or elevated concentrations relative to background (NFESC, 2002).
(10) Test for normality was not performed because the SWMU and/or background data set contains non-detected results (non-parametric tests are used by default if one or more of the data sets contain non-detected results [USEPA, 2010]).
(11) Test for homogeneity of variance was not performed because the SWMU and/or background data set contains non-detected results (non-parametric tests are used by default if one or more of the data sets contain non-detected results [USEPA, 2010]).
(12) Test for homogeneity of variance was not performed because the SWMU and/or background data set is not normally distributed (non-parametric tests are used by default if both data sets are not normally distributed [USEPA, 2010]).
(13) Gehan test was used because: (a) there are less than 50 percent non-detected results in the SWMU and background data sets and (b) the SWMU and background data sets contain different reporting limits (USEPA, 2010).
(14) Tests on the mean/median and right-tail of the SWMU and background data set distributions were not performed because there are less than 8 detected results within the SWMU and/or background data set (USEPA, 2010).
(15) Two sample t-test was used because the SWMU and background data sets are normally distributed and variances are homogeneous (USEPA, 2010).

TABLE 7-38
SUMMARY OF DESCRIPTIVE AND DISTRIBUTIONAL STATISTICS FOR INORGANIC ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY INVESTIGATION
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Notes (continued):

(16) The Wilcoxon Rank Sum test was used because: (a) both data sets have less than 40 percent non-detect results and (b) reporting limits within a given data set are the same (USEPA, 2010).
(17) The quantile test was not performed because non-detected results within the SWMU and/or background data set are greater than the smallest of the "r" largest detected results in the combined data set (NFESC, 2002).

Table References:

Baker Environmental, Inc. (Baker). 2010. Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds, Naval Activity Puerto Rico, Ceiba, Puerto Rico.

Naval Facilities Engineering Service Center (NFESC). 2002. Guidance for Environmental Background Analysis. Volume I: Soil. NFESC User's Guide UG-209-ENV. April 2002.

USEPA. 2011. ProUCLVersion 4.1.01. August 2011. http://www.epa.gov/osp/hstl/tsc/software.htm.

USEPA. 2010. ProUCL Version 4.1.00 Technical Guide (Draft). Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. Office of Research and Development. EPA/600/R-07/041. http://www.epa.gov/osp/hstl/tsc/software.htm.

TABLE 7-39
FREQUENCY AND RANGE OF SURFACE SOIL DATA COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION COMPARED TO SOIL SCREENING VALUES FOR TERRESTRIAL PLANTS AND INVERTEBRATES: STEP 3A RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte [1]	Contaminant Frequency/Range						Soil Screening Values (SSV)	Reference [4]	95% UCL of the Mean HQ [5]	Comments
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	95% UCL of the Mean [2]	Value used in Step 3a Screen [3]				
Inorganics (mg/kg)										
Chromium	10/10	32 - 150	NA	64.500	88.53	150	57	USEPA 2008	1.55	HQ > 1.0
Cobalt	10/10	6J - 36J	NA	20.100	24.84	36	13	USEPA 2005f	1.91	HQ > 1.0
Copper	10/10	50 - 260J	NA	108.900	146.30	260	70	USEPA 2007c	2.09	HQ > 1.0
Nickel	10/10	15 - 47	NA	26.100	32.10	47	38	USEPA 2007d	0.84	HQ < 1.0
Vanadium	10/10	110 - 330	NA	206.000	246.40	330	20	USEPA 2005h	12.32	HQ > 1.0

Notes:

mg/kg = milligram per kilogram
USEPA = United States Environmental Protection Agency
UCL = Upper Confidence Limit
HQ = Hazard Quotient
SSV = Soil Screening Value
NA = Not Applicable
J = Estimated value
U = Not detected

(1) The analytes shown are those chemicals detected in surface soil (minimum of eight detected values with less than seventy percent non-detected results) and identified as ecological chemicals of potential concern in Step 2 of the screening level risk calculation because maximum concentrations exceed soil screening values.
(2) 95% UCL of the mean concentrations were calculated using USEPA ProUCL Version 4.1.01 software (USEPA, 2010a and 2010b).
(3) Risk estimates were re-calculated in Step 3a using 95% UCL of the mean concentrations.
(4) See Table 7-4 for reference citations.
(5) The 95% UCL of the mean HQ is derived by dividing the 95% UCL of the mean concentration by the soil screening value.

Table References:

United States Environmental Protection Agency (USEPA). 2010a. ProUCL Version 4.1.00 User Guide (Draft). Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. Office of Research and Development. EPA/600/R-07/041. May 2010. http://www.epa.gov/osp/hstl/tsc/software.htm.

USEPA. 2010b. ProUCL Version 4.1.00 Technical Guide (Draft). Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. Office of Research and Development. EPA/600/R-07/041. http://www.epa.gov/osp/hstl/tsc/software.htm.

TABLE 7-40
SUMMARY OF DESCRIPTIVE AND DISTRIBUTIONAL STATISTICS FOR INORGANIC ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY INVESTIGATION
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Population [1]	Descriptive Statistics [2]							Test for Normality [6]	Test for Homogeneity of Variance [7]	Distributional Statistics		
		Frequency of Detection	Range of Detections	Range of Non-Detections	Mean [3]	SE	95% UCL [4]	ULM [5]			Mean/Median of the Distribution [8]	Right Tail of the Distribution [9]	
												Quantile Test	Slippage Test
Beryllium	SWMU 59	10/10	0.097 - 0.63J	ND	0.29	0.05	0.38	---	Test not performed [10]	Test not performed [11]	Gehan Test [13] Not elevated at α = 0.05 G(-0.072) < z(1.645)	Not elevated at α = 0.05	Not elevated at α = 0.05
	NAPR Background	16/18	0.085B - 0.58	0.04U - 0.1U	0.29	0.04	0.35	0.586	Test not performed [10]				
Cadmium	SWMU 59	10/10	0.047J - 0.47	ND	0.13	0.04	0.22	---	Test not performed [10]	Test not performed [11]	Test not performed [14]	Test not performed [14]	Test not performed [14]
	NAPR Background	7/20	0.18J - 0.92J	0.059U - 1.2U	0.38	0.07	NA	1.05	Test not performed [10]				
Chromium	SWMU 59	10/10	32 - 150	ND	64.50	11.30	88.53	---	Not normal at α = 0.05	Test not performed [12]	Wilcoxon Rank Sum Test [15] Elevated at α = 0.05 (p < 0.01)	Elevated at α = 0.05	Elevated at α = 0.05
	NAPR Background	20/20	5.9J - 47	ND	25.69	2.73	30.42	50.1	Normal at α = 0.05				
Cobalt	SWMU 59	10/10	6J - 36J	ND	20.10	2.58	24.84	---	Normal at α = 0.05	Test not performed [12]	Wilcoxon Rank Sum Test [15] Not elevated at α = 0.05 (p = 0.608)	Not elevated at α = 0.05	Not elevated at α = 0.05
	NAPR Background	19/19	9.5 - 50.2J	ND	22.84	2.68	27.99	46.2	Not normal at α = 0.05				
Copper	SWMU 59	10/10	50 - 260J	ND	108.90	18.56	146.30	---	Not normal at α = 0.05	Test not performed [12]	Wilcoxon Rank Sum Test [15] Elevated at α = 0.05 (p = 0.042)	Not elevated at α = 0.05	Not elevated at α = 0.05
	NAPR Background	18/18	13N - 180	ND	77.11	11.01	96.27	170.6	Normal at α = 0.05				
Mercury	SWMU 59	4/10	0.014J - 0.069	0.0093U - 0.012U	0.02	0.01	NA	---	Test not performed [10]	Test not performed [11]	Test not performed [14]	Test not performed [14]	Test not performed [14]
	NAPR Background	17/20	0.012B - 0.12J	0.02U - 0.04U	0.05	0.01	0.06	0.108	Test not performed [10]				
Nickel	SWMU 59	10/10	15 - 47	ND	26.10	3.27	32.10	---	Normal at α = 0.05	Test not performed [11]	Wilcoxon Rank Sum Test [15] Elevated at α = 0.05 (p < 0.001)	Elevated at α = 0.05	Elevated at α = 0.05
	NAPR Background	19/19	3.4B - 19	ND	10.54	1.20	13.08	21.0	Not normal at α = 0.05				
Selenium	SWMU 59	3/10	0.47J - 1.2	0.29U - 0.35U	0.46	0.09	NA	---	Test not performed [10]	Test not performed [11]	Test not performed [14]	Test not performed [14]	Test not performed [14]
	NAPR Background	5/20	0.45J - 1.2J	0.13UJ - 2.1UJ	0.84	0.10	NA	1.75	Test not performed [10]				
Tin	SWMU 59	1/10	8.3J - 8.3J	2.9U - 3.5U	3.73	0.51	NA	---	Test not performed [10]	Test not performed [11]	Test not performed [14]	Test not performed [14]	Test not performed [14]
	NAPR Background	12/19	1.4 - 4B	0.69U - 1.3U	1.83	0.20	2.34	3.61	Test not performed [10]				
Vanadium	SWMU 59	10/10	110 - 330	ND	206.00	22.02	246.40	---	Normal at α = 0.05	Variances are equal at α = 0.05 (p = 0.523)	Two Sample T-Test [16] Elevated at α = 0.05 (p = 0.008)	Elevated at α = 0.05	Elevated at α = 0.05
	NAPR Background	18/18	35 - 230	ND	141.60	13.85	165.70	259.1	Normal at α = 0.05				

TABLE 7-40
SUMMARY OF DESCRIPTIVE AND DISTRIBUTIONAL STATISTICS FOR INORGANIC ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY INVESTIGATION
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Population (1)	Descriptive Statistics (2)							Test for Normality (6)	Test for Homogeneity of Variance (7)	Distributional Statistics		
		Frequency of Detection	Range of Detections	Range of Non-Detections	Mean (3)	SE	95% UCL (4)	ULM (5)			Mean/Median of the Distribution (8)	Right Tail of the Distribution (9)	
												Quantile Test	Slippage Test
Zinc	SWMU 59	10/10	42 - 100J	ND	63.40	5.95	74.30	---	Normal at α = 0.05	Variances are equal at α = 0.05 (p = 0.102)	Two Sample T-Test (16) Not elevated at α = 0.05 (p = 0.169)	Elevated at α = 0.05	Not elevated at α = 0.05
	NAPR Background	18/18	6.2E - 120E	ND	52.48	7.62	65.73	117.1	Normal at α = 0.05				

Notes:

SE - Standard error
95% UCL - 95 Percent Upper Confidence Limit of the Mean
ULM - Upper Limit of the Mean
NA - Not applicable
ND - Not detected
J - Estimated value
U - Not detected
UJ - Not detected, estimated value
E - The reported concentrations is estimated due to the presence of matrix interferences
B - The reported concentration is less than the reporting limit but greater than method detection limit

(1) Basewide background surface soil analytical data taken from the Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds (Baker, 2010).
(2) Units in mg/kg.
(3) Arithmetic mean calculated using non-detected data at the limit of detection.
(4) 95% Upper Conficence Limit of the mean concentrations were calculated using USEPA ProUCL Version 4.1.01 software (USEPA, 2011). A value was calculated for those data sets with a minimum of eight detected alues and less than 70 percent non-detected results.
(5) Upper limit of the mean concentration is equal to the mean plus two standard deviations.
(6) Normality verified by the Shapiro-Wilk test (NFESC, 2002 and USEPA, 2010).
(7) Homogeneity of variance verified by F test (NFESC, 2002 and USEPA, 2010).
(8) Parametric tests are used if: (a) the SWMU and background datasets do not contain non-detected results and (b) both data sets are normally distributed. Non-parametric tests are used if: (a) if both data sets are not normally distributed or (b) the site and/or background data sets contain non-detected resuts (USEPA, 2010).
(9) Quantile and slippage tests only determine if a particular inorganic chemical is likely present at equivalent or elevated concentrations relative to background (NFESC, 2002).
(10) Test for normality was not performed because the SWMU and/or background data set contains non-detected results (non-parametric tests are used by default if one or more of the data sets contain non-detected results [USEPA, 2010]).
(11) Test for homogeneity of variance was not performed because the SWMU and/or background data set contains non-detected results (non-parametric tests are used by default if one or more of the data sets contain non-detected results [USEPA, 2010]).
(12) Test for homogeneity of variance was not performed because the SWMU and/or background data set is not normally distributed (non-parametric tests are used by default if both data sets are not normally distributed [USEPA, 2010]).
(13) Gehan test was used because: (a) there are less than 50 percent non-detected results in the SWMU and background data sets and (b) the SWMU and background data sets contain different reporting limits (USEPA, 2010).
(14) Tests on the mean/median and right-tail of the SWMU and background data set distributions were not performed because there are less than 8 detected results within the SWMU and/or background data set (USEPA, 2010).
(15) The Wilcoxon Rank Sum test was used because: (a) both data sets have less than 40 percent non-detect results and (b) reporting limits/limits of detection within a given data set are the same (USEPA, 2010).
(16) Two sample t-test was used because the SWMU and background data sets are normally distributed and variances are homogeneous (USEPA, 2010).

Table References:

Baker Environmental, Inc. (Baker). 2010. Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds, Naval Activity Puerto Rico, Ceiba, Puerto Rico.

Naval Facilities Engineering Service Center (NFESC). 2002. Guidance for Environmental Background Analysis. Volume I: Soil. NFESC User's Guide UG-209-ENV. April 2002.

USEPA. 2011. ProUCLVersion 4.1.01. August 2011. http://www.epa.gov/osp/hstl/tsc/software.htm.

USEPA. 2010. ProUCL Version 4.1.00 Technical Guide (Draft). Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. Office of Research and Development. EPA/600/R-07/041. http://www.epa.gov/osp/hstl/tsc/software.htm.

TABLE 7-41
FREQUENCY AND RANGE OF SUBSURFACE SOIL DATA COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION COMPARED TO SOIL SCREENING VALUES FOR TERRESTRIAL PLANTS AND INVERTEBRATES: STEP 3A RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte [1]	Contaminant Frequency/Range						Soil Screening Values (SSV)	Reference [4]	95% UCL of the Mean HQ [5]	Comments
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	95% UCL of the Mean [2]	Value used in Step 3a Screen [3]				
Metals (mg/kg)										
Chromium	23/23	8 - 79.3J	NA	35.361	42.28	42.28	57	USEPA 2008	0.74	
Cobalt	23/23	9.6J - 72.1J	NA	28.883	35.19	35.19	13	USEPA 2005f	2.71	HQ > 1.0
Copper	23/23	5.1J - 270	NA	88.283	111.80	111.80	70	USEPA 2007c	1.60	
Nickel	23/23	6.3 - 47.3	NA	17.348	20.89	20.89	38	USEPA 2007d	0.55	HQ > 1.0
Selenium	13/23	0.2J - 2.6J	13.2U - 17.7UJ	3.790	1.35	1.35	0.52	USEPA 2007e	2.59	HQ > 1.0
Vanadium	23/23	43.5J - 282J	NA	134.078	156.00	156.00	20	USEPA 2005h	7.80	HQ > 1.0
Zinc	23/23	39.3 - 242J	NA	87.817	105.00	105.00	120	USEPA 2007f	0.88	HQ > 1.0

Notes:

mg/kg = milligram per kilogram
USEPA = United States Environmental Protection Agency
UCL = Upper Confidence Limit
HQ = Hazard Quotient
SSV = Soil Screening Value
NA = Not Applicable
J = Estimated value
U = Not detected

(1) The analytes shown are those chemicals detected in subsurface soil (minimum of eight detected values with less than seventy percent non-detected results) and identified as ecological chemicals of potential concern in Step 2 of the screening level risk calculation because maximum concentrations exceed soil screening values.
(2) 95% UCL of the mean concentrations were calculated using USEPA ProUCL Version 4.1.01 software (USEPA, 2010a and 2010b).
(3) Risk estimates were re-calculated in Step 3a using 95% UCL of the mean concentrations.
(4) See Table 7-4 for reference citations.
(5) The 95% UCL of the mean HQ is derived by dividing the 95% UCL of the mean concentration by the soil screening value.

Table References:

United States Environmental Protection Agency (USEPA). 2010a. ProUCL Version 4.1.00 User Guide (Draft). Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. Office of Research and Development. EPA/600/R-07/041. May 2010. http://www.epa.gov/osp/hstl/tsc/software.htm.

USEPA. 2010b. ProUCL Version 4.1.00 Technical Guide (Draft). Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. Office of Research and Development. EPA/600/R-07/041. http://www.epa.gov/osp/hstl/tsc/software.htm.

TABLE 7-42
SUMMARY OF DESCRIPTIVE AND DISTRIBUTIONAL STATISTICS FOR INORGANIC ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY INVESTIGATION
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Population [1]	Descriptive Statistics [2]							Test for Normality [6]	Test for Homogeneity of Variance [7]	Distributional Statistics		
		Frequency of Detection	Range of Detections	Range of Non-Detections	Mean [3]	SE	95% UCL [4]	ULM [5]			Mean/Median of the Distribution [8]	Right Tail of the Distribution [9]	
												Quantile Test	Slippage Test
Beryllium	SWMU 59	15/23	0.091J - 0.96	2.6U - 3.5U	1.28	0.27	0.48	---	Test not performed [10]	Test not performed [11]	Gehan Test [13] Elevated at α = 0.05 G(2.074) > z(1.645)	Test not performed [18]	Test not performed [19]
	NAPR Background	18/18	0.052B - 0.7	ND	0.26	0.04	0.33	0.589	Test not performed [10]				
Cadmium	SWMU 59	20/23	0.12J - 0.77	3.1U - 3.5U	0.78	0.21	0.49	---	Test not performed [10]	Test not performed [11]	Test not performed [14]	Test not performed [14]	Test not performed [14]
	NAPR Background	6/20	0.099J - 0.48	0.061U - 0.66U	0.37	0.05	NA	0.539	Test not performed [10]				
Chromium	SWMU 59	23/23	8 - 79.3J	ND	35.36	4.03	42.28	---	Normal at α = 0.05	Test not performed [12]	Wilcoxon Rank Sum Test [15] Elevated at α = 0.05 (p = 0.227)	Not elevated at α = 0.05	Not elevated at α = 0.05
	NAPR Background	18/18	3.9 - 148J	ND	37.31	9.10	56.51	114.5	Not normal at α = 0.05				
Cobalt	SWMU 59	23/23	9.6J - 72.1J	ND	28.88	3.41	35.19	---	Test not performed [10]	Test not performed [11]	Wilcoxon Rank Sum Test [15] Elevated at α = 0.05 (p < 0.001)	Not elevated at α = 0.05	Not elevated at α = 0.05
	NAPR Background	17/18	0.83B - 33.8	1.2U - 1.2U	9.15	2.09	18.28	26.9	Test not performed [10]				
Copper	SWMU 59	23/23	5.1J - 270	ND	88.28	11.66	111.80	---	Not normal at α = 0.05	Test not performed [12]	Wilcoxon Rank Sum Test [15] Not elevated at α = 0.05 (p = 0.639)	Not elevated at α = 0.05	Not elevated at α = 0.05
	NAPR Background	17/17	18 - 260J	ND	105.00	17.11	134.80	246.0	Normal at α = 0.05				
Mercury	SWMU 59	10/23	0.009J - 0.1	0.036U - 0.048U	0.03	0.00	0.03	---	Test not performed [10]	Test not performed [11]	Test not performed [14]	Test not performed [14]	Test not performed [14]
	NAPR Background	7/20	0.013B - 0.17J	0.0051UJ - 0.06U	0.04	0.01	NA	0.108	Test not performed [10]				
Nickel	SWMU 59	23/23	6.3 - 47.3	ND	17.35	1.95	20.89	---	Not normal at α = 0.05	Test not performed [12]	Wilcoxon Rank Sum Test [15] Elevated at α = 0.05 (p < 0.001)	Not elevated at α = 0.05	Not elevated at α = 0.05
	NAPR Background	18/18	1.1J - 35.6	ND	7.89	1.98	11.77	24.7	Not normal at α = 0.05				
Selenium	SWMU 59	13/23	0.2J - 2.6J	13.2U - 17.7UJ	7.04	1.50	1.35	---	Test not performed [10]	Test not performed [11]	Test not performed [14]	Test not performed [14]	Test not performed [14]
	NAPR Background	6/20	0.22J - 3.8J	0.15UJ - 1.3U	0.90	0.19	0.91	2.35	Test not performed [10]				
Silver	SWMU 59	5/23	0.1J - 0.57J	0.55U - 3.5U	1.87	0.27	NA	--	Test not performed [10]	Test not performed [11]	Test not performed [13]	Test not performed [13]	Test not performed [13]
	NAPR Background	1/20	0.16B - 0.16B	0.063U - 1.3U	0.50	0.10	NA	0.686	Test not performed [10]				
Tin	SWMU 59	11/23	1.9J - 26	5.1UJ - 6.5UJ	5.23	1.01	5.29	---	Test not performed [10]	Test not performed [11]	Test not performed [16]	Test not performed [18]	Not elevated at α = 0.05
	NAPR Background	13/19	1.5J - 3.1J	0.78U - 1.9UJ	2.05	0.14	2.36	3.05	Test not performed [10]				

TABLE 7-42
SUMMARY OF DESCRIPTIVE AND DISTRIBUTIONAL STATISTICS FOR INORGANIC ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY INVESTIGATION
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Population [1]	Descriptive Statistics [2]							Test for Normality [6]	Test for Homogeneity of Variance [7]	Distributional Statistics		
		Frequency of Detection	Range of Detections	Range of Non-Detections	Mean [3]	SE	95% UCL [4]	ULM [5]			Mean/Median of the Distribution [8]	Right Tail of the Distribution [9]	
												Quantile Test	Slippage Test
Vanadium	SWMU 59	23/23	43.5J - 282J	ND	134.10	12.76	156.00	---	Normal at α = 0.05	Variances are not equal at α = 0.05 (p = 0.008)	Satterthwaite Test [17] Not elevated at α = 0.05 (p = 0.992)	Not elevated at α = 0.05	Not elevated at α = 0.05
	NAPR Background	19/19	25 - 410	ND	208.60	25.86	253.40	434.1	Normal at α = 0.05				
Zinc	SWMU 59	23/23	39.3 - 242J	ND	87.82	9.60	105.00	---	Test not performed [10]	Test not performed [11]	Wilcoxon Rank Sum Test [15] Elevated at α = 0.05 (p < 0.001)	Elevated at α = 0.05	Elevated at α = 0.05
	NAPR Background	18/19	3.9 - 98J	27U - 27U	38.06	5.70	47.61	88.1	Test not performed [10]				

Notes:

SE - Standard error
95% UCL - 95 Percent Upper Confidence Limit of the Mean
ULM - Upper Limit of the Mean
ND - Not detected
NA - Not applicable
J - Estimated value
U - Not detected
UJ - Not detected, estimated value

[1] Basewide background subsurface soil analytical data taken from the Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds (Baker, 2010).
[2] Units in mg/kg.
[2] Arithmetic mean calculated using non-detected data at the reporting limit.
[4] 95% Upper Confidence Limit of the mean concentrations were calculated using USEPA ProUCL Version 4.1.01 software (USEPA, 2011). A value was calculated for those data sets with a minimum of eight detected alues and less than 70 percent non-detected results.
[5] Upper limit of the mean concentration is equal to the mean plus two standard deviations.
[6] Normality verified by the Shapiro-Wilk test (NFESC, 2002 and USEPA, 2010).
[7] Homogeneity of variance verified by F test (NFESC, 2002 and USEPA, 2010).
[8] Parametric tests are used if: (a) the site and background datasets do not contain non-detected results and (b) both data sets are normally distributed. Non-parametric tests are used if: (a) if both data sets are not normally distributed or (b) the site and/or background data sets contain non-detected resuts (USEPA, 2010).
[9] Quantile and slippage tests only determine if a particular inorganic chemical is likely present at equivalent or elevated concentrations relative to background (NFESC, 2002).
[10] Test for normality was not performed because the SWMU and/or background data set contains non-detected results (non-parametric tests are used by default if one or more of the data sets contain non-detected results [USEPA, 2010]).
[11] Test for homogeneity of variance was not performed because the SWMU and/or background data set contains non-detected results (non-parametric tests are used by default if one or more of the data sets contain non-detected results [USEPA, 2010]).
[12] Test for homogeneity of variance was not performed because the SWMU and/or background data set is not normally distributed (non-parametric tests are used by default if both data sets are not normally distributed [USEPA, 2010]).
[13] Gehan test was used because: (a) there are less than 50 percent non-detected results in the site and background data sets and (b) the site and background data sets contain different reporting limits (USEPA, 2010).
[14] Tests on the mean/median and right-tail of the SWMU and background data set distributions were not performed because there are less than 8 detected results within the site and/or background data set (USEPA, 2010).
[15] The Wilcoxon Rank Sum test was used because: (a) both data sets have less than 40 percent non-detect results and (b) reporting limits within a given data set are the same (USEPA, 2010).
[16] A statistical test evaluating the median of the SWMU and background data set distributions was not performed because the SWMU and/or background data sets have greater than 50 percent non-detected results (USEPA, 2010).
[17] Satterthwaite t-test was performed because the site and background data sets are normally distributed but variances are not homogeneous (USEPA, 2010).
[18] The quantile test was not performed because non-detected results within the site and/or background data set are greater than the smallest of the "r" largest detected results in the combined data set (NFESC, 2002).
[19] The slippage test was not performed because the largest detected result for the SWMU data set is less than the largest non-detected result (NFESC, 2002).

Table References:

Baker Environmental, Inc. (Baker). 2010. Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds, Naval Activity Puerto Rico, Ceiba, Puerto Rico.

Naval Facilities Engineering Service Center (NFESC). 2002. Guidance for Environmental Background Analysis. Volume I: Soil. NFESC User's Guide UG-209-ENV. April 2002.

USEPA. 2011. ProUCLVersion 4.1.01. August 2011. http://www.epa.gov/osp/hstl/tsc/software.htm.

USEPA. 2010. ProUCL Version 4.1.00 Technical Guide (Draft). Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. Office of Research and Development. EPA/600/R-07/041. http://www.epa.gov/osp/hstl/tsc/software.htm.

TABLE 7-43
FREQUENCY AND RANGE OF SUBSURFACE SOIL DATA COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION COMPARED TO SOIL SCREENING VALUES FOR TERRESTRIAL PLANTS AND INVERTEBRATES: STEP 3A RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte [1]	Contaminant Frequency/Range						Soil Screening Values (SSV)	Reference [4]	95% UCL of the Mean HQ [5]	Comments
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	95% UCL of the Mean [2]	Value used in Step 3a Screen [3]				
Metals (mg/kg)										
Chromium	10/10	16 - 120	NA	59.600	79.85	79.85	57	USEPA 2008	1.40	HQ > 1.0
Cobalt	10/10	3.5J - 24J	NA	14.020	17.48	17.48	13	USEPA 2005f	1.34	HQ > 1.0
Copper	10/10	48 - 210	NA	102.700	130.70	130.70	70	USEPA 2007c	1.87	HQ > 1.0
Nickel	10/10	5.7 - 44	NA	25.370	32.49	32.49	38	USEPA 2007d	0.86	HQ < 1.0
Vanadium	10/10	110 - 400	NA	223.000	276.30	276.30	20	USEPA 2005h	13.82	HQ > 1.0

Notes:

mg/kg = milligram per kilogram
USEPA = United States Environmental Protection Agency
UCL = Upper Confidence Limit
HQ = Hazard Quotient
SSV = Soil Screening Value
NA = Not Applicable
J = Estimated value
U = Not detected

(1) The analytes shown are those chemicals detected in subsurface soil (minimum of eight detected values with less than seventy percent non-detected results) and identified as ecological chemicals of potential concern in Step 2 of the screening level risk calculation because maximum concentrations exceed soil screening values.
(2) 95% UCL of the mean concentrations were calculated using USEPA ProUCL Version 4.1.01 software (USEPA, 2010a and 2010b).
(3) Risk estimates were re-calculated in Step 3a using 95% UCL of the mean concentrations.
(4) See Table 7-4 for reference citations.
(5) The 95% UCL of the mean HQ is derived by dividing the 95% UCL of the mean concentration by the soil screening value.

Table References:

United States Environmental Protection Agency (USEPA). 2010a. ProUCL Version 4.1.00 User Guide (Draft). Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. Office of Research and Development. EPA/600/R-07/041. May 2010. http://www.epa.gov/osp/hstl/tsc/software.htm.

USEPA. 2010b. ProUCL Version 4.1.00 Technical Guide (Draft). Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. Office of Research and Development. EPA/600/R-07/041. http://www.epa.gov/osp/hstl/tsc/software.htm.

TABLE 7-44
SUMMARY OF DESCRIPTIVE AND DISTRIBUTIONAL STATISTICS FOR INORGANIC ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Population (1)	Descriptive Statistics (2)							Test for Normality (6)	Test for Homogeneity of Variance (7)	Distributional Statistics		
		Frequency of Detection	Range of Detections	Range of Non-Detections	Mean (3)	SE	95% UCL (4)	ULM (5)			Mean/Median of the Distribution (8)	Right Tail of the Distribution (9)	
												Quantile Test	Slippage Test
Beryllium	SWMU 59	10/10	0.12 - 0.5	ND	0.26	0.04	0.38	---	Normal at α = 0.05	Variances are equal at α = 0.05 (p = 0.354)	Two Sample T-Test (13) Not elevated at α = 0.05 (p = 0.500)	Not elevated at α = 0.05	Not elevated at α = 0.05
	NAPR Background	18/18	0.052B - 0.7	ND	0.26	0.04	0.33	0.589	Normal at α = 0.05				
Chromium	SWMU 59	10/10	16 - 120	ND	59.60	11.05	79.85	---	Normal at α = 0.05	Test not performed (11)	Wilcoxon Rank Sum Test (14) Elevated at α = 0.05 (p = 0.033)	Not elevated at α = 0.05	Not elevated at α = 0.05
	NAPR Background	18/18	3.9 - 148J	ND	37.31	9.10	56.51	114.479	Not normal at α = 0.05				
Cobalt	SWMU 59	10/10	3.5J - 24J	ND	14.02	1.89	17.48	---	Test not performed (10)	Test not performed (12)	Wilcoxon Rank Sum Test (14) Elevated at α = 0.05 (p = 0.038)	Not elevated at α = 0.05	Not elevated at α = 0.05
	NAPR Background	17/18	0.83B - 33.8	1.2U - 1.2U	9.15	2.09	18.28	26.939	Test not performed (10)				
Copper	SWMU 59	10/10	48 - 210	ND	102.70	15.30	130.70	---	Normal at α = 0.05	Variances are equal at α = 0.05 (p = 0.253)	Two Sample T-Test (13) Not elevated at α = 0.05 (p = 0.535)	Not elevated at α = 0.05	Not elevated at α = 0.05
	NAPR Background	17/17	18 - 260J	ND	105.00	17.11	134.80	246.043	Normal at α = 0.05				
Mercury	SWMU 59	4/10	0.011J - 0.083	0.0091U - 0.011U	0.02	0.01	NA	---	Test not performed (10)	Test not performed (12)	Test not performed (15)	Test not performed (15)	Test not performed (15)
	NAPR Background	7/20	0.013B - 0.17J	0.0051UJ - 0.06U	0.04	0.01	NA	0.108	Test not performed (10)				
Nickel	SWMU 59	10/10	5.7 - 44	ND	25.37	3.88	32.49	---	Normal at α = 0.05	Test not performed (11)	Wilcoxon Rank Sum Test (14) Elevated at α = 0.05 (p < 0.001)	Elevated at α = 0.05	Not elevated at α = 0.05
	NAPR Background	18/18	1.1J - 35.6	ND	7.89	1.98	11.77	24.741	Not normal at α = 0.05				
Selenium	SWMU 59	4/10	0.49J - 0.69	0.28U - 0.35U	0.43	0.04	---	---	Test not performed (10)	Test not performed (12)	Test not performed (15)	Test not performed (15)	Test not performed (15)
	NAPR Background	6/20	0.22J - 3.8J	0.15UJ - 1.3U	0.90	0.19	0.91	2.347	Test not performed (10)				
Vanadium	SWMU 59	10/10	110 - 400	ND	223.00	29.10	276.30	---	Normal at α = 0.05	Variances are equal at α = 0.05 (p = 0.543)	Two Sample T-Test (13) Not elevated at α = 0.05 (p = 0.365)	Not elevated at α = 0.05	Not elevated at α = 0.05
	NAPR Background	19/19	25 - 410	ND	208.60	25.86	253.40	434.062	Normal at α = 0.05				
Zinc	SWMU 59	10/10	35 - 77	ND	53.30	4.33	61.24	--	Test not performed (10)	Test not performed (12)	Wilcoxon Rank Sum Test (15) Elevated at α = 0.05 (p = 0.023)	Not elevated at α = 0.05	Not elevated at α = 0.05
	NAPR Background	18/19	3.9 - 98J	27U - 27U	38.06	5.70	47.61	88.0738	Test not performed (10)				

TABLE 7-44
SUMMARY OF DESCRIPTIVE AND DISTRIBUTIONAL STATISTICS FOR INORGANIC ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Notes:

SE - Standard error
95% UCL - 95 Percent Upper Confidence Limit of the Mean
ULM - Upper Limit of the Mean
NA - Not applicable
ND - Not detected
J - Estimated value
U - Not detected
UJ - Not detected, estimated value

(1) Basewide background subsurface soil analytical data taken from the Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds (Baker, 2010).
(2) Units in mg/kg.
(2) Arithmetic mean calculated using non-detected data at the reporting limit/limit of detection.
(4) 95% Upper Confidence Limit of the mean concentrations were calculated using USEPA ProUCL Version 4.1.01 software (USEPA, 2011). A value was calculated for those data sets with a minimum of eight detected values and less than 70 percent non-detected results.
(5) Upper limit of the mean concentration is equal to the mean plus two standard deviations.
(6) Normality verified by the Shapiro-Wilk test (NFESC, 2002 and USEPA, 2010).
(7) Homogeneity of variance verified by F test (NFESC, 2002 and USEPA, 2010).
(8) Parametric tests are used if: (a) the site and background datasets do not contain non-detected results and (b) both data sets are normally distributed. Non-parametric tests are used if: (a) both data sets are not normally distributed or (b) the site and/or background data sets contain non-detected resuts (USEPA, 2010).
(9) Quantile and slippage tests only determine if a particular inorganic chemical is likely present at equivalent or elevated concentrations relative to background (NFESC, 2002).
(10) Test for normality was not performed because the SWMU and/or background data set contains non-detected results (non-parametric tests are used by default if one or more of the data sets contain non-detected results [USEPA, 2010]).
(11) Test for homogeneity of variance was not performed because the SWMU and/or background data set is not normally distributed (non-parametric tests are used by default if both data sets are not normally distributed [USEPA, 2010]).
(12) Test for homogeneity of variance was not performed because the SWMU and/or background data set contains non-detected results (non-parametric tests are used by default if one or more of the data sets contain non-detected results [USEPA, 2010]).
(13) Two sample t-test was used because the SWMU and background data sets are normally distributed and variances are homogeneous (USEPA, 2010).
(14) The Wilcoxon Rank Sum test was used because: (a) both data sets have less than 40 percent non-detect results and (b) reporting limits/limits of detection within a given data set are the same (USEPA, 2010).
(15) Tests on the mean/median and right-tail of the SWMU and background data set distributions were not performed because there are less than 8 detected results within the SWMU and/or background data set (USEPA, 2010).

Table References:

Baker Environmental, Inc. (Baker). 2010. Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds, Naval Activity Puerto Rico, Ceiba, Puerto Rico.

Naval Facilities Engineering Service Center (NFESC). 2002. Guidance for Environmental Background Analysis. Volume I: Soil. NFESC User's Guide UG-209-ENV. April 2002.

USEPA. 2011. ProUCLVersion 4.1.01. August 2011. http://www.epa.gov/osp/hstl/tsc/software.htm.

USEPA. 2010. ProUCL Version 4.1.00 Technical Guide (Draft). Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. Office of Research and Development. EPA/600/R-07/041. http://www.epa.gov/osp/hstl/tsc/software.htm.

TABLE 7-45
FREQUENCY AND RANGE OF GROUNDWATER DATA COMPARED TO GROUNDWATER SCREENING VALUES: STEP 3A RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte [1]	Contaminant Frequency/Range (Total Recoverable Fraction) [2]						Groundwater Screening Value (GWSV)	Reference [5]	95% UCL of the Mean HQ [6]	Comments
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	95% UCL of the Mean [3]	Value used in Step 3a Screen [4]				
Metals (µg/L)										
Copper	10/10	3.9 - 21.3	NA	9.510	14.08	14.08	3.73	PREQB 2010	3.77	HQ > GWSV
Vanadium	10/10	9.2 - 171	NA	63.290	93.34	93.34	12.0	USEPA 2003	7.83	HQ > GWSV

Notes:

µg/L = microgram per liter
USEPA = United States Environmental Protection Agency
UCL = Upper Confidence Limit
HQ = Hazard Quotient
GWSV = Groundwater Screening Value
NA = Not Applicable

(1) The analytes shown are those chemicals detected in groundwater (minimum of eight detected values with less than seventy percent non-detected results) and identified as ecological chemicals of potential concern in Step 2 of the screening level risk calculation because maximum total recoverable concentrations exceed groundwater screening values.
(2) Analytical data expressed as total recoverable concentrations.
(3) 95% UCL of the mean concentrations were calculated using USEPA ProUCL Version 4.1.01 software (USEPA, 2010a and 2010b).
(4) Risk estimates were re-calculated in Step 3a using 95% UCL of the mean concentrations.
(5) See Table 7-6 for reference citations.
(6) The 95% UCL of the mean HQ is derived by dividing the 95% UCL of the mean concentration by the groundwater screening value.

Table References:

United States Environmental Protection Agency (USEPA). 2010a. ProUCL Version 4.1.00 User Guide (Draft). Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. Office of Research and Development. EPA/600/R-07/041. May 2010. http://www.epa.gov/osp/hstl/tsc/software.htm.

USEPA. 2010b. ProUCL Version 4.1.00 Technical Guide (Draft). Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. Office of Research and Development. EPA/600/R-07/041. http://www.epa.gov/osp/hstl/tsc/software.htm.

TABLE 7-46
SUMMARY OF DESCRIPTIVE AND DISTRIBUTIONAL STATISTICS FOR INORGANIC ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN GROUNDWATER
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY INVESTIGATION
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Population [1]	Descriptive Statistics [2]							Test for Normality [5]	Test for Homogeneity of Variance [6]	Distributional Statistics		
		Frequency of Detection	Range of Detections	Range of Non-Detections	Mean	SE	95% UCL [3]	ULM [4]			Mean/Median of the Distribution	Right Tail of the Distribution [7]	
												Quantile Test	Slippage Test
Total Recoverable Metals													
Copper	SWMU 59	10/10	3.9 - 21.3	ND	9.51	2.00	14.08	---	Test not performed [10]	Test not performed [11]	Wilcoxon Rank Sum Test [12] Not elevated at α = 0.05 (p = 0.998)	Not elevated at α = 0.05	Not elevated at α = 0.05
	NAPR Background	11/12	8.5 - 352	0.5U - 0.5U	114.40	31.52	171.50	336.1	Test not performed [10]				
Vanadium	SWMU 59	10/10	9.2 - 171	ND	63.29	16.39	93.34	---	Test not performed [10]	Test not performed [11]	Wilcoxon Rank Sum Test [12] Not elevated at α = 0.05 (p = 0.889)	Not elevated at α = 0.05	Not elevated at α = 0.05
	NAPR Background	11/12	1.7J - 549	8.5U - 8.5U	161.20	48.76	248.90	187.8	Test not performed [10]				
Dissolved Metals													
Copper	SWMU 59	10/10	2.3 - 19	ND	7.33	1.52	10.82	---	Test not performed [10]	Test not performed [11]	Test not performed [13]	Test not performed [13]	Test not performed [13]
	NAPR Background	5/12	3.3 - 496J	0.5U - 7.5U	53.29	40.85	NA	332.8	Test not performed [10]				
Vanadium	SWMU 59	10/10	9.5 - 179	ND	65.61	17.91	98.45	---	Test not performed [10]	Test not performed [11]	Test not performed [13]	Test not performed [13]	Test not performed [13]
	NAPR Background	6/12	8.1 - 265	0.8U - 8.5U	39.03	21.47	NA	499.4	Test not performed [10]				
Zinc	SWMU 59	7/9	2.6J - 13.4J	2UJ - 2UJ	4.89	1.24	NA	---	Test not performed [10]	Test not performed [11]	Test not performed [13]	Test not performed [13]	Test not performed [13]
	NAPR Background	10/11	1.6J - 492	2.4U - 2.4U	62.64	43.72	499.80	565.5	Test not performed [10]				

Notes:

SE - Standard error
95% UCL - 95 Percent Upper Confidence Limit of the Mean
ULM - Upper Limit of the Mean
ND = Not Detected
J - Estimated value
U - Not detected

(1) Basewide background groundwater data taken from Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds, Naval Activity Puerto Rico, Ceiba, Puerto Rico. (Baker, 2010).
(2) Units in µg/L.
(3) Arithmetic mean calculated using non-detected data at the reporting limit.
(4) 95% Upper Conficence Limit of the mean concentrations were calculated using USEPA ProUCL Version 4.1.01 software (USEPA, 2011). A value was calculated for those data sets with a minimum of eight detected values and less than 70 percent non-detected results.
(5) Upper limit of the mean concentration is equal to the mean plus two standard deviations.
(6) Normality verified by the Shapiro-Wilk test (NFESC, 2004 and USEPA, 2010).
(7) Homogeneity of variance verified by F test (NFESC, 2004 and USEPA, 2010).
(8) Parametric tests are used if: (a) the site and background datasets do not contain non-detected results and (b) both data sets are normally distributed. Non-parametric tests are used if: (a) both data sets are not normally distributed or (b) the SWMU and/or background data sets contain non-detected resuts (USEPA, 2010).
(9) Quantile and slippage tests only determine if a particular inorganic chemical is likely present at equivalent or elevated concentrations relative to background (NFESC, 2004).
(10) Test for normality was not performed because the SWMU and/or background data set contains non-detected results (non-parametric tests are used by default if one or more of the data sets contain non-detected results [USEPA, 2010]).
(11) Test for homogeneity of variance was not performed because the SWMU and/or background data set contains non-detected results (non-parametric tests are used by default if one or more of the data sets contain non-detected results [USEPA, 2010]).
(12) The Wilcoxon Rank Sum test was used because: (a) both data sets have less than 40 percent non-detect results and (b) reporting limits within a given data set are the same (USEPA, 2010).
(13) Tests on the mean/median and right-tail of the SWMU and background data set distributions were not performed because there are less than 8 detected results within the SWMU and/or background data set (USEPA, 2010).

TABLE 7-46
SUMMARY OF DESCRIPTIVE AND DISTRIBUTIONAL STATISTICS FOR INORGANIC ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN GROUNDWATER
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY INVESTIGATION
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Table References:

Baker Environmental, Inc. (Baker). 2010. Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds, Naval Activity Puerto Rico, Ceiba, Puerto Rico.

Naval Facilities Engineering Service Center (NFESC). 2004. Guidance for Environmental Background Analysis. Volume III: Groundwater. NFESC User's Guide UG-2059-ENV. April 2004.

USEPA. 2011. ProUCLVersion 4.1.01. August 2011. http://www.epa.gov/osp/hstl/tsc/software.htm.

USEPA. 2010. ProUCL Version 4.1.00 Technical Guide (Draft). Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. Office of Research and Development. EPA/600/R-07/041. http://www.epa.gov/osp/hstl/tsc/software.htm.

TABLE 7-47
SUMMARY OF DESCRIPTIVE STATISTICS FOR INORGANIC ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN DRAINAGE DITCH SURFACE WATER
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	SWMU 59 Frequency/Range				Background Frequency/Range [2]				
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean [1]	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean [1]	Upper Limit of the Mean Concentration [3]
Total Metals (µg/L)									
Cadmium	0/3	ND	1U - 1U	0.5	0/6	ND	0.2U - 0.2U	0.2	---
Copper	3/3	3.8 - 4	NA	3.93	5/6	1.1J - 19	1.1U - 1.1U	7.7	23.1
Lead	0/3	ND	1U - 1U	0.5	4/6	0.57J - 1.9	0.5U - 0.5U	1.1	2.31
Silver	0/3	ND	1U - 1UJ	0.5	0/6	ND	3.2U - 3.2U	3.2U	---
Dissolved Metals (µg/L)									
Cadmium	0/3	ND	1U - 1U	0.5	0/6	ND	2.9U - 2.9U	2.9	---
Copper	3/3	2.9 - 3.1	NA	3.0	4/6	1.4J - 7.3	1.3U - 1.3U	1.3	8.72
Lead	0/3	ND	1U - 1U	0.5	1/6	0.22J	0.2U - 0.2U	0.2	---
Silver	0/3	ND	1U - 1U	0.5	0/6	ND	2.5U - 2.5U	2.5	---

Notes:

µg/L - microgram per liter
SWMU - Solid Waste Management Unit
ND - Not Detected
NA - Not Applicable
U - Not Detected
UJ - Not detected, estimated value

(1) Arithmetic mean calculated using non-detected data at the reporting limit.
(2) Background surface water analytical data taken from the Revised Addendum C and Addendum D to the Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds (Baker, 2013).
(3) Upper limit of the mean concentration is equal to the mean plus two standard deviations.

Table References:

Baker. 2013. Revised Addendum C and Addendum D to the Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds, Naval Activity Puerto Rico, Ceiba, Puerto Rico. March 5, 2013.

TABLE 7-48
FREQUENCY AND RANGE OF DRAINAGE DITCH SEDIMENT DATA COMPARED TO SEDIMENT SCREENING VALUES: STEP 3A RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte [1]	Contaminant Frequency/Range (Total Recoverable Fraction)						Sediment Screening Value (SDSV)	Reference [4]	95% UCL of the Mean HQ [5]	Comments
	Frequency of Detection	Range of Positive Detections	Range of Non-Detects	Arithmetic Mean (Half Non-Detects)	95% UCL of the Mean [2]	Value used in Step 3a Screen [3]				
Metals (mg/kg)										
Copper	12/12	36.2J - 187J	NA	113.600	137.60	137.6	31.6	MacDonald et al. 2000	4.35	HQ > SDSV
Lead	10/10	4.92J - 71.2J	NA	32.835	47.67	47.67	35.8	MacDonald et al. 2000	1.33	HQ > SDSV
Zinc	12/12	71.7J - 357J	NA	193.725	238.1	238.1	121	MacDonald et al. 2000	1.97	HQ > SDSV

Notes:

mg/kg = milligram per kilogram
USEPA = United States Environmental Protection Agency
UCL = Upper Confidence Limit
HQ = Hazard Quotient
SDSV = Sediment Screening Value
NA = Not Applicable

(1) The analytes shown are those chemicals detected in groundwater (minimum of eight detected values with less than seventy percent non-detected results) and identified as ecological chemicals of potential concern in Step 2 of the screening level risk calculation because maximum concentrations exceed groundwater screening values.

(2) 95% UCL of the mean concentrations were calculated using USEPA ProUCL Version 4.1.01 software (USEPA, 2010a and 2010b).

(3) Risk estimates were re-calculated in Step 3a using 95% UCL of the mean concentrations.

(4) See Table 7-8 for reference citations.

(5) The 95% UCL of the mean HQ is derived by dividing the 95% UCL of the mean concentration by the sediment screening value.

Table References:

United States Environmental Protection Agency (USEPA). 2010a. ProUCL Version 4.1.00 User Guide (Draft). Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. Office of Research and Development. EPA/600/R-07/041. May 2010. http://www.epa.gov/osp/hstl/tsc/software.htm.

USEPA. 2010b. ProUCL Version 4.1.00 Technical Guide (Draft). Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. Office of Research and Development. EPA/600/R-07/041. http://www.epa.gov/osp/hstl/tsc/software.htm.

TABLE 7-49
SUMMARY OF DESCRIPTIVE AND DISTRIBUTIONAL STATISTICS FOR INORGANIC ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN DRAINAGE DITCH SEDIMENT
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Population [1]	Descriptive Statistics [2]							Test for Normality [6]	Test for Homogeneity of Variance [7]	Distributional Statistics		
		Frequency of Detection	Range of Detections	Range of Non-Detections	Mean [3]	SE	95% UCL [4]	ULM [5]			Mean/Median of the Distribution [8]	Right Tail of the Distribution [9]	
												Quantile Test	Slippage Test
Barium	SWMU 59	3/3	81.6J - 164J	ND	118.20	24.23	NA	---	Test not performed [10]	Test not performed [10]	Test not performed [10]	Test not performed [10]	Test not performed [10]
	NAPR Background	12/12	37.1J - 210	ND	113.70	16.73	143.70	229.6	Test not performed [10]				
Beryllium	SWMU 59	3/3	0.35J - 0.45J	ND	0.39	0.03	NA	---	Test not performed [10]	Test not performed [10]	Test not performed [10]	Test not performed [10]	Test not performed [10]
	NAPR Background	7/12	0.2 - 0.77J	0.43UJ - 0.54U	0.43	0.05	NA	0.711	Test not performed [10]				
Copper	SWMU 59	12/12	36.2J - 187J	ND	113.60	13.34	137.60	---	Normal at α = 0.05	Variances are equal at α = 0.05 (p = 0.053)	Two Sample T-Test [12] Elevated at α = 0.05 (p = 0.021)	Elevated at α = 0.05	Elevated at α = 0.05
	NAPR Background	12/12	45.1 - 111J	ND	80.99	7.21	93.95	131.0	Normal at α = 0.05				
Lead	SWMU 59	10/10	4.92J - 71.2J	ND	32.84	8.09	47.67	---	Normal at α = 0.05	Test not performed [11]	Wilcoxon Rank Sum Test [13] Not elevated at α = 0.05 (p = 0.061)	Elevated at α = 0.05	Elevated at α = 0.05
	NAPR Background	12/12	7.6 - 27J	ND	13.98	1.93	18.00	27.3	Not normal at α = 0.05				
Mercury	SWMU 59	3/3	0.033J - 0.19	ND	0.10	0.05	NA	---	Test not performed [10]	Test not performed [10]	Test not performed [10]	Test not performed [10]	Test not performed [10]
	NAPR Background	11/12	0.029 - 0.16	0.14UJ - 0.14UJ	0.09	0.01	0.11	0.149	Test not performed [10]				
Nickel	SWMU 59	3/3	18.7J - 28.1	ND	23.13	2.73	NA	---	Test not performed [10]	Test not performed [10]	Test not performed [10]	Test not performed [10]	Test not performed [10]
	NAPR Background	12/12	7J - 17.7J	ND	12.90	0.82	14.38	18.6	Test not performed [10]				
Thallium	SWMU 59	2/3	0.053J - 0.14J	1UJ - 1UJ	0.40	0.30	NA	---	Test not performed [10]	Test not performed [10]	Test not performed [10]	Test not performed [10]	Test not performed [10]
	NAPR Background	5/12	0.065J - 0.19J	0.083UJ - 2.7UJ	0.57	0.22	NA	1.05	Test not performed [10]				
Vanadium	SWMU 59	3/3	144J - 232J	ND	177.30	27.55	NA	---	Test not performed [10]	Test not performed [10]	Test not performed [10]	Test not performed [10]	Test not performed [10]
	NAPR Background	12/12	100 - 260J	ND	189.90	13.22	213.70	281.5	Test not performed [10]				
Zinc	SWMU 59	12/12	71.7J - 357J	ND	193.70	24.73	238.10	---	Normal at α = 0.05	Variances are not equal at α = 0.05 (p < 0.001)	Satterthwaite Test [14] Elevated at α = 0.05 (p < 0.001)	Elevated at α = 0.05	Elevated at α = 0.05
	NAPR Background	12/12	41.2J - 99	ND	70.83	5.05	79.90	105.8	Normal at α = 0.05				

TABLE 7-49
SUMMARY OF DESCRIPTIVE AND DISTRIBUTIONAL STATISTICS FOR INORGANIC ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN DRAINAGE DITCH SEDIMENT
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Notes:

SE - Standard error
95% UCL - 95 percent Upper Confidence Limit of the Mean
ULM - Upper Limit of the Mean
ND - Not detected
NA - Not applicable
J - Estimated value
U - Not detected
UJ - Not detected, estimated value

(1) Background sediment analytical data (non-airfield data set) taken from the Revised Addendum C and Addendum D to the Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds (Baker, 2013).
(2) Units in mg/kg.
(3) Arithmetic mean calculated using non-detected data at the reporting limit.
(4) 95% Upper Conficence Limit of the mean concentrations were calculated using USEPA ProUCL Version 4.1.01 software (USEPA, 2011). A value was calculated for those data sets with a minimum of eight detected values and less than 70 percent non-detected results.
(5) Upper limit of the mean concentration is equal to the mean plus two standard deviations.
(6) Normality verified by the Shapiro-Wilk test (NFESC, 2003 and USEPA, 2010).
(7) Homogeneity of variance verified by F test (NFESC, 2003 and USEPA, 2010).
(8) Parametric tests are used if: (a) the site and background datasets do not contain non-detected results and (b) both data sets are normally distributed. Non-parametric tests are used if: (a) both data sets are not normally distributed or (b) the SWMU and/or background data sets contain non-detected resuts (USEPA, 2010).
(9) Quantile and slippage tests only determine if a particular inorganic chemical is likely present at equivalent or elevated concentrations relative to background (NFESC, 2003).
(10) Tests for normality and homogeneity of varience, as well as tests on the mean/median and right-tail of the SWMU and background data set distributions were not performed because there are less than 8 detected results within the SWMU and/or background data set (USEPA, 2010).
(11) Test for homogeneity of variance was not performed because the SWMU and/or background data set contains non-detected results (non-parametric tests are used by default if one or more of the data sets contain non-detected results [USEPA, 2010]).
(12) Two sample t-test was used because the SWMU and background data sets are normally distributed and variances are homogeneous (USEPA, 2010).
(13) The Wilcoxon Rank Sum test was used because: (a) both data sets have less than 40 percent non-detect results and (b) reporting limits/limits of detection within a given data set are the same (USEPA, 2010).
(14) Satterthwaite t-test was performed because the site and background data sets are normally distributed but variances are not homogeneous (USEPA, 2010).

Table References:

Baker. 2013. Revised Addendum C and Addendum D to the Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds, Naval Activity Puerto Rico, Ceiba, Puerto Rico. March 5, 2013.

Naval Facilities Engineering Service Center (NFESC). 2003. Guidance for Environmental Background Analysis, Volume II: Sediment. NFESC User's Guide UG-2054-ENV. April 2003.

USEPA. 2011. ProUCLVersion 4.1.01. August 2011. http://www.epa.gov/osp/hstl/tsc/software.htm.

USEPA. 2010. ProUCL Version 4.1.00 Technical Guide (Draft). Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. Office of Research and Development. EPA/600/R-07/041. http://www.epa.gov/osp/hstl/tsc/software.htm.

TABLE 7-50
ACID VOLATILE SULFIDE/SIMULTANEOUSLY EXTRACTED METALS ANALYTICAL DATA FOR DRAINAGE DITCH SEDIMENT COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTANENCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SD01	59SD02	59SD03
Sample ID	59SD01	59SD02	59SD03
Sampling Date	4/22/2010	4/22/2010	4/22/2010
AVS (µmole/g)			
Acid Volatile Sulfide	NA	0.17 J	0.15
SEM (µmole/g)			
Cadmium	NA	0.00305	0.00269
Copper	NA	0.588	0.339
Lead	NA	0.071 J	0.0485 J
Nickel	NA	0.075	0.066
Silver	NA	0.0018 U	0.0014 U
Zinc	NA	0.92	1.12
Total SEM (µmole/g) [(1)(2)]	NA	1.6589	1.5776
SEM-to-AVS Ratio:	NA	9.7582	10.5173

Notes:

AVS = Acid Volatile Sulfide
SEM = Simultaneously Extracted Metals
µmole/g = micromole per gram
bgs = below ground surface
J = Estimated value
U = Not detected

(1) The total SEM concentration was derived using the following formula: $[SEM]_{total} = [SEM]^{Cd} + [SEM]_{Cu} + [SEM]_{Pb} + [SEM]_{Ni} + [SEM]_{Zn} + (0.5)[SEM]_{Ag}$ (one-half the molar concentration of silver was added into the SEM totals due to silver being largely in a monovalent state)

(2) If a given sediment sample had non-detected results for individual SEM metals, the non-detected results were used in the derivation of the total SEM molar concentration.

TABLE 7-51
HAZARD QUOTIENT VALUES FOR AVIAN AND MAMMALIAN DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 3A RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Brown flower bat			American robin			Mourning dove			Red-tailed hawk		
	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC
Semi-Volatile Organics:												
Butyl benzyl phthalate	---	---	---	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzofuran	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	---	---	---	0.13	0.01	0.04	---	---	---	---	---	---
PAHs:												
Pyrene	0.29	0.06	0.13	---	---	---	---	---	---	---	---	---
Organochlorine Pesticides:												
4,4'-DDE	---	---	---	0.26	0.03	0.08	---	---	---	---	---	---
4,4'-DDT	---	---	---	0.38	0.04	0.12	---	---	---	---	---	---
Endrin	---	---	---	0.72	0.15	0.33	---	---	---	---	---	---
Metals:												
Beryllium	---	---	---	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	---	--	---	0.59	0.14	0.29	---	---	---	---	---	---
Chromium, total	---	---	---	0.62	0.11	0.26	---	---	---	---	---	---
Copper	---	---	---	0.95	0.32	0.55	0.69	0.23	0.40	---	---	---
Lead	---	---	---	5.04	2.52	3.57	3.11	1.55	2.20	0.74	0.07	0.23
Mercury	---	---	---	0.30	0.10	0.18	---	---	---	---	---	---
Nickel	---	---	---	0.34	0.12	0.20	---	---	---	---	---	---
Selenium	0.47	0.31	0.38	0.39	0.20	0.28	---	---	---	---	---	---
Silver	---	---	---	0.30	0.03	0.10	---	---	---	---	---	---
Tin	---	---	---	0.65	0.26	0.41	---	---	---	---	---	---
Vanadium	---	---	---	7.81	3.91	5.53	3.80	1.90	2.68	0.41	0.20	0.29
Zinc	---	---	---	1.01	0.39	0.63	---	---	---	---	---	---

Notes:

Shaded cells indicate a hazard quotient value greater than 1.0
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
NA = Toxicity Reference Value not available (hazard quotient value could not be calculated)
--- = Refined risk estimate was not calculated (chemical does not present an unacceptable risk based on the Step 2 screening level risk calculation [see Table 7-25])

TABLE 7-52
HAZARD QUOTIENT VALUES FOR AVIAN AND MAMMALIAN DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 3A RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Brown flower bat			American robin			Mourning dove			Red-tailed hawk		
	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC
Metals:												
Beryllium	---	---	---	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium, total	---	---	---	1.51	0.26	0.62	0.42	0.07	0.17	---	---	---
Copper	---	---	---	0.98	0.33	0.57	0.73	0.24	0.42	---	---	---
Mercury	---	---	---	0.36	0.12	0.21	---	---	---	---	---	---
Nickel	---	---	---	0.61	0.22	0.37	---	---	---	---	---	---
Tin	---	---	---	0.55	0.22	0.35	---	---	---	---	---	---
Vanadium	---	---	---	11.52	5.76	8.15	5.60	2.80	3.96	0.60	0.30	0.42
Zinc	---	---	---	0.60	0.23	0.37	---	---	---	---	---	---

Notes:

Shaded cells indicate a hazard quotient value greater than 1.0

NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
NA = Toxicity Reference Value not available (hazard quotient value could not be calculated)
--- = Refined risk estimate was not calculated (chemical does not present an unacceptable risk based on the Step 2 screening level risk calculation [see Table 7-26])

TABLE 7-53
HAZARD QUOTIENT VALUES FOR AVIAN AND MAMMALIAN DIETARY EXPOSURES TO CHEMICALS IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 3A RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Brown flower bat			American robin			Mourning dove			Red-tailed hawk		
	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC
Semi-Volatile Organics:												
Pentachlorophenol	---	---	---	0.13	0.01	0.04	---	---	---	---	---	---
Metals:												
Beryllium	---	---	---	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	---	---	---	0.36	0.08	0.17	---	---	---	---	---	---
Chromium, total	---	---	---	0.72	0.12	0.30	---	---	---	---	---	---
Copper	---	---	---	0.85	0.28	0.49	0.62	0.21	0.36	---	---	---
Mercury	---	---	---	0.22	0.07	0.13	---	---	---	---	---	---
Nickel	---	---	---	0.40	0.14	0.24	---	---	---	---	---	---
Selenium	0.69	0.46	0.56	0.51	0.26	0.36	---	---	---	---	---	---
Silver	---	---	---	0.07	<0.01	0.02	---	---	---	---	---	---
Tin	---	---	---	0.10	0.04	0.06	---	---	---	---	---	---
Vanadium	---	---	---	7.30	3.65	5.16	3.55	1.77	2.51	0.38	0.19	0.27
Zinc	---	---	---	0.68	0.26	0.42	---	---	---	---	---	---

Notes:

Shaded cells indicate a hazard quotient value greater than 1.0

NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
NA = Toxicity Reference Value not available (hazard quotient value could not be calculated)
--- = Refined risk estimate was not calculated (chemical does not present an unacceptable risk based on the Step 2 screening level risk calculation [see Table 7-27])

TABLE 7-54
HAZARD QUOTIENT VALUES FOR AVIAN AND MAMMALIAN DIETARY EXPOSURES TO CHEMICALS IN SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 3A RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Brown flower bat			American robin			Mourning dove			Red-tailed hawk		
	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC	NOAEL	LOAEL	MATC
Semi-Volatile Organics:												
Pentachlorobenzene	---	---	---	NA	NA	NA	NA	NA	NA	NA	NA	NA
Metals:												
Beryllium	---	---	---	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium, total	---	---	---	1.36	0.23	0.56	---	---	---	---	---	---
Copper	---	---	---	0.92	0.31	0.53	---	---	---	---	---	---
Mercury	---	---	---	0.55	0.18	0.32	---	---	---	---	---	---
Nickel	---	---	---	0.62	0.22	0.37	---	---	---	---	---	---
Vanadium	---	---	---	12.92	6.46	9.14	3.55	1.77	2.51	0.38	0.19	0.27
Zinc	---	---	---	0.56	0.22	0.35	---	---	---	---	---	---

Notes:

Shaded cells indicate a hazard quotient value greater than 1.0

NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
NA = Toxicity Reference Value not available (hazard quotient value could not be calculated)
--- = Refined risk estimate was not calculated (chemical does not present an unacceptable risk based on the Step 2 screening level risk calculation [see Table 7-28])

TABLE 7-55
HAZARD QUOTIENT VALUES FOR AVIAN DIETARY EXPOSURES TO CHEMICALS IN DRAINAGE DITCH SEDIMENT: STEP 3A RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Green heron		
	NOAEL	LOAEL	MATC
Semi-Volatile Organics:			
bis(2-Ethylhexyl)phthalate	2.29	0.46	1.03
Butyl benzyl phthalate	NA	NA	NA
Organochlorine Pesticides:			
4,4'-DDE	4.29	0.43	1.36
Metals:			
Barium	0.97	0.48	0.68
Beryllium	NA	NA	NA
Chromium, total	0.11	0.02	0.04
Copper	1.10	0.37	0.63
Lead	0.41	0.21	0.29
Mercury	2.37	0.79	1.37
Vanadium	82.82	41.41	58.56
Zinc	0.50	0.19	0.31

Notes:

Shaded cells indicate a hazard quotient value greater than 1.0

NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
NA = Toxicity Reference Value not available (hazard quotient value could not be calculated)
--- = Refined risk estimate was not calculated (chemical does not present an unacceptable risk based on the Step 2 screening level risk calculation [see Table 7-29])

TABLE 7-56
SUMMARY OF ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN AND ECOLOGICAL CHEMICALS OF CONCERN FOR SURFACE AND SUBSURFACE SOIL
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemcials	Lower Trophic Level Receptor Groups (Terrestrial Plants and Invertebrates)				Upper trophic Level Receptors			
	Surface Soil		Subsurface Soil		Surface Soil		Subsurface Soil	
	2010 Data Set [1]	2012 Data Set [2]	2010 Data Set [3]	2012 Data Set [4]	2010 Data Set [1]	2012 Data Set [2]	2010 Data Set [3]	2012 Data Set [4]
Ecological Chemicals of Concern Recommended for Corrective Action Measures [5]	Copper Lead Zinc	Copper	None	None	Lead	None	None	None
Ecological Chemicals of Potential Concern Not Recommended for Further Evaluation [6]	2-Hexanone Acetone Bromomethane Carbon disulfide Chloromethane Methyl acrylonitrile Methyl iodide Propionitrile Dibenzofuran beta-BHC Cobalt Selenium Vanadium 17 non-detected VOCs 4 VOCs with no usable data 59 non-detected SVOCs 1 SVOC with no usable data 4 non-detected pesticide	Acetone Chromium Cobalt Nickel Selenium Vanadium 27 non-detected VOCs 1 VOC with no useable data 56 non-detected SVOCs 1 metal with no useable data	Acetone Bromomethane Carbon disulfide Chloromethane Methyl iodide beta-BHC Chromium Cobalt Copper Nickel Selenium Vanadium Zinc 19 non-detected VOCs 5 VOCs with no useable data 59 non-detected SVOCs 1 SVOC with no usable data 3 non-detected pesticides	Acetone 2,4-Dimethylphenol Chromium Cobalt Copper Nickel Selenium Vanadium 27 non-detected VOCs 1 VOC with no useable data 54 non-detected SVOCs 1 metal with no useable data	Pyrene 4,4'-DDE 4,4'-DDT Butyl Benzyl Phthalate Dibenzofuran Beryllium Cadmium Chromium Copper Lead Mercury Nickel Selenium Silver Tin Vanadium Zinc 9 non-detected VOCs 26 non-detected SVOCs 1 non-detected pesticide	Beryllium Chromium Copper Mercury Nickel Tin Vanadium Zinc 9 non-detected VOCs 27 non-detected SVOCs 1 metal with no useable data	Beryllium Cadmium Chromium Copper Mercury Nickel Selenium Silver Tin Vanadium Zinc 9 non-detected VOCs 29 non-detected SVOCs 1 non-detected pesticide	Pentachlorobenzene Beryllium Chromium Copper Mercury Nickel Vanadium Zinc 9 non-detected VOCs 26 non-detected SVOCs

Notes:

SVOC = Semi-Volatile Organic Compound
VOC = Volatile Organic Compound

[1] Surface soil collected at locations adjacent to concrete pads and paved surfaces.
[2] Surface soil collected at locations beneath concrete pads and paved surfaces.
[3] Subsurface soil predominantly collected at locations adjacent to concrete pads and paved surfaces.
[4] Subsurface soil collected at locations beneath concrete pads and paved surfaces.
[5] Ecological chemcials of concern (COCs) were identified based on the evaluations presented in Sections 7.9.1.1, 7.9.1.2, 7.9.2.1, and 7.9.2.2.
[6] Ecological chemicals of potential concern (COPCs) were identified based on the evaluations presented in Sections 7.6.2.1, 7.6.2.2, 7.6.3.1, and 7.6.3.2.

TABLE 7-57
SUMMARY OF ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN AND ECOLOGICAL CHEMICALS OF CONCERN FOR GROUNDWATER, DRAINAGE DITCH SURFACE WATER, AND DRAINAGE DITCH SEDIMENT
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

	Lower Trophic Level Aquatic Receptor Groups			Upper Trophic Level Receptors
Chemcials	**Groundwater**	**Drainage Ditch Surface Water**	**Drainage Ditch Sediment**	**Drainage Ditch Sediment**
Ecological Chemicals of Concern Recommended for Corrective Action Measures [1]	None	None	Copper Zinc	None
Ecological Chemicals of Potential Concern Not Recommended for Further Evaluation [2]	alpha-Chlordane Copper Vanadium 5 non-detected VOCs 7 VOCs with no usable data 35 non-detected SVOCs 1 SVOC with no usable data 16 non-detected pesticides 2 metals with no usable data	4,4'-DDE 4,4'-DDT Copper 5 non-detected VOCs 7 VOCs with no usable data 39 non-detected SVOCs 1 SVOC with no usable data 14 non-detected pesticides 3 non-detected metals	Acetone Bis(2-ethylhexyl)phthalate 4,4'-DDD 4,4'-DDE alpha-Chlordane gamma-Chlordane Heptachlor Barium Beryllium Lead Mercury Nickel Vanadium 9 non-detected VOCs 4 VOCs with no usable data 79 non-detected SVOCs 1 SVOC with no usable data 4 non-detected pesticides 1 non-detected metal	Bis(2-ethylhexyl)phthalate Butyl benzyl phthalate 4,4'-DDE Barium Beryllium Chromium Copper Lead Mercury Vanadium Zinc 9 non-detected VOCs 24 non-detected SVOCs 1 non-detected pesticide

Notes:

SVOC = Semi-Volatile Organic Compound
VOC = Volatile Organic Compound

[1] Ecological chemcials of concern (COCs) were identified based on the evaluations presented in Sections 7.9.1.3, 7.9.1.4, 7.9.1.5, and 7.9.2.3.

[2] Ecological chemicals of potential concern (COPCs) were identified based on the evaluations presented in Sections 7.6.2.3, 7.6.2.4, 7.6.2.5, and 7.6.3.3.

TABLE 7-58
ECOLOGICAL-BASED CORRECTIVE ACTION OBJECTIVES FOR SURFACE SOIL
SWMU 59 - FORMER VEHICLE MAINTANENCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Ecological Chemical of Concern	Surface Soil Corrective Action Objective (mg/kg)			Final Corrective Action Objective (mg/kg)
	Terrestrial Invertebrates and Plants	American Robin (Avian Omnivore)	Background [1]	
Copper	70 [2]	NA	168	168 [5]
Lead	120 [2]	96 [4]	22	96 [6]
Zinc	120 [3]	NA	115	120 [6]

Notes:

NA = Not applicable (chemical does not present an unacceptable risk to receptor group/species).

[1] Background surface soil upper limit of the mean concentration presented in Baker (2010).
[2] The value shown is an ecological soil screening level for terrestrial plants. (USEPA, 2007a and 2005).
[3] The value shown is an ecological soil screening level for terrestrial invertebrates (USEPA, 2007b).
[4] The value shown is the surface soil concentration that results in a NOAEL-based hazard quotient value of 1.0 for the most sensitive receptor.
[5] Final CAO applicable to surface soil collected during the 2010 CMS field investigation (surface soil adjacent to concrete pads and paved surfaces) and surface soil collected during the 2010 CMS field investigation (surface soil beneath concrete pads and paved surfaces)
[6] Final CAO applicable to surface soil collected during the 2010 CMS field investigation (surface soil adjacent to concrete pads and paved surfaces).

Table References:

Baker Environmental, Inc. (Baker). 2010. Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds, Naval Activity, Puerto Rico, Ceiba, Puerto Rico. July 30, 2010.

United States Environmental Protection Agency (USEPA). 2005. Ecological Soil Screening Levels for Lead (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-70.

USEAP. 2007a. Ecological Soil Screening Levels for Copper (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-68.

USEPA. 2007b. Ecological Soil Screening Levels for Zinc (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-73.

TABLE 7-59
ECOLOGICAL-BASED CORRECTIVE ACTION OBJECTIVES FOR DRAINAGE DITCH SEDIMENT
SWMU 59 - FORMER VEHICLE MAINTANENCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Ecological Chemical of Concern	Surface Soil Corrective Action Objective (mg/kg)			Final Corrective Action Objective (mg/kg)
	Lower Trophic Level Aquatic Receptor Groups	Green Heron (Avian Piscivore)	Background [1]	
Copper	31.6 [2]	NA	131	131
Zinc	121 [2]	NA	105	121

Notes:

NA = Not applicable (chemical does not present an unacceptable risk to receptor group/species).

[1] Background drainage ditch sediment (non-airfield data set) upper limit of the mean concentration presented in Baker (2013).

[2] The value shown is a consensus-based threshold effect concentration (TEC) developed by McDonald et al. (2000).

Table References:

Baker. 2013 Revised Addendum C and Addendum D to the Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds, Naval Activity Puerto Rico, Ceiba, Puerto Rico. March 5, 2013.

MacDonald, D.D., C.G. Ingersoll, T.A. Berger. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. Arch. Environ. Contam. Toxicol. 39:20-31.

TABLE 8-1

COMBINED SURFACE SOIL DATA AND COPC SELECTION SUMMARY
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Contaminant	Criteria [1]		Contaminant Frequency / Range / Location			Background [2]	COPC Selection		Exposure Concentration Selection		
	RegionaI Screening Level Residential SSL		No. of Positive Detects / No. of Samples	Range of Positive Detections	Location of Maximum Detection	Upper Limit of Means (ULM)	Selected as a COPC?	Rationale for Selection or Deletion	95% UCL [3] (ProUCL)	Exposure Concentration	Rationale for Concentration Selection
Volatile Organics (µg/kg)											
2-Hexanone (MBK)	21,000		1/29	4.8 J	59SB12-00	ND	NO	BSL	NA	NA	NA
Acetone	6,100,000		17/29	15 J - 190	59SB21-00	ND	NO	BSL	NA	NA	NA
Acrylonitrile	240		1/29	3.4 J	59SB12-00	ND	NO	BSL	NA	NA	NA
Benzene	1,100		3/29	0.37 J - 0.73 J	59SB15-00	ND	NO	BSL	NA	NA	NA
Bromomethane	730		3/29	2.4 J - 6.3	59SB11-00	ND	NO	BSL	NA	NA	NA
Carbon Disulfide	82,000		2/29	0.52 J - 1 J	59SB17-00	ND	NO	BSL	NA	NA	NA
Chloromethane	12,000		5/29	0.35 J - 0.99 J	59SB11-00	ND	NO	BSL	NA	NA	NA
Methyl Acrylonitrile	760		1/29	3.3 J	59SB12-00	ND	NO	BSL	NA	NA	NA
Methyl Iodide	NE		4/29	0.97 J - 12	59SB11-00	ND	YES	NSC	3.69 (NP)	3.69	95% KM(Percentile Bootstrap) UCL
Propionitrile (Ethyl Cyanide)	NE		1/11	8.1 J	59SB08-00	ND	YES	NSC	NC	NA	Max (Less than 4 detections)
Xylene, m/p-	63,000	(4)	3/19	0.14 J - 0.32 J	59SB02-00	ND	NO	BSL	NA	NA	NA
Xylenes, total	63,000		3/29	0.14 J - 0.32 J	59SB02-00	ND	NO	BSL	NA	NA	NA
Semivolatile Organics (µg/kg)											
Bis(2-ethylhexyl) Phthalate (BEHP)	35,000		11/29	11 J - 630 J	59SB01-00	ND	NO	BSL	NA	NA	NA
Butyl Benzyl Phthalate	260,000		1/29	170 J	59SB15-00	ND	NO	BSL	NA	NA	NA
Dibenzofuran	7,800		1/29	750	59SB04-00	ND	NO	BSL	NA	NA	NA
LLPAHs (µg/kg)											
2-Methylnaphthalene	23,000		4/29	1.2 J - 31 J	59SB04-00	ND	NO	BSL	NA	NA	NA
Acenaphthene	340,000		3/29	0.82 J - 480	59SB04-00	ND	NO	BSL	NA	NA	NA
Acenaphthylene	340,000	(5)	3/29	1.7 J - 27	59SB04-00	ND	NO	BSL	NA	NA	NA
Anthracene	1,700,000		9/29	0.57 J - 690	59SB04-00	ND	NO	BSL	NA	NA	NA
Benzo(a)anthracene *	150		12/29	0.72 J - 84 J	59SB04-00	ND	YES	CHEM	13.0 (NP)	13.0	95% KM(t) UCL
Benzo(a)pyrene (BaP)	15.0		8/29	0.8 J - 390	59SB04-00	ND	YES	ASL	41.4 (NP)	41.4	95% KM(t) UCL
Benzo(b)fluoranthene	150		9/29	0.86 J - 750	59SB04-00	ND	YES	ASL	297 (NP)	297	99% KM(Chebyshev) UCL
Benzo(g,h,i)perylene	170,000	(6)	7/29	0.53 J - 220	59SB04-00	ND	NO	BSL	NA	NA	NA
Benzo(k)fluoranthene *	1,500		9/29	0.75 J - 730	59SB04-00	ND	YES	CHEM	290 (NP)	290	99% KM(Chebyshev) UCL
Chrysene *	15,000		14/29	0.77 J - 1,200	59SB04-00	ND	YES	CHEM	465 (NP)	465	99% KM(Chebyshev) UCL
Dibenz(a,h)anthracene	15.0		2/29	0.92 J - 92	59SB04-00	ND	YES	ASL	NC	NA	Max (Less than 4 detections)
Fluoranthene	230,000		11/29	1.8 J - 4,600	59SB04-00	ND	NO	BSL	NA	NA	NA
Fluorene	230,000		5/29	0.63 J - 580	59SB04-00	ND	NO	BSL	NA	NA	NA
Indeno(1,2,3-cd)pyrene	150		5/29	1.8 J - 240	59SB04-00	ND	YES	ASL	28.8 (NP)	28.8	95% KM(t) UCL
Naphthalene	3,600		4/29	0.92 J - 2.2 J	59SB15-00	ND	NO	BSL	NA	NA	NA
Phenanthrene	220,000		8/29	1.5 J - 7,000	59SB04-00	ND	NO	BSL	NA	NA	NA
Pyrene	170,000		13/29	1 J - 3,000	59SB04-00	ND	NO	BSL	NA	NA	NA
Pesticides (µg/kg)											
4,4'-DDD	2,000		4/19	0.6 J - 8.1 J	59SB15-00	ND	NO	BSL	NA	NA	NA
4,4'-DDE	1,400		10/19	0.46 J - 160	59SB15-00	8.98	NO	BSL	NA	NA	NA
4,4'-DDT	1,700		9/19	0.66 J - 160	59SB15-00	8.90	NO	BSL	NA	NA	NA
BHC, beta-	270		5/18	0.47 J - 9.2 NJ	59SB17-00	ND	NO	BSL	NA	NA	NA
Chlordane, alpha-	1,600	(7)	7/19	0.25 J - 1.9 J	59SB22-00	ND	NO	BSL	NA	NA	NA
Chlordane, gamma-	1,600	(7)	2/19	0.57 J - 3.5 J	59SB15-00	ND	NO	BSL	NA	NA	NA

TABLE 8-1

COMBINED SURFACE SOIL DATA AND COPC SELECTION SUMMARY
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Contaminant	Criteria (1)		Contaminant Frequency / Range / Location			Background (2)	COPC Selection		Exposure Concentration Selection		
	Regional Screening Level Residential SSL		No. of Positive Detects / No. of Samples	Range of Positive Detections	Location of Maximum Detection	Upper Limit of Means (ULM)	Selected as a COPC?	Rationale for Selection or Deletion	95% UCL (3) (ProUCL)	Exposure Concentration	Rationale for Concentration Selection
Pesticides (µg/kg) (cont.)											
Endosulfan Sulfate	37,000	(8)	3/19	0.52 J - 0.72 J	59SB04-00	ND	NO	BSL	NA	NA	NA
Endrin Aldehyde	1,800	(9)	1/12	1.8 J	59SB09-00	ND	NO	BSL	NA	NA	NA
Methoxychlor	31,000		1/19	26 NJ	59SB11-00	ND	NO	BSL	NA	NA	NA
Metals (mg/kg)											
Antimony	3.10		7/29	0.17 J - 8.5 J	59SB15-00	2.46	YES	ASL	1.14 (NP)	1.14	95% KM(t) UCL
Arsenic	0.610		19/29	0.29 J - 5.5	59SB15-00	2.70	YES	ASL	1.39 (NP)	1.39	95% KM(Percentile Bootstrap) UCL
Barium	1,500		29/29	24 - 267 J	59SB08-00	203	NO	BSL	NA	NA	NA
Beryllium	16.0		26/29	0.097 - 0.63 J	59SB24-00	0.595	NO	BSL	NA	NA	NA
Cadmium	7.0		28/29	0.047 J - 2.6	59SB15-00	5.53	NO	BSL	NA	NA	NA
Chromium	12,000	(10)	29/29	5.3 J - 150	59SB33-00	50.1	NO	BSL	NA	NA	NA
Cobalt	2.30		29/29	6 J - 45.2	59SB14-00	23.6	YES	ASL	24.3 (N)	29.8	See Total Soil Exposure
Copper	310		29/29	24.8 J - 291	59SB14-00	171	NO	BSL	NA	NA	NA
Lead	400		19/19	2.6 J - 654 J	59SB09-00	10.9	YES	ASL	537 (NP)	537	99% Chebyshev(Mean,Sd) UCL
Mercury	1.0		19/29	0.009 J - 0.095	59SB12-00	0.111	NO	BSL	NA	NA	NA
Nickel	150		29/29	6.1 - 47	59SB33-00	12.7	NO	BSL	NA	NA	NA
Selenium	39.0		17/29	0.21 J - 2.4 J	59SB20-00	1.12	NO	BSL	NA	NA	NA
Silver	39.0		8/29	0.088 J - 2.6	59SB09-00	ND	NO	BSL	NA	NA	NA
Thallium	0.0780		9/29	0.027 J - 0.37 J	59SB20-00	ND	YES	ASL	0.0966 (NP)	0.133	See Total Soil Exposure
Tin	4,700		12/29	3 J - 36.5	59SB09-00	3.80	NO	BSL	NA	NA	NA
Vanadium	39.0		29/29	72.8 J - 330	59SB33-00	259	YES	ASL	186 (N)	186	95% Student's-t UCL
Zinc	2,300		29/29	34.1 J - 747	59SB15-00	117	NO	BSL	NA	NA	NA

Notes:

NA - Not Applicable
ND - Not Detected
J - Analyte present - Reported value is estimated
K - Analyte present - Reported value is biased high
NJ - Presumptive evidence for the presence of the material at an estimated value

COPC - Chemical of Potential Concern
UCL - Upper Confidence Limit

mg/kg = milligrams per kilogram
µg/kg = microgram per kilogram

Rationale Codes:

(ASL) Above Screening Level
(CHEM) Same Chemical Class

Shaded constituents were identified as COPCs for quantitative risk evaluation.

* These compounds were retained because one or more of its related carcinogenic PAHs were retained, and these compounds are known to exist together in mixtures

(1) All non-carcinogenic criteria were divided by 10 to account for potential additive effects of chemicals.
USEPA Regional Screening Levels, Residential Soil (May 2013)
(2) Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds (Baker, 2013): Upper Limit of Mean (Mean+2 Std Dev)
(3) ProUCL was used to calculate the 95% UCL and distribution (>8 samples and >4 detections):
(N) - Normal distribution
(NP) - Nonparametric distribution
(4) Screening value for **xylenes (total)** used as a surrogate.
(5) Screening value for **acenaphthene** used as a surrogate.
(6) Screening value for **pyrene** used as a surrogate.
(7) Screening value for **chlordane** used as a surrogate.
(8) Screening value for **endosulfan** used as a surrogate.
(9) Screening value for **endrin** used as a surrogate.
(10) Screening value for **chromium III** used as a surrogate.

TABLE 8-2

SURFACE SOIL DATA AND COPC SELECTION SUMMARY, 2012 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Contaminant	Criteria (1)	Contaminant Frequency / Range / Location			Background (2)	COPC Selection		Exposure Concentration Selection		
	RegionaI Screening Level Residential SSL	No. of Positive Detects / No. of Samples	Range of Positive Detections	Location of Maximum Detection	Upper Limit of Means (ULM)	Selected as a COPC?	Rationale for Selection or Deletion	95% UCL (3) (ProUCL)	Exposure Concentration	Rationale for Concentration Selection
Volatile Organics (µg/kg)										
Acetone	6,100,000	4/10	15 J - 45 J	59SB32-00	ND	NO	BSL	NA	NA	NA
Semivolatile Organics (µg/kg)										
Bis(2-ethylhexyl) Phthalate (BEHP)	35,000	5/10	11 J - 78 J	59SB25-00	ND	NO	BSL	NA	NA	NA
LLPAHs (µg/kg)										
2-Methylnaphthalene	23,000	1/10	6.4 J	59SB31-00	ND	NO	BSL	NA	NA	NA
Phenanthrene	220,000	1/10	6 J	59SB31-00	ND	NO	BSL	NA	NA	NA
Metals (mg/kg)										
Arsenic	0.610	10/10	0.46 - 1.8	59SB24-00	2.70	YES	ASL	1.35 (N)	1.35	95% Student's-t UCL
Barium	1,500	10/10	24 - 210 J	59SB24-00	203	NO	BSL	NA	NA	NA
Beryllium	16.0	10/10	0.097 - 0.63 J	59SB24-00	0.595	NO	BSL	NA	NA	NA
Cadmium	7.0	10/10	0.047 J - 0.47	59SB25-00	5.53	NO	BSL	NA	NA	NA
Chromium	12,000 (3)	10/10	32 - 150	59SB33-00	50.1	NO	BSL	NA	NA	NA
Cobalt	2.30	10/10	6 J - 36 J	59SB26-00	23.6	YES	ASL	24.8 (N)	24.8	95% Student's-t UCL
Copper	310	10/10	50 - 260 J	59SB24-00	171	NO	BSL	NA	NA	NA
Mercury	1.0	4/10	0.014 J - 0.069	59SB25-00	0.111	NO	BSL	NA	NA	NA
Nickel	150	10/10	15 - 47	59SB33-00	12.7	NO	BSL	NA	NA	NA
Selenium	39.0	3/10	0.47 J - 1.2	59SB32-00	1.12	NO	BSL	NA	NA	NA
Silver	39.0	3/10	0.088 J - 0.35	59SB32-00	ND	NO	BSL	NA	NA	NA
Thallium	0.0780	3/10	0.039 J - 0.073 J	59SB30-00	ND	NO	BSL	NA	NA	NA
Tin	4,700	1/10	8.3 J	59SB24-00	3.80	NO	BSL	NA	NA	NA
Vanadium	39.0	10/10	110 - 330	59SB33-00	259	YES	ASL	246 (N)	246	95% Student's-t UCL
Zinc	2,300	10/10	42 - 100 J	59SB24-00	117	NO	BSL	NA	NA	NA

Notes:

NA - Not Applicable
ND - Not Detected
J - Analyte present - Reported value is estimated

COPC - Chemical of Potential Concern
UCL - Upper Confidence Limit
ULM - Upper Limit of Means

mg/kg = milligrams per kilogram
µg/kg = microgram per kilogram

Rationale Codes:

(ASL) Above Screening Level
(BSL) Below Screening Level

Shaded constituents were identified as COPCs for quantitative risk evaluation.

(1) All non-carcinogenic criteria were divided by 10 to account for potential additive effects of chemicals.
USEPA Regional Screening Levels, Residential Soil (May 2013)
(2) Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds (Baker, 2013): Upper Limit of Mean (Mean+2 Std Dev)
(N) - Normal distribution
(3) Value for **chromium III** used as a surrogate.

TABLE 8-3

COMBINED TOTAL SOIL DATA AND COPC SELECTION SUMMARY
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Contaminant	Criteria [1]		Contaminant Frequency / Range / Location			Background [2]	COPC Selection		Exposure Concentration Selection		
	RegionaI Screening Level Residential SSL		No. of Positive Detects / No. of Samples	Range of Positive Detections	Location of Maximum Detection	Upper Limit of Means (ULM)	Selected as a COPC?	Rationale for Selection or Deletion	95% UCL [3] (ProUCL)	Exposure Concentration	Rationale for Concentration Selection
Volatile Organics (µg/kg)											
2-Hexanone (MBK)	21,000		1/85	4.8 J	59SB12-00	ND	NO	BSL	NA	NA	NA
Acetone	6,100,000		24/85	14 J - 190	59SB21-00	ND	NO	BSL	NA	NA	NA
Acrylonitrile	240		1/85	3.4 J	59SB12-00	ND	NO	BSL	NA	NA	NA
Benzene	1,100		5/85	0.37 J - 0.73 J	59SB15-00	ND	NO	BSL	NA	NA	NA
Bromoform	62,000		1/85	35	59SB02-04	ND	NO	BSL	NA	NA	NA
Bromomethane	730		6/85	1.2 J - 6.3	59SB11-00	ND	NO	BSL	NA	NA	NA
Carbon Disulfide	82,000		7/85	0.52 J - 10	59SB06-03	ND	NO	BSL	NA	NA	NA
Chloromethane	12,000		9/85	0.35 J - 1.1 J	59SB02-01	ND	NO	BSL	NA	NA	NA
Dibromochloromethane	680		1/85	0.9 J	59SB02-04	ND	NO	BSL	NA	NA	NA
Methyl Acrylonitrile	760		1/85	3.3 J	59SB12-00	ND	NO	BSL	NA	NA	NA
Methyl Iodide	NE		7/85	0.97 J - 30 J	59SB02-01	ND	YES	NSC	3.13 (NP)	3.69	See Surface Soil Exposure
Methylene Chloride	56,000		1/85	7.2	59SB31-01	ND	NO	BSL	NA	NA	NA
Propionitrile (Ethyl Cyanide)	NE		1/21	8.1 J	59SB08-00	ND	YES	NSC	NC	8.1	Max (Less than 4 detections)
Xylene, m/p-	63,000	(4)	15/65	0.12 J - 0.32 J	59SB02-00	ND	NO	BSL	NA	NA	NA
Xylenes, total	63,000		15/85	0.12 J - 0.32 J	59SB02-00	ND	NO	BSL	NA	NA	NA
Semivolatile Organics (µg/kg)											
2,4-Dimethylphenol	120,000		1/85	17 J	59SB25-01	ND	NO	BSL	NA	NA	NA
Bis(2-ethylhexyl) Phthalate (BEHP)	35,000		23/85	8.5 J - 630 J	59SB01-00	ND	NO	BSL	NA	NA	NA
Butyl Benzyl Phthalate	260,000		1/85	170 J	59SB15-00	ND	NO	BSL	NA	NA	NA
Dibenzofuran	7,800		1/85	750	59SB04-00	ND	NO	BSL	NA	NA	NA
Di-n-octyl Phthalate	61,000		1/85	55 J	59SB22-01	ND	NO	BSL	NA	NA	NA
Pentachlorobenzene	4,900		1/85	5.6 J	59SB24-01	ND	NO	BSL	NA	NA	NA
LLPAHs (µg/kg)											
2-Methylnaphthalene	23,000		6/85	0.96 J - 31 J	59SB04-00	ND	NO	BSL	NA	NA	NA
Acenaphthene	340,000		5/85	0.82 J - 480	59SB04-00	ND	NO	BSL	NA	NA	NA
Acenaphthylene	340,000	(5)	5/85	0.61 J - 27	59SB04-00	ND	NO	BSL	NA	NA	NA
Anthracene	1,700,000		10/85	0.57 J - 690	59SB04-00	ND	NO	BSL	NA	NA	NA
Benzo(a)anthracene *	150		20/85	0.63 J - 84 J	59SB04-00	ND	YES	CHEM	5.63 (NP)	13.0	See Surface Soil Exposure
Benzo(a)pyrene (BaP)	15.0		13/85	0.8 J - 390	59SB04-00	ND	YES	ASL	27.7 (NP)	41.4	See Surface Soil Exposure
Benzo(b)fluoranthene	150		14/85	0.64 J - 750	59SB04-00	ND	YES	ASL	50.8 (NP)	297	See Surface Soil Exposure
Benzo(g,h,i)perylene	170,000	(6)	10/85	0.53 J - 220	59SB04-00	ND	NO	BSL	NA	NA	NA
Benzo(k)fluoranthene *	1,500		14/85	0.49 J - 730	59SB04-00	ND	YES	CHEM	66.4 (NP)	290	See Surface Soil Exposure
Chrysene *	15,000		22/85	0.77 J - 1,200	59SB04-00	ND	YES	CHEM	79.7 (NP)	465	See Surface Soil Exposure
Dibenz(a,h)anthracene	15.0		3/85	0.39 J - 92	59SB04-00	ND	YES	ASL	NC	92	Max (Less than 4 detections)
Fluoranthene	230,000		15/85	1.7 J - 4,600	59SB04-00	ND	NO	BSL	NA	NA	NA
Fluorene	230,000		6/85	0.63 J - 580	59SB04-00	ND	NO	BSL	NA	NA	NA
Indeno(1,2,3-cd)pyrene	150		8/85	0.77 J - 240	59SB04-00	ND	YES	ASL	25.0 (NP)	28.8	See Surface Soil Exposure
Naphthalene	3,600		7/85	0.92 J - 2.2 J	59SB15-00	ND	NO	BSL	NA	NA	NA
Phenanthrene	220,000		13/85	1.5 J - 7,000	59SB04-00	ND	NO	BSL	NA	NA	NA
Pyrene	170,000		21/85	0.92 J - 3,000	59SB04-00	ND	NO	BSL	NA	NA	NA

TABLE 8-3

COMBINED TOTAL SOIL DATA AND COPC SELECTION SUMMARY
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Contaminant	Criteria [1]		Contaminant Frequency / Range / Location			Background [2]	COPC Selection		Exposure Concentration Selection		
	Regional Screening Level Residential SSL		No. of Positive Detects / No. of Samples	Range of Positive Detections	Location of Maximum Detection	Upper Limit of Means (ULM)	Selected as a COPC?	Rationale for Selection or Deletion	95% UCL [3] (ProUCL)	Exposure Concentration	Rationale for Concentration Selection
Pesticides (µg/kg)											
4,4'-DDD	2,000		5/65	0.39 J - 8.1 J	59SB15-00	ND	NO	BSL	NA	NA	NA
4,4'-DDE	1,400		16/65	0.46 J - 160	59SB15-00	ND	NO	BSL	NA	NA	NA
4,4'-DDT	1,700		13/65	0.63 J - 160	59SB15-00	ND	NO	BSL	NA	NA	NA
BHC, beta-	270		12/64	0.47 J - 12 NJ	59SB12-05	ND	NO	BSL	NA	NA	NA
BHC, delta-	270	(7)	1/65	0.27 J	59SB03-04	ND	NO	BSL	NA	NA	NA
Chlordane, alpha-	1,600	(8)	8/65	0.25 J - 8.4	59SB03-04	ND	NO	BSL	NA	NA	NA
Chlordane, gamma-	1,600	(8)	2/65	0.57 J - 3.5 J	59SB15-00	ND	NO	BSL	NA	NA	NA
Endosulfan Sulfate	37,000	(9)	3/65	0.52 J - 0.72 J	59SB04-00	ND	NO	BSL	NA	NA	NA
Endrin	1,800		1/65	0.56 J	59SB04-01	ND	NO	BSL	NA	NA	NA
Endrin Aldehyde	1,800	(10)	4/56	0.46 J - 1.8 J	59SB09-00	ND	NO	BSL	NA	NA	NA
Heptachlor	110		1/65	0.22 J	59SB13-01	ND	NO	BSL	NA	NA	NA
Methoxychlor	31,000		1/65	26 NJ	59SB11-00	ND	NO	BSL	NA	NA	NA
Metals (mg/kg)											
Antimony	3.10		15/85	0.15 J - 8.5 J	59SB15-00	2.43	YES	ASL	0.730 (NP)	1.14	See Surface Soil Exposure
Arsenic	0.610		42/85	0.19 J - 5.5	59SB15-00	2.37	YES	ASL	1.01 (NP)	1.39	See Surface Soil Exposure
Barium	1,500		67/67	4.1 J - 312	59SB19-05	233	NO	BSL	NA	NA	NA
Beryllium	16.0		68/85	0.075 J - 0.96	59SB13-01	0.717	NO	BSL	NA	NA	NA
Cadmium	7.0		72/85	0.016 J - 5	59SB08-05	0.655	NO	BSL	NA	NA	NA
Chromium	12,000	(12)	84/85	5.3 J - 232 J	59SB16-05	87.6	NO	BSL	NA	NA	NA
Cobalt	2.30		85/85	3.5 J - 83.9 J	59SB02-04	51.9	YES	ASL	29.8 (NP)	29.8	95% Chebyshev(Mean, Sd) UCL
Copper	310		85/85	5.1 J - 291	59SB14-00	225	NO	BSL	NA	NA	NA
Lead	400		49/63	0.72 J - 654 J	59SB09-00	28.2	YES	ASL	92.1 (NP)	537	See Surface Soil Exposure
Mercury	1.0		45/85	0.005 J - 0.15	59SB06-03	0.112	NO	BSL	NA	NA	NA
Nickel	150		85/85	4.7 J - 47.3	59SB17-01	27	NO	BSL	NA	NA	NA
Selenium	39.0		45/85	0.2 J - 2.9 J	59SB19-05	1.85	NO	BSL	NA	NA	NA
Silver	39.0		17/85	0.088 J - 2.6	59SB09-00	ND	NO	BSL	NA	NA	NA
Thallium	0.0780		21/85	0.027 J - 0.53 J	59SB18-02	0.775	YES	ASL	0.133 (NP)	0.133	95% KM(BCA) UCL
Tin	4,700		33/85	1.9 J - 36.5	59SB09-00	3.68	NO	BSL	NA	NA	NA
Vanadium	39.0		85/85	43.5 J - 407	59SB12-05	367	YES	ASL	177 (G)	186	See Surface Soil Exposure
Zinc	2,300		85/85	34.1 J - 747	59SB15-00	113	NO	BSL	NA	NA	NA

Notes:

NA - Not Applicable
ND - Not Detected
J - Analyte present - Reported value is estimated
NJ - Presumptive evidence for the presence of the material at an estimated value

COPC - Chemical of Potential Concern
UCL - Upper Confidence Limit
ULM - Upper Limit of Means

mg/kg = milligrams per kilogram
µg/kg = microgram per kilogram

Rationale Codes:

(ASL) Above Screening Level
(CHEM) Same Chemical Class
(NSC) No Screening Criteria
(BSL) Below Screening Level

Shaded constituents were identified as COPCs for quantitative risk evaluation.

TABLE 8-3

COMBINED TOTAL SOIL DATA AND COPC SELECTION SUMMARY
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Notes:

* These compounds were retained because one or more of its related carcinogenic PAHs were retained, and these compounds are known to exist together in mixtures

(1) All non-carcinogenic criteria were divided by 10 to account for potential additive effects of chemicals.
USEPA Regional Screening Levels, Residential Soil (May 2013)
(2) Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds (Baker, 2013): Upper Limit of Mean (Mean+2 Std Dev)
(3) ProUCL was used to calculate the 95% UCL and distribution (>8 samples and >4 detections):
(NP) - Nonparametric distribution
(G) - Gamma distribution
(4) Screening value for **xylenes (total)** used as a surrogate.
(5) Screening value for **acenaphthene** used as a surrogate.
(6) Screening value for **pyrene** used as a surrogate.
(7) Value for **technical-BHC** used as a surrogate.
(8) Screening value for **chlordane** used as a surrogate.
(9) Screening value for **endosulfan** used as a surrogate.
(10) Screening value for **endrin** used as a surrogate.
(12) Screening value for **chromium III** used as a surrogate.

TABLE 8-4

TOTAL SOIL DATA AND COPC SELECTION SUMMARY, 2012 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Contaminant	Criteria (1)	Contaminant Frequency / Range / Location			Background (2)	COPC Selection		Exposure Concentration Selection		
	Regional Screening Level Residential SSL	No. of Positive Detects / No. of Samples	Range of Positive Detections	Location of Maximum Detection	Upper Limit of Means (ULM)	Selected as a COPC?	Rationale for Selection or Deletion	95% UCL (3) (ProUCL)	Exposure Concentration	Rationale for Concentration Selection
Volatile Organics (µg/kg)										
Acetone	6,100,000	7/20	14 J - 45 J	59SB32-00	ND	NO	BSL	NA	NA	NA
Methylene Chloride	56,000	1/20	7.2	59SB31-01	ND	NO	BSL	NA	NA	NA
Semivolatile Organics (µg/kg)										
2,4-Dimethylphenol	120,000	1/20	17 J	59SB25-01	ND	NO	BSL	NA	NA	NA
Bis(2-ethylhexyl) Phthalate (BEHP)	35,000	13/20	8.5 J - 78 J	59SB25-00	ND	NO	BSL	NA	NA	NA
Pentachlorobenzene	4,900	1/20	5.6 J	59SB24-01	ND	NO	BSL	NA	NA	NA
LLPAHs (µg/kg)										
2-Methylnaphthalene	23,000	1/20	6.4 J	59SB31-00	ND	NO	BSL	NA	NA	NA
Phenanthrene	220,000	2/20	4.6 J - 6 J	59SB31-00	ND	NO	BSL	NA	NA	NA
Metals (mg/kg)										
Arsenic	0.610	20/20	0.46 - 1.8	59SB24-00	2.37	YES	ASL	1.16 (N)	1.35	See Surface Soil Exposure
Barium	1,500	20/20	24 - 210 J	59SB24-00	233	NO	BSL	NA	NA	NA
Beryllium	16.0	20/20	0.097 - 0.63 J	59SB24-00	0.717	NO	BSL	NA	NA	NA
Cadmium	7.0	19/20	0.016 J - 0.47	59SB25-00	0.655	NO	BSL	NA	NA	NA
Chromium	12,000 (3)	20/20	16 - 150	59SB33-00	87.6	NO	BSL	NA	NA	NA
Cobalt	2.30	20/20	3.5 J - 36 J	59SB26-00	51.9	YES	ASL	20.0 (N)	24.8	See Surface Soil Exposure
Copper	310	20/20	48 - 260 J	59SB24-00	225	NO	BSL	NA	NA	NA
Mercury	1.0	8/20	0.011 J - 0.083	59SB29-01	0.112	NO	BSL	NA	NA	NA
Nickel	150	20/20	5.7 - 47	59SB33-00	27.0	NO	BSL	NA	NA	NA
Selenium	39.0	7/20	0.47 J - 1.2	59SB32-00	1.85	NO	BSL	NA	NA	NA
Silver	39.0	4/20	0.088 J - 0.35	59SB32-00	ND	NO	BSL	NA	NA	NA
Thallium	0.0780	4/20	0.037 J - 0.073 J	59SB30-00	0.775	NO	BSL	NA	NA	NA
Tin	4,700	1/20	8.3 J	59SB24-00	3.68	NO	BSL	NA	NA	NA
Vanadium	39.0	20/20	110 - 400	59SB33-01	367	YES	ASL	245 (N)	246	See Surface Soil Exposure
Zinc	2,300	20/20	35 - 100 J	59SB24-00	113	NO	BSL	NA	NA	NA

Notes:

NA - Not Applicable
ND - Not Detected
J - Analyte present - Reported value is estimated

COPC - Chemical of Potential Concern
UCL - Upper Confidence Limit
ULM - Upper Limit of Means

mg/kg = milligrams per kilogram
µg/kg = microgram per kilogram

Rationale Codes:

(ASL) Above Screening Level
(BSL) Below Screening Level

Shaded constituents were identified as COPCs for quantitative risk evaluation.

(1) All non-carcinogenic criteria were divided by 10 to account for potential additive effects of chemicals.
USEPA Regional Screening Levels, Residential Soil (May 2010)
(2) Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds (Baker, 2010): Upper Limit of Mean (Mean+2 Std Dev)
(N) - Normal distribution
(3) Value for **chromium III** used as a surrogate.

TABLE 8-5

GROUNDWATER DATA AND COPC SELECTION SUMMARY
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Contaminant	Criteria [1]		Contaminant Frequency / Range / Location			Background [2]	COPC Selection		Exposure Concentration Selection		
	Regional Screening Level Tapwater		No. of Positive Detects / No. of Samples	Range of Positive Detections	Location of Maximum Detection	Upper Limit of Means (ULM)	Selected as a COPC?	Rationale for Selection or Deletion	95% UCL [3] (ProUCL)	Exposure Concentration	Rationale for Concentration Selection
Volatile Organics (µg/L)											
Benzene	0.390		4/10	0.036 J - 0.1 J	59GW09	ND	NO	BSL	NA	NA	NA
Carbon Disulfide	72.0		3/10	0.05 J - 0.15 J	59GW09	ND	NO	BSL	NA	NA	NA
Semivolatile Organics (µg/L)											
Bis(2-ethylhexyl) Phthalate (BEHP)	4.80		1/10	2.4 J	59GW05	ND	NO	BSL	NA	NA	NA
LLPAHs (µg/L)											
Naphthalene	0.140		1/10	1.3 J	59GW06	ND	YES	ASL	NC	1.3	Max (Conservative Estimate)
Phenanthrene	30.0		1/10	0.054 J	59GW10	ND	NO	BSL	NA	NA	NA
Pyrene	8.70		2/10	0.01 J - 0.01 J	59GW01, 59GW02	ND	NO	BSL	NA	NA	NA
Pesticides (µg/L)											
Chlordane, alpha-	0.190	(4)	1/10	0.016 NJ	59GW04	ND	NO	BSL	NA	NA	NA
Dissolved Metals (µg/L)											
Antimony	0.60		7/10	0.23 J - 0.47 J	59GW04	ND	NO	BSL	NA	NA	NA
Arsenic	0.0450		10/10	0.92 J - 5.3	59GW01	ND	YES	ASL	NC	5.3	Max (Conservative Estimate)
Barium	290		10/10	4.6 J - 45.7	59GW06	ND	NO	BSL	NA	NA	NA
Cadmium	0.690		4/10	0.1 J - 0.55 J	59GW01, 59GW06	ND	NO	BSL	NA	NA	NA
Chromium	1,600	(5)	9/10	0.27 J - 1.4 J	59GW01	ND	NO	BSL	NA	NA	NA
Cobalt	0.470		10/10	0.19 J - 3.5	59GW06	ND	YES	ASL	NC	3.5	Max (Conservative Estimate)
Copper	62.0		10/10	2.3 - 19	59GW01	ND	NO	BSL	NA	NA	NA
Nickel	30.0		8/10	1.1 - 8.3	59GW01	ND	NO	BSL	NA	NA	NA
Selenium	7.80		10/10	0.6 J - 23.8	59GW01	ND	YES	ASL	NC	23.8	Max (Conservative Estimate)
Silver	7.10		2/10	0.045 J - 0.055 J	59GW04	ND	NO	BSL	NA	NA	NA
Thallium	2.0	(6)	5/10	0.084 J - 0.39 J	59GW01	ND	NO	BSL	NA	NA	NA
Vanadium	6.30		10/10	9.5 - 179	59GW10	ND	YES	ASL	NC	179	Max (Conservative Estimate)
Zinc	470		7/9	2.6 J - 13.4 J	59GW01	ND	NO	BSL	NA	NA	NA
Total Metals (µg/L)											
Antimony	0.60		6/10	0.26 J - 0.54 J	59GW09	12.2	NO	BSL	NA	NA	NA
Arsenic	0.0450		10/10	0.94 J - 6.2	59GW01	18.9	YES	ASL	NC	6.2	Max (Conservative Estimate)
Barium	290		10/10	6.5 J - 49.1	59GW06	686	NO	BSL	NA	NA	NA
Beryllium	1.60		1/10	0.055 J	59GW03	2.21	NO	BSL	NA	NA	NA
Cadmium	0.690		7/10	0.069 J - 0.71 J	59GW01	16.6	YES	ASL	NC	0.71	Max (Conservative Estimate)
Chromium	1,600	(5)(27)	10/10	0.46 J - 5.5	59GW03	162	NO	BSL	NA	NA	NA
Cobalt	0.470		10/10	0.3 J - 5.8	59GW03	633	YES	ASL	NC	5.8	Max (Conservative Estimate)
Copper	62.0		10/10	3.9 - 21.3	59GW01	324	NO	BSL	NA	NA	NA
Lead	15.0	(5)	2/10	1.7 - 5	59GW03	26.2	NO	BSL	NA	NA	NA
Nickel	30.0		9/10	1.2 - 8	59GW01	95.7	NO	BSL	NA	NA	NA
Selenium	7.80		10/10	0.48 J - 24.2	59GW01	29.9	YES	ASL	NC	24.2	Max (Conservative Estimate)
Silver	7.10		6/10	0.054 J - 0.65 J	59GW01	18.3	NO	BSL	NA	NA	NA
Thallium	2.0	(6)	5/10	0.096 J - 0.43 J	59GW01	ND	NO	BSL	NA	NA	NA
Vanadium	6.30		10/10	9.2 - 171	59GW10	485	YES	ASL	NC	171	Max (Conservative Estimate)

TABLE 8-5

GROUNDWATER DATA AND COPC SELECTION SUMMARY
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Notes:

NA - Not Applicable
NC - Not Calculated
ND - Not Detected

COPC - Chemical of Potential Concern
UCL - Upper Confidence Limit
ULM - Upper Limit of Means

µg/L - microgram per liter

Rationale Codes:

(ASL) Above Screening Level
(BSL) Below Screening Level

J - Analyte present - Reported value is estimated
NJ - Presumptive evidence for the presence of the material at an estimated value

Shaded constituents were identified as COPCs for quantitative risk evaluation.

(1) All non-carcinogenic criteria were divided by 10 to account for potential additive effects of chemicals.
USEPA Regional Screening Levels, Tapwater (May 2013)
(2) Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds (Baker, 2013): Upper Limit of Mean (Mean+2 Std Dev)
(3) ProUCL was not calculated (NC) since the maximum was used as a conservative estimate.
(4) Screening value for **chlordane** used as a surrogate.
(5) Screening value for **chromium III** used as a surrogate.
(6) Value for **MCL**

TABLE 8-6

SURFACE WATER DATA AND COPC SELECTION SUMMARY
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Contaminant	Criteria (1)	Contaminant Frequency / Range / Location			Background (2)	COPC Selection		Exposure Concentration Selection		
	Regional Screening Level Tapwater	No. of Positive Detects / No. of Samples	Range of Positive Detections	Location of Maximum Detection	Upper Limit of Means (ULM)	Selected as a COPC?	Rationale for Selection or Deletion	95% UCL (3) (ProUCL)	Exposure Concentration	Rationale for Concentration Selection
Volatile Organics (µg/L)										
Bromodichloromethane	0.120	1/3	0.34 J	59SW01	ND	YES	ASL	NC	0.34	Max (Less than 8 samples)
Carbon Disulfide	72.0	1/3	0.021 J	59SW03	ND	NO	BSL	NA	NA	NA
Chloroform	0.190	1/3	1.2	59SW01	ND	YES	ASL	NC	1.2	Max (Less than 8 samples)
Dibromochloromethane	0.150	1/3	0.16 J	59SW01	ND	YES	ASL	NC	0.16	Max (Less than 8 samples)
LLPAHs (µg/L)										
Fluoranthene	63.0	2/3	0.017 J - 0.019 J	59SW02	ND	NO	BSL	NA	NA	NA
Pyrene	8.70	2/3	0.018 J - 0.02 J	59SW02	ND	NO	BSL	NA	NA	NA
Pesticides (µg/L)										
4,4'-DDE	0.20	1/3	0.006 J	59SW01	ND	NO	BSL	NA	NA	NA
4,4'-DDT	0.20	1/3	0.0065 J	59SW01	ND	NO	BSL	NA	NA	NA
Dissolved Inorganics (µg/L)										
Antimony	0.60	2/3	0.23 J - 0.23 J	59SW02, 59SW03	2.90	NO	BSL	NA	NA	NA
Arsenic	0.0450	3/3	0.4 J - 0.52 J	59SW01	1.30	YES	ASL	NC	0.52	Max (Less than 8 samples)
Barium	290	3/3	17.7 - 20.5	59SW01	235	NO	BSL	NA	NA	NA
Chromium	1,600 (3)	3/3	0.39 J - 0.4 J	59SW02	2.50	NO	BSL	NA	NA	NA
Cobalt	0.470	3/3	0.061 J - 0.084 J	59SW01	10.5	NO	BSL	NA	NA	NA
Copper	62.0	3/3	2.9 - 3.1	59SW01	14.4	NO	BSL	NA	NA	NA
Selenium	7.80	3/3	0.48 J - 0.82 J	59SW01	--	NO	BSL	NA	NA	NA
Vanadium	6.30	3/3	6.1 - 6.3	59SW01	17.4	YES	ASL	NC	6.3	Max (Less than 8 samples)
Zinc	470	3/3	2.2 J - 5.5 J	59SW01	8.30	NO	BSL	NA	NA	NA
Total Inorganics (µg/L)										
Antimony	0.60	2/3	0.23 J - 0.26 J	59SW02	2.0	NO	BSL	NA	NA	NA
Arsenic	0.0450	3/3	0.42 J - 0.49 J	59SW01	2.62	YES	ASL	NC	0.49	Max (Less than 8 samples)
Barium	290	3/3	19.4 - 21.4	59SW01	246	NO	BSL	NA	NA	NA
Calcium +	NE	1/1	18900	59SW01	ND	NO	NUT	NA	NA	NA
Chromium	1,600 (3)	3/3	0.68 J - 0.76 J	59SW02	8.26	NO	BSL	NA	NA	NA
Cobalt	0.470	3/3	0.32 J - 0.34 J	59SW02, 59SW03	12.3	NO	BSL	NA	NA	NA
Copper	62.0	3/3	3.8 - 4	59SW02, 59SW03	37.8	NO	BSL	NA	NA	NA
Selenium	7.80	3/3	0.47 J - 0.75 J	59SW01	1.10	NO	BSL	NA	NA	NA
Vanadium	6.30	3/3	7 - 7.6	59SW02	36.8	YES	ASL	NC	7.6	Max (Less than 8 samples)
Zinc	470	1/1	7.9 J	59SW01	23.3	NO	BSL	NA	NA	NA

Notes:

NA - Not Applicable
NC - Not Calculated
J - Analyte present - Reported valu

COPC - Chemical of Potential Concern
ND - Not Detected

UCL - Upper Confidence Limit
ULM - Upper Limit of Means
µg/L - microgram per liter

Rationale Codes:

(ASL) Above Screening Level
(BSL) Below Screening Level
(NUT) Essential Nutrient

Shaded constituents were identified as COPCs for quantitative risk evaluation.

Notes:

(1) All non-carcinogenic criteria were divided by 10 to account for potential additive effects of chemicals.
USEPA Regional Screening Levels, Tapwater (May 2013)
(2) Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds (Baker, 2013): Upper Limit of Mean (Mean+2 Std Dev)
(3) Screening value for **chromium III** used as a surrogate.

TABLE 8-7

SEDIMENT DATA AND COPC SELECTION SUMMARY
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Contaminant	Criteria [1]		Contaminant Frequency / Range / Location			Background [2]	COPC Selection		Exposure Concentration Selection		
	RegionaI Screening Level Residential SSL		No. of Positive Detects / No. of Samples	Range of Positive Detections	Location of Maximum Detection	Upper Limit of Means (ULM)	Selected as a COPC?	Rationale for Selection or Deletion	95% UCL [3] (ProUCL)	Exposure Concentration	Rationale for Concentration Selection
Volatile Organics (µg/kg)											
Acetone	6,100,000		2/2	78 - 150 J	59SD02	ND	NO	BSL	NA	NA	NA
Carbon Disulfide	82,000		1/3	2.3 J	59SD01	ND	NO	BSL	NA	NA	NA
Xylene, m/p-	63,000	(4)	1/3	0.79 J	59SD01	ND	NO	BSL	NA	NA	NA
Xylenes, total	63,000		1/3	0.79 J	59SD01	ND	NO	BSL	NA	NA	NA
Semivolatile Organics (µg/kg)											
Bis(2-ethylhexyl) Phthalate (BEHP)	35,000		3/3	110 J - 730	59SD03	ND	NO	BSL	NA	NA	NA
Butyl Benzyl Phthalate	260,000		1/3	63 J	59SD01	ND	NO	BSL	NA	NA	NA
LLPAHs (µg/kg)											
2-Methylnaphthalene	23,000		1/3	4.4 J	59SD01	ND	NO	BSL	NA	NA	NA
Acenaphthylene	340,000	(5)	1/3	1.6 J	59SD01	ND	NO	BSL	NA	NA	NA
Anthracene	1,700,000		1/3	4.6 J	59SD01	ND	NO	BSL	NA	NA	NA
Benzo(a)anthracene	150		1/3	5 J	59SD01	ND	NO	BSL	NA	NA	NA
Chrysene	15,000		1/3	6.9 J	59SD01	ND	NO	BSL	NA	NA	NA
Fluoranthene	230,000		2/3	7.2 J - 36 J	59SD03	ND	NO	BSL	NA	NA	NA
Fluorene	230,000		1/3	2.3 J	59SD01	ND	NO	BSL	NA	NA	NA
Indeno(1,2,3-cd)pyrene	150		1/3	8.3 J	59SD01	ND	NO	BSL	NA	NA	NA
Phenanthrene	220,000		1/3	6.3 J	59SD01	ND	NO	BSL	NA	NA	NA
Pyrene	170,000		2/3	8.8 J - 41 J	59SD03	ND	NO	BSL	NA	NA	NA
Pesticides (µg/kg)											
4,4'-DDD	2,000		3/3	1.6 J - 5.9 J	59SD03	ND	NO	BSL	NA	NA	NA
4,4'-DDE	1,400		3/3	32 J - 160	59SD03	ND	NO	BSL	NA	NA	NA
4,4'-DDT	1,700		1/3	1.3 J	59SD01	ND	NO	BSL	NA	NA	NA
Aldrin	29.0		1/3	0.66 J	59SD03	ND	NO	BSL	NA	NA	NA
Chlordane, alpha-	1,600	(6)	2/3	2.1 NJ - 25 NJ	59SD02	ND	NO	BSL	NA	NA	NA
Chlordane, gamma-	1,600	(6)	2/3	18 J - 31 J	59SD02	ND	NO	BSL	NA	NA	NA
Dieldrin	30.0		1/3	0.9 J	59SD01	ND	NO	BSL	NA	NA	NA
Endrin Aldehyde	1,800	(7)	2/3	0.87 J - 1.1 J	59SD01	ND	NO	BSL	NA	NA	NA
Heptachlor	110		1/3	1.2 J	59SD02	ND	NO	BSL	NA	NA	NA
Metals (mg/kg)											
Antimony	3.10		2/3	0.58 J - 0.8 J	59SD02	9.73	NO	BSL	NA	NA	NA
Arsenic	0.610		3/3	0.65 J - 1.5	59SD03	6.38	YES	ASL	NC	1.5	Max (Less than 8 samples)
Barium	1,500		3/3	81.6 J - 164 J	59SD02	345	NO	BSL	NA	NA	NA
Beryllium	16.0		3/3	0.35 J - 0.45 J	59SD02	1.05	NO	BSL	NA	NA	NA
Cadmium	7.0		3/3	0.69 J - 0.99 J	59SD03	0.468	NO	BSL	NA	NA	NA
Chromium	12,000	(8)	3/3	37.3 - 42.1 J	59SD02	104	NO	BSL	NA	NA	NA
Cobalt	2.30		3/3	20.9 J - 31.9 J	59SD02	92.6	YES	ASL	NC	31.9	Max (Less than 8 samples)
Copper	310		13/13	36.2 J - 187 J	59SD05	213	NO	BSL	NA	NA	NA
Lead	400		11/11	4.92 J - 71.2 J	59SD01	41.6	NO	BSL	NA	NA	NA
Mercury	1.0		3/3	0.033 J - 0.19	59SD03	0.237	NO	BSL	NA	NA	NA
Nickel	150		3/3	18.7 J - 28.1	59SD03	31.6	NO	BSL	NA	NA	NA
Selenium	39.0		3/3	0.69 J - 1 J	59SD02	4.71	NO	BSL	NA	NA	NA

TABLE 8-7

SEDIMENT DATA AND COPC SELECTION SUMMARY
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Contaminant	Criteria (1)	Contaminant Frequency / Range / Location			Background (2)	COPC Selection		Exposure Concentration Selection		
	RegionaI Screening Level Residential SSL	No. of Positive Detects / No. of Samples	Range of Positive Detections	Location of Maximum Detection	Upper Limit of Means (ULM)	Selected as a COPC?	Rationale for Selection or Deletion	95% UCL (3) (ProUCL)	Exposure Concentration	Rationale for Concentration Selection
Metals (mg/kg) (cont.)										
Silver	39.0	3/3	0.17 J - 0.23 J	59SD02	0.297	NO	BSL	NA	NA	NA
Thallium	0.0780	2/3	0.053 J - 0.14 J	59SD02	ND	YES	ASL	NC	0.14	Max (Less than 8 samples)
Vanadium	39.0	3/3	144 J - 232 J	59SD02	473	YES	ASL	NC	232	Max (Less than 8 samples)
Zinc	2,300	13/13	71.7 J - 357 J	59SD05	177	NO	BSL	NA	NA	NA

Notes:

NA - Not Applicable
NC - Not Calculated
ND - Not Detected

COPC - Chemical of Potential Concern
UCL - Upper Confidence Limit
ULM - Upper Limit of Means

mg/kg = milligrams per kilogram
µg/kg = microgram per kilogram

Rationale Codes:

(ASL) Above Screening Level
(NSC) No Screening Criteria
(BSL) Below Screening Level

J - Analyte present - Reported value is estimated
NJ - Presumptive evidence for the presence of the material at an estimated value

Shaded constituents were identified as COPCs for quantitative risk evaluation.

(1) All non-carcinogenic criteria were divided by 10 to account for potential additive effects of chemicals.
USEPA Regional Screening Levels, Residential Soil (May 2013)
(2) Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds (Baker, 2013): Upper Limit of Mean (Mean+2 Std Dev)
(3) ProUCL was used to calculate the 95% UCL and distribution (>8 samples and >4 detections):
(4) Screening value for **xylenes (total)** used as a surrogate.
(5) Screening value for **acenaphthene** used as a surrogate.
(6) Screening value for **chlordane** used as a surrogate.
(7) Screening value for **endrin** used as a surrogate.
(8) Screening value for **chromium III** used as a surrogate.

TABLE 8-8

SUMMARY OF EXPOSURE PARAMETERS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Parameter	Units	Current and Future Adult Trespassers RME	Current and Future Youth Trespassers RME	Current and Future Adult On-Site Workers RME	Future Adult Residents RME	Future Young Child Residents RME	Future Adult Industrial / Commercial Workers RME	Future Adult Construction Workers RME
Soil								
Ingestion Rate of Soil (IR-S)	mg/day	100 USEPA, 1991	100 USEPA, 1991	100 USEPA, 2002	100 USEPA, 1991	200 USEPA, 1991	100 USEPA, 2002	330 USEPA, 2002
Fraction Ingested from Source (FI)	NA	1 Prof Judge (1)	1 Prof Judge (1)	1 Prof Judge (1)	1 Prof Judge (1)	1 Prof Judge (1)	1 Prof Judge (1)	1 Prof Judge (1)
Exposure Frequency (EF)	days/year	52 Prof Judge (2)	52 Prof Judge (2)	250 USEPA, 2004	350 USEPA, 2004	350 USEPA, 2004	250 USEPA, 2004	250 USEPA, 2004
Exposure Duration (ED)	years	24 USEPA, 1991	11 Prof Judge (3)	25 USEPA, 2004	24 USEPA, 1991	6 USEPA, 1991	25 USEPA, 2004	1 Prof Judge (4)
Exposure Time (ET)	hours/day	2 VDEQ, 2013 (5)	2 VDEQ, 2013 (5)	8 Prof Judge (6)	24 Prof Judge (7)	24 Prof Judge (7)	8 Prof Judge (6)	8 Prof Judge (6)
Surface Area Available for Contact (SA)	cm2/day	5,700 USEPA, 2004	3,200 USEPA, 2011	3,300 USEPA, 2004	5,700 USEPA, 2004	2,800 USEPA, 2004	3,300 USEPA, 2004	3,300 USEPA, 2004
Conversion Factor (CF)	kg/mg	1.00E-06 USEPA, 1989	1.00E-06 USEPA, 1989	1.00E-06 USEPA, 1989	1.00E-06 USEPA, 1989	1.00E-06 USEPA, 1989	1.00E-06 USEPA, 1989	1.00E-06 USEPA, 1989
Averaging Time (Non-Cancer) (AT-N)	days	8,760 USEPA, 1989	4,015 USEPA, 1989	9,125 USEPA, 1989	8,760 USEPA, 1989	2,190 USEPA, 1989	9,125 USEPA, 1989	365 USEPA, 1989
Groundwater								
Ingestion Rate of Groundwater (IR-W)	L/day	--	--	--	2 USEPA, 1989	1 USEPA, 1989	1 USEPA, 1991	0.02 VDEQ, 2013
Exposure Frequency (EF)	days/year	--	--	--	350 USEPA, 2004	350 USEPA, 2004	250 USEPA, 2004	50 Prof Judge (8)
Exposure Duration (ED)	years	--	--	--	24 USEPA, 1991	6 USEPA, 1991	25 USEPA, 2004	1 Prof Judge (4)
Exposure Time (ET)	hours/day	--	--	--	0.58 USEPA, 2004	1 USEPA, 2004	--	2 Prof Judge (9)
Surface Area Available for Contact (SA)	cm2	--	--	--	18,000 USEPA, 2004	6,600 USEPA, 2004	--	3,300 USEPA, 2004
Conversion Factor (CF)	L/cm3	--	--	--	1.00E-03 USEPA, 1989	1.00E-03 USEPA, 1989	--	1.00E-03 USEPA, 1989
Averaging Time (Non-Cancer) (AT-N)	days	--	--	--	8,760 USEPA, 1989	2,190 USEPA, 1989	9,125 USEPA, 1989	365 USEPA, 1989
Surface Water								
Ingestion Rate of Surface Water (IR-W)	L/hour	0.005 VDEQ, 2013 (10)	0.005 VDEQ, 2013 (10)	0.005 VDEQ, 2013 (15)	0.005 VDEQ, 2013 (10)	0.005 VDEQ, 2013 (10)	--	--
Exposure Frequency (EF)	days/year	52 Prof Judge (3)	52 Prof Judge (3)	250 USEPA, 2004	52 Prof Judge (3)	52 Prof Judge (3)	--	--
Exposure Duration (ED)	years	24 USEPA, 1991	11 USEPA, 1991	25 USEPA, 2004	24 USEPA, 1991	6 USEPA, 1991	--	--
Exposure Time (ET)	hours/day	2 VDEQ, 2013 (6)	2 VDEQ, 2013 (6)	2 VDEQ, 2013 (6)	2 VDEQ, 2013 (6)	2 VDEQ, 2013 (6)	--	--
Surface Area Available for Contact (SA)	cm2	5,700 USEPA, 2004	3,200 USEPA, 2011	3,300 USEPA, 2004	5,700 USEPA, 2004	2,800 USEPA, 2004	--	--
Conversion Factor (CF)	L/cm3	1.00E-03 USEPA, 1989	1.00E-03 USEPA, 1989	1.00E-03 USEPA, 1989	1.00E-03 USEPA, 1989	1.00E-03 USEPA, 1989	--	--
Averaging Time (Non-Cancer) (AT-N)	days	8,760 USEPA, 1989	4,015 USEPA, 1989	9,125 USEPA, 1989	8,760 USEPA, 1989	2,190 USEPA, 1989	--	--

TABLE 8-8

SUMMARY OF EXPOSURE PARAMETERS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Parameter	Units	Current and Future Adult Trespassers RME	Current and Future Youth Trespassers RME	Current and Future Adult On-Site Workers RME	Future Adult Residents RME	Future Young Child Residents RME	Future Adult Industrial / Commercial Workers RME	Future Adult Construction Workers RME
Sediment								
Ingestion Rate of Sediment (IR-S)	mg/day	100 USEPA, 1991	100 USEPA, 1991	100 USEPA, 2002	100 USEPA, 1991	200 USEPA, 1991	--	--
Fraction Ingested from Source (Fi)	NA	1 Prof Judge (2)	1 Prof Judge (2)	1 Prof Judge (2)	1 Prof Judge (2)	1 Prof Judge (2)	--	--
Exposure Frequency (EF)	days/year	52 Prof Judge (3)	52 Prof Judge (3)	250 USEPA, 2004	52 Prof Judge (3)	52 Prof Judge (3)	--	--
Exposure Duration (ED)	years	24 USEPA, 1991	11 Prof Judge (3)	25 USEPA, 2004	24 USEPA, 1991	6 USEPA, 1991	--	--
Surface Area Available for Contact (SA)	cm2/day	5,700 USEPA, 2004	3,200 USEPA, 2011	3,300 USEPA, 2004	5,700 USEPA, 2004	2,800 USEPA, 2004	--	--
Conversion Factor (CF)	kg/mg	1.00E-06 USEPA, 1989	1.00E-06 USEPA, 1989	1.00E-06 USEPA, 1989	1.00E-06 USEPA, 1989	1.00E-06 USEPA, 1989	--	--
Averaging Time (Non-Cancer) (AT-N)	days	8,760 USEPA, 1989	4,015 USEPA, 1989	9,125 USEPA, 1989	8,760 USEPA, 1989	2,190 USEPA, 1989	--	--
Other Parameters								
Body Weight (BW)	kg	70 USEPA, 1991	45 USEPA, 1991	70 USEPA, 1991	70 USEPA,1991	15 USEPA, 1991	70 USEPA, 1991	70 USEPA, 1991
Soil to Skin Adherence Factor (AF)	mg/cm2	0.07 USEPA, 2004	0.2 USEPA, 2004	0.2 USEPA, 2004	0.07 USEPA, 2004	0.2 USEPA, 2004	0.2 USEPA, 2004	0.3 USEPA, 2002
Sediment to Skin Adherence Factor (AF)	mg/cm2	0.3 VDEQ, 2013	0.3 VDEQ, 2013	0.3 VDEQ, 2013	0.3 VDEQ, 2013	0.3 VDEQ, 2013	--	--
Particulate Emission Factor (PEF)	m3/kg	1.36E+09 USEPA, 2002	1.36E+09 USEPA, 2002	1.36E+09 USEPA, 2002	1.36E+09 USEPA, 2002	1.36E+09 USEPA, 2002	1.36E+09 USEPA, 2002	2.89E+06 USEPA, 2002
Averaging Time (Cancer) (AT-C)	days	25,550 USEPA, 1989	25,550 USEPA, 1989	25,550 USEPA, 1989	25,550 USEPA, 1989	25,550 USEPA, 1989	25,550 USEPA, 1989	25,550 USEPA, 1989

Notes:

RME - Reasonalble Maximum Exposure
Prof Judge - Professional Judgment
Gastrointestinal absorption efficiencies (GIABS), dermal absorption factors (ABS), and permeability constants (Kp) obtained from RAGS Part E (USEPA, 2004).
(1) Conservative assumption of 100% ingested from source.
(2) Assumes individuals trespass on site 1 day/week.
(3) Represents youth from 6 to 16 years of age.
(4) Assumes a construction period of 1 year.
(5) Recommended outdoor activity factor for adults.
(6) Assumes an 8 hour work day.
(7) Conservatively assumes receptor remains at residence 24 hours/day.
(8) Assumes 20% of time spent in trench.
(9) Assumes 2 hours/event in trench.
(10) Ingestion rate for wading assumes one order of magnitude less than the USEPA default ingestion rate for swimming.

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.
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USEPA, 2002: Draft Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.
USEPA, 2004: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005.
USEPA, 2011: Exposure Factors Handbook. EPA/600/R-09/052F.
Virginia Department of Environmental Quality (VDEQ), 2013. Virginia Voluntary Remediation Program Risk Assessment Guidance, Section 3.2.2,
(http://www.deq.state.va.us/Programs/LandProtectionRevitalization/RemediationProgram/VoluntaryRemediationProgram/VRPRiskAssessmentGuidance/Guidance.aspx).

TABLE 8-9

HUMAN HEALTH RISK ASSESSMENT TOXICITY FACTORS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Constituents	Oral CSF $(mg/kg/day)^{-1}$	Inhalation UR $1/(\mu g/m^3)$	Oral RfD $(mg/kg/day)^{-1}$	Inhalation RfC (mg/m^3)	Oral Absorption Factors (1)	Oral to (2) Dermal Adjustment	WOE	Target Organ (Systemic Toxicity)	Critical Effect (Systemic Toxicity)
Volatiles									
Bromodichloromethane	6.20E-02	3.70E-05	2.00E-02	NA		100%	(o) B2, (i) D	Kidney	Kidney: Renal cytomegaly
Chloroform	3.10E-02	2.30E-05	1.00E-02	9.80E-02		100%	B2	Liver	Liver: Moderate/marked fatty cyst formation in the liver and elevated SGPT
Dibromochloromethane	8.40E-02	2.70E-05	2.00E-02	NA	0.1	100%	(o) C, (i) D	Liver	Liver: Hepatic Lesions
Methyl Iodide	NA	NA	NA	NA	NA	100%	D	NA	NA
Propionitrile (Ethyl Cyanide)	NA	NA	NA	NA	NA	100%	D	NA	NA
Benzo(a)anthracene	7.30E-01	1.10E-04	NA	NA	0.13	100%	(o) B2, (i) D	NA	NA
Benzo(a)pyrene (BaP)	7.30E+00	1.10E-03	NA	NA	0.13	100%	B2	NA	NA
Benzo(b)fluoranthene	7.30E-01	1.10E-04	NA	NA	0.13	100%	B2	NA	NA
Benzo(k)fluoranthene	7.30E-02	1.10E-04	NA	NA	0.13	100%	B2	NA	NA
Chrysene	7.30E-03	1.10E-05	NA	NA	0.13	100%	B2	NA	NA
Dibenz(a,h)anthracene	7.30E+00	1.20E-03	NA	NA	0.13	100%	(o) B2, (i) D	NA	NA
Indeno(1,2,3-cd)pyrene	7.30E-01	1.10E-04	NA	NA	0.13	100%	B2	NA	NA
Naphthalene	NA	3.40E-05	2.00E-02	3.00E-03	0.13	100%	(o) D, (i) C	(o) Whole Body, (i) RsS	(o) - Whole Body: Decreased mean terminal body weight in males; (i) - RsS: Nasal effects: Hyperplasia and metaplasia in respiratory and olfactory epithelium, respectively
Antimony	NA	NA	4.00E-04	NA	0.01	15%	D	Whole Body, CVS	Whole Body, CVS: Longevity, blood glucose and cholesterol
Arsenic	1.50E+00	4.30E-03	3.00E-04	1.50E-05	0.03	100%	A	Skin / CVS	Skin / CVS: Hyperpigmentation, keratosis, possible vascular complications
Cadmium	NA	1.80E-03	5.00E-04	1.00E-05	0.001	3%	(o) D, (i) B1	Kidney	Kidney: 10% Probability of abnormally high urinary NAG excretion
Cobalt	NA	9.00E-03	3.00E-04	6.00E-06	0.01	100%	D	(o) CVS, (i) RsS	(o) - CVS: Blood; (i) - RsS: Lesions on the respiratory tract
Lead	NA	NA	NA	NA	0.01	100%	B2	NA	NA
Selenium	NA	NA	5.00E-03	2.00E-02	0.01	100%	D	Skin	Skin: Clinical Selenosis
Thallium	NA	NA	1.00E-05	NA	0.01	100%	D	Liver / CVS / Skin	Liver / CVS / Skin: Increased levels of SGOT and LDH in blood
Vanadium	NA	NA	5.00E-03	1.00E-04	0.01	3%	D	GIS / Kidney	GIS / Kidney: Gastrointestinal disturbances, Discoloration of mouth and tongue

Notes:

CSF = Cancer Slope Factor
UR = Unit Risk
RfD = Reference Dose
RfC = Reference Concentration
WOE = Weight of Evidence

NA = Not Available
(o) = Toxicty due to oral exposure
(i) = Toxicity due to inhalation exposure

WOE / EPA Group:

A - Human carcinogen
B1 - Probable human carcinogen - indicates that limited human data are available
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans
C - Possible human carcinogen — Known/Likely (EPA classes A, B1, B2, C)
D - Not classifiable as a human carcinogen — Cannot be Determined (EPA class D)
E - Evidence of noncarcinogenicity — Not Likely (EPA class E)

Target Organ Abbreviations:

CVS = Cardiovascular System
GIS = Gastrointestinal System
RsS = Respiratory System

TABLE 8-9

HUMAN HEALTH RISK ASSESSMENT TOXICITY FACTORS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Notes (cont.):
(1) - ABS - Absorption Factors
The following USEPA Region IV default absorbance factors will be applied in the absence of reference values from USEPA, 2004 to estimate dermal intake of COPCs in soil and sediment in tl

0.1% - Inorganics

(2) - Oral to dermal adjustment taken from RAGS Part E (USEPA, 2004)

TABLE 8-10

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COMBINED COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Receptor Population: Trespassers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Soil											
			Methyl Iodide	--	--	--	--	--	NA	--	--	--	--
			Propionitrile (Ethyl Cyanide)	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)anthracene	1.6E-09	--	1.3E-09	--	2.9E-09	NA	--	--	--	--
			Benzo(a)pyrene (BaP)	5.2E-08	--	4.1E-08	--	9.3E-08	NA	--	--	--	--
			Benzo(b)fluoranthene	3.7E-08	--	3.0E-08	--	6.7E-08	NA	--	--	--	--
			Benzo(k)fluoranthene	3.7E-09	--	2.9E-09	--	6.5E-09	NA	--	--	--	--
			Chrysene	5.9E-10	--	4.6E-10	--	1.0E-09	NA	--	--	--	--
			Dibenz(a,h)anthracene	1.2E-07	--	9.1E-08	--	2.1E-07	NA	--	--	--	--
			Indeno(1,2,3-cd)pyrene	3.6E-09	--	2.9E-09	--	6.5E-09	NA	--	--	--	--
			Antimony	--	--	--	--	--	Whole Body, CVS	<0.01	--	<0.01	<0.01
			Arsenic	1.5E-07	--	6.4E-06	--	6.5E-06	Skin / CVS	<0.01	--	<0.01	<0.01
			Cobalt	--	--	--	--	--	CVS	0.02	--	<0.01	0.02
			Lead	--	--	--	--	--	NA	--	--	--	--
			Thallium	--	--	--	--	--	Liver / CVS / Skin	<0.01	--	<0.01	<0.01
			Vanadium	--	--	--	--	--	GIS / Kidney	<0.01	--	0.01	0.02
			Chemical Total	3.6E-07	--	6.5E-06	--	6.9E-06		0.03	--	0.01	0.04
		Exposure Point Total						6.9E-06					0.04
	Exposure Medium Total							6.9E-06					0.04
	Air	Fugative Dust											
			Methyl Iodide	--	--	--	--	--	NA	--	--	--	--
			Propionitrile (Ethyl Cyanide)	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)anthracene	--	7.3E-15	--	--	7.3E-15	NA	--	--	--	--
			Benzo(a)pyrene (BaP)	--	2.3E-13	--	--	2.3E-13	NA	--	--	--	--
			Benzo(b)fluoranthene	--	1.7E-13	--	--	1.7E-13	NA	--	--	--	--
			Benzo(k)fluoranthene	--	1.6E-13	--	--	1.6E-13	NA	--	--	--	--
			Chrysene	--	2.6E-14	--	--	2.6E-14	NA	--	--	--	--
			Dibenz(a,h)anthracene	--	5.6E-13	--	--	5.6E-13	NA	--	--	--	--
			Indeno(1,2,3-cd)pyrene	--	1.6E-14	--	--	1.6E-14	NA	--	--	--	--
			Antimony	--	--	--	--	--	NA	--	--	--	--
			Arsenic	--	1.8E-11	--	--	1.8E-11	NA	--	<0.01	--	<0.01
			Cobalt	--	8.0E-10	--	--	8.0E-10	RsS	--	<0.01	--	<0.01
			Lead	--	--	--	--	--	NA	--	--	--	--
			Thallium	--	--	--	--	--	NA	--	--	--	--
			Vanadium	--	--	--	--	--	NA	--	<0.01	--	<0.01
			Chemical Total	--	8.2E-10	--	--	8.2E-10		--	<0.01	--	<0.01
		Exposure Point Total						8.2E-10					<0.01
	Exposure Medium Total							8.2E-10					<0.01
Soil Total								**6.89E-06**					**0.04**

TABLE 8-10

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COMBINED COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Receptor Population: Trespassers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Water	Surface Water	Surface Water											
			Bromodichloromethane	1.5E-10	--	6.7E-10	--	8.2E-10	Kidney	<0.01	--	<0.01	<0.01
			Chloroform	2.6E-10	--	2.0E-09	--	2.3E-09	Liver	<0.01	--	<0.01	<0.01
			Dibromochloromethane	9.4E-11	--	3.1E-10	--	4.0E-10	Liver	<0.01	--	<0.01	<0.01
			Arsenic	5.1E-09	--	5.8E-09	--	1.1E-08	Skin / CVS	<0.01	--	<0.01	<0.01
			Vanadium	--	--	--	--	--	GIS / Kidney	<0.01	--	<0.01	<0.01
			Chemical Total	5.6E-09	--	8.9E-09	--	1.4E-08		<0.01	--	<0.01	<0.01
		Exposure Point Total						1.4E-08					<0.01
	Exposure Medium Total							1.4E-08					<0.01
Surface Water Total								**1.45E-08**					**<0.01**
Sediment	Sediment	Sediment											
			Arsenic	1.6E-07	--	8.1E-08	--	2.4E-07	Skin / CVS	<0.01	--	<0.01	<0.01
			Cobalt	--	--	--	--	--	CVS	0.02	--	<0.01	0.03
			Thallium	--	--	--	--	--	Liver / CVS / Skin	<0.01	--	<0.01	<0.01
			Vanadium	--	--	--	--	--	GIS / Kidney	<0.01	--	0.06	0.07
			Chemical Total	1.6E-07	--	8.1E-08	--	2.4E-07		0.03	--	0.07	0.10
		Exposure Point Total						2.4E-07					0.10
	Exposure Medium Total							2.4E-07					0.10
Sediment Total								**2.38E-07**					**0.10**
Adult Trespassers Total								**7.14E-06**					**0.15**

Total Risk Across Soil	6.9E-06	Total Hazard Index Across Soil	0.04
Total Risk Across Surface Water	1.4E-08	l Hazard Index Across Surface Water	0.0
Total Risk Across Sediment	2.4E-07	Total Hazard Index Across Sediment	0.10
Total Risk Across All Media and All Exposure Routes	7.1E-06	oss All Media and All Exposure Routes	0.15

Notes:

Target Organ Abbreviations:
CVS = Cardiovascular System
GIS = Gastrointestinal System
RsS = Respiratory System

	Inhalation	Oral/Dermal	Total
Whole Body HI =		<0.01	<0.01
Gastrointestinal System HI =		0.09	0.09
Cardiovascular System HI =		0.06	0.06
Skin HI =		<0.01	<0.01
Kidney HI =		0.09	0.09
Liver HI =		<0.01	<0.01
Respiratory System HI =	<0.01		<0.01

TABLE 8-11

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR 2012 CMS INVESTIGATION COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Receptor Population: Trespassers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Soil	Arsenic	1.4E-07	--	1.7E-08	--	1.6E-07	Skin / CVS	<0.01	--	<0.01	<0.01
			Cobalt	--	--	--	--	--	CVS	0.02	--	<0.01	0.02
			Vanadium	--	--	--	--	--	GIS / Kidney	0.01	--	0.02	0.03
			Chemical Total	1.4E-07	--	1.7E-08	--	1.6E-07		0.03	--	0.02	0.04
		Exposure Point Total						1.6E-07					0.04
	Exposure Medium Total							1.6E-07					0.04
	Air	Fugative Dust	Arsenic	--	1.7E-11	--	--	1.7E-11	NA	--	<0.01	--	<0.01
			Cobalt	--	6.7E-10	--	--	6.7E-10	RsS	--	<0.01	--	<0.01
			Vanadium	--	--	--	--	--	NA	--	<0.01	--	<0.01
			Chemical Total	--	6.9E-10	--	--	6.9E-10		--	<0.01	--	<0.01
		Exposure Point Total						6.9E-10					<0.01
	Exposure Medium Total							6.9E-10					<0.01
Soil Total								**1.59E-07**					**0.04**
Adult Trespassers Total								**1.59E-07**					**0.04**

Total Risk Across Soil	1.6E-07	Total Hazard Index Across Soil	0.04
Total Risk Across All Media and All Exposure Routes	1.6E-07	ss All Media and All Exposure Routes	0.04

Notes:

Target Organ Abbreviations:
CVS = Cardiovascular System
GIS = Gastrointestinal System
RsS = Respiratory System

	Inhalation	Oral/Dermal	Total
Gastrointestinal System HI =		0.03	0.03
Cardiovascular System HI =		0.02	0.02
Skin HI =		<0.01	<0.01
Kidney HI =		0.03	0.03
Respiratory System HI =	<0.01		<0.01

TABLE 8-12

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COMBINED COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Receptor Population: Trespassers
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Soil											
			Methyl Iodide	--	--	--	--	--	NA	--	--	--	--
			Propionitrile (Ethyl Cyanide)	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)anthracene	1.4E-09	--	1.2E-09	--	2.6E-09	NA	--	--	--	--
			Benzo(a)pyrene (BaP)	4.5E-08	--	3.8E-08	--	8.3E-08	NA	--	--	--	--
			Benzo(b)fluoranthene	3.2E-08	--	2.7E-08	--	5.9E-08	NA	--	--	--	--
			Benzo(k)fluoranthene	3.2E-09	--	2.6E-09	--	5.8E-09	NA	--	--	--	--
			Chrysene	5.1E-10	--	4.2E-10	--	9.3E-10	NA	--	--	--	--
			Dibenz(a,h)anthracene	1.0E-07	--	8.3E-08	--	1.8E-07	NA	--	--	--	--
			Indeno(1,2,3-cd)pyrene	3.1E-09	--	2.6E-09	--	5.7E-09	NA	--	--	--	--
			Antimony	--	--	--	--	--	Whole Body, CVS	<0.01	--	<0.01	<0.01
			Arsenic	1.0E-07	--	2.0E-08	--	1.2E-07	Skin / CVS	<0.01	--	<0.01	<0.01
			Cobalt	--	--	--	--	--	CVS	0.03	--	<0.01	0.03
			Lead	--	--	--	--	--	NA	--	--	--	--
			Thallium	--	--	--	--	--	Liver / CVS / Skin	<0.01	--	<0.01	<0.01
			Vanadium	--	--	--	--	--	GIS / Kidney	0.01	--	0.03	0.04
			Chemical Total	2.9E-07	--	1.7E-07	--	4.6E-07		0.05	--	0.03	0.08
		Exposure Point Total						4.6E-07					0.08
	Exposure Medium Total							4.6E-07					0.08
	Air	Fugative Dust											
			Methyl Iodide	--	--	--	--	--	NA	--	--	--	--
			Propionitrile (Ethyl Cyanide)	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)anthracene	--	5.9E-15	--	--	5.9E-15	NA	--	--	--	--
			Benzo(a)pyrene (BaP)	--	1.9E-13	--	--	1.9E-13	NA	--	--	--	--
			Benzo(b)fluoranthene	--	1.3E-13	--	--	1.3E-13	NA	--	--	--	--
			Benzo(k)fluoranthene	--	1.3E-13	--	--	1.3E-13	NA	--	--	--	--
			Chrysene	--	2.1E-14	--	--	2.1E-14	NA	--	--	--	--
			Dibenz(a,h)anthracene	--	4.5E-13	--	--	4.5E-13	NA	--	--	--	--
			Indeno(1,2,3-cd)pyrene	--	1.3E-14	--	--	1.3E-14	NA	--	--	--	--
			Antimony	--	--	--	--	--	NA	--	--	--	--
			Arsenic	--	8.2E-12	--	--	8.2E-12	NA	--	<0.01	--	<0.01
			Cobalt	--	3.7E-10	--	--	3.7E-10	RsS	--	<0.01	--	<0.01
			Lead	--	--	--	--	--	NA	--	--	--	--
			Thallium	--	--	--	--	--	NA	--	--	--	--
			Vanadium	--	--	--	--	--	NA	--	<0.01	--	<0.01
			Chemical Total	--	3.8E-10	--	--	3.8E-10		--	<0.01	--	<0.01
		Exposure Point Total						3.8E-10					<0.01
	Exposure Medium Total							3.8E-10					<0.01
Soil Total								**4.65E-07**					**0.08**

TABLE 8-12

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COMBINED COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Receptor Population: Trespassers
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Water	Surface Water	Surface Water											
			Bromodichloromethane	1.0E-10	--	2.7E-10	--	3.7E-10	Kidney	<0.01	--	<0.01	<0.01
			Chloroform	1.9E-10	--	8.1E-10	--	9.9E-10	Liver	<0.01	--	<0.01	<0.01
			Dibromochloromethane	6.7E-11	--	1.2E-10	--	1.9E-10	Liver	<0.01	--	<0.01	<0.01
			Arsenic	3.7E-09	--	2.3E-09	--	6.0E-09	Skin / CVS	<0.01	--	<0.01	<0.01
			Vanadium	--	--	--	--	--	GIS / Kidney	<0.01	--	<0.01	<0.01
			Chemical Total	4.0E-09	--	3.5E-09	--	7.6E-09		<0.01	--	<0.01	<0.01
		Exposure Point Total						7.6E-09					<0.01
	Exposure Medium Total							7.6E-09					<0.01
Surface Water Total								**7.56E-09**					**<0.01**
Sediment	Sediment	Sediment											
			Arsenic	1.1E-07	--	3.2E-08	--	1.4E-07	Skin / CVS	<0.01	--	<0.01	<0.01
			Cobalt	--	--	--	--	--	CVS	0.03	--	<0.01	0.04
			Thallium	--	--	--	--	--	Liver / CVS / Skin	<0.01	--	<0.01	<0.01
			Vanadium	--	--	--	--	--	GIS / Kidney	0.01	--	0.05	0.07
			Chemical Total	1.1E-07	--	3.2E-08	--	1.4E-07		0.05	--	0.06	0.11
		Exposure Point Total						1.4E-07					0.11
	Exposure Medium Total							1.4E-07					0.11
Sediment Total								**1.44E-07**					**0.11**
Youth Trespassers Total								**6.16E-07**					**0.20**

Total Risk Across Soil	4.6E-07	Total Hazard Index Across Soil	0.08
Total Risk Across Surface Water	7.6E-09	l Hazard Index Across Surface Water	0.0
Total Risk Across Sediment	1.4E-07	Total Hazard Index Across Sediment	0.11
Total Risk Across All Media and All Exposure Routes	6.2E-07	oss All Media and All Exposure Routes	0.20

Notes:
Target Organ Abbreviations:
CVS = Cardiovascular System
GIS = Gastrointestinal System
RsS = Respiratory System

	Inhalation	Oral/Dermal	Total
Whole Body HI =		<0.01	<0.01
Gastrointestinal System HI =		0.11	0.11
Cardiovascular System HI =		0.08	0.08
Skin HI =		0.01	0.01
Kidney HI =		0.11	0.11
Liver HI =		<0.01	<0.01
Respiratory System HI =	<0.01		<0.01

TABLE 8-13

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR 2012 CMS INVESTIGATION COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Receptor Population: Trespassers
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Soil	Arsenic	1.0E-07	--	1.9E-08	--	1.2E-07	Skin / CVS	<0.01	--	<0.01	<0.01
			Cobalt	--	--	--	--	--	CVS	0.03	--	<0.01	0.03
			Vanadium	--	--	--	--	--	GIS / Kidney	0.02	--	0.04	0.05
			Chemical Total	1.0E-07	--	1.9E-08	--	1.2E-07		0.04	--	0.04	0.08
		Exposure Point Total						1.2E-07					0.08
	Exposure Medium Total							1.2E-07					0.08
	Air	Fugative Dust	Arsenic	--	8.0E-12	--	--	8.0E-12	NA	--	<0.01	--	<0.01
			Cobalt	--	3.1E-10	--	--	3.1E-10	RsS	--	<0.01	--	<0.01
			Vanadium	--	--	--	--	--	NA	--	<0.01	--	<0.01
			Chemical Total	--	3.1E-10	--	--	3.1E-10		--	<0.01	--	<0.01
		Exposure Point Total						3.1E-10					<0.01
	Exposure Medium Total							3.1E-10					<0.01
Soil Total								**1.20E-07**					**0.08**
Youth Trespassers Total								**1.20E-07**					**0.08**

Total Risk Across Soil	1.2E-07	Total Hazard Index Across Soil	0.08
Total Risk Across All Media and All Exposure Routes	1.2E-07	ss All Media and All Exposure Routes	0.08

Notes:

Target Organ Abbreviations:
CVS = Cardiovascular System
GIS = Gastrointestinal System
RsS = Respiratory System

	Inhalation	Oral/Dermal	Total
Gastrointestinal System HI =		0.05	0.05
Cardiovascular System HI =		0.03	0.03
Skin HI =		<0.01	<0.01
Kidney HI =		0.05	0.05
Respiratory System HI =	<0.01		<0.01

TABLE 8-14

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COMBINED COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Receptor Population: On-Site Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Soil											
			Methyl Iodide	--	--	--	--	--	NA	--	--	--	--
			Propionitrile (Ethyl Cyanide)	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)anthracene	3.3E-09	--	2.8E-09	--	6.2E-09	NA	--	--	--	--
			Benzo(a)pyrene (BaP)	1.1E-07	--	9.1E-08	--	2.0E-07	NA	--	--	--	--
			Benzo(b)fluoranthene	7.6E-08	--	6.5E-08	--	1.4E-07	NA	--	--	--	--
			Benzo(k)fluoranthene	7.4E-09	--	6.3E-09	--	1.4E-08	NA	--	--	--	--
			Chrysene	1.2E-09	--	1.0E-09	--	2.2E-09	NA	--	--	--	--
			Dibenz(a,h)anthracene	2.3E-07	--	2.0E-07	--	4.4E-07	NA	--	--	--	--
			Indeno(1,2,3-cd)pyrene	7.3E-09	--	6.3E-09	--	1.4E-08	NA	--	--	--	--
			Antimony	--	--	--	--	--	Whole Body, CVS	<0.01	--	<0.01	<0.01
			Arsenic	7.3E-07	--	1.4E-07	--	8.7E-07	Skin / CVS	<0.01	--	<0.01	<0.01
			Cobalt	--	--	--	--	--	CVS	0.10	--	<0.01	0.10
			Lead	--	--	--	--	--	NA	--	--	--	--
			Thallium	--	--	--	--	--	Liver / CVS / Skin	0.01	--	<0.01	0.01
			Vanadium	--	--	--	--	--	GIS / Kidney	0.04	--	0.09	0.13
			Chemical Total	1.2E-06	--	5.2E-07	--	1.7E-06		0.15	--	0.10	0.26
		Exposure Point Total						1.7E-06					0.26
	Exposure Medium Total							1.7E-06					0.26
	Air	Fugative Dust											
			Methyl Iodide	--	--	--	--	--	NA	--	--	--	--
			Propionitrile (Ethyl Cyanide)	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)anthracene	--	6.5E-12	--	--	6.5E-12	NA	--	--	--	--
			Benzo(a)pyrene (BaP)	--	1.1E-10	--	--	1.1E-10	NA	--	--	--	--
			Benzo(b)fluoranthene	--	1.3E-10	--	--	1.3E-10	NA	--	--	--	--
			Benzo(k)fluoranthene	--	5.9E-11	--	--	5.9E-11	NA	--	--	--	--
			Chrysene	--	1.5E-10	--	--	1.5E-10	NA	--	--	--	--
			Dibenz(a,h)anthracene	--	1.1E-10	--	--	1.1E-10	NA	--	--	--	--
			Indeno(1,2,3-cd)pyrene	--	3.3E-12	--	--	3.3E-12	NA	--	--	--	--
			Antimony	--	--	--	--	--	NA	--	--	--	--
			Arsenic	--	3.6E-10	--	--	3.6E-10	NA	--	<0.01	--	<0.01
			Cobalt	--	1.6E-08	--	--	1.6E-08	RsS	--	<0.01	--	<0.01
			Lead	--	--	--	--	--	NA	--	--	--	--
			Thallium	--	--	--	--	--	NA	--	--	--	--
			Vanadium	--	--	--	--	--	NA	--	<0.01	--	<0.01
			Chemical Total	--	1.7E-08	--	--	1.7E-08		--	<0.01	--	<0.01
		Exposure Point Total						1.7E-08					<0.01
	Exposure Medium Total							1.7E-08					<0.01
Soil Total								**1.70E-06**					**0.26**

TABLE 8-14

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COMBINED COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Receptor Population: On-Site Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Water	Surface Water	Surface Water	Bromodichloromethane	7.4E-10	--	2.0E-09	--	2.7E-09	Kidney	<0.01	--	<0.01	<0.01
			Chloroform	1.3E-09	--	5.9E-09	--	7.2E-09	Liver	<0.01	--	<0.01	<0.01
			Dibromochloromethane	4.7E-10	--	9.0E-10	--	1.4E-09	Liver	<0.01	--	<0.01	<0.01
			Arsenic	2.6E-08	--	1.7E-08	--	4.3E-08	Skin / CVS	<0.01	--	<0.01	<0.01
			Vanadium	--	--	--	--	--	GIS / Kidney	<0.01	--	<0.01	<0.01
			Chemical Total	2.8E-08	--	2.6E-08	--	5.4E-08		<0.01	--	<0.01	<0.01
		Exposure Point Total						5.4E-08					<0.01
	Exposure Medium Total							5.4E-08					<0.01
Surface Water Total								**5.39E-08**					**<0.01**
Sediment	Sediment	Sediment	Arsenic	7.9E-07	--	2.3E-07	--	1.0E-06	Skin / CVS	<0.01	--	<0.01	<0.01
			Cobalt	--	--	--	--	--	CVS	0.10	--	0.01	0.11
			Thallium	--	--	--	--	--	Liver / CVS / Skin	0.01	--	<0.01	0.02
			Vanadium	--	--	--	--	--	GIS / Kidney	0.05	--	0.17	0.22
			Chemical Total	7.9E-07	--	2.3E-07	--	1.0E-06		0.17	--	0.19	0.35
		Exposure Point Total						1.0E-06					0.35
	Exposure Medium Total							1.0E-06					0.35
Sediment Total								**1.02E-06**					**0.35**
On-Site Workers Total								**2.77E-06**					**0.62**

Total Risk Across Soil	1.7E-06	Total Hazard Index Across Soil	0.26
Total Risk Across Surface Water	5.4E-08	Total Hazard Index Across Surface Water	0.0
Total Risk Across Sediment	1.0E-06	Total Hazard Index Across Sediment	0.35
Total Risk Across All Media and All Exposure Routes	2.8E-06	Total Hazard Index Across All Media and All Exposure Routes	0.62

Notes:

Target Organ Abbreviations:
CVS = Cardiovascular System
GIS = Gastrointestinal System
RsS = Respiratory System

	Inhalation	Oral/Dermal	Total
Whole Body HI =		<0.01	<0.01
Gastrointestinal System HI =		0.35	0.35
Cardiovascular System HI =		0.26	0.26
Skin HI =		0.04	0.04
Kidney HI =		0.35	0.35
Liver HI =		0.03	0.03
Respiratory System HI =	<0.01		<0.01

TABLE 8-15

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR 2012 CMS INVESTIGATION COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Receptor Population: On-Site Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Soil											
			Arsenic	7.1E-07	--	1.4E-07	--	8.5E-07	Skin / CVS	<0.01	--	<0.01	<0.01
			Cobalt	--	--	--	--	--	CVS	0.08	--	<0.01	0.09
			Vanadium	--	--	--	--	--	GIS / Kidney	0.05	--	0.12	0.17
			Chemical Total	7.1E-07	--	1.4E-07	--	8.5E-07		0.13	--	0.13	0.26
		Exposure Point Total						8.5E-07					0.26
	Exposure Medium Total							8.5E-07					0.26
	Air	Fugative Dust											
			Arsenic	--	3.5E-10	--	--	3.5E-10	NA	--	<0.01	--	<0.01
			Cobalt	--	1.3E-08	--	--	1.3E-08	RsS	--	<0.01	--	<0.01
			Vanadium	--	--	--	--	--	NA	--	<0.01	--	<0.01
			Chemical Total	--	1.4E-08	--	--	1.4E-08		--	<0.01	--	<0.01
		Exposure Point Total						1.4E-08					<0.01
	Exposure Medium Total							1.4E-08					<0.01
Soil Total								**8.61E-07**					**0.26**
On-Site Workers Total								**8.61E-07**					**0.26**

Total Risk Across Soil	8.6E-07	Total Hazard Index Across Soil	0.26
Total Risk Across All Media and All Exposure Routes	8.6E-07	ss All Media and All Exposure Routes	0.26

Notes:
Target Organ Abbreviations:
CVS = Cardiovascular System
GIS = Gastrointestinal System
RsS = Respiratory System

	Inhalation	Oral/Dermal	Total
Gastrointestinal System HI =		0.17	0.17
Cardiovascular System HI =		0.09	0.09
Skin HI =		<0.01	<0.01
Kidney HI =		0.17	0.17
Respiratory System HI =	<0.01		<0.01

TABLE 8-16

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COMBINED COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Soil											
			Methyl Iodide	--	--	--	--	--	NA	--	--	--	--
			Propionitrile (Ethyl Cyanide)	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)anthracene	6.6E-08	--	2.3E-08	--	8.9E-08	NA	--	--	--	--
			Benzo(a)pyrene (BaP)	2.1E-06	--	7.5E-07	--	2.8E-06	NA	--	--	--	--
			Benzo(b)fluoranthene	1.5E-06	--	5.4E-07	--	2.0E-06	NA	--	--	--	--
			Benzo(k)fluoranthene	1.5E-07	--	5.2E-08	--	2.0E-07	NA	--	--	--	--
			Chrysene	2.3E-08	--	8.4E-09	--	3.2E-08	NA	--	--	--	--
			Dibenz(a,h)anthracene	4.6E-06	--	1.7E-06	--	6.3E-06	NA	--	--	--	--
			Indeno(1,2,3-cd)pyrene	1.5E-07	--	5.2E-08	--	2.0E-07	NA	--	--	--	--
			Antimony	--	--	--	--	--	Whole Body, CVS	<0.01	--	<0.01	<0.01
			Arsenic	9.8E-07	--	1.2E-07	--	1.1E-06	Skin / CVS	<0.01	--	<0.01	<0.01
			Cobalt	--	--	--	--	--	CVS	0.14	--	<0.01	0.14
			Lead	--	--	--	--	--	NA	--	--	--	--
			Thallium	--	--	--	--	--	Liver / CVS / Skin	0.02	--	<0.01	0.02
			Vanadium	--	--	--	--	--	GIS / Kidney	0.05	--	0.08	0.13
			Chemical Total	9.6E-06	--	3.2E-06	--	1.3E-05		0.22	--	0.09	0.30
		Exposure Point Total						1.3E-05					0.30
	Exposure Medium Total							1.3E-05					0.30
	Air	Fugative Dust											
			Methyl Iodide	--	--	--	--	--	NA	--	--	--	--
			Propionitrile (Ethyl Cyanide)	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)anthracene	--	1.0E-12	--	--	1.0E-12	NA	--	--	--	--
			Benzo(a)pyrene (BaP)	--	3.2E-11	--	--	3.2E-11	NA	--	--	--	--
			Benzo(b)fluoranthene	--	2.3E-11	--	--	2.3E-11	NA	--	--	--	--
			Benzo(k)fluoranthene	--	2.2E-11	--	--	2.2E-11	NA	--	--	--	--
			Chrysene	--	3.6E-12	--	--	3.6E-12	NA	--	--	--	--
			Dibenz(a,h)anthracene	--	7.8E-11	--	--	7.8E-11	NA	--	--	--	--
			Indeno(1,2,3-cd)pyrene	--	2.2E-12	--	--	2.2E-12	NA	--	--	--	--
			Antimony	--	--	--	--	--	NA	--	--	--	--
			Arsenic	--	4.8E-10	--	--	4.8E-10	NA	--	<0.01	--	<0.01
			Cobalt	--	2.2E-08	--	--	2.2E-08	RsS	--	<0.01	--	<0.01
			Lead	--	--	--	--	--	NA	--	--	--	--
			Thallium	--	--	--	--	--	NA	--	--	--	--
			Vanadium	--	--	--	--	--	NA	--	<0.01	--	<0.01
			Chemical Total	--	2.2E-08	--	--	2.2E-08		--	<0.01	--	<0.01
		Exposure Point Total						2.2E-08					<0.01
	Exposure Medium Total							2.2E-08					<0.01
Soil Total								**1.28E-05**					**0.31**

TABLE 8-16

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COMBINED COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Tap											
			Naphthalene	--	--	--	--	--	Whole Body	<0.01	--	<0.01	<0.01
			Arsenic	8.7E-05	--	4.6E-07	--	8.8E-05	Skin / CVS	0.57	--	<0.01	0.57
			Cadmium	--	--	--	--	--	Kidney	0.04	--	<0.01	0.05
			Cobalt	--	--	--	--	--	CVS	0.53	--	<0.01	0.53
			Selenium	--	--	--	--	--	Skin	0.13	--	<0.01	0.13
			Vanadium	--	--	--	--	--	GIS / Kidney	0.94	--	0.19	**1.13**
			Chemical Total	8.7E-05	--	4.6E-07	--	8.8E-05		2.21	--	0.20	**2.41**
		Exposure Point Total						8.8E-05					**2.41**
	Exposure Medium Total							8.8E-05					**2.41**
Groundwater Total								**8.78E-05**					**2.41**
Surface Water	Surface Water	Surface Water											
			Bromodichloromethane	1.5E-10	--	6.7E-10	--	8.2E-10	Kidney	<0.01	--	<0.01	<0.01
			Chloroform	2.6E-10	--	2.0E-09	--	2.3E-09	Liver	<0.01	--	<0.01	<0.01
			Dibromochloromethane	9.4E-11	--	3.1E-10	--	4.0E-10	Liver	<0.01	--	<0.01	<0.01
			Arsenic	5.1E-09	--	5.8E-09	--	1.1E-08	Skin / CVS	<0.01	--	<0.01	<0.01
			Vanadium	--	--	--	--	--	GIS / Kidney	<0.01	--	<0.01	<0.01
			Chemical Total	5.6E-09	--	8.9E-09	--	1.4E-08		<0.01	--	<0.01	<0.01
		Exposure Point Total						1.4E-08					<0.01
	Exposure Medium Total							1.4E-08					<0.01
Surface Water Total								**1.45E-08**					**<0.01**
Sediment	Sediment	Sediment											
			Arsenic	1.6E-07	--	8.1E-08	--	2.4E-07	Skin / CVS	<0.01	--	<0.01	<0.01
			Cobalt	--	--	--	--	--	CVS	0.02	--	<0.01	0.03
			Thallium	--	--	--	--	--	Liver / CVS / Skin	<0.01	--	<0.01	<0.01
			Vanadium	--	--	--	--	--	GIS / Kidney	<0.01	--	0.06	0.07
			Chemical Total	1.6E-07	--	8.1E-08	--	2.4E-07		0.03	--	0.07	0.10
		Exposure Point Total						2.4E-07					0.10
	Exposure Medium Total							2.4E-07					0.10
Sediment Total								**2.38E-07**					**0.10**

TABLE 8-16

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COMBINED COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Adult Residents Total								**1.01E-04**					**2.82**

Total Risk Across Soil	1.3E-05	Total Hazard Index Across Soil	0.31
Total Risk Across Groundwater	8.8E-05	tal Hazard Index Across Groundwater	**2.4**
Total Risk Across Surface Water	1.4E-08	l Hazard Index Across Surface Water	0.0
Total Risk Across Sediment	2.4E-07	Total Hazard Index Across Sediment	0.10
Total Risk Across All Media and All Exposure Routes	**1.0E-04**	oss All Media and All Exposure Routes	**2.8**

Notes:
Target Organ Abbreviations:
CVS = Cardiovascular System
GIS = Gastrointestinal System
RsS = Respiratory System

	Inhalation	Oral/Dermal	Total
Whole Body HI =		<0.01	<0.01
Gastrointestinal System HI =		**1.3**	**1.3**
Cardiovascular System HI =		**1.3**	**1.3**
Skin HI =		0.73	0.73
Kidney HI =		**1.4**	**1.4**
Liver HI =		0.02	0.02
Respiratory System HI =	<0.01		<0.01

TABLE 8-17

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR 2012 CMS INVESTIGATION COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Soil	Arsenic	9.5E-07	--	1.1E-07	--	1.1E-06	Skin / CVS	<0.01	--	<0.01	<0.01
			Cobalt	--	--	--	--	--	CVS	0.11	--	<0.01	0.12
			Vanadium	--	--	--	--	--	GIS / Kidney	0.07	--	0.10	0.17
			Chemical Total	9.5E-07	--	1.1E-07	--	1.1E-06		0.19	--	0.11	0.30
		Exposure Point Total						1.1E-06					0.30
	Exposure Medium Total							1.1E-06					0.30
	Air	Fugative Dust	Arsenic	--	1.4E-09	--	--	1.4E-09	NA	--	<0.01	--	<0.01
			Cobalt	--	5.4E-08	--	--	5.4E-08	RsS	--	<0.01	--	<0.01
			Vanadium	--	--	--	--	--	NA	--	<0.01	--	<0.01
			Chemical Total	--	5.5E-08	--	--	5.5E-08		--	<0.01	--	<0.01
		Exposure Point Total						5.5E-08					<0.01
	Exposure Medium Total							5.5E-08					<0.01
Soil Total								**1.12E-06**					**0.30**
Adult Residents Total								**1.12E-06**					**0.30**

Total Risk Across Soil	1.1E-06	Total Hazard Index Across Soil	0.30
Total Risk Across All Media and All Exposure Routes	1.1E-06	ss All Media and All Exposure Routes	0.30

Notes:

Target Organ Abbreviations:
CVS = Cardiovascular System
GIS = Gastrointestinal System
RsS = Respiratory System

	Inhalation	Oral/Dermal	Total
Gastrointestinal System HI =		0.17	0.17
Cardiovascular System HI =		0.12	0.12
Skin HI =		<0.01	<0.01
Kidney HI =		0.17	0.17
Respiratory System HI =	<0.01		<0.01

TABLE 8-18

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COMBINED COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Young Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Soil											
			Methyl Iodide	--	--	--	--	--	NA	--	--	--	--
			Propionitrile (Ethyl Cyanide)	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)anthracene	5.5E-08	--	2.0E-08	--	7.6E-08	NA	--	--	--	--
			Benzo(a)pyrene (BaP)	1.8E-06	--	6.4E-07	--	2.4E-06	NA	--	--	--	--
			Benzo(b)fluoranthene	1.3E-06	--	4.6E-07	--	1.7E-06	NA	--	--	--	--
			\	1.2E-07	--	4.5E-08	--	1.7E-07	NA	--	--	--	--
			Chrysene	2.0E-08	--	7.2E-09	--	2.7E-08	NA	--	--	--	--
			Dibenz(a,h)anthracene	3.9E-06	--	1.4E-06	--	5.4E-06	NA	--	--	--	--
			Indeno(1,2,3-cd)pyrene	1.2E-07	--	4.5E-08	--	1.7E-07	NA	--	--	--	--
			Antimony	--	--	--	--	--	Whole Body, CVS	0.04	--	<0.01	0.04
			Arsenic	2.3E-06	--	1.9E-07	--	2.5E-06	Skin / CVS	0.06	--	<0.01	0.06
			Cobalt	--	--	--	--	--	CVS	1.27	--	0.04	**1.31**
			Lead	--	--	--	--	--	NA	--	--	--	--
			Thallium	--	--	--	--	--	Liver / CVS / Skin	0.17	--	<0.01	0.17
			Vanadium	--	--	--	--	--	GIS / Kidney	0.48	--	0.51	0.99
			Chemical Total	9.6E-06	--	2.8E-06	--	1.2E-05		2.01	--	0.56	**2.58**
		Exposure Point Total						1.2E-05					**2.58**
	Exposure Medium Total							1.2E-05					**2.58**
	Air	Fugative Dust											
			Methyl Iodide	--	--	--	--	--	NA	--	--	--	--
			Propionitrile (Ethyl Cyanide)	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)anthracene	--	4.6E-13	--	--	4.6E-13	NA	--	--	--	--
			Benzo(a)pyrene (BaP)	--	1.5E-11	--	--	1.5E-11	NA	--	--	--	--
			Benzo(b)fluoranthene	--	1.1E-11	--	--	1.1E-11	NA	--	--	--	--
			Benzo(k)fluoranthene	--	1.0E-11	--	--	1.0E-11	NA	--	--	--	--
			Chrysene	--	1.6E-12	--	--	1.6E-12	NA	--	--	--	--
			Dibenz(a,h)anthracene	--	3.6E-11	--	--	3.6E-11	NA	--	--	--	--
			Indeno(1,2,3-cd)pyrene	--	1.0E-12	--	--	1.0E-12	NA	--	--	--	--
			Antimony	--	--	--	--	--	NA	--	--	--	--
			Arsenic	--	1.2E-10	--	--	1.2E-10	NA	--	<0.01	--	<0.01
			Cobalt	--	5.4E-09	--	--	5.4E-09	RsS	--	<0.01	--	<0.01
			Lead	--	--	--	--	--	NA	--	--	--	--
			Thallium	--	--	--	--	--	NA	--	--	--	--
			Vanadium	--	--	--	--	--	NA	--	<0.01	--	<0.01
			Chemical Total	--	5.6E-09	--	--	5.6E-09		--	<0.01	--	<0.01
		Exposure Point Total						5.6E-09					<0.01
	Exposure Medium Total							5.6E-09					<0.01
Soil Total								**1.24E-05**					**2.58**

TABLE 8-18

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COMBINED COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Young Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Tap											
			Naphthalene	--	--	--	--	--	Whole Body	<0.01	--	<0.01	<0.01
			Arsenic	5.1E-05	--	3.4E-07	--	5.1E-05	Skin / CVS	1.32	--	<0.01	**1.33**
			Cadmium	--	--	--	--	--	Kidney	0.09	--	0.02	0.11
			Cobalt	--	--	--	--	--	CVS	1.24	--	<0.01	**1.24**
			Selenium	--	--	--	--	--	Skin	0.31	--	<0.01	0.31
			Vanadium	--	--	--	--	--	GIS / Kidney	2.19	--	0.55	**2.74**
			Chemical Total	5.1E-05	--	3.4E-07	--	5.1E-05		5.15	--	0.59	**5.74**
		Exposure Point Total						5.1E-05					**5.74**
	Exposure Medium Total							5.1E-05					**5.74**
Groundwater Total								**5.13E-05**					**5.74**
Surface Water	Surface Water	Surface Water											
			Bromodichloromethane	1.7E-10	--	3.9E-10	--	5.6E-10	Kidney	<0.01	--	<0.01	<0.01
			Chloroform	3.0E-10	--	1.2E-09	--	1.5E-09	Liver	<0.01	--	<0.01	<0.01
			Dibromochloromethane	1.1E-10	--	1.8E-10	--	2.9E-10	Liver	<0.01	--	<0.01	<0.01
			Arsenic	6.0E-09	--	3.4E-09	--	9.3E-09	Skin / CVS	<0.01	--	<0.01	<0.01
			Vanadium	--	--	--	--	--	GIS / Kidney	<0.01	--	<0.01	<0.01
			Chemical Total	6.6E-09	--	5.1E-09	--	1.2E-08		<0.01	--	<0.01	<0.01
		Exposure Point Total						1.2E-08					<0.01
	Exposure Medium Total							1.2E-08					<0.01
Surface Water Total								**1.16E-08**					**<0.01**
Sediment	Sediment	Sediment											
			Arsenic	3.7E-07	--	4.6E-08	--	4.1E-07	Skin / CVS	<0.01	--	<0.01	0.01
			Cobalt	--	--	--	--	--	CVS	0.20	--	<0.01	0.21
			Thallium	--	--	--	--	--	Liver / CVS / Skin	0.03	--	<0.01	0.03
			Vanadium	--	--	--	--	--	GIS / Kidney	0.09	--	0.14	0.23
			Chemical Total	3.7E-07	--	4.6E-08	--	4.1E-07		0.33	--	0.15	0.48
		Exposure Point Total						4.1E-07					0.48
	Exposure Medium Total							4.1E-07					0.48
Sediment Total								**4.12E-07**					**0.48**

TABLE 8-18

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COMBINED COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Young Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Young Child Residents Total								**6.41E-05**					**8.80**

Total Risk Across Soil	1.2E-05	Total Hazard Index Across Soil	**2.6**
Total Risk Across Groundwater	5.1E-05	tal Hazard Index Across Groundwater	**5.7**
Total Risk Across Surface Water	1.2E-08	l Hazard Index Across Surface Water	0.0
Total Risk Across Sediment	4.1E-07	Total Hazard Index Across Sediment	0.48
Total Risk Across All Media and All Exposure Routes	6.4E-05	oss All Media and All Exposure Routes	**8.8**

Notes:
Target Organ Abbreviations:
CVS = Cardiovascular System
GIS = Gastrointestinal System
RsS = Respiratory System

	Inhalation	Oral/Dermal	Total
Whole Body HI =		0.05	0.05
Gastrointestinal System HI =		**4.0**	**4.0**
Cardiovascular System HI =		**4.4**	**4.4**
Skin HI =		**1.9**	**1.9**
Kidney HI =		**4.1**	**4.1**
Liver HI =		0.20	0.20
Respiratory System HI =	<0.01		<0.01

TABLE 8-19

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR 2012 CMS INVESTIGATION COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Young Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Soil	Arsenic	2.2E-06	--	1.9E-07	--	2.4E-06	Skin / CVS	0.06	--	<0.01	0.06
			Cobalt	--	--	--	--	--	CVS	1.06	--	0.03	**1.09**
			Vanadium	--	--	--	--	--	GIS / Kidney	0.63	--	0.68	**1.31**
			Chemical Total	2.2E-06	--	1.9E-07	--	2.4E-06		1.74	--	0.71	**2.46**
		Exposure Point Total						2.4E-06					**2.46**
	Exposure Medium Total							2.4E-06					**2.46**
	Air	Fugative Dust	Arsenic	--	3.5E-10	--	--	3.5E-10	NA	--	<0.01	--	<0.01
			Cobalt	--	1.3E-08	--	--	1.3E-08	RsS	--	<0.01	--	<0.01
			Vanadium	--	--	--	--	--	NA	--	<0.01	--	<0.01
			Chemical Total	--	1.4E-08	--	--	1.4E-08		--	<0.01	--	<0.01
		Exposure Point Total						1.4E-08					<0.01
	Exposure Medium Total							1.4E-08					<0.01
Soil Total								**2.42E-06**					**2.46**
Young Child Residents Total								**2.42E-06**					**2.46**

Total Risk Across Soil	2.4E-06	Total Hazard Index Across Soil	**2.5**
Total Risk Across All Media and All Exposure Routes	2.4E-06	Total Hazard Index Across All Media and All Exposure Routes	**2.5**

Notes:

Target Organ Abbreviations:
CVS = Cardiovascular System
GIS = Gastrointestinal System
RsS = Respiratory System

	Inhalation	Oral/Dermal	Total
Gastrointestinal System HI =		**1.3**	**1.3**
Cardiovascular System HI =		**1.1**	**1.1**
Skin HI =		0.06	0.06
Kidney HI =		**1.3**	**1.3**
Respiratory System HI =	<0.01		<0.01

TABLE 8-20

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COMBINED COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Industrial / Commercial Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Soil											
			Methyl Iodide	--	--	--	--	--	NA	--	--	--	--
			Propionitrile (Ethyl Cyanide)	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)anthracene	3.3E-09	--	2.8E-09	--	6.2E-09	NA	--	--	--	--
			Benzo(a)pyrene (BaP)	1.1E-07	--	9.1E-08	--	2.0E-07	NA	--	--	--	--
			Benzo(b)fluoranthene	7.6E-08	--	6.5E-08	--	1.4E-07	NA	--	--	--	--
			Benzo(k)fluoranthene	7.4E-09	--	6.3E-09	--	1.4E-08	NA	--	--	--	--
			Chrysene	1.2E-09	--	1.0E-09	--	2.2E-09	NA	--	--	--	--
			Dibenz(a,h)anthracene	2.3E-07	--	2.0E-07	--	4.4E-07	NA	--	--	--	--
			Indeno(1,2,3-cd)pyrene	7.3E-09	--	6.3E-09	--	1.4E-08	NA	--	--	--	--
			Antimony	--	--	--	--	--	Whole Body, CVS	<0.01	--	<0.01	<0.01
			Arsenic	7.3E-07	--	1.4E-07	--	8.7E-07	Skin / CVS	<0.01	--	<0.01	<0.01
			Cobalt	--	--	--	--	--	CVS	0.10	--	<0.01	0.10
			Lead	--	--	--	--	--	NA	--	--	--	--
			Thallium	--	--	--	--	--	Liver / CVS / Skin	0.01	--	<0.01	0.01
			Vanadium	--	--	--	--	--	GIS / Kidney	0.04	--	0.09	0.13
			Chemical Total	1.2E-06	--	5.2E-07	--	1.7E-06		0.15	--	0.10	0.26
		Exposure Point Total						1.7E-06					0.26
	Exposure Medium Total							1.7E-06					0.26
	Air	Fugative Dust											
			Methyl Iodide	--	--	--	--	--	NA	--	--	--	--
			Propionitrile (Ethyl Cyanide)	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)anthracene	--	8.6E-14	--	--	8.6E-14	NA	--	--	--	--
			Benzo(a)pyrene (BaP)	--	2.7E-12	--	--	2.7E-12	NA	--	--	--	--
			Benzo(b)fluoranthene	--	2.0E-12	--	--	2.0E-12	NA	--	--	--	--
			Benzo(k)fluoranthene	--	1.9E-12	--	--	1.9E-12	NA	--	--	--	--
			Chrysene	--	3.1E-13	--	--	3.1E-13	NA	--	--	--	--
			Dibenz(a,h)anthracene	--	6.6E-12	--	--	6.6E-12	NA	--	--	--	--
			Indeno(1,2,3-cd)pyrene	--	1.9E-13	--	--	1.9E-13	NA	--	--	--	--
			Antimony	--	--	--	--	--	NA	--	--	--	--
			Arsenic	--	3.6E-10	--	--	3.6E-10	NA	--	<0.01	--	<0.01
			Cobalt	--	1.6E-08	--	--	1.6E-08	RsS	--	<0.01	--	<0.01
			Lead	--	--	--	--	--	NA	--	--	--	--
			Thallium	--	--	--	--	--	NA	--	--	--	--
			Vanadium	--	--	--	--	--	NA	--	<0.01	--	<0.01
			Chemical Total	--	1.6E-08	--	--	1.6E-08		--	<0.01	--	<0.01
		Exposure Point Total						1.6E-08					<0.01
	Exposure Medium Total							1.6E-08					<0.01
Soil Total								**1.70E-06**					**0.26**

TABLE 8-20

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COMBINED COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Industrial / Commercial Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Tap											
			Naphthalene	--	--	--	--	0.0E+00	Whole Body	<0.01	--	--	<0.01
			Arsenic	3.2E-05	--	--	--	3.2E-05	Skin / CVS	0.20	--	--	0.20
			Cadmium	--	--	--	--	0.0E+00	Kidney	0.01	--	--	0.01
			Cobalt	--	--	--	--	0.0E+00	CVS	0.19	--	--	0.19
			Selenium	--	--	--	--	0.0E+00	Skin	0.05	--	--	0.05
			Vanadium	--	--	--	--	0.0E+00	GIS / Kidney	0.33	--	--	0.33
			Chemical Total	3.2E-05	--	--	--	3.2E-05		0.79	--	--	0.79
		Exposure Point Total						3.2E-05					0.79
	Exposure Medium Total							3.2E-05					0.79
Groundwater Total								**3.25E-05**					**0.79**
Industrial / Commercial Workers Total								**3.42E-05**					**1.04**

Total Risk Across Soil	1.7E-06	Total Hazard Index Across Soil	0.26
Total Risk Across Groundwater	3.2E-05	Total Hazard Index Across Groundwater	0.79
Total Risk Across All Media and All Exposure Routes	3.4E-05	Total Hazard Index Across All Media and All Exposure Routes	**1.0**

Notes:

Target Organ Abbreviations:
CVS = Cardiovascular System
GIS = Gastrointestinal System
RsS = Respiratory System

	Inhalation	Oral/Dermal	Total
Whole Body HI =		<0.01	<0.01
Gastrointestinal System HI =		0.46	0.46
Cardiovascular System HI =		0.52	0.52
Skin HI =		0.27	0.27
Kidney HI =		0.48	0.48
Liver HI =		0.01	0.01
Respiratory System HI =	<0.01		<0.01

TABLE 8-21

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR 2012 CMS INVESTIGATION COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Industrial / Commercial Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Soil	Arsenic	7.1E-07	--	1.4E-07	--	8.5E-07	Skin / CVS	<0.01	--	<0.01	<0.01
			Cobalt	--	--	--	--	--	CVS	0.08	--	<0.01	0.09
			Vanadium	--	--	--	--	--	GIS / Kidney	0.05	--	0.12	0.17
			Chemical Total	7.1E-07	--	1.4E-07	--	8.5E-07		0.13	--	0.13	0.26
		Exposure Point Total						8.5E-07					0.26
	Exposure Medium Total							8.5E-07					0.26
	Air	Fugative Dust	Arsenic	--	3.5E-10	--	--	3.5E-10	NA	--	<0.01	--	<0.01
			Cobalt	--	1.3E-08	--	--	1.3E-08	RsS	--	<0.01	--	<0.01
			Vanadium	--	--	--	--	--	NA	--	<0.01	--	<0.01
			Chemical Total	--	1.4E-08	--	--	1.4E-08		--	<0.01	--	<0.01
		Exposure Point Total						1.4E-08					<0.01
	Exposure Medium Total							1.4E-08					<0.01
Soil Total								**8.61E-07**					**0.26**
Industrial / Commercial Workers Total								**8.61E-07**					**0.26**

Total Risk Across Soil	8.6E-07	Total Hazard Index Across Soil	0.26
Total Risk Across All Media and All Exposure Routes	8.6E-07	Total Hazard Index Across All Media and All Exposure Routes	0.26

Notes:

Target Organ Abbreviations:
CVS = Cardiovascular System
GIS = Gastrointestinal System
RsS = Respiratory System

	Inhalation	Oral/Dermal	Total
Gastrointestinal System HI =		0.17	0.17
Cardiovascular System HI =		0.09	0.09
Skin HI =		<0.01	<0.01
Kidney HI =		0.17	0.17
Respiratory System HI =	<0.01		<0.01

TABLE 8-22

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COMBINED COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Soil											
			Methyl Iodide	--	--	--	--	--	NA	--	--	--	--
			Propionitrile (Ethyl Cyanide)	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)anthracene	4.4E-10	--	1.7E-10	--	6.1E-10	NA	--	--	--	--
			Benzo(a)pyrene (BaP)	1.4E-08	--	5.4E-09	--	1.9E-08	NA	--	--	--	--
			Benzo(b)fluoranthene	1.0E-08	--	3.9E-09	--	1.4E-08	NA	--	--	--	--
			Benzo(k)fluoranthene	9.8E-10	--	3.8E-10	--	1.4E-09	NA	--	--	--	--
			Chrysene	1.6E-10	--	6.1E-11	--	2.2E-10	NA	--	--	--	--
			Dibenz(a,h)anthracene	3.1E-08	--	1.2E-08	--	4.3E-08	NA	--	--	--	--
			Indeno(1,2,3-cd)pyrene	9.7E-10	--	3.8E-10	--	1.3E-09	NA	--	--	--	--
			Antimony	--	--	--	--	--	Whole Body, CVS	<0.01	--	<0.01	0.01
			Arsenic	9.6E-08	--	8.7E-09	--	1.0E-07	Skin / CVS	0.01	--	<0.01	0.02
			Cobalt	--	--	--	--	--	CVS	0.32	--	<0.01	0.33
			Lead	--	--	--	--	--	NA	--	--	--	--
			Thallium	--	--	--	--	--	Liver / CVS / Skin	0.04	--	<0.01	0.04
			Vanadium	--	--	--	--	--	GIS / Kidney	0.12	--	0.14	0.26
			Chemical Total	1.5E-07	--	3.1E-08	--	1.8E-07		0.51	--	0.15	0.66
		Exposure Point Total						1.8E-07					0.66
	Exposure Medium Total							1.8E-07					0.66
	Air	Fugative Dust											
			Methyl Iodide	--	--	--	--	--	NA	--	--	--	--
			Propionitrile (Ethyl Cyanide)	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)anthracene	--	1.6E-12	--	--	1.6E-12	NA	--	--	--	--
			Benzo(a)pyrene (BaP)	--	5.1E-11	--	--	5.1E-11	NA	--	--	--	--
			Benzo(b)fluoranthene	--	3.7E-11	--	--	3.7E-11	NA	--	--	--	--
			Benzo(k)fluoranthene	--	3.6E-11	--	--	3.6E-11	NA	--	--	--	--
			Chrysene	--	5.8E-12	--	--	5.8E-12	NA	--	--	--	--
			Dibenz(a,h)anthracene	--	1.2E-10	--	--	1.2E-10	NA	--	--	--	--
			Indeno(1,2,3-cd)pyrene	--	3.6E-12	--	--	3.6E-12	NA	--	--	--	--
			Antimony	--	--	--	--	--	NA	--	--	--	--
			Arsenic	--	6.8E-09	--	--	6.8E-09	NA	--	<0.01	--	<0.01
			Cobalt	--	3.0E-07	--	--	3.0E-07	RsS	--	0.39	--	0.39
			Lead	--	--	--	--	--	NA	--	--	--	--
			Thallium	--	--	--	--	--	NA	--	--	--	--
			Vanadium	--	--	--	--	--	NA	--	0.15	--	0.15
			Chemical Total	--	3.1E-07	--	--	3.1E-07		--	0.55	--	0.55
		Exposure Point Total						3.1E-07					0.55
	Exposure Medium Total							3.1E-07					0.55
Soil Total								**4.95E-07**					**1.21**

TABLE 8-22

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COMBINED COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Tap											
			Naphthalene	--	--	--	--	--	Whole Body	<0.01	--	<0.01	<0.01
			Arsenic	5.2E-09	--	1.7E-09	--	6.9E-09	Skin / CVS	<0.01	--	<0.01	<0.01
			Cadmium	--	--	--	--	--	Kidney	<0.01	--	<0.01	<0.01
			Cobalt	--	--	--	--	--	CVS	<0.01	--	<0.01	<0.01
			Selenium	--	--	--	--	--	Skin	<0.01	--	<0.01	<0.01
			Vanadium	--	--	--	--	--	GIS / Kidney	<0.01	--	0.02	0.02
			Chemical Total	5.2E-09	--	1.7E-09	--	6.9E-09		<0.01	--	0.02	0.02
		Exposure Point Total						6.9E-09					0.02
	Exposure Medium Total							6.9E-09					0.02
Groundwater Total								**6.92E-09**					**0.02**
Construction Workers Total								**5.02E-07**					**1.23**

Total Risk Across Soil	4.9E-07	Total Hazard Index Across Soil	**1.2**
Total Risk Across Groundwater	6.9E-09	Total Hazard Index Across Groundwater	0.02
Total Risk Across All Media and All Exposure Routes	5.0E-07	Total Hazard Index Across All Media and All Exposure Routes	**1.2**

Notes:

Target Organ Abbreviations:
CVS = Cardiovascular System
GIS = Gastrointestinal System
RsS = Respiratory System

	Inhalation	Oral/Dermal	Total
Whole Body HI =		0.01	0.01
Gastrointestinal System HI =		0.28	0.28
Cardiovascular System HI =		0.40	0.40
Skin HI =		0.06	0.06
Kidney HI =		0.28	0.28
Liver HI =		0.04	0.04
Respiratory System HI =	0.39		0.39

TABLE 8-23

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR 2012 CMS INVESTIGATION COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Soil	Arsenic	9.3E-08	--	8.4E-09	--	1.0E-07	Skin / CVS	0.01	--	<0.01	0.02
			Cobalt	--	--	--	--	--	CVS	0.27	--	<0.01	0.27
			Vanadium	--	--	--	--	--	GIS / Kidney	0.16	--	0.18	0.34
			Chemical Total	9.3E-08	--	8.4E-09	--	1.0E-07		0.44	--	0.19	0.63
		Exposure Point Total						1.0E-07					0.63
	Exposure Medium Total							1.0E-07					0.63
	Air	Fugative Dust	Arsenic	--	6.6E-09	--	--	6.6E-09	NA	--	<0.01	--	<0.01
			Cobalt	--	2.5E-07	--	--	2.5E-07	RsS	--	0.33	--	0.33
			Vanadium	--	--	--	--	--	NA	--	0.19	--	0.19
			Chemical Total	--	2.6E-07	--	--	2.6E-07		--	0.53	--	0.53
		Exposure Point Total						2.6E-07					0.53
	Exposure Medium Total							2.6E-07					0.53
Soil Total								**3.61E-07**					**1.16**
Construction Workers Total								**3.61E-07**					**1.16**

Total Risk Across Soil	3.6E-07	Total Hazard Index Across Soil	**1.2**
Total Risk Across All Media and All Exposure Routes	3.6E-07	Total Hazard Index Across All Media and All Exposure Routes	**1.2**

Notes:

Target Organ Abbreviations:
CVS = Cardiovascular System
GIS = Gastrointestinal System
RsS = Respiratory System

	Inhalation	Oral/Dermal	Total
Gastrointestinal System HI =		0.34	0.34
Cardiovascular System HI =		0.29	0.29
Skin HI =		0.02	0.02
Kidney HI =		0.34	0.34
Respiratory System HI =	0.33		0.33

TABLE 8-24

SUMMARY OF UNCERTAINTIES IN THE RESULTS OF THE HUMAN HEALTH RISK ASSESSMENT SWMU 59 (FORMER VEHICLE MAINTENANCE AND REFUELING AREA) CORRECTIVE MEASURES STUDY INVESTIGATION NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

	Potential Magnitude for Over-Estimation of	Potential Magnitude for Under-Estimation	Potential Magnitude for Over or Under-Estimation of Risks
Environmental Sampling and Analysis			
Sufficient samples may not have been taken to characterize the media being evaluated.			Moderate
Systematic or random errors in the chemical analysis may yield erroneous data.			Low
Selection of COPCs			
The use of site-specific background and USEPA Regional Screening Levels in selecting COPCs in all media of concern.		Low	
Maximum detection limits in excess of screening levels.		Low	
Exposure Assessment			
The standard assumptions regarding body weight, exposure period, life expectancy, population characteristics, and lifestyle may not be representative of the actual exposure situations.			Moderate
The use of the 95th percentile upper confidence level data for the normal or lognormal distribution in the estimation of the RME.			Low
The amount of media intake is assumed to be constant and representative of any actual exposure.			Low
The use of an ABS of 0.01 for metals in the absence of reference values from USEPA RAGS Part E.	Moderate		
Toxicological Assessment			
Toxicological indices derived from high dose animal studies, extrapolated to low dose human exposure.	Moderate		
Use of PPRTV RfD for vanadium.	Moderate		
Chemicals lacking screening criteria.		Low	
Risk Characterization			
Assumption of additivity in the quantitation of cancer risks without consideration of synergism, antagonism, promotion and initiation.			Moderate
Assumption of additivity in the estimation of systemic health effects without consideration of synergism, antagonism, etc.			Moderate
Additivity of risks by individual exposure pathways (dermal and ingestion and inhalation).			Low
Comparison to Background Levels			
Contribution of background levels of vanadium to risks calculated for SWMU 59.	Moderate		

Notes:

Low - Assumptions categorized as "low" may effect risk estimates by less than one order of magnitude.
Moderate - Assumptions categorized as "moderate" may effect estimates of risk by between one and two orders of magnitude.
High - Assumptions categorized as "high" may effect estimates of risk by more than two orders of magnitude.

Source: Risk Assessment Guidance for Superfund, Volume 1, Part A: Human Health Evaluation Manual. USEPA, 1989.

TABLE 9-1

METALS IN SURFACE SOIL EXCEEDING CAOs
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	Corrective Action Objectives	5E-01	5E-02	5E-03	5E-04	5E-04	5E-05	5E-06	59SB01	59SB01	59SB02
Sample ID		5E-SS01	5E-SS02	5E-SS03	5E-SS04	5E-SS04D	5E-SS05	5E-SS06	59SB01-00	59SB01-00D	59SB02-00
Sample Date		5/3/2004	5/3/2004	5/3/2004	5/3/2004	5/3/2004	5/3/2004	5/3/2004	4/19/2010	4/19/2010	4/20/2010
Sample Depth (ft bgs)		0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Metals (mg/kg)											
Copper	168	100 N	150 N	250 N	110 N	130 N	64 N	110 N	93.6 J	96.8 J	84.7 J
Lead	96	10	120	280	98	94	3.4	1100	5.9 J	17 J	31 J
Zinc	120	78	210	930	280	290	49	160	33.8 J	34.1 J	57 J

TABLE 9-1

METALS IN SURFACE SOIL EXCEEDING CAOs
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	Corrective Action Objectives	59SB03	59SB04	59SB06	59SB07	59SB08	59SB09	59SB11	59SB11	59SB12	59SB13
Sample ID		59SB03-00	59SB04-00	59SB06-00	59SB07-00	59SB08-00	59SB09-00	59SB11-00	59SB11-00D	59SB12-00	59SB13-00
Sample Date		4/19/2010	4/22/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010
Sample Depth (ft bgs)		0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Metals (mg/kg)											
Copper	168	106 J	24.8 J	91.7 J	126 J	41.5 J	237 J	107	92.2	81.3	94.9 J
Lead	96	51.3 J	3.4 J	10.5 J	27.3 J	2.6 J	654 J	5.5 J	8.7 J	47.4	5.2
Zinc	120	101 J	62.3 J	77.9 J	82.4 J	80.5 J	468 J	53.5	64.5	232	58.6

TABLE 9-1

METALS IN SURFACE SOIL EXCEEDING CAOs
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	Corrective Action Objectives	59SB14	59SB15	59SB17	59SB17	59SB18	59SB20	59SB21	59SB22	59SB23	59SB24
Sample ID		59SB14-00	59SB15-00	59SB17-00	59SB17-00D	59SB18-00	59SB20-00	59SB21-00	59SB22-00	59SB23-00	59SB24-00
Sample Date		5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	9/13/2012
Sample Depth (ft bgs)		0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Metals (mg/kg)											
Copper	168	291	120	76.3	68.8	59.5 J	94.2 J	102 J	76.6 J	73.9 J	260 J
Lead	96	3.5	638	22.4	9.8	7.1	3.6	15.1	16.7	11.8	9.6 R
Zinc	120	123	747	132	63.2	59.9	81.5	87.7	77.4	52	100 J

TABLE 9-1

METALS IN SURFACE SOIL EXCEEDING CAOs
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	Corrective Action Objectives	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID		59SB24-00D	59SB25-00	59SB26-00	59SB27-00	59SB28-00	59SB29-00	59SB30-00	59SB31-00	59SB32-00	59SB33-00
Sample Date		9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Sample Depth (ft bgs)		0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Metals (mg/kg)											
Copper	168	170 J	71	100	50	66	130	83	99	120	110
Lead	96	12 R	12 R	3 R	1.4 R	1.8 R	2.7 R	4.4 R	3.2 R	6.9 R	4.7 R
Zinc	120	67 J	73	76	42	44	68	50	78	46	57

TABLE 9-1

METALS IN SURFACE SOIL EXCEEDING CAOs
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	Corrective Action Objectives	59SS01	59SS02	59SS03	59SS04	59SS04D	59SS05	59SS06	59SS07	59SS08	59SS09
Sample ID		59SS01	59SS02	59SS03	59SS04	59SS04D	59SS05	59SS06	59SS07	59SS08	59SS09
Sample Date		9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012
Sample Depth (ft bgs)		0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Metals (mg/kg)											
Copper	168	NA	NA	NA	415	244	46	89	100	NA	NA
Lead	96	45.2	23	5.49	230	214	0.92	4	75.2	242	580
Zinc	120	132	61	66.7	284	289	37	70	250	302	74

TABLE 9-1

METALS IN SURFACE SOIL EXCEEDING CAOs
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	Corrective Action Objectives	59SS10	59SS11	59SS12	59SS13	59SS14	59SS14D	59SS15	59SS16	59SS17	59SS18
Sample ID		59SS10	59SS11	59SS12	59SS13	59SS14	59SS14D	59SS15	59SS16	59SS17	59SS18
Sample Date		9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012
Sample Depth (ft bgs)		0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Metals (mg/kg)											
Copper	168	NA	67.8	113	136	NA	NA	NA	NA	NA	NA
Lead	96	1.4	NA	NA	NA	19.9	26.5	66.7	3.96	NA	NA
Zinc	120	59	63.3	140	66.8	72.7	99.2	656	119	97.9	60

TABLE 9-1

METALS IN SURFACE SOIL EXCEEDING CAOs
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	Corrective Action Objectives	59SS19	59SS20	59SS21	59SS21D	59SS22	59SS23	59SS24	59SS25	59SS26	59SS26D
Sample ID		59SS19	59SS20	59SS21	59SS21D	59SS22	59SS23	59SS24	59SS25	59SS26	59SS26D
Sample Date		9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	11/10/2012	11/10/2012	11/10/2012
Sample Depth (ft bgs)		0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Metals (mg/kg)											
Copper	168	NA	NA	NA	NA	NA	NA	NA	NA	140 J	150
Lead	96	NA	NA	NA	NA	NA	NA	NA	NA	59 J	68
Zinc	120	111	150	240	237	215	86	110	120	120 J	130

TABLE 9-1

METALS IN SURFACE SOIL EXCEEDING CAOs
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	Corrective Action Objectives	59SS27	59SS28	59SS29	59SS30	59SS31	59SS32	59SS33	59SS34
Sample ID		59SS27	59SS28	59SS29	59SS30	59SS31	59SS32	59SS33	59SS34
Sample Date		11/10/2012	11/10/2012	11/10/2012	11/10/2012	11/10/2012	11/10/2012	11/10/2012	11/10/2012
Sample Depth (ft bgs)		0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Metals (mg/kg)									
Copper	168	NA	NA	NA	NA	NA	NA	NA	NA
Lead	96	49	100	110	270	NA	NA	NA	NA
Zinc	120	200	240	NA	NA	230	2100 D	390	86

Notes/Qualifiers:

D - The reported value is from a dilution.
J - Estimated: The analyte was positively identified; the quantitation is an estimation.
N - The matrix spike recovery was not within control limits.
R - Rejected data; data is not usable.
ft bgs - feet below ground surface
mg/kg - milligram per kilogram
NA - Not Analyzed

TABLE 9-2

METALS IN SEDIMENT EXCEEDING CAOs
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	CAOs	59SD01	59SD02	59SD03	59SD04	59SD04	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Sample ID		59SD01	59SD02	59SD03	59SD04	59SD04D	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Sample Date		4/22/2010	5/20/2010	5/20/2010	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012
Sample Depth (ft bgs)		0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5
Metals (mg/kg)														
Copper	131	125 J	144 J	90.7 J	107	83.8	187 J	160 J	87.6 J	134 J	36.2 J	78.3 J	161 J	52.4 J
Zinc	121	122 J	139 J	176	193 J	130 J	357 J	319 J	191 J	154 J	71.7 J	108 J	232 J	262 J

Notes:

J - Estimated: The analyte was positively identified; the quantitation is an estimation.
CAO - Corrective Action Objective
ft bgs - feet below ground surface
mg/kg - milligram per kilogram

TABLE 10-1

BUDGETARY COST ESTIMATE - EXCAVATION AND OFF-SITE DISPOSAL
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Cost Item	Quantity	Units	Unit Cost	Total Cost	Source	Assumptions (Basis of Cost Estimate)
DIRECT CAPITAL COSTS						
I. Site Preparation						
A. Construction Survey	2	DAY	$ 1,500.00	$ 3,000.00	Engineer's Estimate	Survey crew for excavation layout
B. Erosion and Sediment Controls	1	LS	$ 1,800.00	$ 1,800.00	Engineer's Estimate	30" silt fence and hay bails
C. Clearing and Grubbing	1.00	AC	$ 4,425.00	$ 4,425.00	Means Site Work & Landscape	Cut & chip trees to 12" diameter; use as mulch in site restoration; ASV RC-100 skid steer equipped with Magnum Systems Mulcher for small trees/brush
D. Laydown and Load-Out Areas	1	LS	$ 1,500.00	$ 1,500.00	Engineer's Estimate	Equipment laydown and staging areas
II. Excavation and Off-Site Disposal (soil)						
A. Excavation and Loading	1,275	CY	$ 15.00	$ 19,125.00	Vendor Quote - Recent Project	Excavating; bulk bank measure; includes concrete from Area 5
B. Hauling (20% increase in loaded volume)	79	TRIP	$ 825.00	$ 65,175.00	Vendor Quote - Recent Project	1,530 loose CY soil; 26 CY concrete; 20 CY truck, approx 3.5-hr round trip haul to Peñuelas Valley Landfill plus 15 min. wait/load/unload
C. Landfill Disposal	2,041	TON	$ 45.00	$ 91,845.00	Vendor Quote - Recent Project	Peñuelas Valley Landfill; non-hazardous waste; 1.3 tons/loose CY soil (1,989 tons); 2 tons/CY concrete (52 tons)
D. Post-Excavation Confirmation Sampling - Copper, Lead, Zinc	41	EA	$ 45.00	$ 1,845.00	Vendor Quote - Recent Project	72 hr TAT; Area 1: 1 sample every 25 linear feet along sidewalls except where excavation extends up to concrete/asphalt slabs, buildings, or other site structures; includes QA/QC
E. Post-Excavation Confirmation Sampling - Lead, Zinc	6	EA	$ 35.00	$ 210.00	Vendor Quote - Recent Project	72 hr TAT; Area 2: 1 sample every 25 linear feet along sidewalls except where excavation extends up to concrete/asphalt slabs, buildings, or other site structures; includes QA/QC
F. Post-Excavation Confirmation Sampling - Zinc	21	EA	$ 25.00	$ 525.00	Vendor Quote - Recent Project	72 hr TAT; Area 3 and Area 4: 1 sample every 25 linear feet along sidewalls except where excavation extends up to concrete/asphalt slabs, buildings, or other site structures; includes QA/QC
G. Post-Excavation Confirmation Sampling - Copper	6	EA	$ 25.00	$ 150.00	Vendor Quote - Recent Project	72 hr TAT; Area 5: 1 sample every 25 linear feet along sidewalls except where excavation extends up to concrete/asphalt slabs, buildings, or other site structures; includes QA/QC
H. Waste Disposal Characterization Sampling	2	EA	$ 250.00	$ 500.00	Vendor Quote - Recent Project	1 week TAT; TCLP Metals, RCI, Paint Filter Test; actual analyses to be dictated by selected disposal facility
III. Excavation and Off-Site Disposal (sediment)						
A. Delineation Sampling - Copper, Zinc	6	EA	$ 35.00	$ 210.00	Vendor Quote - Recent Project	72 hr TAT; 4 samples to be collected downgradient of location 59SD12; includes QA/QC.
A. Excavation and Dewatering	73	CY	$ 125.00	$ 9,125.00	Engineer's Estimate	Excavating; placing sediment on polyethylene sheets to dewater and dry.
B. Hauling (20% increase in loaded volume)	4	TRIP	$ 825.00	$ 3,300.00	Vendor Quote - Recent Project	66 CY dry sediment; 20 CY truck, approx 3.5-hr round trip haul to Peñuelas Valley Landfill plus 15 min. wait/load/unload
C. Landfill Disposal	96	TON	$ 45.00	$ 4,320.00	Vendor Quote - Recent Project	Peñuelas Valley Landfill; non-hazardous waste; 1.3 tons/l CY dry sediment (86 tons)
D. Post-Excavation Confirmation Sampling - Copper, Zinc	6	EA	$ 35.00	$ 210.00	Vendor Quote - Recent Project	72 hr TAT; 1 sample will be collcected from the excavation edge, perpendicular to the channel; includes QA/QC.
E. Management, Treatment, and Disposal of Liquid from Dewatered Sediment	1,220	GAL	$ 2.50	$ 3,050.00	Engineer's Estimate	Estimating about 20 gallons per 1 cubic yard of sediment.

TABLE 10-1

BUDGETARY COST ESTIMATE - EXCAVATION AND OFF-SITE DISPOSAL
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Cost Item	Quantity	Units	Unit Cost	Total Cost	Source	Assumptions (Basis of Cost Estimate)
IV. Site Restoration						
A. Purchase and Transport Backfill Soil	1,097	CY	$ 18.00	$ 19,746.00	Vendor Quote - Recent Project	Common borrow from off-site source
B. Purchase and Transport Topsoil	459	CY	$ 30.00	$ 13,770.00	Vendor Quote - Recent Project	Topsoil from off-site source
C. Place and Compact Soil Backfill/Place and Grade Topsoil	1,530	CY	$ 4.19	$ 6,410.70	Means Site Work & Landscape	Common earth backfill: 300 HP dozer & roller compactor, 6" lifts, 4 passes; topsoil: grade with dozer
D. Purchase, Transport, and Place Clay Backfill soil and riprap	73	CY	$ 75.00	$ 5,475.00	Engineer's Estimate	Drainage ditch area; includes spreading and compaction in 6" lifts (excavation volume plus 20%)
E. Vegetative Cover (Seeding/Mulching)	1.00	AC	$ 3,000.00	$ 3,000.00	Engineer's Estimate	Hydro or air seeding with mulch and fertilizer; 25% increase in excavation area to account for disturbed area
F. Confirm Clean Backfill Analysis	3	EA	$ 1,300.00	$ 3,900.00	Vendor Quote - Recent Project	1 sample from common borrow; 1 sample from topsoil; 1 sample from clay backfill; BTEX, TPH, full TCLP, RCI, Geotechnical Parameters
V. Post Closure O&M	6	WEEK	$ 1,000.00	$ 6,000.00	Engineer's Estimate	Periodic visual inspections to verify soil cover is not eroding and permanent vegetation has established; does not include costs for re-vegetation if warranted
SUBTOTAL - DIRECT CAPITAL COSTS				**$ 268,616.70**		
OTHER COSTS/CONTRACTOR PROFIT/CONTINGENCY						
I. Mobilization/Demobilization	1	LS	$ 7,000.00	$ 7,000.00	Engineer's Estimate	
II. ARB and PAT	1	LS	$ 1,477.39	$ 1,477.39	Vendor Quote	0.55% of Subtotal Direct Capital Cost
III. FONDO	1	LS	$ 8,595.73	$ 8,595.73	Vendor Quote	3.2% of Subtotal Direct Capital Cost
IV. Contractor Profit	1	LS	$ 40,292.51	$ 40,292.51	Vendor Quote	15% of Subtotal Direct Capital Cost
V. Contractor Overhead	1	LS	$ 37,606.34	$ 37,606.34	Vendor Quote	14% of Subtotal Direct Capital Cost
TOTAL - CONTRACTOR COST				**$ 363,588.67**		
VI. Contingency Allowance	1	LS	$ 54,538.30	$ 54,538.30	Engineer's Estimate	15% of Total Contractor Cost
PROFESSIONAL SERVICES						
I. Project Management	1	LS	$ 21,815.32	$ 21,815.32	Engineer's Estimate	6% of Total Contractor Cost
II. Engineering Support	1	LS	$ 43,630.64	$ 43,630.64	Engineer's Estimate	12% of Total Contractor Cost
III. Construction Oversight/Quality Assurance	1	LS	$ 29,087.09	$ 29,087.09	Engineer's Estimate	8% of Total Contractor Cost
TOTAL - PROFESSIONAL SERVICES				**$ 94,533.05**		
TOTAL PROJECT COST SUMMARY						
TOTAL CONTRACTOR COST				**$ 363,589**		
CONTINGENCY				**$ 54,538**		
PROFESIONAL SERVICES				**$ 94,533**		
TOTAL PROJECT COST				**$ 512,660**		

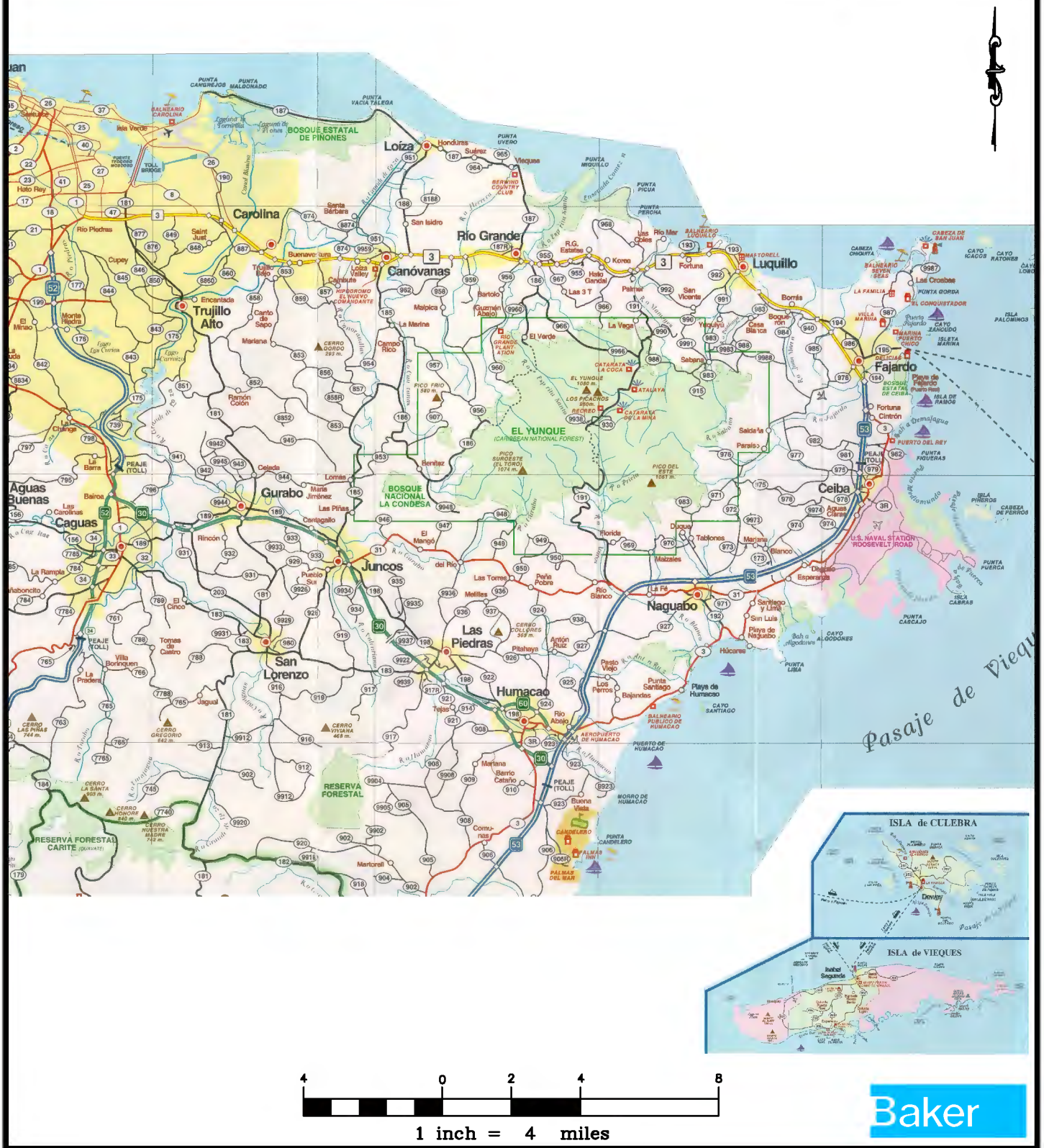
TABLE 11-1

DESIGN CONSIDERATIONS
SWMU 59 – FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Design Consideration	Applicability
Site Ownership	SWMU 59 is located within Sale Parcel III, which was transferred from the Navy to the Commonwealth of Puerto Rico on January 25, 2012. However, SWMU 59 was not included in the transfer at the time. Rather, it was "carved out" of the transfer while the Navy continues with implementation of the remaining corrective action obligations in accordance with the RCRA §7003 Administrative Order on Consent.
Site Access	SWMU 59 is located within the east-central portion of NAP and is easily accessible from the western side via Forrestal Drive. The remedial contractor will coordinate site access with the Navy. Dense vegetation is present at the majority of excavation areas but is not expected to impact implementation of the proposed removal action.
Existing Structures	The majority of the site is developed, with concrete and paved (asphalt) surfaces throughout. Site features include Buildings 60, 258, and 377; abandoned fuel islands (a total of four), a wash pad, and an oil water separator.
Disruption of Adjacent Facilities	There will be no disruption of adjacent facilities or operations during implementation of the proposed removal action.
Available Utilities	Utilities are not available in the immediate vicinity of the excavation areas but are not required for implementation of the proposed removal action.
Utility Clearance	The remedial contractor will be responsible for clearing underground utilities at all excavation areas.
Extent of Contamination	The extent of contaminated soil has been delineated. Post-excavation confirmation samples will be collected from the excavation areas to ensure removal of contaminated soil has been completed.
Decontamination and Staging Areas	Decontamination, equipment lay down, and staging areas may be placed on the concrete slab and/or asphalt surface or alternate location requested by the remedial contractor and approved by Navy representative. The exact location of the decontamination and staging areas will be discussed in the Corrective Measures Implementation Design.
Off-Site Disposal	Contaminated soil will be transported to an on-island, permitted, disposal facility unless characterization testing indicates levels exceeding landfill acceptance criteria. The on-island disposal facilities are located in Peñuelas and Humacao. Licensed waste haulers are available and will transport the soil to the disposal facility. No hazardous waste is anticipated. However, if the waste is characterized as hazardous, then it must be disposed of off-island at a facility in the continental United States thereby substantially increasing project costs.

FIGURES

K:_SOUTHNAVFAC\119197 JM01\SWMU 59\Report\CMS\Draft Final Report\FIGURES\119197_CMS59_01.dwg



4 0 2 4 8

1 inch = 4 miles

Baker

FIGURE 2-1
REGIONAL LOCATION MAP
SWMU 59-FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO

SOURCE: METRODATA, INC., 1999.

K:_SOUTHNAVFAC\119197 JM01\SWMU 59\Report\CMS\Draft Final Report\FIGURES\119197_CMS59_02.dwg

LEGEND

1 – SWMUs

59 – AREA TO WHICH THIS REPORT PERTAINS TO

AOC D – AOCs

SOURCE: GEO–MARINE, INC., SEPTEMBER 6, 2000.

3000 0 1500 3000

1 inch = 3000 ft.

FIGURE 2–2

SWMU/AOC LOCATION MAP

SWMU 59–FORMER VEHICLE MAINTENANCE AND REFUELING AREA

CORRECTIVE MEASURES STUDY REPORT

NAVAL ACTIVITY PUERTO RICO

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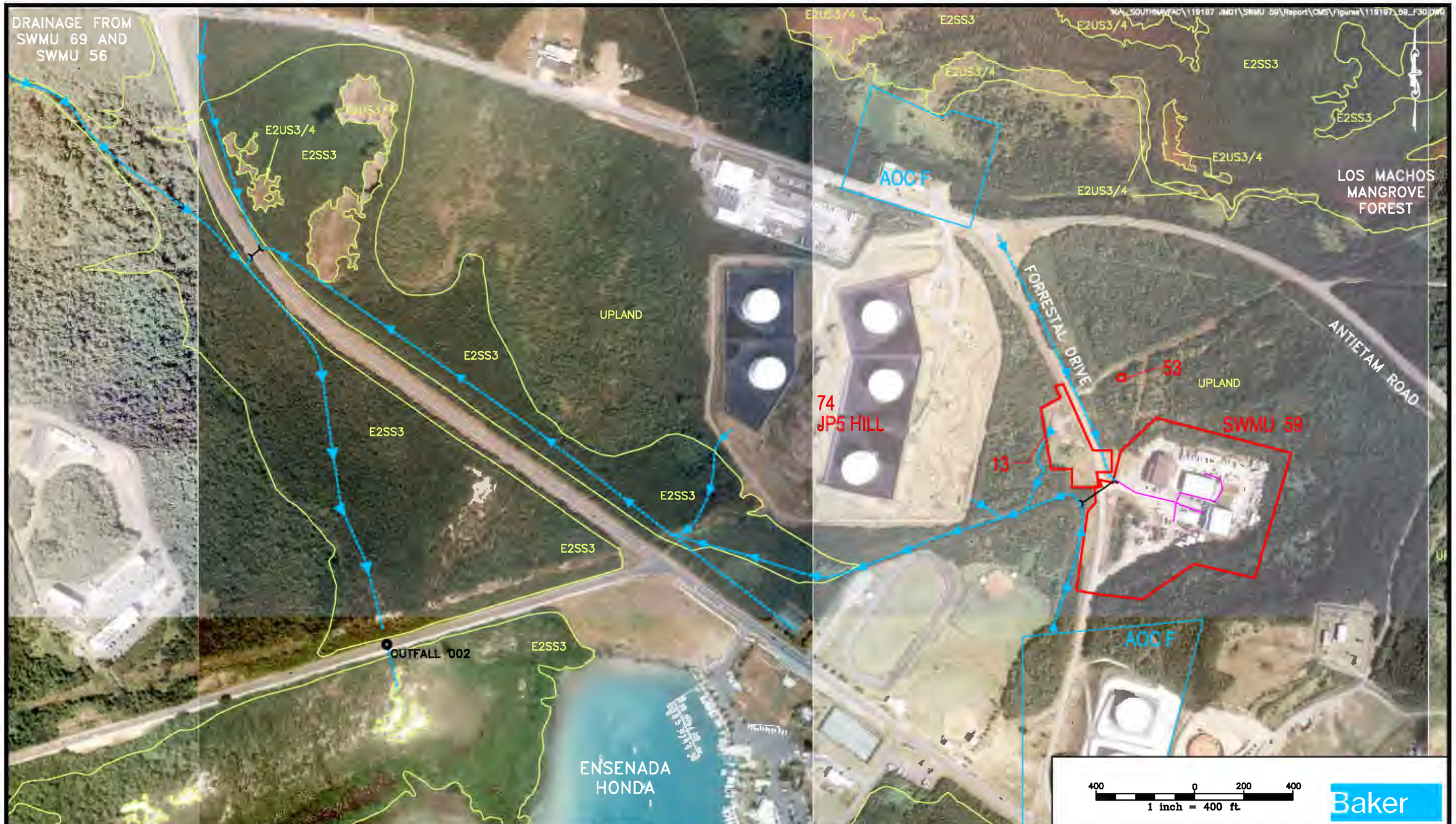
LEGEND

- -1958 POLYGON FEATURE
- -1961 POLYGON FEATURE
- -1964 POLYGON FEATURE
- -1976 POLYGON FEATURE
- -1977 POLYGON FEATURE
- -1985 POLYGON FEATURE
- -1995 POLYGON FEATURE
- -SWMU BOUNDARY

FIGURE 2-3
1976 AERIAL PHOTOGRAPH
SWMU 59-FORMER VEHICLE
MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT

NAVAL ACTIVITY PUERTO RICO



NOTE
1. INFORMATION ON AND IS ON FIGURE 7-4 THE COWARDIN WETLAND CLASSIFICATION SYSTEM
2. DOES NOT DEPICT ENTIRE STORMWATER DRAINAGE SYSTEM

LEGEND
- -SWMU BOUNDARY
- -AOC BOUNDARY
- -DRAINAGE DITCHS
- -STORM FLOW ARROW
- -STORM PIPE
- -STORM OUTFALL
- -WETLAND DELINEATION CLASSIFICATION IDENTIFICATION
- -WETLAND DELINEATION BOUNDARY

FIGURE 2-4
DRAINAGE DITCH SYSTEM ASSOCIATED WITH SWMU 59
SWMU 59-FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO

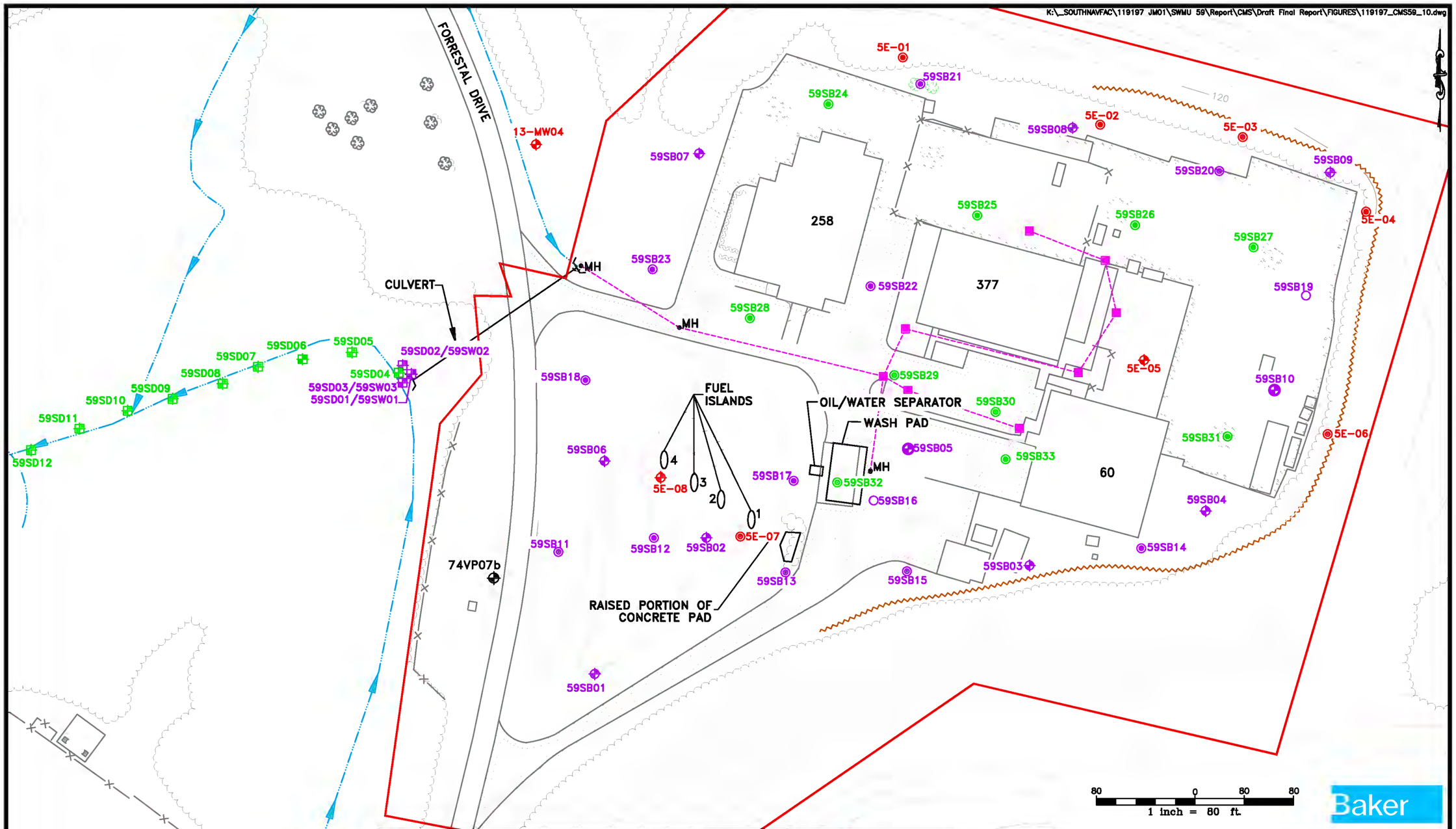
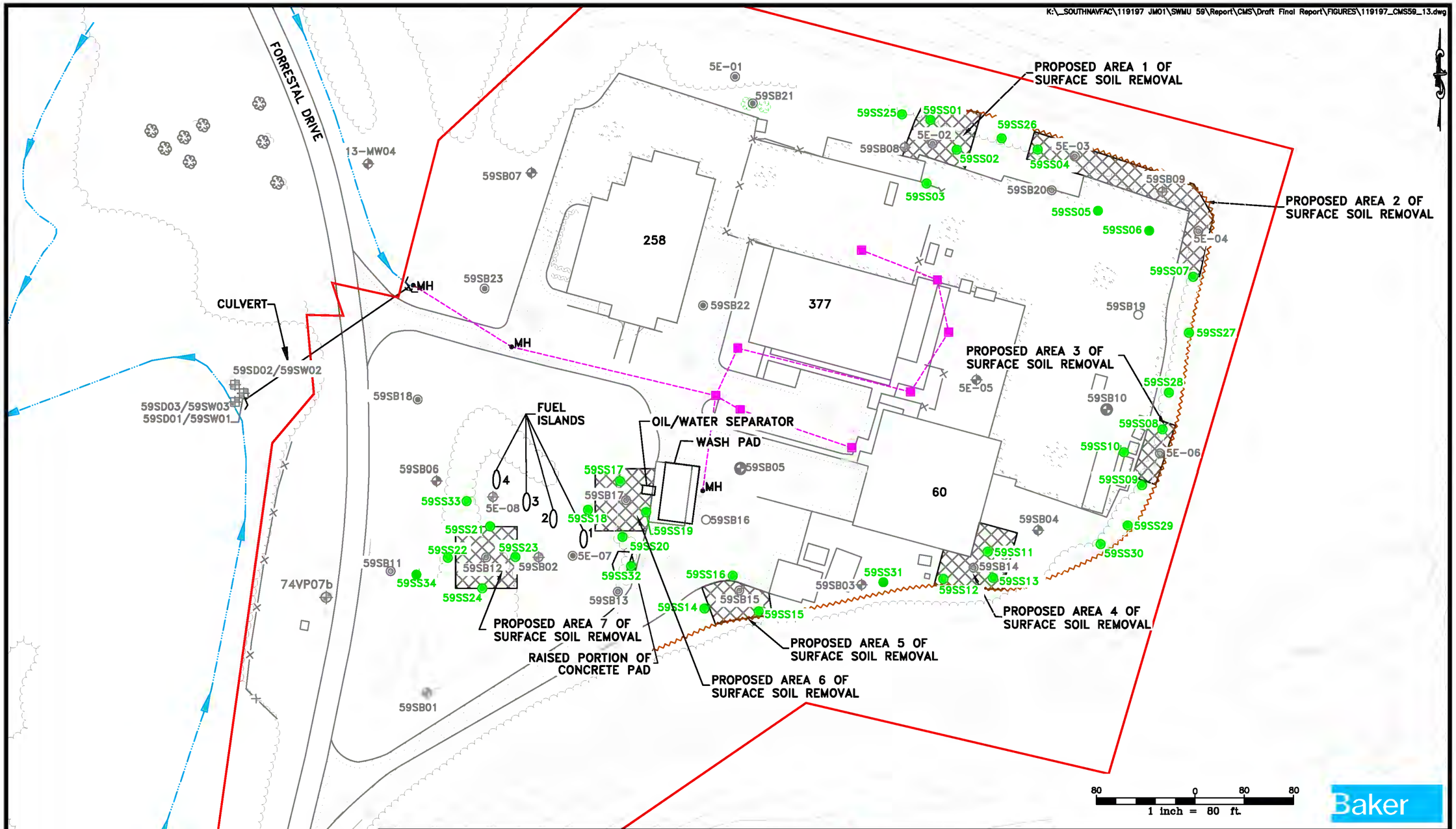


FIGURE 4-1
CMS SAMPLE LOCATION MAP
SWMU 59-FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO

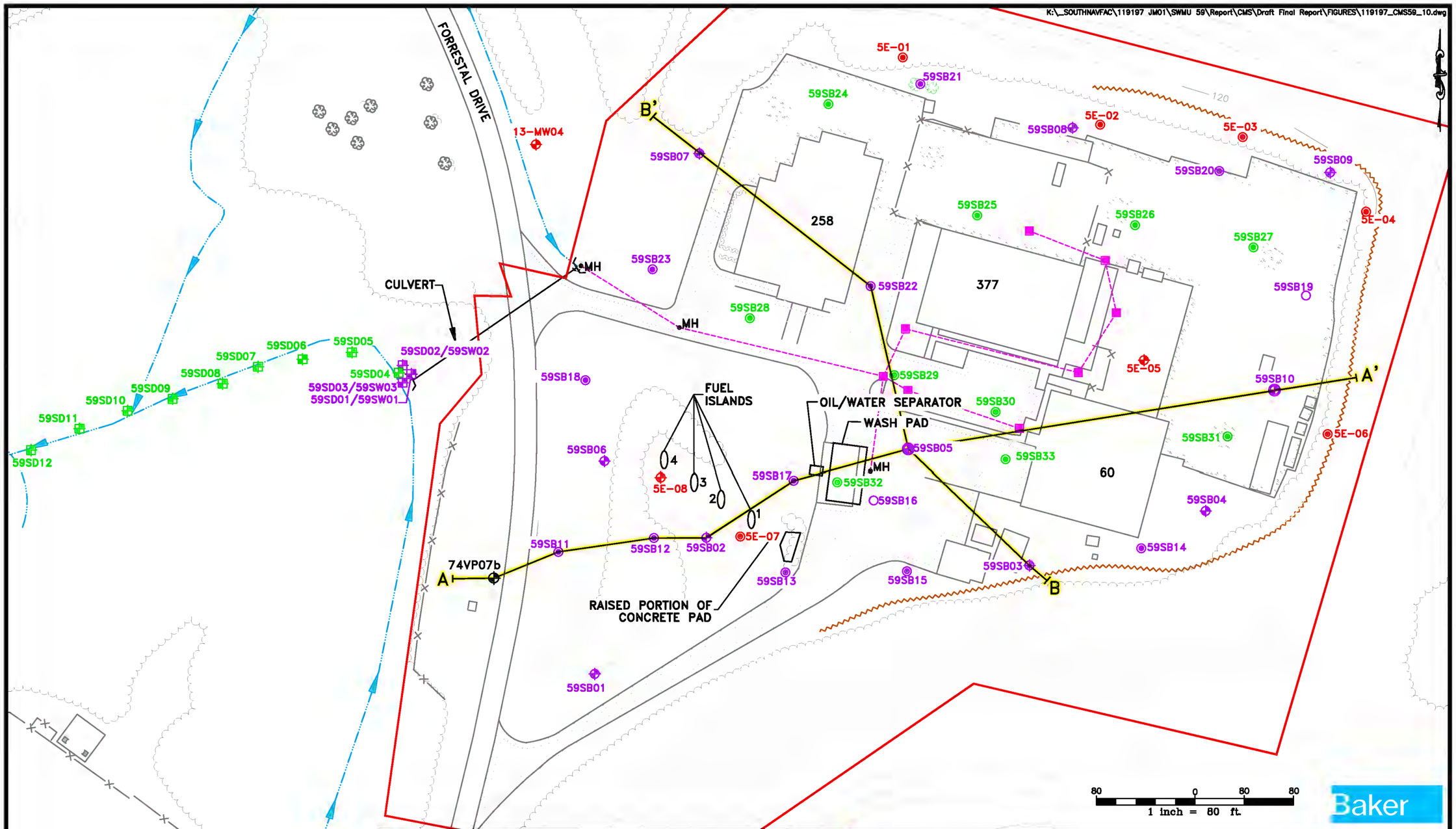
K:_SOUTHNAVFAC\119197 JM01\SWMU 59\Report\CMS\Draft Final Report\FIGURES\119197_CMS59_13.dwg



LEGEND

- –SURFACE AND/OR SUBSURFACE SOIL SAMPLE LOCATION (ECP 2004)
- –SURFACE SOIL AND/OR SUBSURFACE SOIL AND/OR GROUNDWATER SAMPLE LOCATION (ECP 2004)
- –SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- –SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- –SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- –SURFACE, SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- –SURFACE WATER/SEDIMENT SAMPLE LOCATION (CMS 2010)
- –PRE-EXCAVATION DELINEATION SURFACE SOIL SAMPLE LOCATION (2012)
- –SWMU 59 BOUNDARY
- –DRAINAGE DITCH
- –STORM MANHOLE
- –STORM PIPE
- –STORM INLET
- –PROPOSED AREA OF SOIL REMOVAL (CMS 2010)
- –APPROXIMATE EDGE OF SLOPE
- –VEGETATION
- –CONCRETE
- –ASPHALT

FIGURE 4-2
PRE-EXCAVATION DELINEATION SAMPLE LOCATION MAP
SWMU 59-FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO

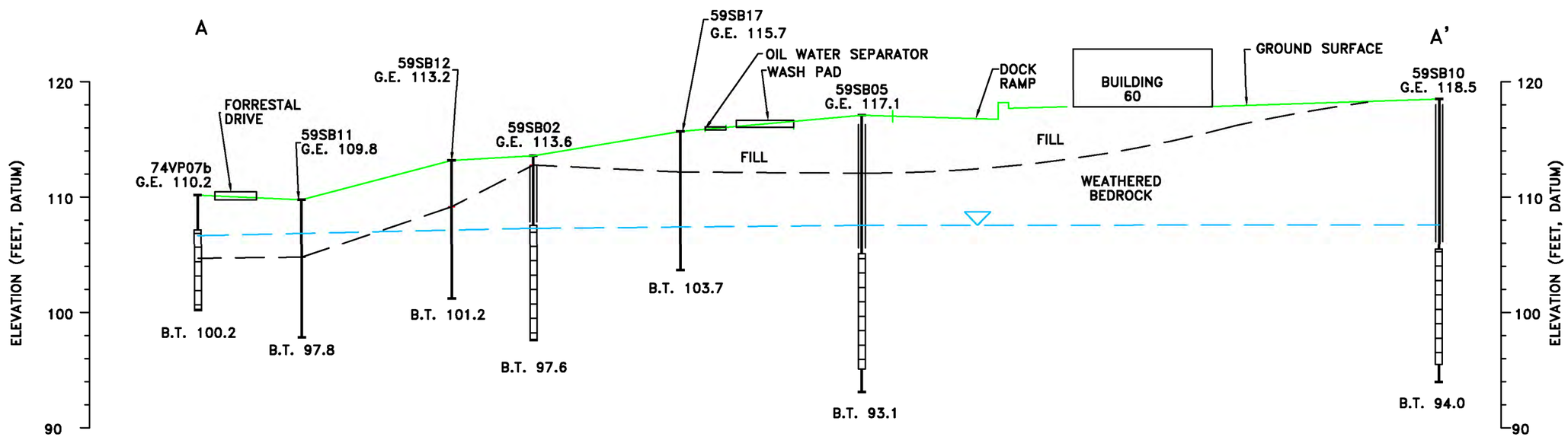


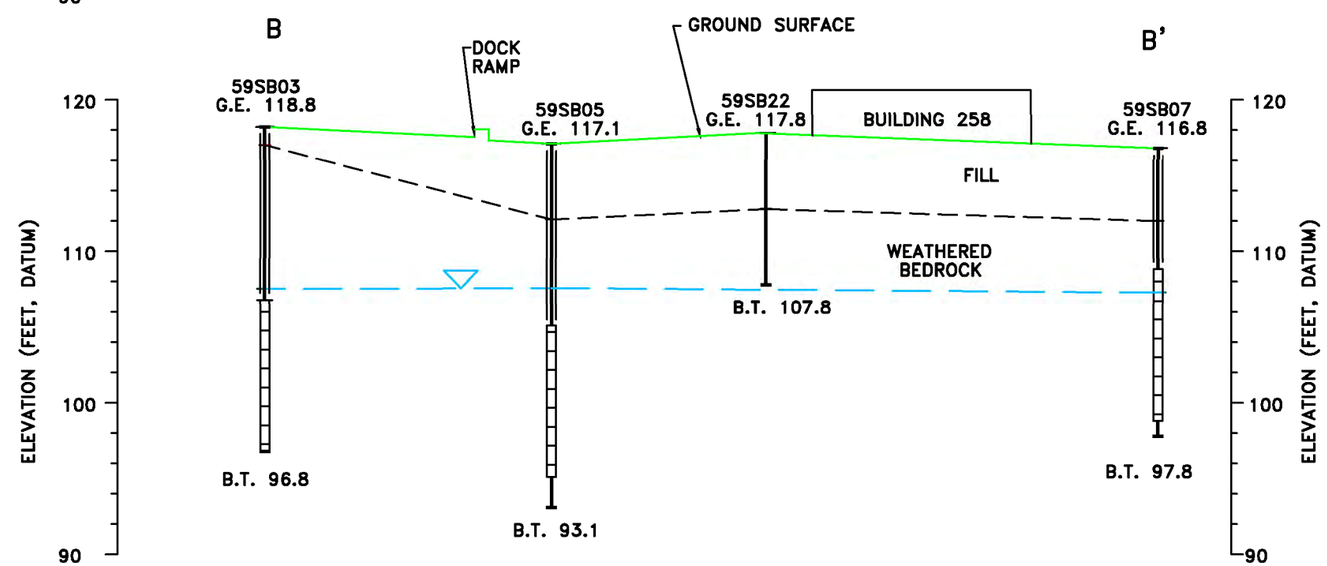
LEGEND

- –SURFACE AND/OR SUBSURFACE SOIL SAMPLE LOCATION (ECP 2004)
- –SURFACE SOIL AND/OR SUBSURFACE SOIL AND/OR GROUNDWATER SAMPLE LOCATION (ECP 2004)
- –SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- –SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- –SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- –SURFACE, SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- –SURFACE WATER/SEDIMENT SAMPLE LOCATION (CMS 2010)
- –SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (CMS 2012)
- –SEDIMENT SAMPLE LOCATION (CMS 2012)
- –MONITORING WELL (SWMU 74)
- –SWMU 59 BOUNDARY
- A A' –CROSS SECTION TRAVERSE
- –DRAINAGE DITCH
- –STORM MANHOLE
- –STORM PIPE
- –STORM INLET
- –APPROXIMATE EDGE OF SLOPE
- –VEGETATION
- –CONCRETE
- –ASPHALT

FIGURE 5-1
GEOLOGIC CROSS SECTION ORIENTATION MAP
SWMU 59-FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO

K:_SOUTHNAVFAC\119197 JM01\SWMU 59\Report\CMS\Draft Final Report\FIGURES\119197_CMS59_15.dwg





THE SOIL BORING INFORMATION IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS. SUBSURFACE CONDITIONS INTERPOLATED BETWEEN BORINGS ARE ESTIMATED BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND GEOLOGIC JUDGEMENT.

NOTE: DATUM PLAN USED IS THE MEAN LOW WATER +100.00 FOOT AS ESTABLISHED BY THE U.S. NAVY SECTION (NOVEMBER 1941).

60 0 30 60
1 inch = 60 ft.
HORIZONTAL SCALE

10 0 5 10
1 inch = 10 ft.
VERTICAL SCALE
EXACGERATION 10x

Baker

LEGEND

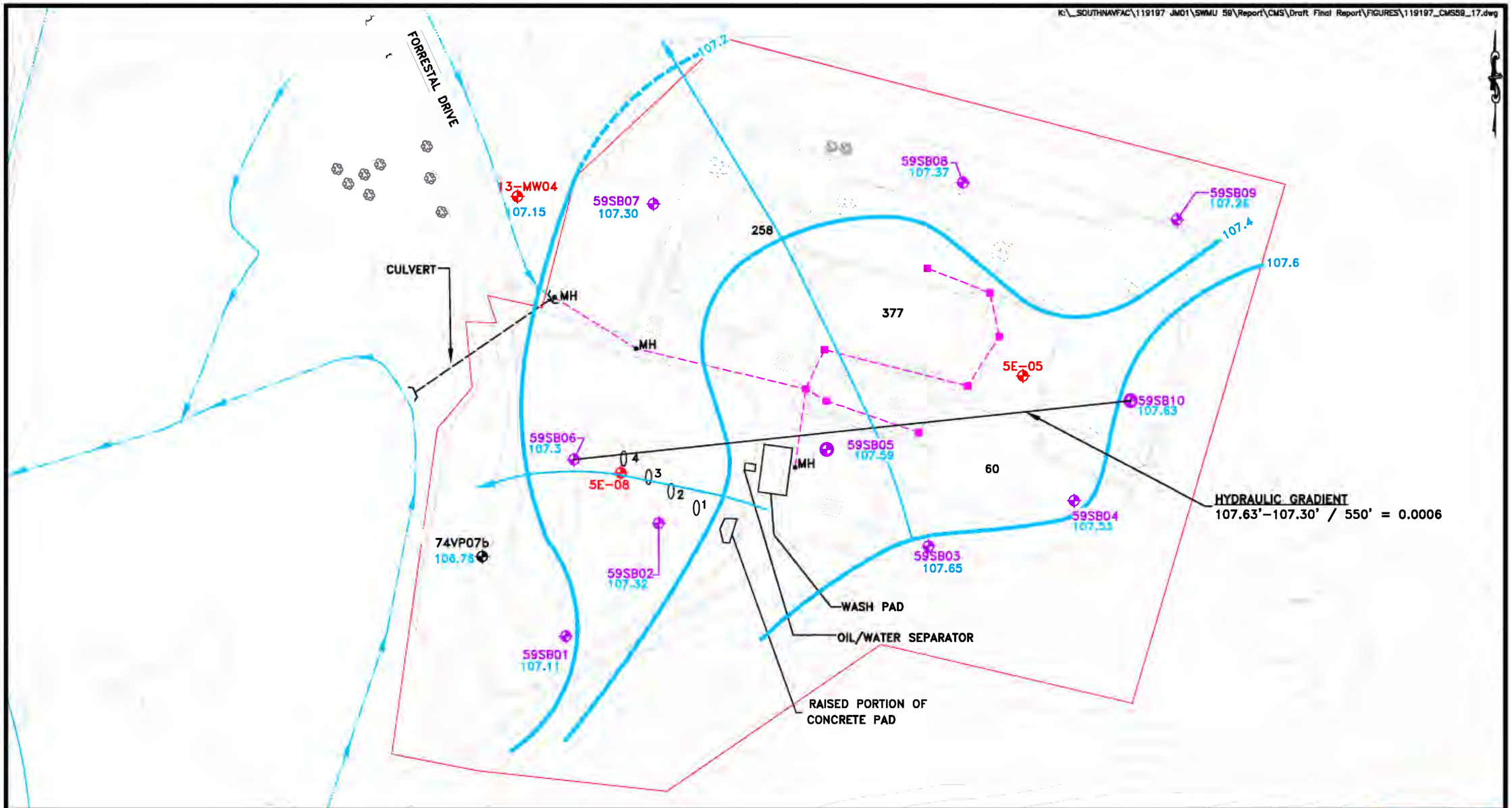
- ESTIMATED/PROJECTED CONTACT
- ESTMATED TOP OF GROUNDWATER
- BORING
- BORING AND RISER
- SCREEN

G.E. 110.2 –GROUND ELEVATION, DATUM ELEVATION
B.T. 97.8 –BORING TERMINATED, DATUM ELEVATION

FIGURE 5–2
GEOLOGIC CROSS SECTIONS A–A' AND B–B'
SWMU 59–FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT

NAVAL ACTIVITY PUERTO RICO

K:_SOUTHNAVFAC\119197 JM01\SWMU 59\Report\CMS\Draft Final Report\FIGURES\119197_CMS59_17.dwg



NOTE: DATUM PLAN USED IS THE MEAN LOW WATER +100.00 FOOT AS ESTABLISHED BY THE U.S. NAVY SECTION (NOVEMBER 1941).

Baker

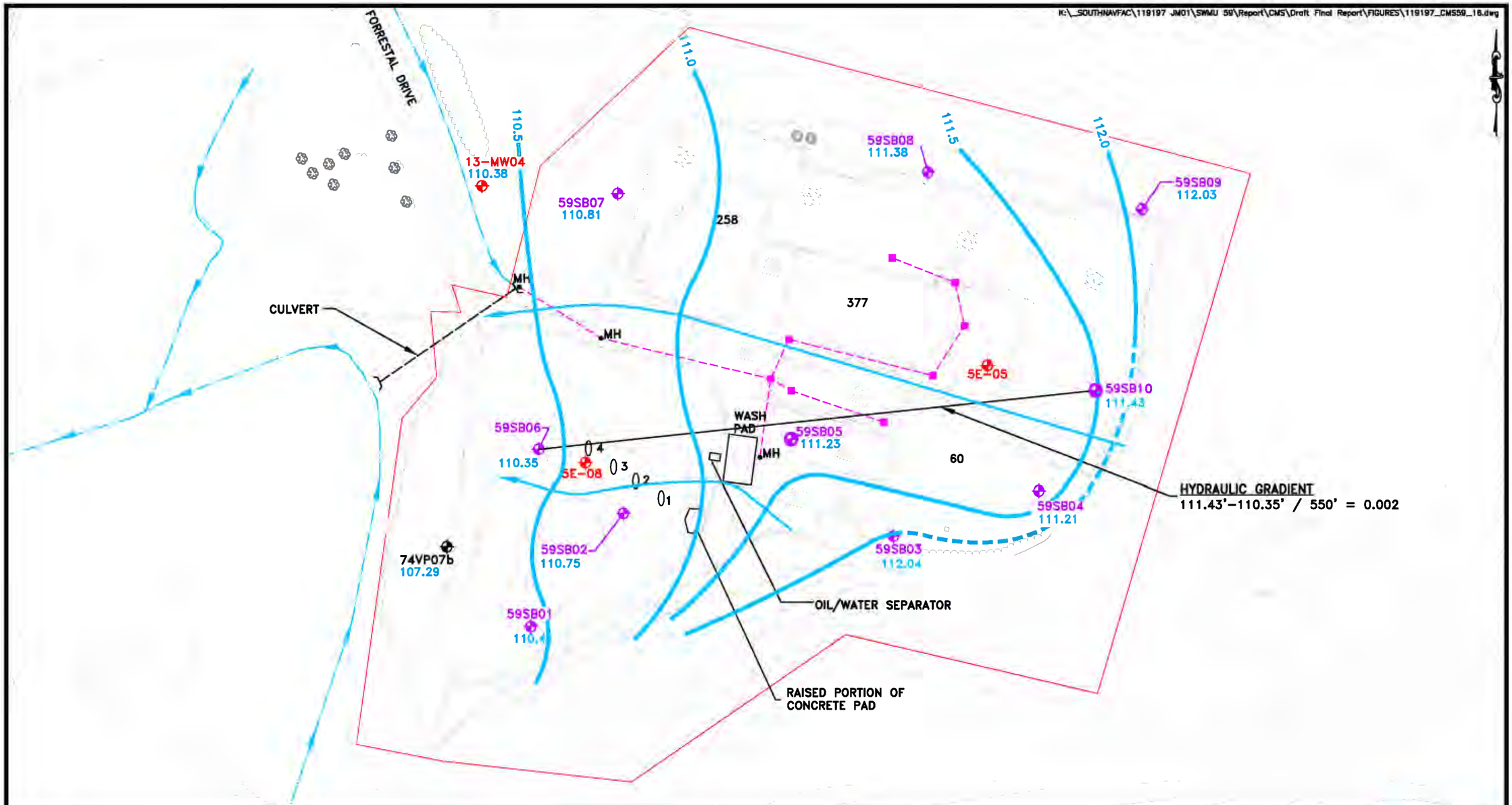
LEGEND

- -SWMU BOUNDARY
- -SURFACE SOIL AND/OR SUBSURFACE SOIL, AND/OR GROUNDWATER SAMPLE LOCATION (ECP 2004)
- -SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- -SURFACE, SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- -GROUNDWATER SAMPLE LOCATION FROM SWMU 74
- -DRAINAGE DITCH
- -STORM MANHOLE
- -STORM PIPE
- -STORM INLET
- 107.11-GROUNDWATER ELEVATION
- -GROUNDWATER CONTOUR LINE (ESTIMATED)
- -GROUNDWATER FLOW DIRECTION
- -VEGETATION
- -CONCRETE
- -ASPHALT

FIGURE 5-3
GROUNDWATER CONTOUR MAP
JANUARY 13, 2011
SWMU 59-FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT

NAVAL ACTIVITY PUERTO RICO

K:_SOUTHNAVFAC\119197 JM01\SWMU 59\Report\CMS\Draft Final Report\FIGURES\119197_CMS59_16.dwg



NOTE: DATUM PLAN USED IS THE MEAN LOW WATER +100.00 FOOT AS ESTABLISHED BY THE U.S. NAVY SECTION (NOVEMBER 1941).

100 0 50 100
1 inch = 100 ft.

Baker

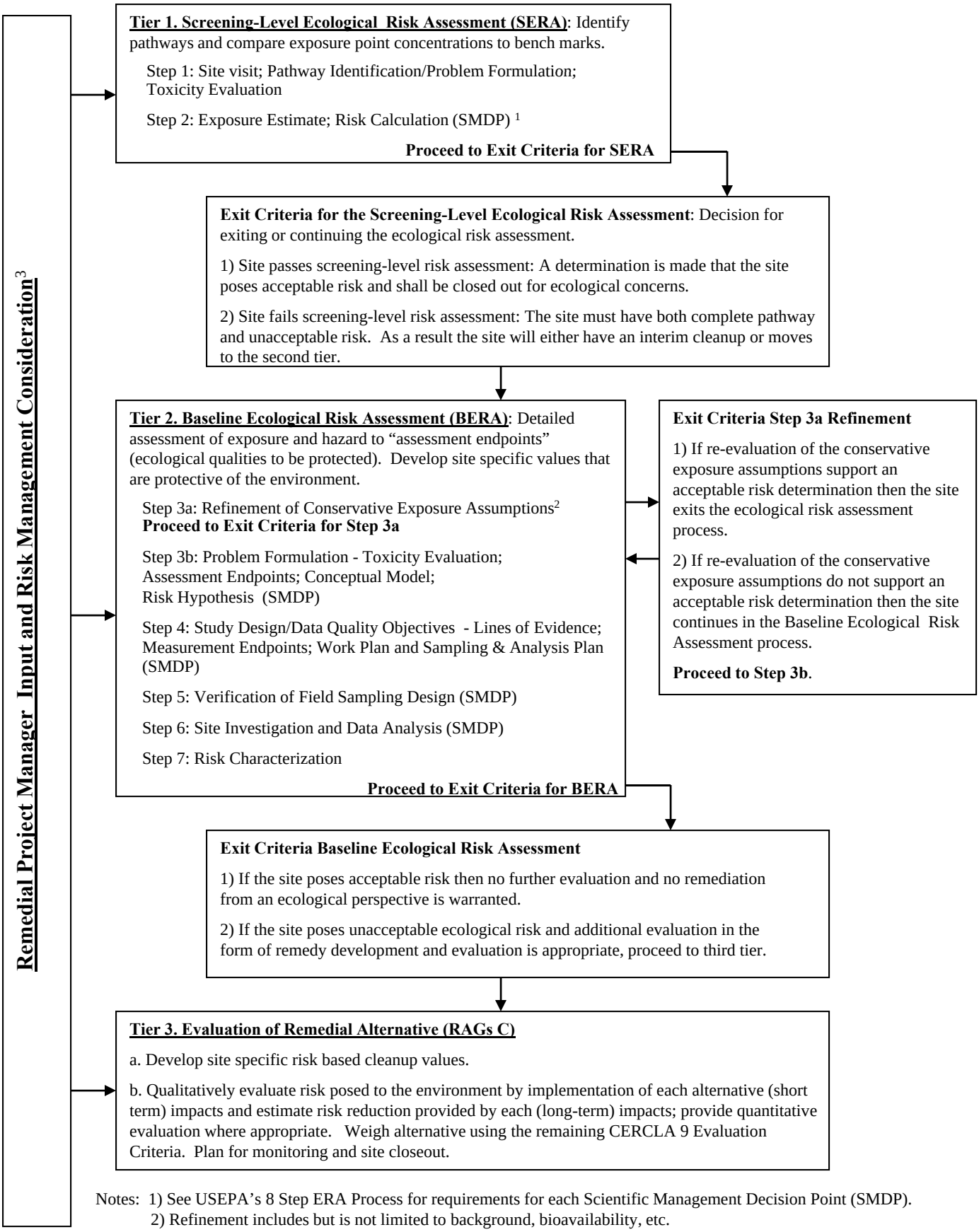
LEGEND

- -SWMU BOUNDARY
- -SURFACE SOIL AND/OR SUBSURFACE SOIL, AND/OR GROUNDWATER SAMPLE LOCATION (ECP 2004)
- -SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- -SURFACE, SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- -GROUNDWATER SAMPLE LOCATION FROM SWMU 74
- -DRAINAGE DITCH
- -STORM MANHOLE
- -STORM PIPE
- -STORM INLET
- 110.35 -GROUNDWATER ELEVATION
- -GROUNDWATER CONTOUR LINE (ESTIMATED)
- -GROUNDWATER FLOW DIRECTION
- -VEGETATION
- -CONCRETE
- -ASPHALT

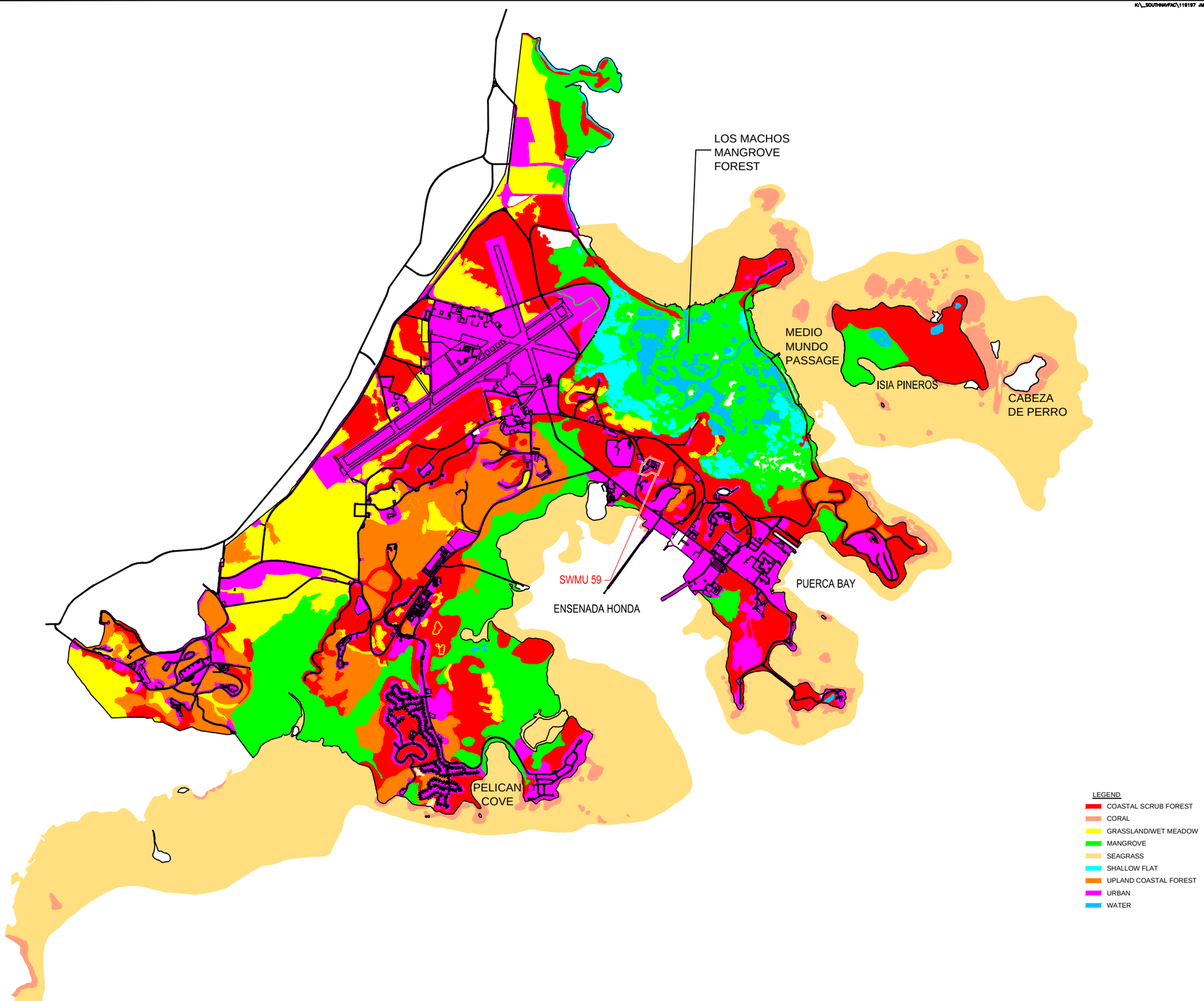
FIGURE 5-4
GROUNDWATER CONTOUR MAP
AUGUST 30, 2011
SWMU 59-FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT

NAVAL ACTIVITY PUERTO RICO

Figure 7-1
Navy Ecological Risk Assessment Tiered Approach



Notes: 1) See USEPA's 8 Step ERA Process for requirements for each Scientific Management Decision Point (SMDP).
2) Refinement includes but is not limited to background, bioavailability, etc.
3) Risk management is incorporated throughout the tiered approach.



SOURCE: GEO-MARINE, INC. 1998

REVISIONS		NORTH				
	DRAWN RR REVIEWED JM S.O.# 119197 CADD# 119197_CMS59_06.dwg			SWMU 59-FORMER VEHICLE MAINTENANCE AND REFUELING AREA NAVAL ACTIVITY PUERTO RICO BAKER ENVIRONMENTAL, Inc. Coraopolis, Pennsylvania	Baker	"TERRESTRIAL AND AQUATIC HABITAT OCCURRING AT NAVAL ACTIVITY PUERTO RICO" SWMU 59-FORMER VEHICLE MAINTENANCE AND REFUELING AREA CORRECTIVE MEASURES STUDY REPORT SCALE FULLSIZE 1" = 600' DATE OCT 2013

FIGURE
7-2

LEGEND

- SWMU 59 BOUNDARY
- E2SS3 – WETLAND DELINEATION CLASSIFICATION IDENTIFICATION
- WETLAND DELINEATION BOUNDARY

NOTE: SEE FIGURE 7–4 FOR THE COWARDIN WETLAND CLASSIFICATION SYSTEM

SOURCE: GEO–MARINE, INC., SEPTEMBER 6, 2000.

400 0 200 400

1 inch = 400 ft.

FIGURE 7–3
WETLAND LOCATION MAP
SWMU 59–FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT

NAVAL ACTIVITY PUERTO RICO

M - MARINE

SYSTEM	M - MARINE											
SUBSYSTEM	1 - SUBTIDAL					2 - INTERTIDAL						
CLASS	RB - Rock Bottom	UB - Unconsolidated Bottom	AB - Aquatic Bed	RF - Reef	OW - Open Water (unknown bottom)	AB - Aquatic Bed	RF - Reef	RS - Rocky Shore	US - Unconsolidated Shore	RB - Rock Bottom	UB - Unconsolidated Bottom
Subclass	1 Bedrock 2 Rubble	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic	1 Algal 3 Rooted Vasc 5 Unknown	1 Coral 3 Worm		1 Algal 3 Rooted Vasc 5 Unknown	1 Coral 3 Worm	1 Bedrock 2 Rubble	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic	1 Bedrock 2 Rubble	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic

E - ESTUARINE

SYSTEM	E - ESTUARINE											
SUBSYSTEM	1 - SUBTIDAL			2 - INTERTIDAL								
CLASS	AB - Aquatic Bed	RF - Reef	OW - Open Water (unknown bottom)	AB - Aquatic Bed	RF - Reef	SB - Streambed	RS - Rocky Shore	US - Unconsolidated Shore	EM - Emergent	SS - Scrub-Shrub	FO - Forested
Subclass	1 Algal 3 Rooted Vasc 4 Floating Vasc 5 *Unknown Submerg.* 6 *Unknown Surface*	2 Mollusk 3 Worm		1 Algal 3 Rooted Vasc 4 Floating Vasc 5 *Unknown Submerg.* 6 *Unknown Surface*	2 Mollusk 3 Worm	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic	1 Bedrock 2 Rubble	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic 5 Dead	1 Persistent 2 Nonpersistent	1 Broad-leaved Decid. 2 Needle-leaved Decid. 3 Broad-leaved Everg. 4 Needle-leaved Everg. 5 Dead 6 *Deciduous* 7 *Evergreen*	1 Broad-leaved Decid. 2 Needle-leaved Decid. 3 Broad-leaved Everg. 4 Needle-leaved Everg. 5 Dead 6 *Deciduous* 7 *Evergreen*

R - RIVERINE

SYSTEM	R - RIVERINE									
SUBSYSTEM	1 - TIDAL	2 - LOWER PERENNIAL		3 - UPPER PERENNIAL		4 INTERMITTENT	5 - UNKNOWN PERENNIAL			
CLASS	RB - Rock	UB - Unconsolidated Bottom	SB - Streambed	AB - Aquatic Bed	RS - Rocky Shore	US - Unconsolidated Shore	OW - Open Water (unknown bottom)	**EM - Emergent	RB - Rock Bottom	UB - Unconsolidated Bottom
Subclass	1 Bedrock 2 Rubble	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic	1 Bedrock 2 Rubble 3 Cobble - Gravel 4 Sand 5 Mud 6 Organic 7 Vegetated	1 Algal 2 Aquatic Moss 3 Rooted Vasc 4 Floating Vasc 5 *Unknown Submerg.* 6 *Unknown Surface*	1 Bedrock 2 Rubble	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic		2 Nonpersistent	1 Bedrock 2 Rubble	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic

L - LACUSTRINE

SYSTEM	L - LACUSTRINE									
SUBSYSTEM	1 - LIMNETIC			2 - LITTORAL						
CLASS	AB - Aquatic Bed	OW - Open Water (unknown bottom)	RB - Rock Bottom	RS - Rocky Shore	UB - Unconsolidated Bottom	AB - Aquatic Bed	US - Unconsolidated Shore	EM - Emergent	OW - Open Water (unknown bottom)	
Subclass	1 Algal 2 Aquatic Moss 3 Rooted Vasc 4 Floating Vasc 5 *Unknown Submerg.* 6 *Unknown Surface*		1 Bedrock 2 Rubble	1 Bedrock 2 Rubble	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic	1 Algal 2 Aquatic Moss 3 Rooted Vasc 4 Floating Vasc 5 *Unknown Submerg.* 6 *Unknown Surface*	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated	2 Nonpersistent		

P - PALUSTRINE

SYSTEM	P - PALUSTRINE								
CLASS	RB - Rock Bottom	UB - Unconsolidated Bottom	AB - Aquatic Bed	US - Unconsolidated Shore	ML - Moss-Lichen	EM - Emergent	SS - Scrub-Shrub	FO - Forested	OW - Open Water (unknown bottom)
Subclass	1 Bedrock 2 Rubble	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic	1 Algal 2 Aquatic Moss 3 Rooted Vasc 4 Floating Vasc 5 *Unknown Submerg.* 6 *Unknown Surface*	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated	1 Moss 2 Lichen	1 Persistent 2 Nonpersistent	1 Broad-leaved Decid. 2 Needle-leaved Decid. 3 Broad-leaved Everg. 4 Needle-leaved Everg. 5 Dead 6 *Deciduous* 7 *Evergreen*	1 Broad-leaved Decid. 2 Needle-leaved Decid. 3 Broad-leaved Everg. 4 Needle-leaved Everg. 5 Dead 6 *Deciduous* 7 *Evergreen*	

MODIFIERS

WATER REGIME

Non-Tidal		Tidal	
A Temp. Flooded	H Permanently Flooded	K Artificially Flooded	*S Temporary-Tidal
B Saturated	J Intermittently Flooded	L Subtidal	*R Seasonal-Tidal
C Seasonally Flooded	K Artificially Flooded	M Irregularly Flooded	*T Semipermanent- Tidal
D Seasonally Flooded/ Well Drained	W Intermittently Flooded/ Temporary	N Regularly Flooded	*V Permanent-Tidal
E Seasonally Flooded/ Saturated	Y Saturated/Semipermanent/ Seasonal	P Irregularly Flooded	U Unknown
F Semipermanently Flooded	Z Intermittently Exposed Permanent		
G Intermittently Exposed	U Unknown		

* These water regimes are only used in tidally influenced, freshwater systems.

WATER CHEMISTRY

Coastal Halinity	Inland Salinity	pH (fresh water)
1 Hyperhaline	7 Hypersaline	a Acid
2 Euhaline	8 Eusaline	t circumneutral
3 Mixohaline	9 Mixosaline	i Alkaline
4 Polyhaline	0 Fresh	
5 Mesohaline		
6 Oligohaline		
0 Fresh		

SOIL

g Organic
n Mineral

SPECIAL

b Beaver
d partially drained/ditched
f Farmed
h Diked/Impounded
r Artificial Substrate
s Spoil
x Excavated

SOURCE: UNITED STATES, FISH AND WILDLIFE SERVICE. CLASSIFICATION OF WETLANDS AND DEEPWATER HABITATS OF THE UNITED STATES, 1985

Baker

FIGURE 7-4
THE COWARDIN WETLAND
CLASSIFICATION SYSTEM
SWMU 59-FORMER VEHICLE MAINTENANCE
AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO

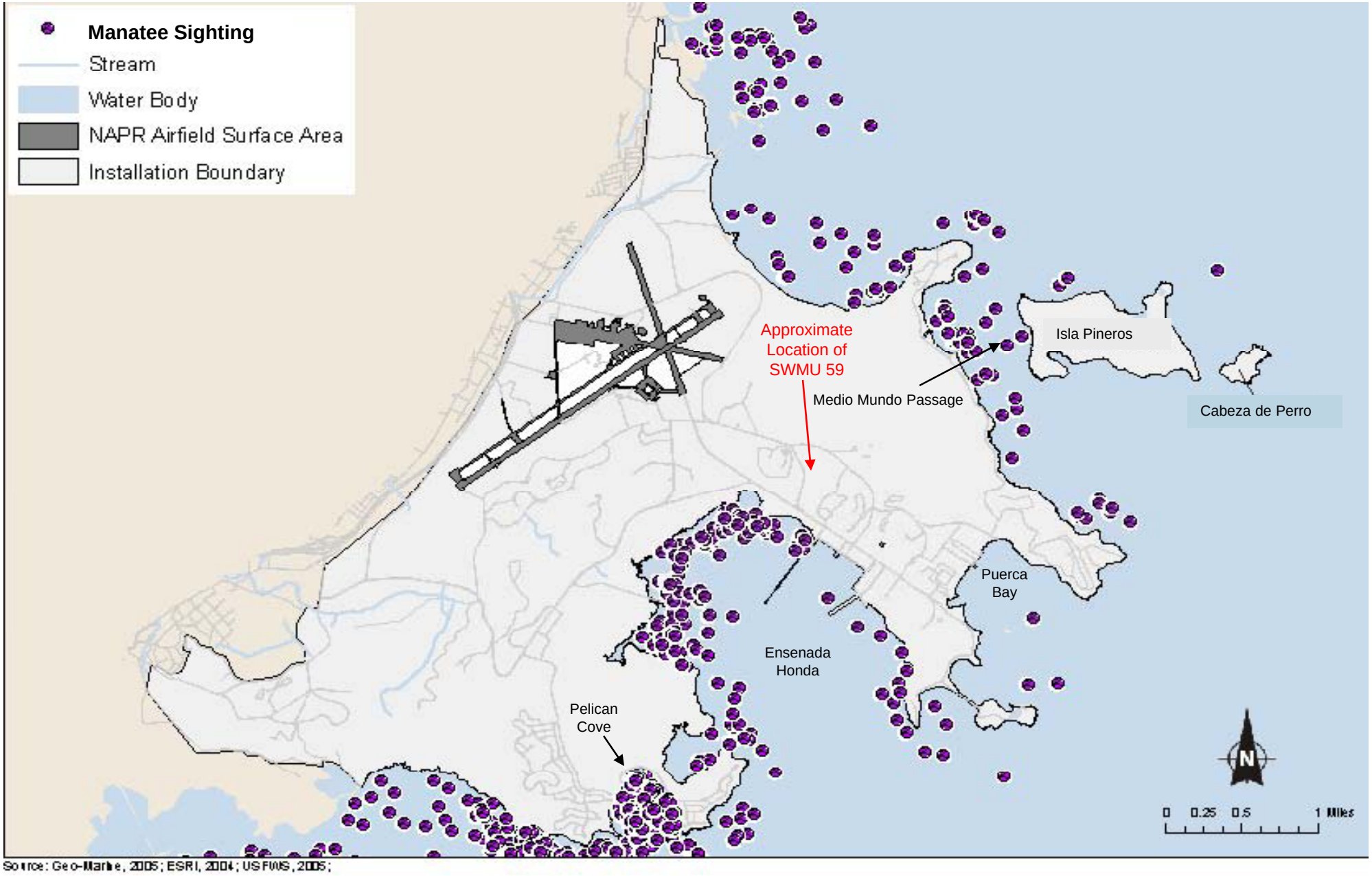
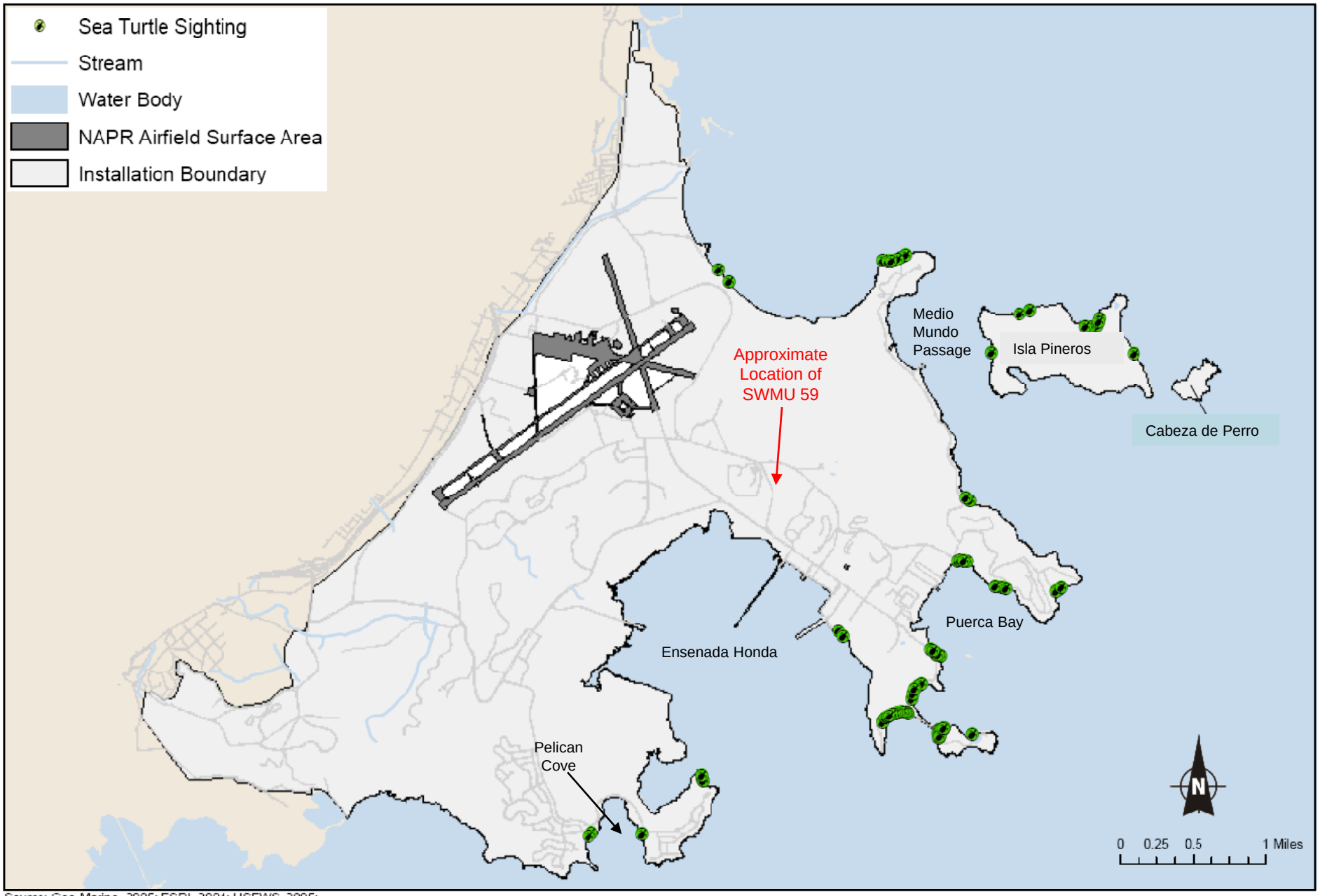


Figure from: Department of the Navy (DoN). 2007. *Environmental Assessment for the Disposal of Naval Activity Puerto Rico (formerly Naval Station Roosevelt Roads).* April 2007.

FIGURE 7-5
HISTORICAL MANATEE SIGHTINGS IN EASTERN PUERTO RICO
SWMU 59 – FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

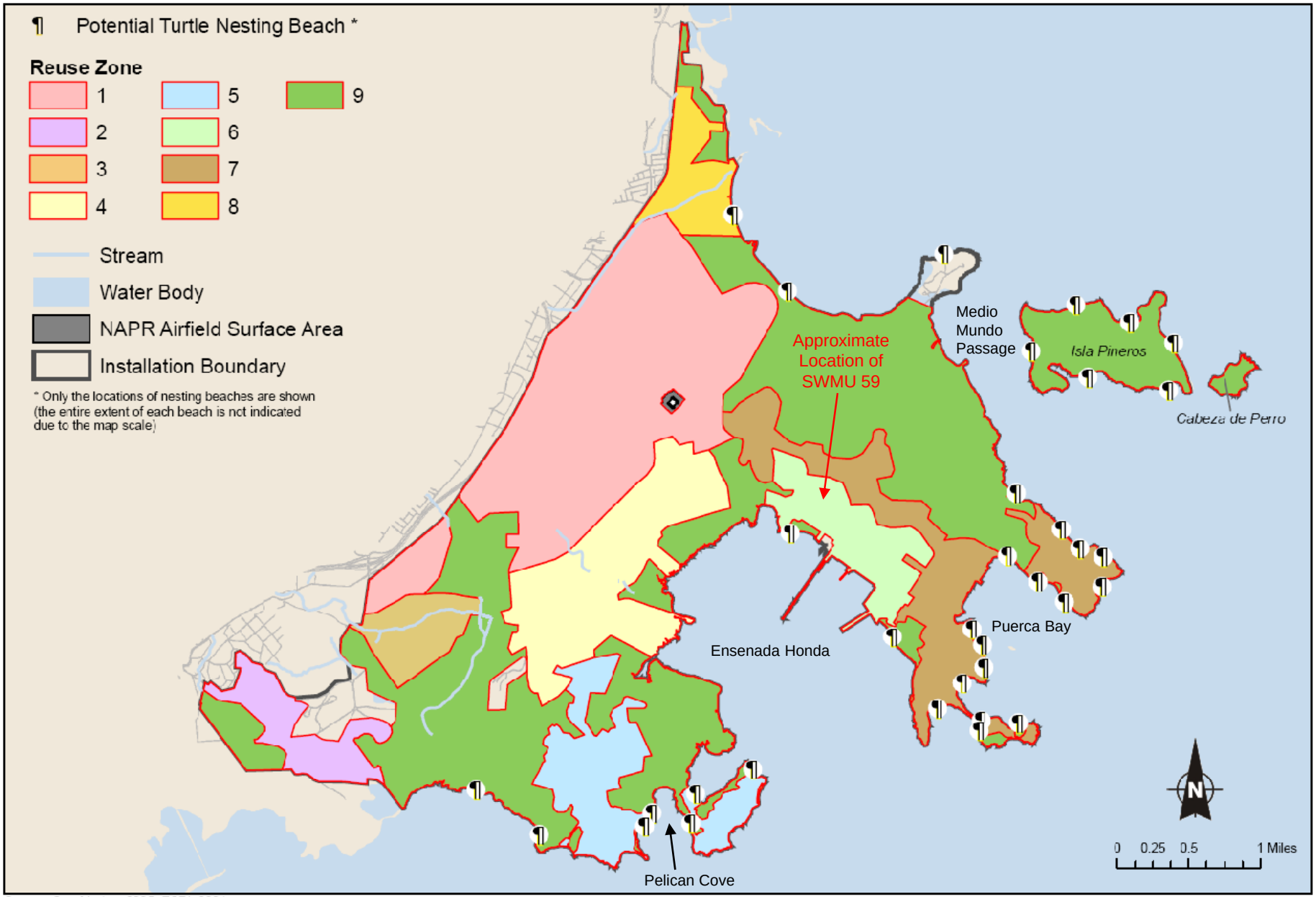


Source: Geo-Marine, 2005; ESRI, 2004; USFWS, 2005;

Cumulative sea turtle sightings from March 1984 through March 1995 obtained from weekly aerial surveys of the Former Naval Station Roosevelt Roads.

Figure from: Department of the Navy (DoN). 2007. *Environmental Assessment for the Disposal of Naval Activity Puerto Rico (formerly Naval Station Roosevelt Roads).* April 2007.

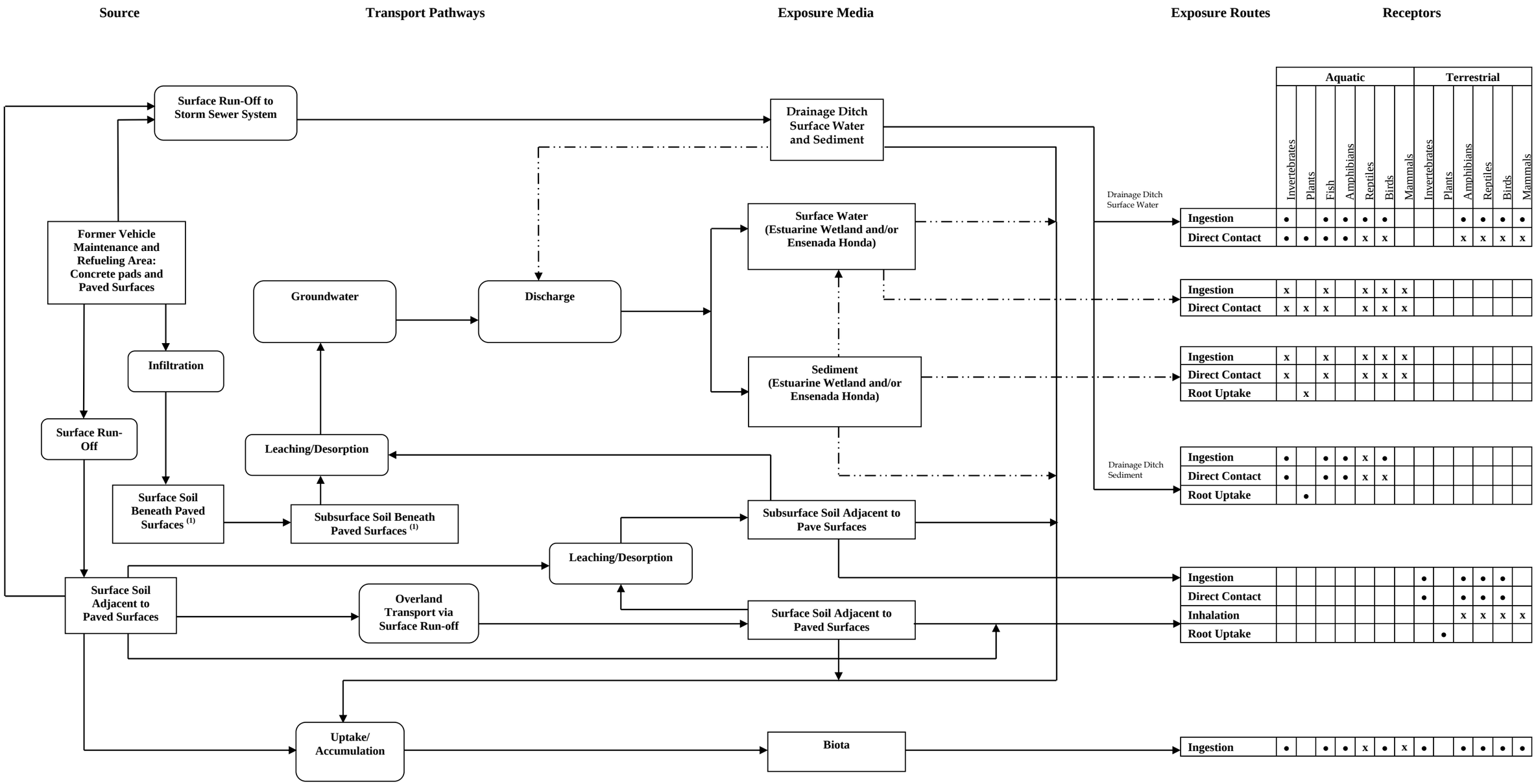
FIGURE 7-6
SEA TURTLE SIGHTINGS AT NAVAL ACTIVITY PUERTO RICO
SWMU 59 – FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



Source: Geo-Marine, 2005; ESRI, 2004;

Figure from: Department of Navy (DoN). 2007. *Environmental Assessment for the Disposal of Naval Activity Puerto Rico (formerly Naval Station Roosevelt Roads).* April 2007

FIGURE 7-7
POTENTIAL TURTLE NESTING SITES
SWMU 59 – FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

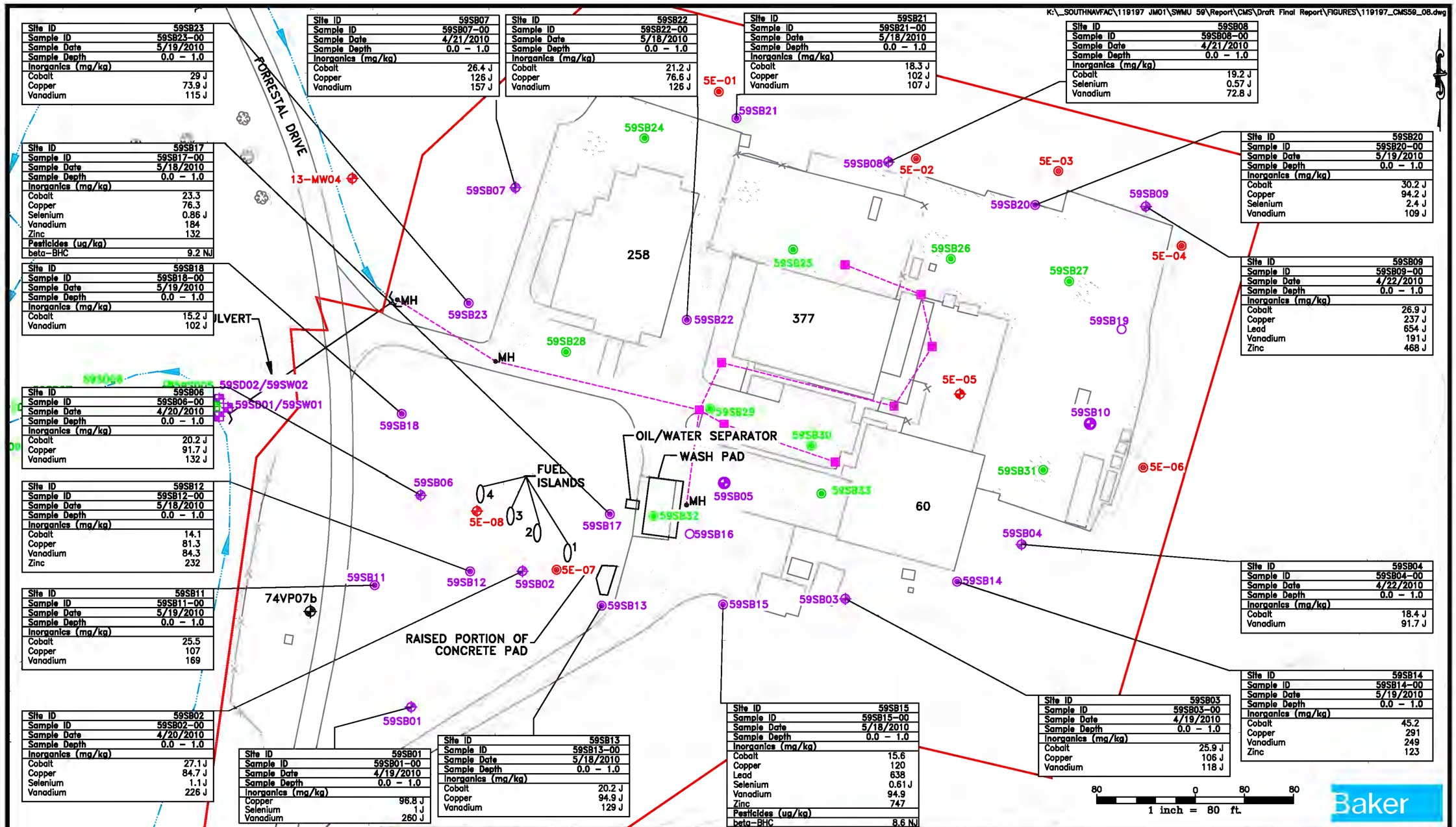


Exposure Route	Aquatic							Terrestrial					
	Invertebrates	Plants	Fish	Amphibians	Reptiles	Birds	Mammals	Invertebrates	Plants	Amphibians	Reptiles	Birds	Mammals
Drainage Ditch Surface Water													
Ingestion	●		●	●	●	●				●	●	●	●
Direct Contact	●	●	●	●	x	x				x	x	x	x
Surface Water (Estuarine Wetland and/or Ensenada Honda)													
Ingestion	x		x		x	x	x						
Direct Contact	x	x	x		x	x	x						
Sediment (Estuarine Wetland and/or Ensenada Honda)													
Ingestion	x		x		x	x	x						
Direct Contact	x		x		x	x	x						
Root Uptake		x											
Drainage Ditch Sediment													
Ingestion	●		●	●	x	●							
Direct Contact	●		●	●	x	x							
Root Uptake		●											
Subsurface Soil Adjacent to Pave Surfaces / Surface Soil Adjacent to Paved Surfaces													
Ingestion								●		●	●	●	
Direct Contact								●		●	●	●	
Inhalation										x	x	x	x
Root Uptake									●				
Biota													
Ingestion	●		●	●	x	●	x	●		●	●	●	●

FIGURE 7-8
PRELIMINARY CONCEPTUAL MODEL
SWMU 59 – FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

● - Receptor/pathway evaluated quantitatively or qualitatively
x - Receptor/pathway not evaluated

(1) Pathways depicted for surface and subsurface soil adjacent to paved surfaces are also applicable to surface and subsurface soil beneath paved surfaces if soil is exposed.



Site ID	59SB23
Sample ID	59SB23-00
Sample Date	5/19/2010
Sample Depth	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	29 J
Copper	73.9 J
Vanadium	115 J

Site ID	59SB07
Sample ID	59SB07-00
Sample Date	4/21/2010
Sample Depth	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	26.4 J
Copper	126 J
Vanadium	157 J

Site ID	59SB22
Sample ID	59SB22-00
Sample Date	5/18/2010
Sample Depth	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	21.2 J
Copper	76.6 J
Vanadium	126 J

Site ID	59SB21
Sample ID	59SB21-00
Sample Date	5/18/2010
Sample Depth	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	18.3 J
Copper	102 J
Vanadium	107 J

Site ID	59SB08
Sample ID	59SB08-00
Sample Date	4/21/2010
Sample Depth	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	19.2 J
Selenium	0.57 J
Vanadium	72.8 J

Site ID	59SB20
Sample ID	59SB20-00
Sample Date	5/19/2010
Sample Depth	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	30.2 J
Copper	94.2 J
Selenium	2.4 J
Vanadium	109 J

Site ID	59SB09
Sample ID	59SB09-00
Sample Date	4/22/2010
Sample Depth	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	26.9 J
Copper	237 J
Lead	654 J
Vanadium	191 J
Zinc	468 J

Site ID	59SB17
Sample ID	59SB17-00
Sample Date	5/18/2010
Sample Depth	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	23.3
Copper	76.3
Selenium	0.86 J
Vanadium	184
Zinc	132
Pesticides (ug/kg)	
beta-BHC	9.2 NJ

Site ID	59SB18
Sample ID	59SB18-00
Sample Date	5/19/2010
Sample Depth	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	15.2 J
Vanadium	102 J

Site ID	59SB06
Sample ID	59SB06-00
Sample Date	4/20/2010
Sample Depth	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	20.2 J
Copper	91.7 J
Vanadium	132 J

Site ID	59SB12
Sample ID	59SB12-00
Sample Date	5/18/2010
Sample Depth	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	14.1
Copper	81.3
Vanadium	84.3
Zinc	232

Site ID	59SB11
Sample ID	59SB11-00
Sample Date	5/19/2010
Sample Depth	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	25.5
Copper	107
Vanadium	169

Site ID	59SB02
Sample ID	59SB02-00
Sample Date	4/20/2010
Sample Depth	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	27.1 J
Copper	84.7 J
Selenium	1.1 J
Vanadium	226 J

Site ID	59SB01
Sample ID	59SB01-00
Sample Date	4/19/2010
Sample Depth	0.0 – 1.0
Inorganics (mg/kg)	
Copper	96.8 J
Selenium	1 J
Vanadium	260 J

Site ID	59SB13
Sample ID	59SB13-00
Sample Date	5/18/2010
Sample Depth	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	20.2 J
Copper	94.9 J
Vanadium	129 J

Site ID	59SB15
Sample ID	59SB15-00
Sample Date	5/18/2010
Sample Depth	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	15.6
Copper	120
Lead	638
Selenium	0.61 J
Vanadium	94.9
Zinc	747
Pesticides (ug/kg)	
beta-BHC	8.6 NJ

Site ID	59SB03
Sample ID	59SB03-00
Sample Date	4/19/2010
Sample Depth	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	25.9 J
Copper	106 J
Vanadium	118 J

Site ID	59SB04
Sample ID	59SB04-00
Sample Date	4/22/2010
Sample Depth	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	18.4 J
Vanadium	91.7 J

Site ID	59SB14
Sample ID	59SB14-00
Sample Date	5/19/2010
Sample Depth	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	45.2
Copper	291
Vanadium	249
Zinc	123

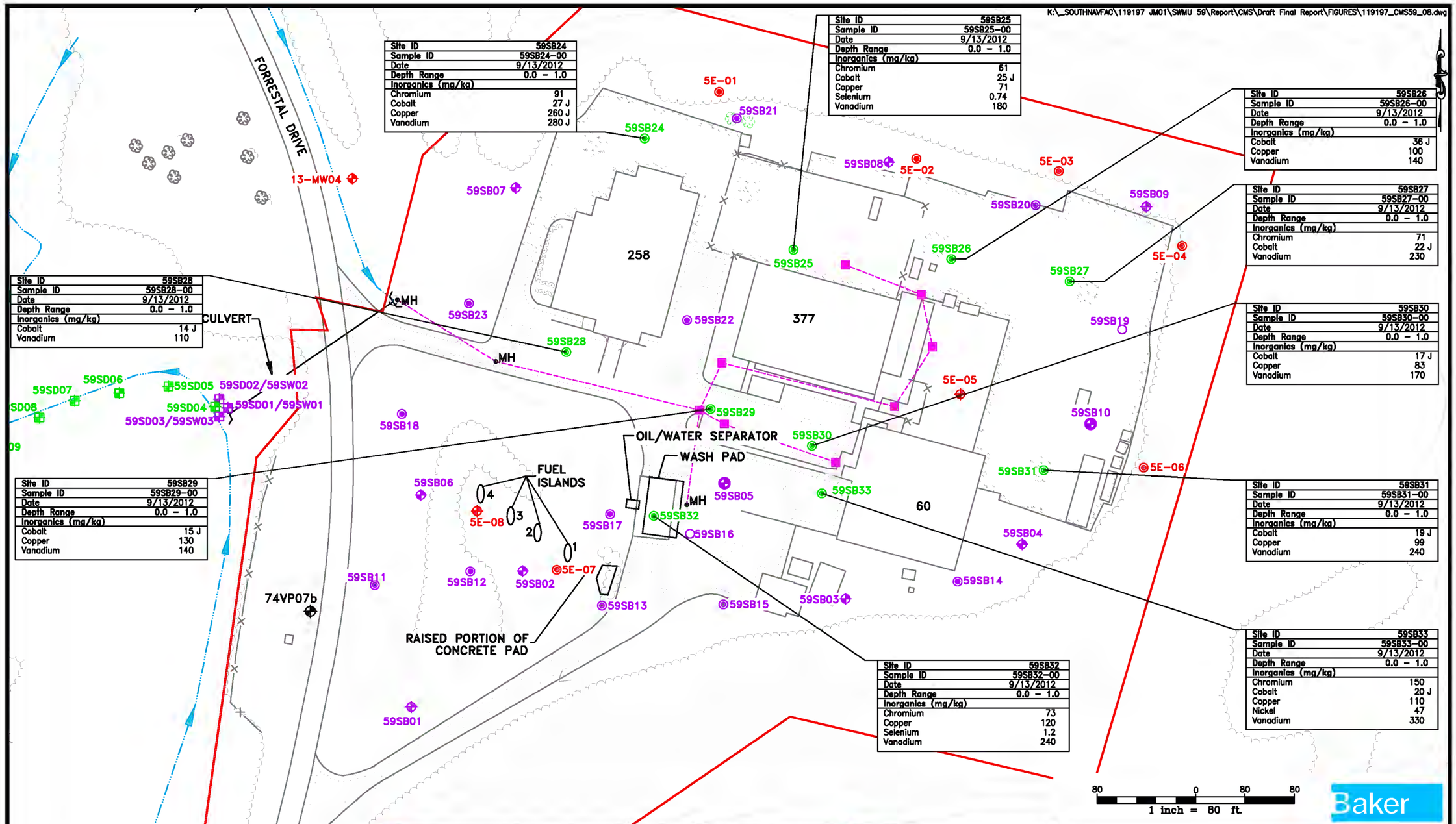
SOIL SCREENING VALUE	
Inorganics (mg/kg)	
Cobalt	13
Copper	70
Lead	120
Selenium	0.52
Vanadium	20
Zinc	120
Pesticides (ug/kg)	
beta-BHC	3.98

LEGEND

- -SURFACE AND/OR SUBSURFACE SOIL SAMPLE LOCATION (ECP 2004)
- -SURFACE SOIL AND/OR SUBSURFACE SOIL, AND/OR GROUNDWATER SAMPLE LOCATION (ECP 2004)
- -SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- -SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- -SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- -SURFACE, SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- -SURFACE WATER/SEDIMENT SAMPLE LOCATION (CMS 2010)
- -SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (CMS 2012)
- -SEDIMENT SAMPLE LOCATION (CMS 2012)
- -MONITORING WELL (SWMU 74)
- -SWMU 59 BOUNDARY
- -OTHER SWMU BOUNDARY
- -DRAINAGE DITCH
- -STORM MANHOLE
- -STORM PIPE
- -STORM INLET
- -APPROXIMATE EDGE OF SLOPE
- -VEGETATION
- -CONCRETE
- -ASPHALT

FIGURE 7-9
DETECTED CONCENTRATIONS IN SURFACE SOIL EXCEEDING SOIL SCREENING VALUES: 2010 CMS FIELD INVESTIGATION
SWMU 59-FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO

K:_SOUTHNAVFAC\119197 JM01\SWMU 59\Report\CMS\Draft Final Report\FIGURES\119197_CMS59_08.dwg



Site ID	59SB24
Sample ID	59SB24-00
Date	9/13/2012
Depth Range	0.0 - 1.0
Inorganics (mg/kg)	
Chromium	91
Cobalt	27 J
Copper	260 J
Vanadium	280 J

Site ID	59SB25
Sample ID	59SB25-00
Date	9/13/2012
Depth Range	0.0 - 1.0
Inorganics (mg/kg)	
Chromium	61
Cobalt	25 J
Copper	71
Selenium	0.74
Vanadium	180

Site ID	59SB26
Sample ID	59SB26-00
Date	9/13/2012
Depth Range	0.0 - 1.0
Inorganics (mg/kg)	
Cobalt	36 J
Copper	100
Vanadium	140

Site ID	59SB27
Sample ID	59SB27-00
Date	9/13/2012
Depth Range	0.0 - 1.0
Inorganics (mg/kg)	
Chromium	71
Cobalt	22 J
Vanadium	230

Site ID	59SB28
Sample ID	59SB28-00
Date	9/13/2012
Depth Range	0.0 - 1.0
Inorganics (mg/kg)	
Cobalt	14 J
Vanadium	110

Site ID	59SB30
Sample ID	59SB30-00
Date	9/13/2012
Depth Range	0.0 - 1.0
Inorganics (mg/kg)	
Cobalt	17 J
Copper	83
Vanadium	170

Site ID	59SB29
Sample ID	59SB29-00
Date	9/13/2012
Depth Range	0.0 - 1.0
Inorganics (mg/kg)	
Cobalt	15 J
Copper	130
Vanadium	140

Site ID	59SB31
Sample ID	59SB31-00
Date	9/13/2012
Depth Range	0.0 - 1.0
Inorganics (mg/kg)	
Cobalt	19 J
Copper	99
Vanadium	240

Site ID	59SB33
Sample ID	59SB33-00
Date	9/13/2012
Depth Range	0.0 - 1.0
Inorganics (mg/kg)	
Chromium	150
Cobalt	20 J
Copper	110
Nickel	47
Vanadium	330

Site ID	59SB32
Sample ID	59SB32-00
Date	9/13/2012
Depth Range	0.0 - 1.0
Inorganics (mg/kg)	
Chromium	73
Copper	120
Selenium	1.2
Vanadium	240

SOIL SCREENING VALUE	
Inorganics (mg/kg)	
Chromium	57
Cobalt	13
Copper	701
Nickel	3.8
Selenium	0.52
Vanadium	20

LEGEND

- -SURFACE AND/OR SUBSURFACE SOIL SAMPLE LOCATION (ECP 2004)
- -SURFACE SOIL AND/OR SUBSURFACE SOIL, AND/OR GROUNDWATER SAMPLE LOCATION (ECP 2004)
- -SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- -SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- -SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- -SURFACE, SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- -SURFACE WATER/SEDIMENT SAMPLE LOCATION (CMS 2010)
- -SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (CMS 2012)
- -SEDIMENT SAMPLE LOCATION (CMS 2012)
- -MONITORING WELL (SWMU 74)
- -SWMU 59 BOUNDARY
- -DRAINAGE DITCH
- -STORM MANHOLE
- -STORM PIPE
- -STORM INLET
- -APPROXIMATE EDGE OF SLOPE
- -VEGETATION
- -CONCRETE
- -ASPHALT

FIGURE 7-10
DETECTED CONCENTRATIONS IN SURFACE SOIL EXCEEDING SOIL SCREENING VALUES: 2012 CMS FIELD INVESTIGATION
SWMU 59-FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO

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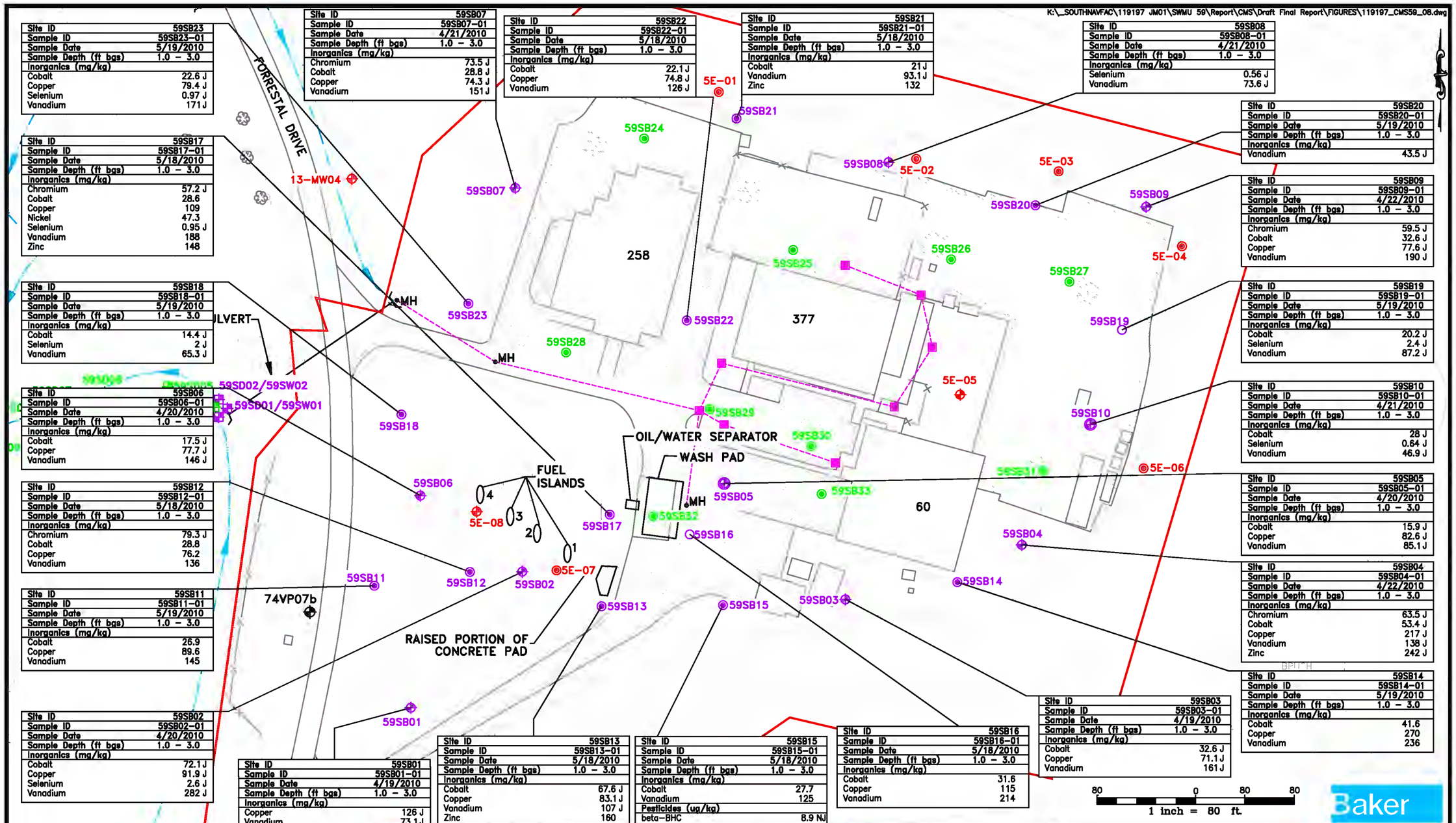


Site ID	59SB23
Sample ID	59SB23-01
Sample Date	5/19/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	22.6 J
Copper	79.4 J
Selenium	0.97 J
Vanadium	171 J

Site ID	59SB17
Sample ID	59SB17-01
Sample Date	5/18/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Chromium	57.2 J
Cobalt	28.6
Copper	109
Nickel	47.3
Selenium	0.95 J
Vanadium	188
Zinc	148

Site ID	59SB18
Sample ID	59SB18-01
Sample Date	5/19/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	14.4 J
Selenium	2 J
Vanadium	65.3 J

Site ID	59SB06
Sample ID	59SB06-01
Sample Date	4/20/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	17.5 J
Copper	77.7 J
Vanadium	146 J

Site ID	59SB12
Sample ID	59SB12-01
Sample Date	5/18/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Chromium	79.3 J
Cobalt	28.8
Copper	76.2
Vanadium	136

Site ID	59SB11
Sample ID	59SB11-01
Sample Date	5/19/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	26.9
Copper	89.6
Vanadium	145

Site ID	59SB02
Sample ID	59SB02-01
Sample Date	4/20/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	72.1 J
Copper	91.9 J
Selenium	2.6 J
Vanadium	282 J

Site ID	59SB07
Sample ID	59SB07-01
Sample Date	4/21/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Chromium	73.5 J
Cobalt	28.8 J
Copper	74.3 J
Vanadium	151 J

Site ID	59SB22
Sample ID	59SB22-01
Sample Date	5/18/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	22.1 J
Copper	74.8 J
Vanadium	126 J

Site ID	59SB21
Sample ID	59SB21-01
Sample Date	5/18/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	21 J
Vanadium	93.1 J
Zinc	132

Site ID	59SB08
Sample ID	59SB08-01
Sample Date	4/21/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Selenium	0.56 J
Vanadium	73.6 J

Site ID	59SB20
Sample ID	59SB20-01
Sample Date	5/19/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Vanadium	43.5 J

Site ID	59SB09
Sample ID	59SB09-01
Sample Date	4/22/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Chromium	59.5 J
Cobalt	32.6 J
Copper	77.6 J
Vanadium	190 J

Site ID	59SB19
Sample ID	59SB19-01
Sample Date	5/19/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	20.2 J
Selenium	2.4 J
Vanadium	87.2 J

Site ID	59SB10
Sample ID	59SB10-01
Sample Date	4/21/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	28 J
Selenium	0.64 J
Vanadium	46.9 J

Site ID	59SB05
Sample ID	59SB05-01
Sample Date	4/20/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	15.9 J
Copper	82.6 J
Vanadium	85.1 J

Site ID	59SB04
Sample ID	59SB04-01
Sample Date	4/22/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Chromium	63.5 J
Cobalt	53.4 J
Copper	217 J
Vanadium	138 J
Zinc	242 J

Site ID	59SB14
Sample ID	59SB14-01
Sample Date	5/19/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	41.6
Copper	270
Vanadium	236

Site ID	59SB03
Sample ID	59SB03-01
Sample Date	4/19/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	32.6 J
Copper	71.1 J
Vanadium	161 J

Site ID	59SB16
Sample ID	59SB16-01
Sample Date	5/18/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	31.6
Copper	115
Vanadium	214

Site ID	59SB15
Sample ID	59SB15-01
Sample Date	5/18/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	27.7
Vanadium	125
Pesticides (ug/kg)	
beta-BHC	8.9 NJ

Site ID	59SB13
Sample ID	59SB13-01
Sample Date	5/18/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	67.6 J
Copper	83.1 J
Vanadium	107 J
Zinc	160

Site ID	59SB01
Sample ID	59SB01-01
Sample Date	4/19/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Copper	126 J
Vanadium	73.1 J

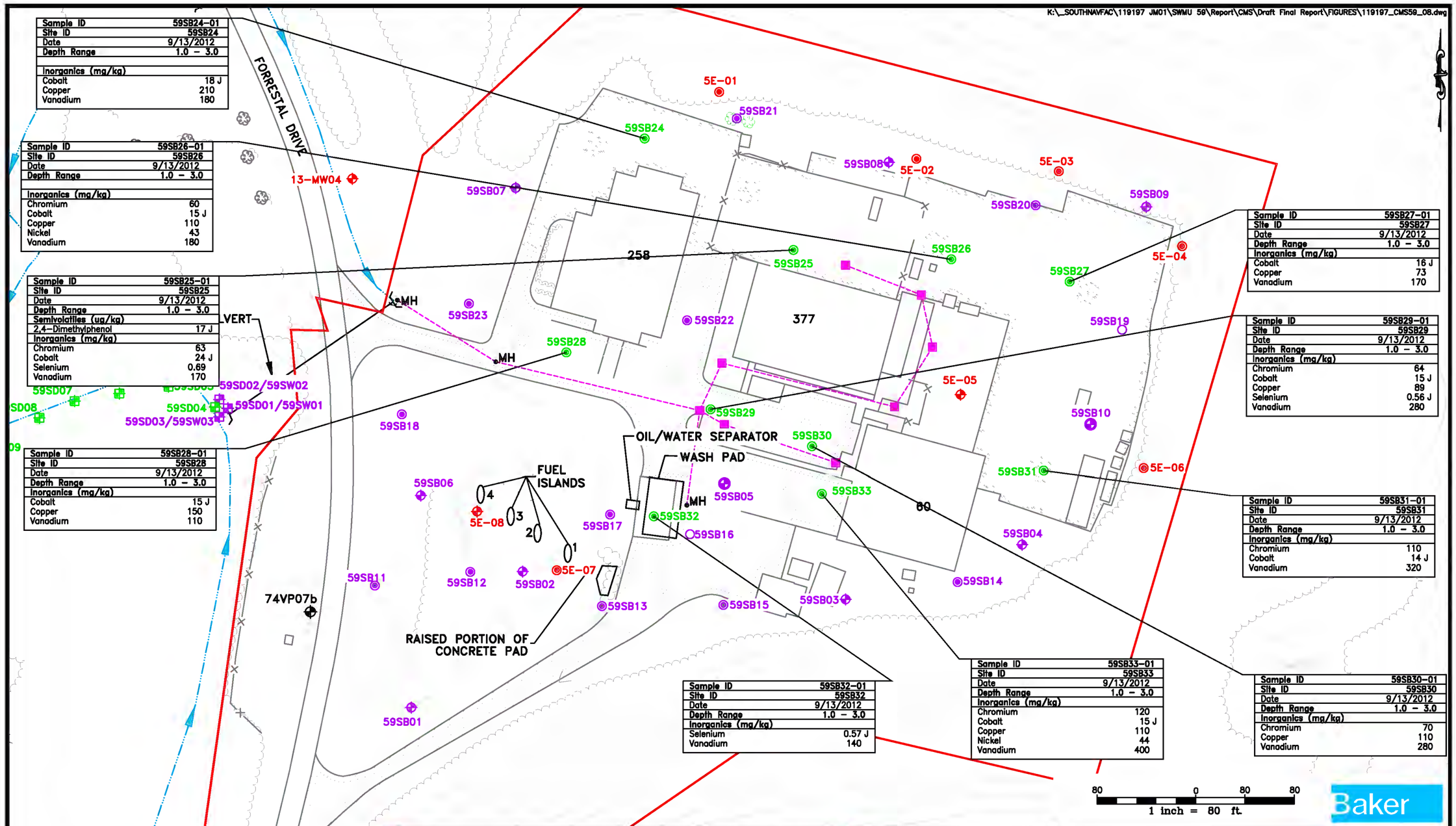
SOIL SCREENING VALUE	
Inorganics (mg/kg)	
Chromium	57
Cobalt	13
Copper	70
Nickel	38
Selenium	0.52
Vanadium	20
Zinc	120
Pesticides (ug/kg)	
beta-BHC	3.98

LEGEND

- –SURFACE AND/OR SUBSURFACE SOIL SAMPLE LOCATION (ECP 2004)
- –SURFACE SOIL AND/OR SUBSURFACE SOIL, AND/OR GROUNDWATER SAMPLE LOCATION (ECP 2004)
- –SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- –SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- –SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- –SURFACE, SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- –SURFACE WATER/SEDIMENT SAMPLE LOCATION (CMS 2010)
- –SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (CMS 2012)
- –SEDIMENT SAMPLE LOCATION (CMS 2012)
- –MONITORING WELL (SWMU 74)
- –SWMU 59 BOUNDARY
- –DRAINAGE DITCH
- –STORM MANHOLE
- –STORM PIPE
- –STORM INLET
- –APPROXIMATE EDGE OF SLOPE
- –VEGETATION
- –CONCRETE
- –ASPHALT

FIGURE 7-11
DETECTED CONCENTRATIONS IN SUBSURFACE SOIL EXCEEDING SOIL SCREENING VALUES: 2010 CMS FIELD INVESTIGATION
SWMU 59-FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO

K:_SOUTHNAVFAC\119197 JM01\SWMU 59\Report\CMS\Draft Final Report\FIGURES\119197_CMS59_08.dwg



Sample ID	59SB24-01
Site ID	59SB24
Date	9/13/2012
Depth Range	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	18 J
Copper	210
Vanadium	180

Sample ID	59SB26-01
Site ID	59SB26
Date	9/13/2012
Depth Range	1.0 – 3.0
Inorganics (mg/kg)	
Chromium	60
Cobalt	15 J
Copper	110
Nickel	43
Vanadium	180

Sample ID	59SB25-01
Site ID	59SB25
Date	9/13/2012
Depth Range	1.0 – 3.0
Semivolatiles (ug/kg)	
2,4-Dimethylphenol	17 J
Inorganics (mg/kg)	
Chromium	63
Cobalt	24 J
Selenium	0.69
Vanadium	170

Sample ID	59SB28-01
Site ID	59SB28
Date	9/13/2012
Depth Range	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	15 J
Copper	150
Vanadium	110

Sample ID	59SB27-01
Site ID	59SB27
Date	9/13/2012
Depth Range	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	16 J
Copper	73
Vanadium	170

Sample ID	59SB29-01
Site ID	59SB29
Date	9/13/2012
Depth Range	1.0 – 3.0
Inorganics (mg/kg)	
Chromium	64
Cobalt	15 J
Copper	89
Selenium	0.56 J
Vanadium	280

Sample ID	59SB31-01
Site ID	59SB31
Date	9/13/2012
Depth Range	1.0 – 3.0
Inorganics (mg/kg)	
Chromium	110
Cobalt	14 J
Vanadium	320

Sample ID	59SB32-01
Site ID	59SB32
Date	9/13/2012
Depth Range	1.0 – 3.0
Inorganics (mg/kg)	
Selenium	0.57 J
Vanadium	140

Sample ID	59SB33-01
Site ID	59SB33
Date	9/13/2012
Depth Range	1.0 – 3.0
Inorganics (mg/kg)	
Chromium	120
Cobalt	15 J
Copper	110
Nickel	44
Vanadium	400

Sample ID	59SB30-01
Site ID	59SB30
Date	9/13/2012
Depth Range	1.0 – 3.0
Inorganics (mg/kg)	
Chromium	70
Copper	110
Vanadium	280

SOIL SCREENING VALUE	
Semivolatiles (ug/kg)	
2,4-Dimethylphenol	10
Inorganics (mg/kg)	
Chromium	57
Cobalt	13
Copper	70
Nickel	38
Selenium	0.52
Vanadium	20

LEGEND

- –SURFACE AND/OR SUBSURFACE SOIL SAMPLE LOCATION (ECP 2004)
- –SURFACE SOIL AND/OR SUBSURFACE SOIL, AND/OR GROUNDWATER SAMPLE LOCATION (ECP 2004)
- –SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- –SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- –SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- –SURFACE, SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- –SURFACE WATER/SEDIMENT SAMPLE LOCATION (CMS 2010)
- –SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (CMS 2012)
- –SEDIMENT SAMPLE LOCATION (CMS 2012)
- –MONITORING WELL (SWMU 74)
- –SWMU 59 BOUNDARY
- –DRAINAGE DITCH
- –STORM MANHOLE
- –STORM PIPE
- –STORM INLET
- –APPROXIMATE EDGE OF SLOPE
- –VEGETATION
- –CONCRETE
- –ASPHALT

FIGURE 7-12
DETECTED CONCENTRATIONS IN SUBSURFACE SOIL EXCEEDING SOIL SCREENING VALUES: 2012 CMS FIELD INVESTIGATION
SWMU 59-FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO

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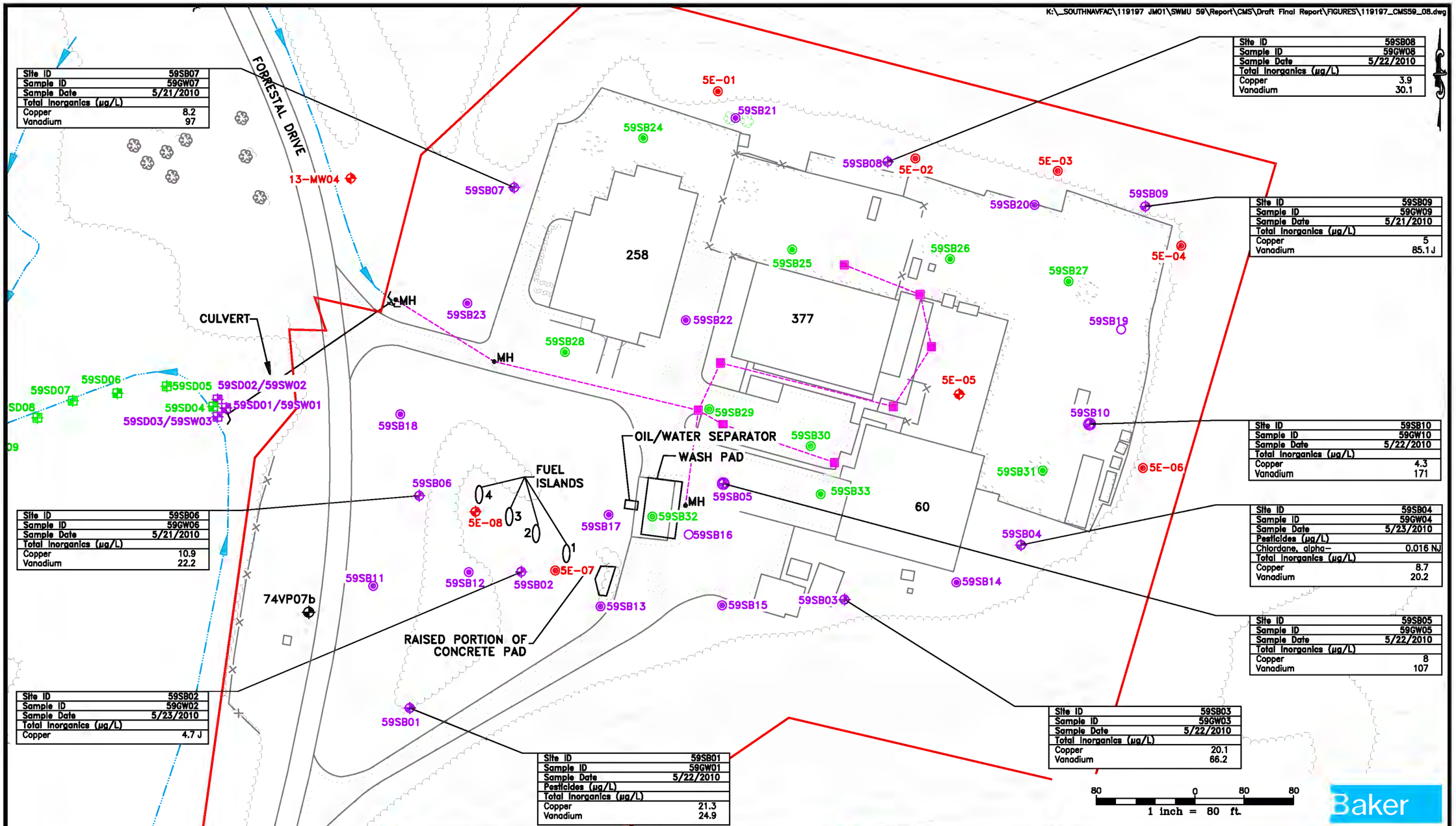


Site ID	59SB07
Sample ID	59GW07
Sample Date	5/21/2010
Total Inorganics (µg/L)	
Copper	8.2
Vanadium	97

Site ID	59SB08
Sample ID	59GW08
Sample Date	5/22/2010
Total Inorganics (µg/L)	
Copper	3.9
Vanadium	30.1

Site ID	59SB09
Sample ID	59GW09
Sample Date	5/21/2010
Total Inorganics (µg/L)	
Copper	5
Vanadium	85.1 J

Site ID	59SB10
Sample ID	59GW10
Sample Date	5/22/2010
Total Inorganics (µg/L)	
Copper	4.3
Vanadium	171

Site ID	59SB06
Sample ID	59GW06
Sample Date	5/21/2010
Total Inorganics (µg/L)	
Copper	10.9
Vanadium	22.2

Site ID	59SB04
Sample ID	59GW04
Sample Date	5/23/2010
Pesticides (µg/L)	
Chlordane, alpha-	0.016 NJ
Total Inorganics (µg/L)	
Copper	8.7
Vanadium	20.2

Site ID	59SB05
Sample ID	59GW05
Sample Date	5/22/2010
Total Inorganics (µg/L)	
Copper	8
Vanadium	107

Site ID	59SB02
Sample ID	59GW02
Sample Date	5/23/2010
Total Inorganics (µg/L)	
Copper	4.7 J

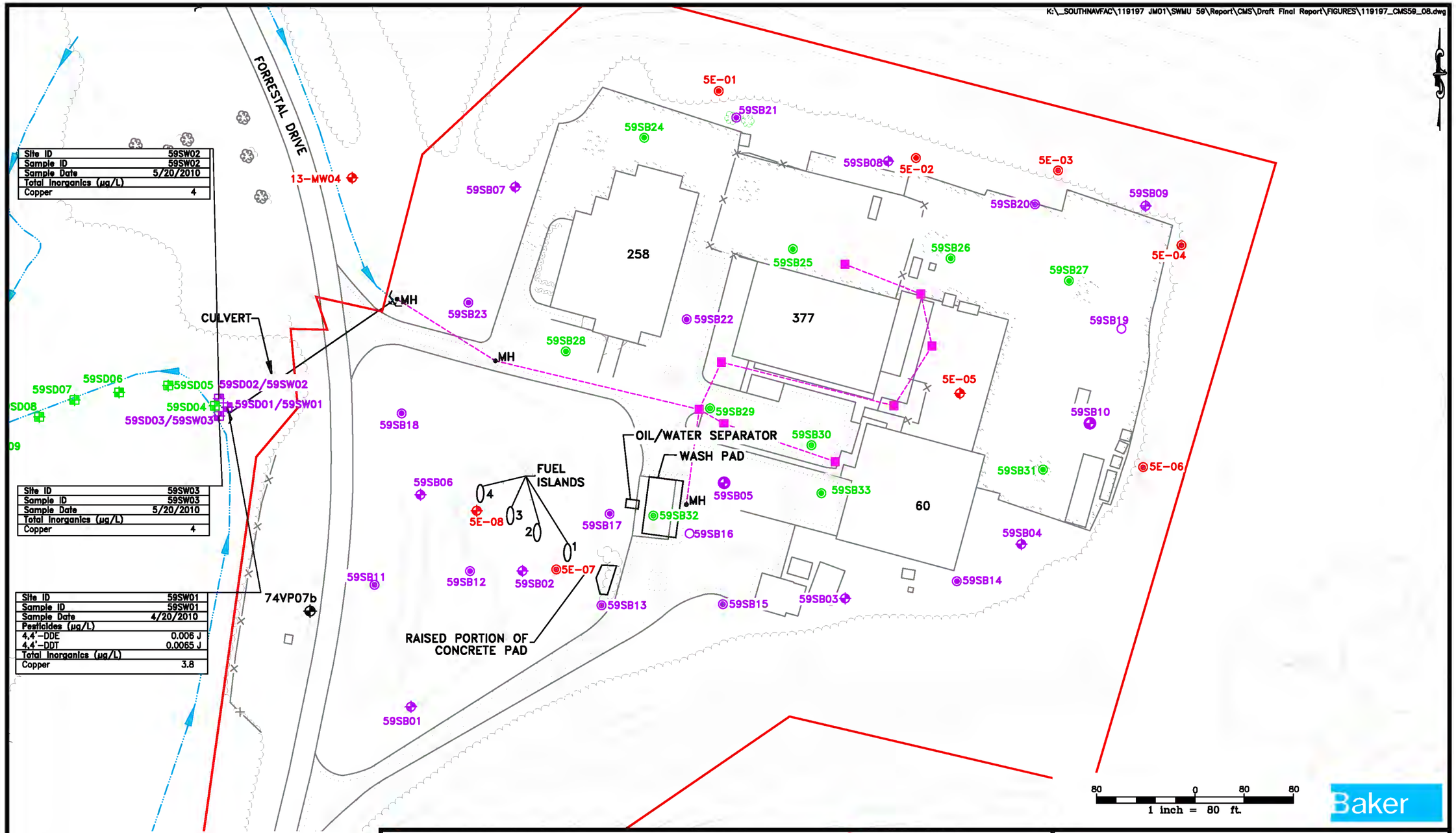
Site ID	59SB03
Sample ID	59GW03
Sample Date	5/22/2010
Total Inorganics (µg/L)	
Copper	20.1
Vanadium	66.2

Site ID	59SB01
Sample ID	59GW01
Sample Date	5/22/2010
Pesticides (µg/L)	
Total Inorganics (µg/L)	
Copper	21.3
Vanadium	24.9

GROUNDWATER SCREENING VALUES	
Pesticides (µg/L)	
Chlordane, alpha-	0.004
Total Inorganics (µg/L)	
Copper	3.73
Vanadium	12

- -SURFACE AND/OR SUBSURFACE SOIL SAMPLE LOCATION (ECP 2004)
- -SURFACE SOIL AND/OR SUBSURFACE SOIL, AND/OR GROUNDWATER SAMPLE LOCATION (ECP 2004)
- -SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- -SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- -SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- -SURFACE, SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- -SURFACE WATER/SEDIMENT SAMPLE LOCATION (CMS 2010)
- -SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (CMS 2012)
- -SEDIMENT SAMPLE LOCATION (CMS 2012)
- -MONITORING WELL (SWMU 74)
- -SWMU 59 BOUNDARY
- -DRAINAGE DITCH
- -STORM MANHOLE
- -STORM PIPE
- -STORM INLET
- -APPROXIMATE EDGE OF SLOPE
- -VEGETATION
- -CONCRETE
- -ASPHALT

FIGURE 7-13
DETECTED CONCENTRATIONS IN GROUNDWATER EXCEEDING GROUNDWATER SCREENING VALUES
SWMU 59-FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO



Site ID	59SW02
Sample ID	59SW02
Sample Date	5/20/2010
Total Inorganics (µg/L)	
Copper	4

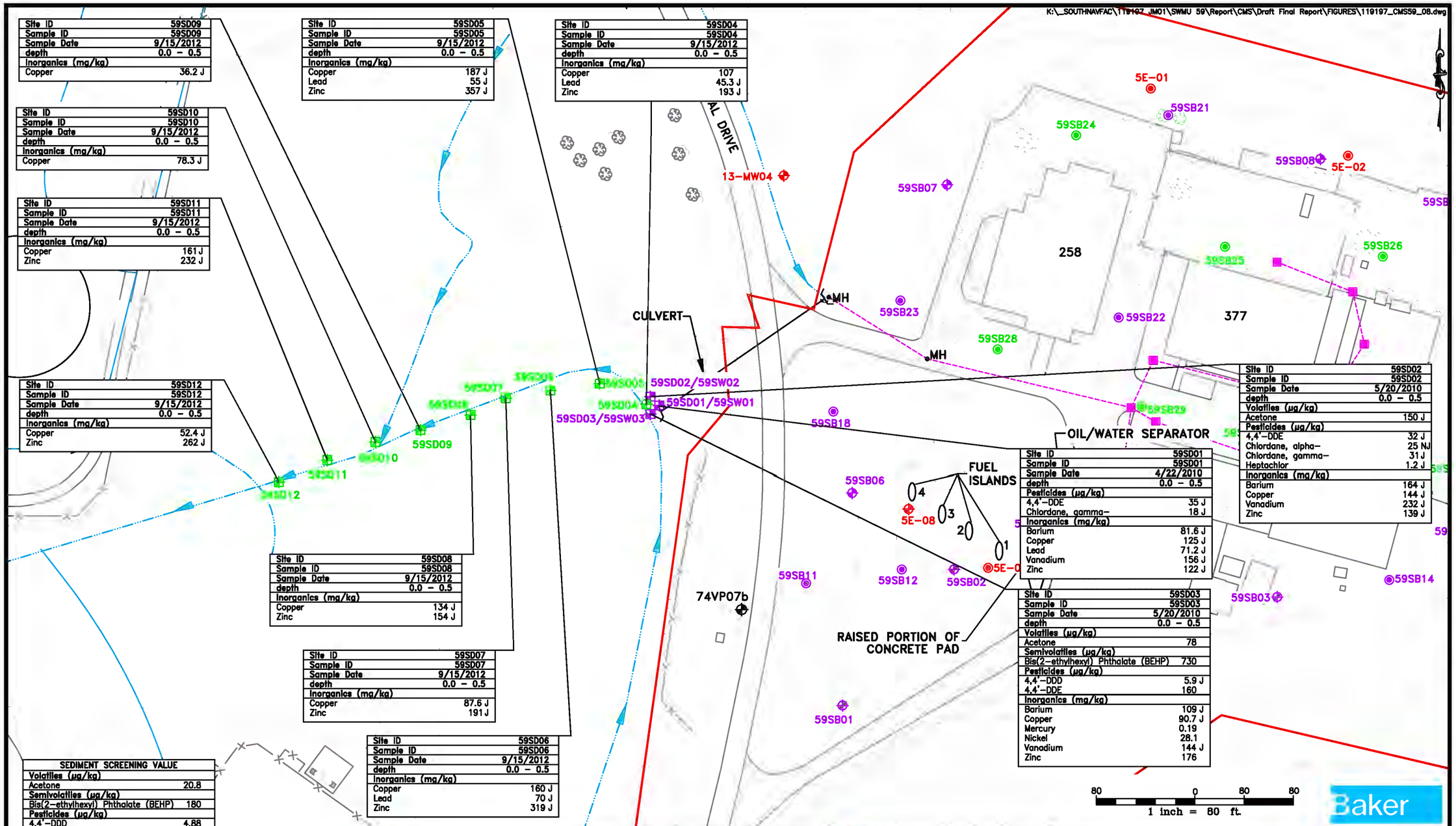
Site ID	59SW03
Sample ID	59SW03
Sample Date	5/20/2010
Total Inorganics (µg/L)	
Copper	4

Site ID	59SW01
Sample ID	59SW01
Sample Date	4/20/2010
Pesticides (µg/L)	
4,4'-DDE	0.006 J
4,4'-DDT	0.0065 J
Total Inorganics (µg/L)	
Copper	3.8

SURFACEWATER SCREENING VALUES	
Pesticides (µg/L)	
4,4'-DDE	0.001
4,4'-DDT	0.001
Total Inorganics (µg/L)	
Copper	3.46

- -SURFACE AND/OR SUBSURFACE SOIL SAMPLE LOCATION (ECP 2004)
- -SURFACE SOIL AND/OR SUBSURFACE SOIL, AND/OR GROUNDWATER SAMPLE LOCATION (ECP 2004)
- -SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- -SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- -SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- -SURFACE, SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- -SURFACE WATER/SEDIMENT SAMPLE LOCATION (CMS 2010)
- -SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (CMS 2012)
- -SEDIMENT SAMPLE LOCATION (CMS 2012)
- -MONITORING WELL (SWMU 74)
- -SWMU 59 BOUNDARY
- -DRAINAGE DITCH
- -STORM MANHOLE
- -STORM PIPE
- -STORM INLET
- -APPROXIMATE EDGE OF SLOPE
- -VEGETATION
- -CONCRETE
- -ASPHALT

FIGURE 7-14
DETECTED CONCENTRATIONS IN SURFACE WATER EXCEEDING SURFACE WATER SCREENING VALUES
SWMU 59-FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO



Site ID	59SD09
Sample ID	59SD09
Sample Date	9/15/2012
depth	0.0 – 0.5
Inorganics (mg/kg)	
Copper	36.2 J

Site ID	59SD10
Sample ID	59SD10
Sample Date	9/15/2012
depth	0.0 – 0.5
Inorganics (mg/kg)	
Copper	78.3 J

Site ID	59SD11
Sample ID	59SD11
Sample Date	9/15/2012
depth	0.0 – 0.5
Inorganics (mg/kg)	
Copper	161 J
Zinc	232 J

Site ID	59SD12
Sample ID	59SD12
Sample Date	9/15/2012
depth	0.0 – 0.5
Inorganics (mg/kg)	
Copper	52.4 J
Zinc	262 J

Site ID	59SD05
Sample ID	59SD05
Sample Date	9/15/2012
depth	0.0 – 0.5
Inorganics (mg/kg)	
Copper	187 J
Lead	55 J
Zinc	357 J

Site ID	59SD04
Sample ID	59SD04
Sample Date	9/15/2012
depth	0.0 – 0.5
Inorganics (mg/kg)	
Copper	107
Lead	45.3 J
Zinc	193 J

Site ID	59SD08
Sample ID	59SD08
Sample Date	9/15/2012
depth	0.0 – 0.5
Inorganics (mg/kg)	
Copper	134 J
Zinc	154 J

Site ID	59SD07
Sample ID	59SD07
Sample Date	9/15/2012
depth	0.0 – 0.5
Inorganics (mg/kg)	
Copper	87.6 J
Zinc	191 J

Site ID	59SD06
Sample ID	59SD06
Sample Date	9/15/2012
depth	0.0 – 0.5
Inorganics (mg/kg)	
Copper	160 J
Lead	70 J
Zinc	319 J

Site ID	59SD02
Sample ID	59SD02
Sample Date	5/20/2010
depth	0.0 – 0.5
Volatiles (µg/kg)	
Acetone	150 J
Pesticides (µg/kg)	
4,4'–DDE	32 J
Chlordane, alpha–	25 NJ
Chlordane, gamma–	31 J
Heptachlor	1.2 J
Inorganics (mg/kg)	
Barium	164 J
Copper	144 J
Vanadium	232 J
Zinc	139 J

Site ID	59SD01
Sample ID	59SD01
Sample Date	4/22/2010
depth	0.0 – 0.5
Pesticides (µg/kg)	
4,4'–DDE	35 J
Chlordane, gamma–	18 J
Inorganics (mg/kg)	
Barium	81.6 J
Copper	125 J
Lead	71.2 J
Vanadium	156 J
Zinc	122 J

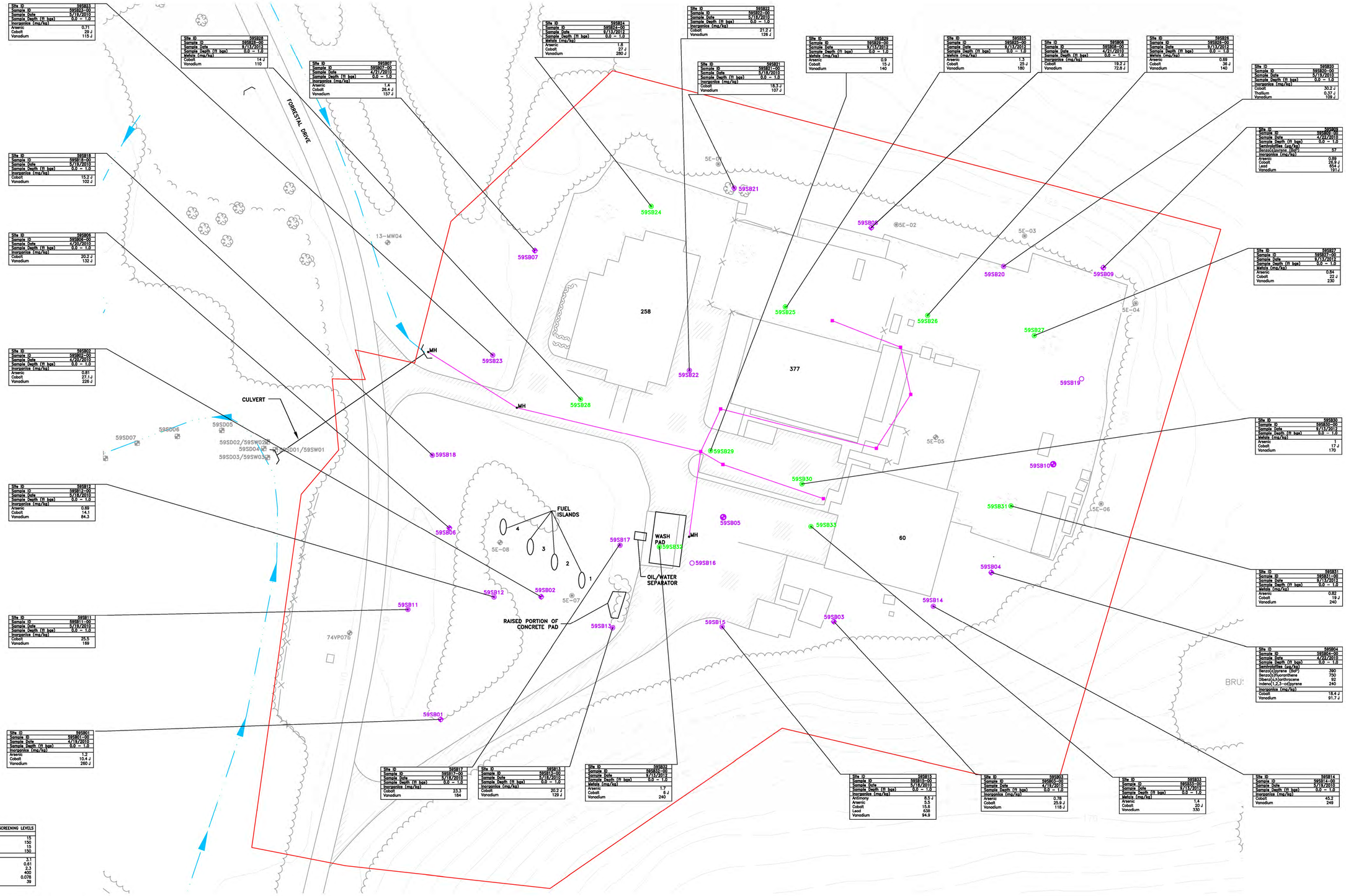
Site ID	59SD03
Sample ID	59SD03
Sample Date	5/20/2010
depth	0.0 – 0.5
Volatiles (µg/kg)	
Acetone	78
Semivolatiles (µg/kg)	
Bis(2–ethylhexyl) Phthalate (BEHP)	730
Pesticides (µg/kg)	
4,4'–DDD	5.9 J
4,4'–DDE	160
Inorganics (mg/kg)	
Barium	109 J
Copper	90.7 J
Mercury	0.19
Nickel	28.1
Vanadium	144 J
Zinc	176

SEDIMENT SCREENING VALUE	
Volatiles (µg/kg)	
Acetone	20.8
Semivolatiles (µg/kg)	
Bis(2–ethylhexyl) Phthalate (BEHP)	180
Pesticides (µg/kg)	
4,4'–DDD	4.88
4,4'–DDE	3.16
Chlordane, alpha–	3.24
Chlordane, gamma–	3.24
Heptachlor	0.30
Inorganics (mg/kg)	
Barium	20
Copper	31.6
Lead	35.8
Mercury	0.18
Nickel	22.7
Vanadium	57
Zinc	121

LEGEND

- –SURFACE AND/OR SUBSURFACE SOIL SAMPLE LOCATION (ECP 2004)
- –SURFACE SOIL AND/OR SUBSURFACE SOIL, AND/OR GROUNDWATER SAMPLE LOCATION (ECP 2004)
- –SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- –SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- –SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- –SURFACE, SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- –SURFACE WATER/SEDIMENT SAMPLE LOCATION (CMS 2010)
- –SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (CMS 2012)
- –SEDIMENT SAMPLE LOCATION (CMS 2012)
- –MONITORING WELL (SWMU 74)
- –SWMU 59 BOUNDARY
- –DRAINAGE DITCH
- –STORM MANHOLE
- –STORM PIPE
- –STORM INLET
- –APPROXIMATE EDGE OF SLOPE
- –VEGETATION
- –CONCRETE
- –ASPHALT

FIGURE 7–15
DETECTED CONCENTRATIONS IN SEDIMENT EXCEEDING SEDIMENT SCREENING VALUES
SWMU 59–FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO



Site ID	59SB23
Sample ID	59SB23-00
Sample Date	5/19/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Arsenic	0.71
Cobalt	29 J
Vanadium	115 J

Site ID	59SB28
Sample ID	59SB28-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 – 1.0
Metals (mg/kg)	
Cobalt	14 J
Vanadium	110

Site ID	59SB07
Sample ID	59SB07-00
Sample Date	4/21/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Arsenic	1.4
Cobalt	26.4 J
Vanadium	157 J

Site ID	59SB24
Sample ID	59SB24-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 – 1.0
Metals (mg/kg)	
Arsenic	1.8
Cobalt	27 J
Vanadium	280 J

Site ID	59SB22
Sample ID	59SB22-00
Sample Date	5/18/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	31.2 J
Vanadium	126 J

Site ID	59SB21
Sample ID	59SB21-00
Sample Date	5/18/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	18.3 J
Vanadium	107 J

Site ID	59SB29
Sample ID	59SB29-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 – 1.0
Metals (mg/kg)	
Arsenic	0.9
Cobalt	15 J
Vanadium	140

Site ID	59SB25
Sample ID	59SB25-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 – 1.0
Metals (mg/kg)	
Arsenic	1.3
Cobalt	25 J
Vanadium	180

Site ID	59SB08
Sample ID	59SB08-00
Sample Date	4/21/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	19.2 J
Vanadium	72.8 J

Site ID	59SB26
Sample ID	59SB26-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 – 1.0
Metals (mg/kg)	
Arsenic	0.69
Cobalt	36 J
Vanadium	140

Site ID	59SB30
Sample ID	59SB30-00
Sample Date	5/17/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	30.2 J
Thallium	0.37 J
Vanadium	109 J

Site ID	59SB09
Sample ID	59SB09-00
Sample Date	4/22/2010
Sample Depth (ft bgs)	0.0 – 1.0
Semivolatiles (ug/kg)	
Isosafrole	57
Inorganics (mg/kg)	
Arsenic	0.99
Cobalt	26.9 J
Lead	554 J
Vanadium	191 J

Site ID	59SB27
Sample ID	59SB27-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 – 1.0
Metals (mg/kg)	
Arsenic	0.84
Cobalt	22 J
Vanadium	230

Site ID	59SB18
Sample ID	59SB18-00
Sample Date	5/19/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	15.2 J
Vanadium	102 J

Site ID	59SB06
Sample ID	59SB06-00
Sample Date	4/30/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	30.2 J
Vanadium	132 J

Site ID	59SB02
Sample ID	59SB02-00
Sample Date	4/20/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Arsenic	0.81
Cobalt	27.1 J
Vanadium	226 J

Site ID	59SB12
Sample ID	59SB12-00
Sample Date	5/18/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Arsenic	0.69
Cobalt	14.1
Vanadium	84.3

Site ID	59SB11
Sample ID	59SB11-00
Sample Date	5/19/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	25.5
Vanadium	169

Site ID	59SB01
Sample ID	59SB01-00
Sample Date	4/19/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Arsenic	1.2
Cobalt	10.4 J
Vanadium	260 J

Site ID	59SB17
Sample ID	59SB17-00
Sample Date	5/18/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	23.3
Vanadium	164

Site ID	59SB13
Sample ID	59SB13-00
Sample Date	5/18/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	20.2 J
Vanadium	129 J

Site ID	59SB32
Sample ID	59SB32-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 – 1.0
Metals (mg/kg)	
Arsenic	1.7
Cobalt	9 J
Vanadium	240

Site ID	59SB15
Sample ID	59SB15-00
Sample Date	5/18/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Antimony	8.5 J
Arsenic	5.5
Cobalt	15.6
Lead	638
Vanadium	94.9

Site ID	59SB03
Sample ID	59SB03-00
Sample Date	4/19/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Arsenic	0.78
Cobalt	25.9 J
Vanadium	118 J

Site ID	59SB33
Sample ID	59SB33-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 – 1.0
Metals (mg/kg)	
Arsenic	1.4
Cobalt	20 J
Vanadium	330

Site ID	59SB14
Sample ID	59SB14-00
Sample Date	5/19/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	43.2
Vanadium	249

Site ID	59SB31
Sample ID	59SB31-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 – 1.0
Metals (mg/kg)	
Arsenic	0.82
Cobalt	19 J
Vanadium	240

Site ID	59SB04
Sample ID	59SB04-00
Sample Date	4/22/2010
Sample Depth (ft bgs)	0.0 – 1.0
Semivolatiles (ug/kg)	
Benzo(a)pyrene (BaP)	390
Benzo(b)fluoranthene	750
Dibenz(a,h)anthracene	92
Indeno(1,2,3-cd)pyrene	240
Inorganics (mg/kg)	
Cobalt	18.4 J
Vanadium	91.7 J

RESIDENTIAL SOIL REGIONAL SCREENING LEVELS	
Semivolatiles (ug/kg)	
Benzo(a)pyrene (BaP)	15
Benzo(b)fluoranthene	150
Dibenz(a,h)anthracene	15
Indeno(1,2,3-cd)pyrene	150
Inorganics (mg/kg)	
Antimony	3.1
Arsenic	0.61
Cobalt	2.3
Lead	400
Thallium	0.078
Vanadium	39

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LEGEND

- SWMU BOUNDARY
- SURFACE AND/OR SUBSURFACE SOIL SAMPLE LOCATION (ECP 2004)
- SURFACE SOIL AND/OR SUBSURFACE SOIL, AND/OR GROUNDWATER SAMPLE LOCATION (ECP 2004)
- SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- SURFACE, SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- SURFACE WATER/SEDIMENT SAMPLE LOCATION (CMS 2010)
- SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (CMS 2012)
- SEDIMENT SAMPLE LOCATION (CMS 2012)
- MONITORING WELL (SWMU 74)
- DRAINAGE DITCH
- STORM MANHOLE
- STORM PIPE
- STORM INLET
- VEGETATION
- CONCRETE
- ASPHALT

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REVIEWED	KTW
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CADD#	119197_CMS59_18.dwg

NORTH

SWMU 59-FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO

MICHAEL BAKER Jr., Inc.
Moon Township, Pennsylvania

Baker

DETECTED CONCENTRATIONS IN COMBINED SURFACE SOIL EXCEEDING RESIDENTIAL SOIL REGIONAL SCREENING LEVELS,

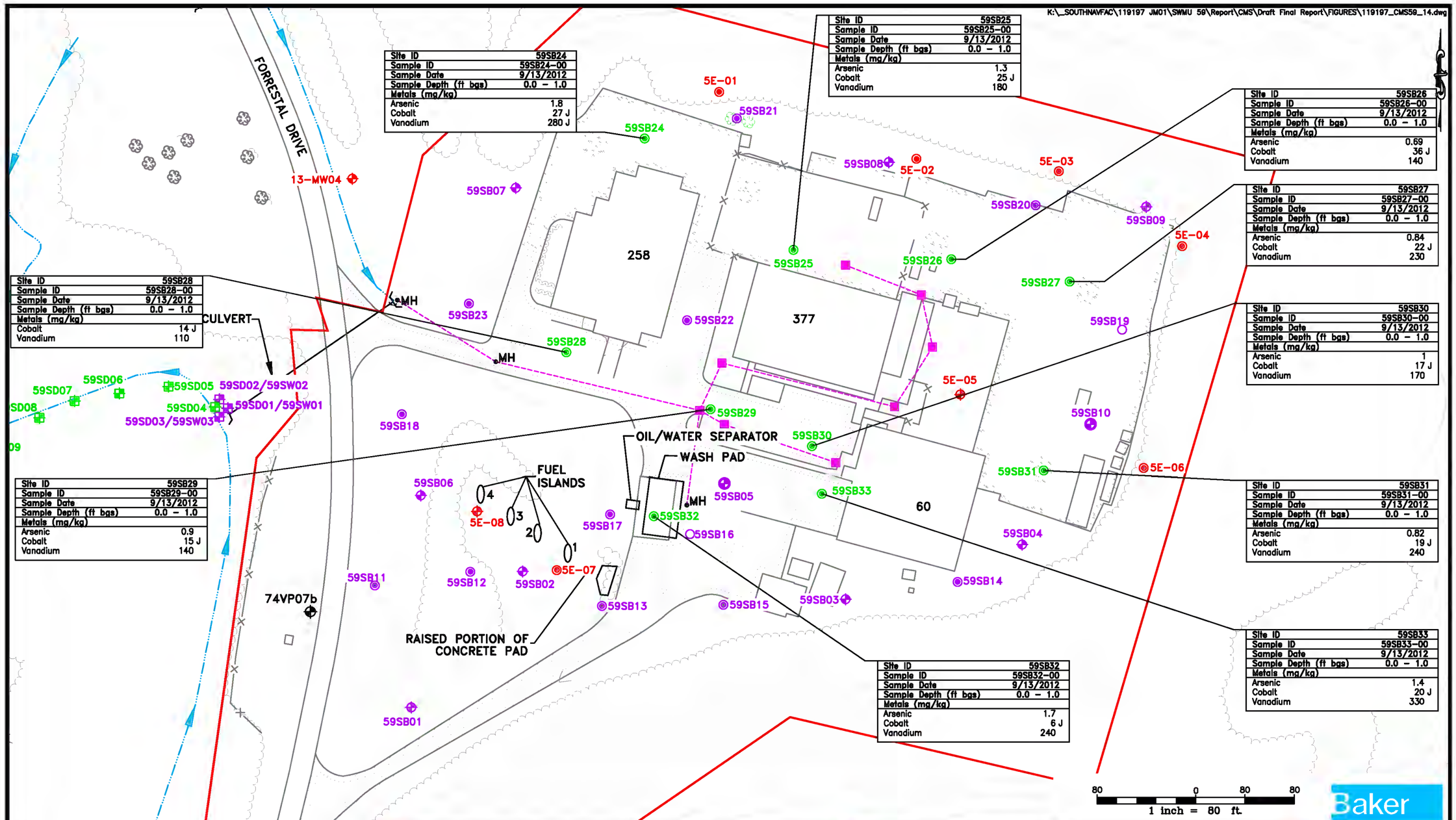
SCALE 1"=40'

DATE SEPTEMBER 2013

FIGURE

8-1

K:_SOUTHNAVFAC\119197 JM01\SWMU 59\Report\CMS\Draft Final Report\FIGURES\119197_CMS59_14.dwg



Site ID	59SB24
Sample ID	59SB24-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 - 1.0
Metals (mg/kg)	
Arsenic	1.8
Cobalt	27 J
Vanadium	280 J

Site ID	59SB25
Sample ID	59SB25-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 - 1.0
Metals (mg/kg)	
Arsenic	1.3
Cobalt	25 J
Vanadium	180

Site ID	59SB26
Sample ID	59SB26-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 - 1.0
Metals (mg/kg)	
Arsenic	0.69
Cobalt	36 J
Vanadium	140

Site ID	59SB27
Sample ID	59SB27-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 - 1.0
Metals (mg/kg)	
Arsenic	0.84
Cobalt	22 J
Vanadium	230

Site ID	59SB28
Sample ID	59SB28-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 - 1.0
Metals (mg/kg)	
Cobalt	14 J
Vanadium	110

Site ID	59SB29
Sample ID	59SB29-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 - 1.0
Metals (mg/kg)	
Arsenic	0.9
Cobalt	15 J
Vanadium	140

Site ID	59SB30
Sample ID	59SB30-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 - 1.0
Metals (mg/kg)	
Arsenic	1
Cobalt	17 J
Vanadium	170

Site ID	59SB31
Sample ID	59SB31-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 - 1.0
Metals (mg/kg)	
Arsenic	0.82
Cobalt	19 J
Vanadium	240

Site ID	59SB32
Sample ID	59SB32-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 - 1.0
Metals (mg/kg)	
Arsenic	1.7
Cobalt	6 J
Vanadium	240

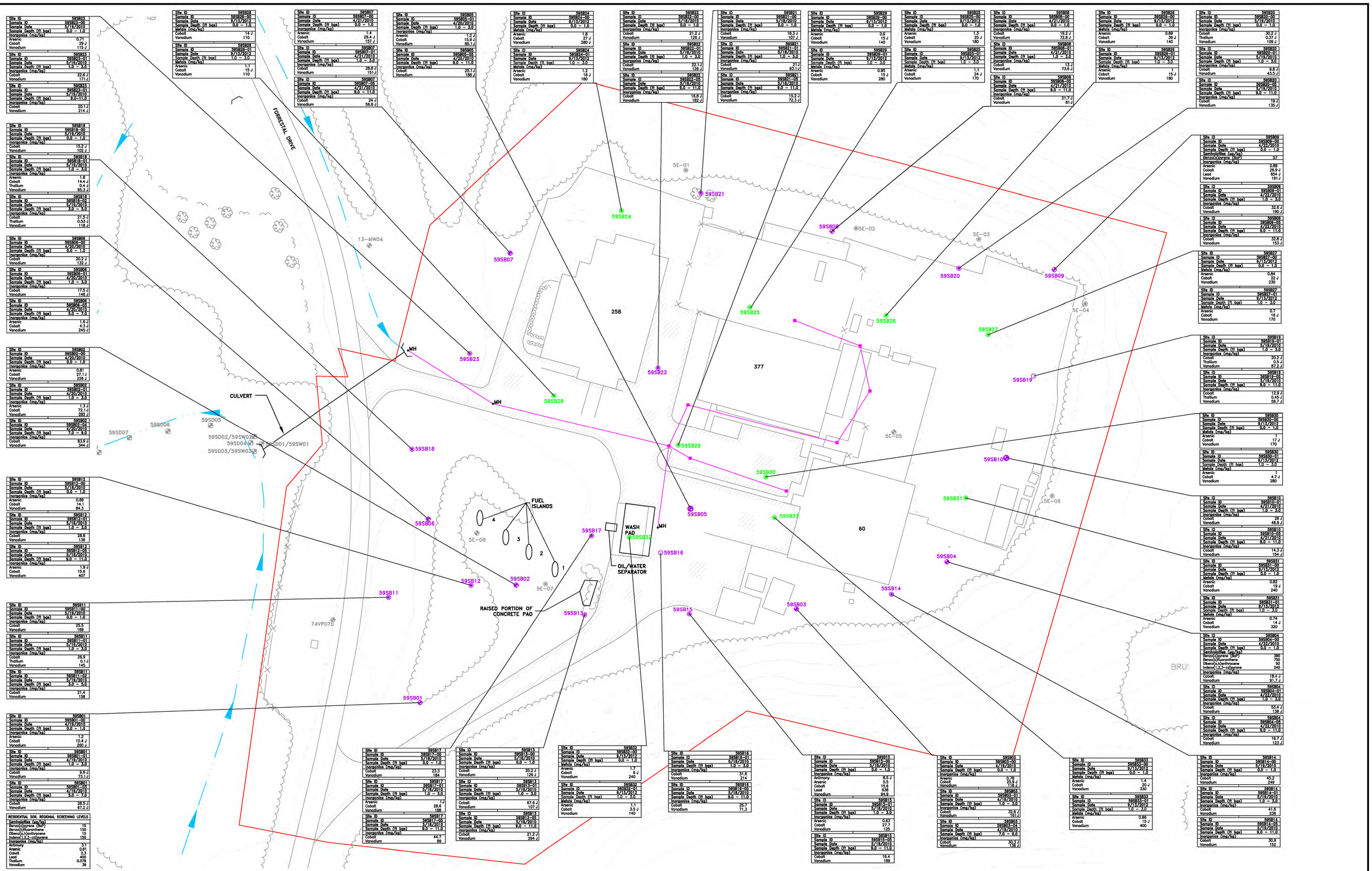
Site ID	59SB33
Sample ID	59SB33-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 - 1.0
Metals (mg/kg)	
Arsenic	1.4
Cobalt	20 J
Vanadium	330

Residential Soil Regional Screening Levels	
Metals (mg/kg)	
Arsenic	0.61
Cobalt	2.3
Vanadium	39

LEGEND

- -SURFACE AND/OR SUBSURFACE SOIL SAMPLE LOCATION (ECP 2004)
- -SURFACE SOIL AND/OR SUBSURFACE SOIL AND/OR GROUNDWATER SAMPLE LOCATION (ECP 2004)
- -SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- -SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- -SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- -SURFACE, SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- -SURFACE WATER/SEDIMENT SAMPLE LOCATION (CMS 2010)
- -SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (CMS 2012)
- -SEDIMENT SAMPLE LOCATION (CMS 2012)
- -MONITORING WELL (SWMU 74)
- -SWMU 59 BOUNDARY
- -DRAINAGE DITCH
- -STORM MANHOLE
- -STORM PIPE
- -STORM INLET
- -APPROXIMATE EDGE OF SLOPE
- -VEGETATION
- -CONCRETE
- -ASPHALT

FIGURE 8-2
DETECTED CONCENTRATIONS IN SURFACE SOIL EXCEEDING SOIL SCREENING VALUES: 2012 CMS FIELD INVESTIGATION
SWMU 59-FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO



Site ID	59SB23
Sample ID	59SB23-00
Sample Date	5/18/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Arsenic	0.71
Cobalt	29 J
Vanadium	115 J

Site ID	59SB23
Sample ID	59SB23-01
Sample Date	5/18/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	22.6 J
Vanadium	171 J

Site ID	59SB23
Sample ID	59SB23-03
Sample Date	5/18/2010
Sample Depth (ft bgs)	9.0–11.0
Inorganics (mg/kg)	
Cobalt	20.1 J
Vanadium	214 J

Site ID	59SB18
Sample ID	59SB18-00
Sample Date	5/18/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	15.2 J
Vanadium	102 J

Site ID	59SB18
Sample ID	59SB18-01
Sample Date	5/18/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Arsenic	1.8
Cobalt	14.4 J
Thallium	0.4 J
Vanadium	65.3 J

Site ID	59SB18
Sample ID	59SB18-02
Sample Date	5/18/2010
Sample Depth (ft bgs)	3.0 – 5.0
Inorganics (mg/kg)	
Cobalt	21.5 J
Thallium	0.53 J
Vanadium	118 J

Site ID	59SB06
Sample ID	59SB06-00
Sample Date	4/30/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	20.2 J
Vanadium	132 J

Site ID	59SB06
Sample ID	59SB06-01
Sample Date	4/30/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	17.5 J
Vanadium	146 J

Site ID	59SB06
Sample ID	59SB06-03
Sample Date	4/30/2010
Sample Depth (ft bgs)	5.0 – 7.0
Inorganics (mg/kg)	
Arsenic	1.6 J
Cobalt	4.3 J
Vanadium	245 J

Site ID	59SB02
Sample ID	59SB02-00
Sample Date	4/30/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Arsenic	0.81
Cobalt	27.1 J
Vanadium	226 J

Site ID	59SB02
Sample ID	59SB02-01
Sample Date	4/30/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Arsenic	1.3 J
Cobalt	72.1 J
Vanadium	282 J

Site ID	59SB02
Sample ID	59SB02-04
Sample Date	4/30/2010
Sample Depth (ft bgs)	7.0 – 9.0
Inorganics (mg/kg)	
Cobalt	63.9 J
Vanadium	344 J

Site ID	59SB12
Sample ID	59SB12-00
Sample Date	5/18/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Arsenic	0.69
Cobalt	14.1
Vanadium	84.3

Site ID	59SB12
Sample ID	59SB12-01
Sample Date	5/18/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	28.8
Vanadium	136

Site ID	59SB17
Sample ID	59SB17-03
Sample Date	5/18/2010
Sample Depth (ft bgs)	9.0 – 11.0
Inorganics (mg/kg)	
Arsenic	1.9 J
Cobalt	15.6
Vanadium	407

Site ID	59SB11
Sample ID	59SB11-00
Sample Date	5/18/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	25.5
Vanadium	159

Site ID	59SB11
Sample ID	59SB11-01
Sample Date	5/18/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	26.9
Thallium	0.1 J
Vanadium	145

Site ID	59SB11
Sample ID	59SB11-02
Sample Date	5/18/2010
Sample Depth (ft bgs)	3.0 – 5.0
Inorganics (mg/kg)	
Cobalt	21.4
Vanadium	158

Site ID	59SB01
Sample ID	59SB01-00
Sample Date	4/19/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Arsenic	1.2
Cobalt	10.4 J
Vanadium	260 J

Site ID	59SB01
Sample ID	59SB01-01
Sample Date	4/19/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	9.6 J
Vanadium	73.1 J

Site ID	59SB01
Sample ID	59SB01-03
Sample Date	4/19/2010
Sample Depth (ft bgs)	5.0 – 7.0
Inorganics (mg/kg)	
Cobalt	28.5 J
Vanadium	67.2 J

RESIDENTIAL SOIL REGIONAL SCREENING LEVELS

Semivolatiles (mg/kg)	
Benzo(a)pyrene (BaP)	15
Benzo(b)fluoranthene	150
Dibenz(a,h)anthracene	15
Indeno(1,2,3-cd)pyrene	150
Inorganics (mg/kg)	
Antimony	3.1
Arsenic	0.61
Cobalt	2.3
Lead	400
Thallium	0.078
Vanadium	39

Site ID	59SB07
Sample ID	59SB07-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 – 1.0
Metals (mg/kg)	
Cobalt	14 J
Vanadium	110

Site ID	59SB07
Sample ID	59SB07-01
Sample Date	9/13/2012
Sample Depth (ft bgs)	1.0 – 3.0
Metals (mg/kg)	
Arsenic	1.1
Cobalt	15 J
Vanadium	110

Site ID	59SB07
Sample ID	59SB07-00
Sample Date	4/21/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	14.4 J
Vanadium	137 J

Site ID	59SB07
Sample ID	59SB07-01
Sample Date	4/21/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	28.8 J
Vanadium	151 J

Site ID	59SB07
Sample ID	59SB07-05
Sample Date	4/21/2010
Sample Depth (ft bgs)	9.0 – 11.0
Inorganics (mg/kg)	
Cobalt	24 J
Vanadium	56.8 J

Site ID	59SB05
Sample ID	59SB05-01
Sample Date	4/20/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Arsenic	1.2 J
Cobalt	15.9 J
Vanadium	85.1 J

Site ID	59SB05
Sample ID	59SB05-05
Sample Date	4/20/2010
Sample Depth (ft bgs)	9.0 – 11.0
Inorganics (mg/kg)	
Cobalt	25.1 J
Vanadium	189 J

Site ID	59SB24
Sample ID	59SB24-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 – 1.0
Metals (mg/kg)	
Arsenic	1.8
Cobalt	27 J
Vanadium	280 J

Site ID	59SB24
Sample ID	59SB24-01
Sample Date	9/13/2012
Sample Depth (ft bgs)	1.0 – 3.0
Metals (mg/kg)	
Arsenic	1.2
Cobalt	18 J
Vanadium	180

Site ID	59SB22
Sample ID	59SB22-00
Sample Date	5/18/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	21.2 J
Vanadium	126 J

Site ID	59SB22
Sample ID	59SB22-01
Sample Date	5/18/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	22.1 J
Vanadium	126 J

Site ID	59SB22
Sample ID	59SB22-05
Sample Date	5/18/2010
Sample Depth (ft bgs)	9.0 – 11.0
Inorganics (mg/kg)	
Cobalt	16.8 J
Vanadium	162 J

Site ID	59SB21
Sample ID	59SB21-00
Sample Date	5/18/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	18.3 J
Vanadium	107 J

Site ID	59SB21
Sample ID	59SB21-01
Sample Date	5/18/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	21 J
Vanadium	93.1 J

Site ID	59SB21
Sample ID	59SB21-05
Sample Date	5/18/2010
Sample Depth (ft bgs)	9.0 – 11.0
Inorganics (mg/kg)	
Cobalt	15.2 J
Vanadium	72.3 J

Site ID	59SB29
Sample ID	59SB29-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 – 1.0
Metals (mg/kg)	
Arsenic	0.9
Cobalt	15 J
Vanadium	140

Site ID	59SB29
Sample ID	59SB29-01
Sample Date	9/13/2012
Sample Depth (ft bgs)	1.0 – 3.0
Metals (mg/kg)	
Arsenic	0.95
Cobalt	15 J
Vanadium	280

Site ID	59SB25
Sample ID	59SB25-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 – 1.0
Metals (mg/kg)	
Arsenic	1.3
Cobalt	25 J
Vanadium	180

Site ID	59SB25
Sample ID	59SB25-01
Sample Date	9/13/2012
Sample Depth (ft bgs)	1.0 – 3.0
Metals (mg/kg)	
Arsenic	1.1
Cobalt	24 J
Vanadium	170

Site ID	59SB08
Sample ID	59SB08-00
Sample Date	4/21/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	19.2 J
Vanadium	72.8 J

Site ID	59SB08
Sample ID	59SB08-01
Sample Date	4/21/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	13 J
Vanadium	73.6 J

Site ID	59SB08
Sample ID	59SB08-05
Sample Date	4/21/2010
Sample Depth (ft bgs)	9.0 – 11.0
Inorganics (mg/kg)	
Cobalt	21.7 J
Vanadium	81 J

Site ID	59SB26
Sample ID	59SB26-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 – 1.0
Metals (mg/kg)	
Arsenic	0.69
Cobalt	36 J
Vanadium	140

Site ID	59SB26
Sample ID	59SB26-01
Sample Date	9/13/2012
Sample Depth (ft bgs)	1.0 – 3.0
Metals (mg/kg)	
Arsenic	1
Cobalt	15 J
Vanadium	180

Site ID	59SB20
Sample ID	59SB20-00
Sample Date	5/18/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	30.2 J
Thallium	0.37 J
Vanadium	109 J

Site ID	59SB20
Sample ID	59SB20-01
Sample Date	5/18/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	9.8 J
Vanadium	43.5 J

Site ID	59SB20
Sample ID	59SB20-05
Sample Date	5/18/2010
Sample Depth (ft bgs)	9.0 – 11.0
Inorganics (mg/kg)	
Cobalt	19 J
Vanadium	135 J

Site ID	59SB09
Sample ID	59SB09-00
Sample Date	4/22/2010
Sample Depth (ft bgs)	0.0 – 1.0
Semivolatiles (ug/kg)	
Benzo(a)pyrene (BaP)	57
Inorganics (mg/kg)	
Arsenic	0.89
Cobalt	28.9 J
Lead	654 J
Vanadium	191 J

Site ID	59SB09
Sample ID	59SB09-01
Sample Date	4/22/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	32.6 J
Vanadium	190 J

Site ID	59SB09
Sample ID	59SB09-05
Sample Date	4/22/2010
Sample Depth (ft bgs)	9.0 – 11.0
Inorganics (mg/kg)	
Cobalt	32.8 J
Vanadium	153 J

Site ID	59SB27
Sample ID	59SB27-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 – 1.0
Metals (mg/kg)	
Arsenic	0.84
Cobalt	22 J
Vanadium	232

Site ID	59SB27
Sample ID	59SB27-01
Sample Date	9/13/2012
Sample Depth (ft bgs)	1.0 – 3.0
Metals (mg/kg)	
Arsenic	0.7
Cobalt	16 J
Vanadium	170

Site ID	59SB19
Sample ID	59SB19-01
Sample Date	5/18/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	20.2 J
Thallium	0.5 J
Vanadium	87.2 J

Site ID	59SB19
Sample ID	59SB19-05
Sample Date	5/18/2010
Sample Depth (ft bgs)	9.0 – 11.0
Inorganics (mg/kg)	
Cobalt	12.9 J
Thallium	0.45 J
Vanadium	59.7 J

Site ID	59SB30
Sample ID	59SB30-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 – 1.0
Metals (mg/kg)	
Arsenic	1
Cobalt	17 J
Vanadium	170

Site ID	59SB30
Sample ID	59SB30-01
Sample Date	9/13/2012
Sample Depth (ft bgs)	1.0 – 3.0
Metals (mg/kg)	
Arsenic	1
Cobalt	4.7 J
Vanadium	280

Site ID	59SB10
Sample ID	59SB10-01
Sample Date	4/21/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	28 J
Vanadium	46.9 J

Site ID	59SB10
Sample ID	59SB10-05
Sample Date	4/21/2010
Sample Depth (ft bgs)	9.0 – 11.0
Inorganics (mg/kg)	
Cobalt	14.3 J
Vanadium	154 J

Site ID	59SB31
Sample ID	59SB31-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 – 1.0
Metals (mg/kg)	
Arsenic	0.82
Cobalt	19 J
Vanadium	240

Site ID	59SB31
Sample ID	59SB31-01
Sample Date	9/13/2012
Sample Depth (ft bgs)	1.0 – 3.0
Metals (mg/kg)	
Arsenic	0.74
Cobalt	14 J
Vanadium	320

Site ID	59SB04
Sample ID	59SB04-00
Sample Date	4/22/2010
Sample Depth (ft bgs)	0.0 – 1.0
Semivolatiles (ug/kg)	
Benzo(a)pyrene (BaP)	390
Benzo(b)fluoranthene	720
Dibenz(a,h)anthracene	92
Indeno(1,2,3-cd)pyrene	240
Inorganics (mg/kg)	
Cobalt	18.4 J
Vanadium	91.7 J

Site ID	59SB04
Sample ID	59SB04-01
Sample Date	4/22/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	53.4 J
Vanadium	138 J

Site ID	59SB04
Sample ID	59SB04-05
Sample Date	4/22/2010
Sample Depth (ft bgs)	9.0 – 11.0
Inorganics (mg/kg)	
Cobalt	16.7 J
Vanadium	123 J

Site ID	59SB17
Sample ID	59SB17-00
Sample Date	5/18/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	23.3 J
Vanadium	164

Site ID	59SB17
Sample ID	59SB17-01
Sample Date	5/18/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Arsenic	1 J
Cobalt	28.6
Vanadium	188

Site ID	59SB17
Sample ID	59SB17-05
Sample Date	5/18/2010
Sample Depth (ft bgs)	9.0 – 11.0
Inorganics (mg/kg)	
Cobalt	44.7 J
Vanadium	89

Site ID	59SB13
Sample ID	59SB13-00
Sample Date	5/18/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	30.2 J
Vanadium	129 J

Site ID	59SB13
Sample ID	59SB13-01
Sample Date	5/18/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	67.6 J
Vanadium	107 J

Site ID	59SB13
Sample ID	59SB13-05
Sample Date	5/18/2010
Sample Depth (ft bgs)	9.0 – 11.0
Inorganics (mg/kg)	
Cobalt	21.2 J
Vanadium	294 J

Site ID	59SB32
Sample ID	59SB32-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 – 1.0
Metals (mg/kg)	
Arsenic	1.7
Cobalt	9 J
Vanadium	240

Site ID	59SB32
Sample ID	59SB32-01
Sample Date	9/13/2012
Sample Depth (ft bgs)	1.0 – 3.0
Metals (mg/kg)	
Arsenic	1.1
Cobalt	3.5 J
Vanadium	140

Site ID	59SB15
Sample ID	59SB15-01
Sample Date	5/18/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	31.6
Vanadium	214

Site ID	59SB15
Sample ID	59SB15-05
Sample Date	5/18/2010
Sample Depth (ft bgs)	9.0 – 11.0
Inorganics (mg/kg)	
Cobalt	25.7
Vanadium	71.3

Site ID	59SB15
Sample ID	59SB15-00
Sample Date	5/18/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Antimony	8.5 J
Arsenic	3.5
Cobalt	15.6
Lead	638
Vanadium	94.8

Site ID	59SB15
Sample ID	59SB15-01
Sample Date	5/18/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Arsenic	0.63
Cobalt	27.7
Vanadium	125

Site ID	59SB15
Sample ID	59SB15-05
Sample Date	5/18/2010
Sample Depth (ft bgs)	9.0 – 11.0
Inorganics (mg/kg)	
Cobalt	16.4
Vanadium	189

Site ID	59SB03
Sample ID	59SB03-00
Sample Date	4/19/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Arsenic	0.78
Cobalt	25.9 J
Vanadium	118 J

Site ID	59SB03
Sample ID	59SB03-01
Sample Date	4/19/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	32.6 J
Vanadium	161 J

Site ID	59SB03
Sample ID	59SB03-05
Sample Date	4/19/2010
Sample Depth (ft bgs)	7.0 – 9.0
Inorganics (mg/kg)	
Cobalt	30.3 J
Vanadium	136 J

Site ID	59SB33
Sample ID	59SB33-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 – 1.0
Metals (mg/kg)	
Arsenic	1.4
Cobalt	20 J
Vanadium	330

Site ID	59SB33
Sample ID	59SB33-01
Sample Date	9/13/2012
Sample Depth (ft bgs)	1.0 – 3.0
Metals (mg/kg)	
Arsenic	0.86
Cobalt	15 J
Vanadium	400

Site ID	59SB14
Sample ID	59SB14-00
Sample Date	5/18/2010
Sample Depth (ft bgs)	0.0 – 1.0
Inorganics (mg/kg)	
Cobalt	45.2
Vanadium	249

Site ID	59SB14
Sample ID	59SB14-01
Sample Date	5/18/2010
Sample Depth (ft bgs)	1.0 – 3.0
Inorganics (mg/kg)	
Cobalt	41.6
Vanadium	236

Site ID	59SB14
Sample ID	59SB14-05
Sample Date	5/18/2010
Sample Depth (ft bgs)	9.0 – 11.0
Inorganics (mg/kg)	
Cobalt	30.9
Vanadium	152

LEGEND

- SWMU BOUNDARY
- SURFACE AND/OR SUBSURFACE SOIL SAMPLE LOCATION (ECP 2004)
- SURFACE SOIL AND/OR SUBSURFACE SOIL, AND/OR GROUNDWATER SAMPLE LOCATION (ECP 2004)
- SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- SURFACE, SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- SURFACE WATER/SEDIMENT SAMPLE LOCATION (CMS 2010)
- SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (CMS 2012)
- SEDIMENT SAMPLE LOCATION (CMS 2012)
- MONITORING WELL (SWMU 74)
- DRAINAGE DITCH
- STORM MANHOLE
- STORM PIPE
- STORM INLET
- VEGETATION
- CONCRETE
- ASPHALT

DRAWN	RRR
REVIEWED	KTW
S.O.#	119197
CADD#	119197_CMS59_18.dwg

NORTH

SWMU 59-FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO

MICHAEL BAKER Jr., Inc.
Moon Township, Pennsylvania

Baker

DETECTED CONCENTRATIONS IN COMBINED TOTAL SOIL EXCEEDING RESIDENTIAL SOIL REGIONAL SCREENING LEVELS,

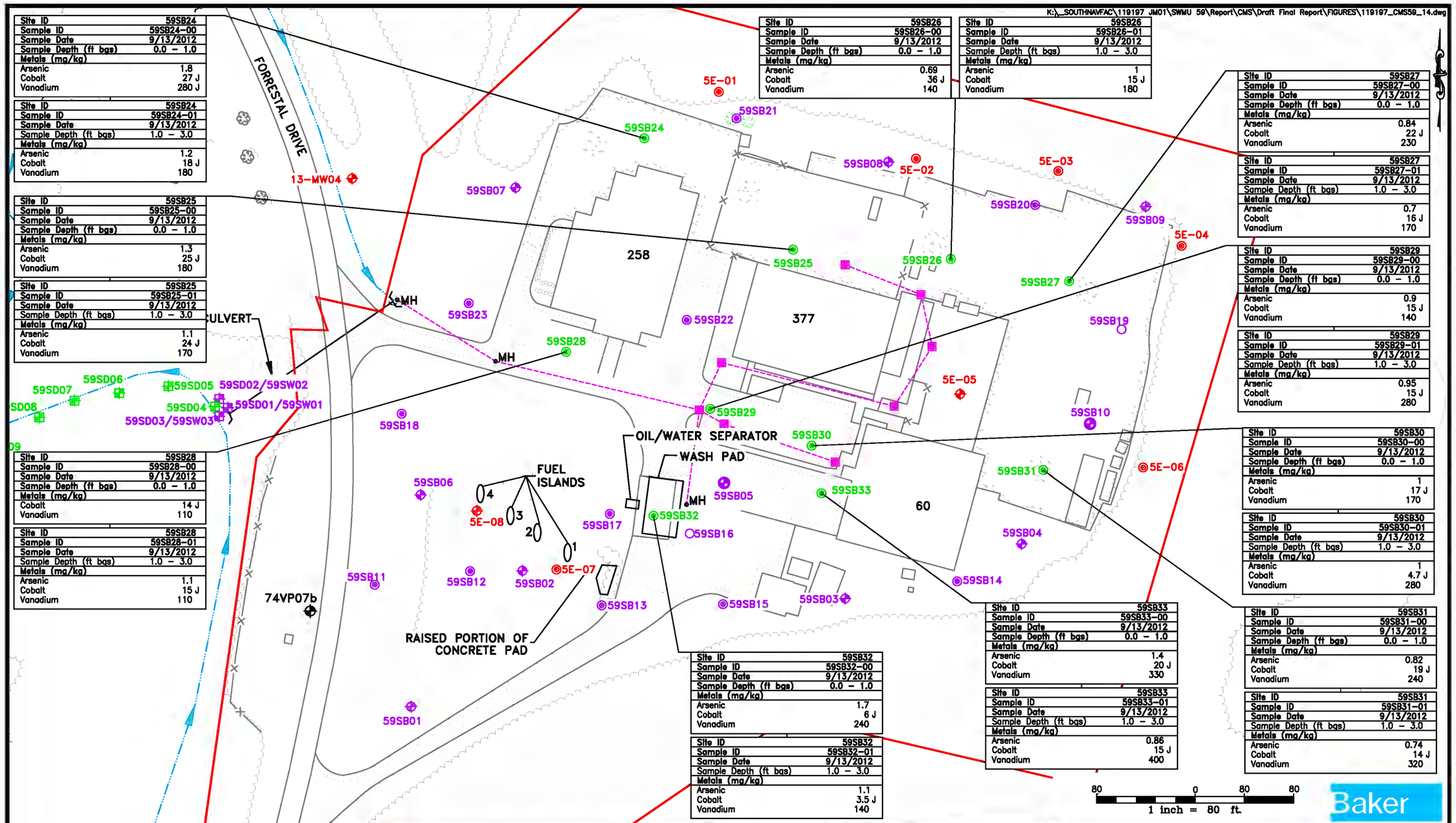
SCALE 1"=40'

DATE SEPTEMBER 2013

FIGURE

8-3

K:_SOUTHNAVFAC\119197 JM01\SWMU 59\Report\CMS\Draft Final Report\FIGURES\119197_CMS59_14.dwg



Site ID	59SB24
Sample ID	59SB24-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 – 1.0
Metals (mg/kg)	
Arsenic	1.8
Cobalt	27 J
Vanadium	280 J

Site ID	59SB24
Sample ID	59SB24-01
Sample Date	9/13/2012
Sample Depth (ft bgs)	1.0 – 3.0
Metals (mg/kg)	
Arsenic	1.2
Cobalt	18 J
Vanadium	180

Site ID	59SB25
Sample ID	59SB25-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 – 1.0
Metals (mg/kg)	
Arsenic	1.3
Cobalt	25 J
Vanadium	180

Site ID	59SB25
Sample ID	59SB25-01
Sample Date	9/13/2012
Sample Depth (ft bgs)	1.0 – 3.0
Metals (mg/kg)	
Arsenic	1.1
Cobalt	24 J
Vanadium	170

Site ID	59SB28
Sample ID	59SB28-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 – 1.0
Metals (mg/kg)	
Cobalt	14 J
Vanadium	110

Site ID	59SB28
Sample ID	59SB28-01
Sample Date	9/13/2012
Sample Depth (ft bgs)	1.0 – 3.0
Metals (mg/kg)	
Arsenic	1.1
Cobalt	15 J
Vanadium	110

Site ID	59SB26
Sample ID	59SB26-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 – 1.0
Metals (mg/kg)	
Arsenic	0.69
Cobalt	36 J
Vanadium	140

Site ID	59SB26
Sample ID	59SB26-01
Sample Date	9/13/2012
Sample Depth (ft bgs)	1.0 – 3.0
Metals (mg/kg)	
Arsenic	1
Cobalt	15 J
Vanadium	180

Site ID	59SB27
Sample ID	59SB27-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 – 1.0
Metals (mg/kg)	
Arsenic	0.84
Cobalt	22 J
Vanadium	230

Site ID	59SB27
Sample ID	59SB27-01
Sample Date	9/13/2012
Sample Depth (ft bgs)	1.0 – 3.0
Metals (mg/kg)	
Arsenic	0.7
Cobalt	16 J
Vanadium	170

Site ID	59SB29
Sample ID	59SB29-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 – 1.0
Metals (mg/kg)	
Arsenic	0.9
Cobalt	15 J
Vanadium	140

Site ID	59SB29
Sample ID	59SB29-01
Sample Date	9/13/2012
Sample Depth (ft bgs)	1.0 – 3.0
Metals (mg/kg)	
Arsenic	0.95
Cobalt	15 J
Vanadium	280

Site ID	59SB30
Sample ID	59SB30-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 – 1.0
Metals (mg/kg)	
Arsenic	1
Cobalt	17 J
Vanadium	170

Site ID	59SB30
Sample ID	59SB30-01
Sample Date	9/13/2012
Sample Depth (ft bgs)	1.0 – 3.0
Metals (mg/kg)	
Arsenic	1
Cobalt	4.7 J
Vanadium	280

Site ID	59SB33
Sample ID	59SB33-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 – 1.0
Metals (mg/kg)	
Arsenic	1.4
Cobalt	20 J
Vanadium	330

Site ID	59SB33
Sample ID	59SB33-01
Sample Date	9/13/2012
Sample Depth (ft bgs)	1.0 – 3.0
Metals (mg/kg)	
Arsenic	0.86
Cobalt	15 J
Vanadium	400

Site ID	59SB31
Sample ID	59SB31-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 – 1.0
Metals (mg/kg)	
Arsenic	0.82
Cobalt	19 J
Vanadium	240

Site ID	59SB31
Sample ID	59SB31-01
Sample Date	9/13/2012
Sample Depth (ft bgs)	1.0 – 3.0
Metals (mg/kg)	
Arsenic	0.74
Cobalt	14 J
Vanadium	320

Site ID	59SB32
Sample ID	59SB32-00
Sample Date	9/13/2012
Sample Depth (ft bgs)	0.0 – 1.0
Metals (mg/kg)	
Arsenic	1.7
Cobalt	6 J
Vanadium	240

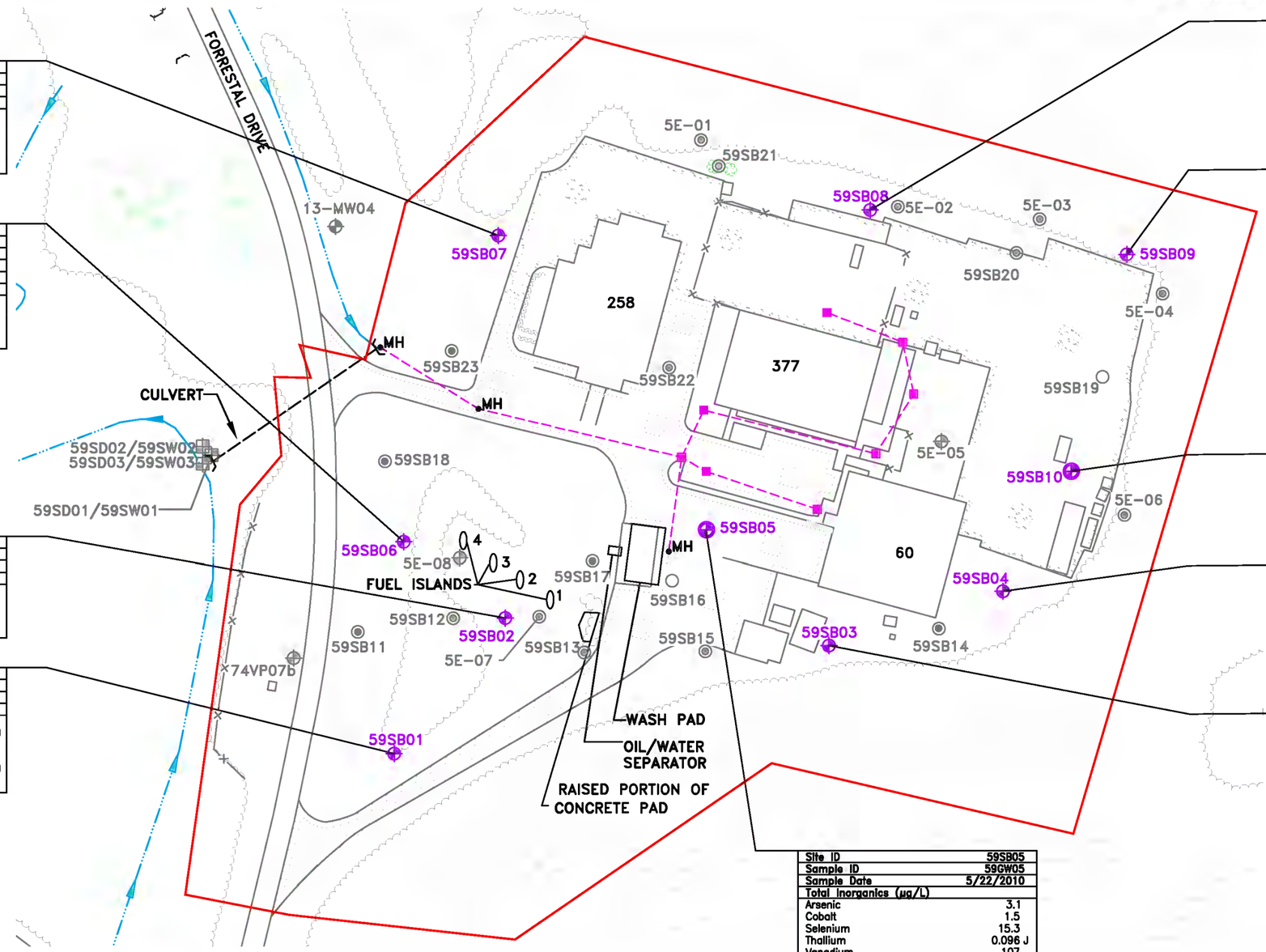
Site ID	59SB32
Sample ID	59SB32-01
Sample Date	9/13/2012
Sample Depth (ft bgs)	1.0 – 3.0
Metals (mg/kg)	
Arsenic	1.1
Cobalt	3.5 J
Vanadium	140

Residential Soil Regional Screening Levels	
Metals (mg/kg)	
Arsenic	0.61
Cobalt	2.3
Vanadium	39

LEGEND

- –SURFACE AND/OR SUBSURFACE SOIL SAMPLE LOCATION (ECP 2004)
- –SURFACE SOIL AND/OR SUBSURFACE SOIL AND/OR GROUNDWATER SAMPLE LOCATION (ECP 2004)
- –SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- –SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- –SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- –SURFACE, SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- –SURFACE WATER/SEDIMENT SAMPLE LOCATION (CMS 2010)
- –SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (CMS 2012)
- –SEDIMENT SAMPLE LOCATION (CMS 2012)
- –MONITORING WELL (SWMU 74)
- –SWMU 59 BOUNDARY
- –DRAINAGE DITCH
- –STORM MANHOLE
- –STORM PIPE
- –STORM INLET
- –APPROXIMATE EDGE OF SLOPE
- –VEGETATION
- –CONCRETE
- –ASPHALT

FIGURE 8-4
DETECTED CONCENTRATIONS IN TOTAL SOIL EXCEEDING SOIL SCREENING VALUES: 2012 CMS FIELD INVESTIGATION
SWMU 59-FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO



Site ID	59SB07
Sample ID	59GW07
Sample Date	5/21/2010
Total Inorganics (µg/L)	
Arsenic	4.3
Cobalt	0.81 J
Selenium	10.1
Thallium	0.2 J
Vanadium	97

Site ID	59SB06
Sample ID	59GW06
Sample Date	5/21/2010
Semivolatiles (µg/L)	
Naphthalene	1.3 J
Total Inorganics (µg/L)	
Arsenic	4.1
Cobalt	5.5
Selenium	18.1
Vanadium	22.2

Site ID	59SB02
Sample ID	59GW02
Sample Date	5/23/2010
Total Inorganics (µg/L)	
Arsenic	4.5
Cobalt	2.1
Selenium	13.9
Vanadium	9.2

Site ID	59SB01
Sample ID	59GW01
Sample Date	5/22/2010
Total Inorganics (µg/L)	
Arsenic	6.2
Cadmium	0.71 J
Cobalt	2.6
Selenium	24.2
Thallium	0.43 J
Vanadium	24.9

Site ID	59SB08
Sample ID	59GW08
Sample Date	5/22/2010
Total Inorganics (µg/L)	
Arsenic	0.94 J
Cobalt	0.77 J
Vanadium	30.1

Site ID	59SB09
Sample ID	59GW09
Sample Date	5/21/2010
Total Inorganics (µg/L)	
Arsenic	2.9
Thallium	0.1 J
Vanadium	85.1 J

Site ID	59SB10
Sample ID	59GW10
Sample Date	5/22/2010
Total Inorganics (µg/L)	
Arsenic	2.1
Cobalt	1.8
Vanadium	171

Site ID	59SB04
Sample ID	59GW04
Sample Date	5/23/2010
Total Inorganics (µg/L)	
Arsenic	2.9
Cobalt	1.9
Selenium	11.7
Thallium	0.2 J
Vanadium	20.2

Site ID	59SB03
Sample ID	59GW03
Sample Date	5/22/2010
Total Inorganics (µg/L)	
Arsenic	1.1
Cobalt	5.8
Vanadium	66.2

Site ID	59SB05
Sample ID	59GW05
Sample Date	5/22/2010
Total Inorganics (µg/L)	
Arsenic	3.1
Cobalt	1.5
Selenium	15.3
Thallium	0.096 J
Vanadium	107

100 0 50 100
1 inch = 100 ft.

Baker

TAPWATER REGIONAL SCREENING LEVELS	
Semivolatiles (µg/L)	
Naphthalene	0.14
Total Inorganics (µg/L)	
Arsenic	0.045
Cadmium	0.69
Cobalt	0.47
Selenium	7.8
Thallium	0.016
Vanadium	6.3

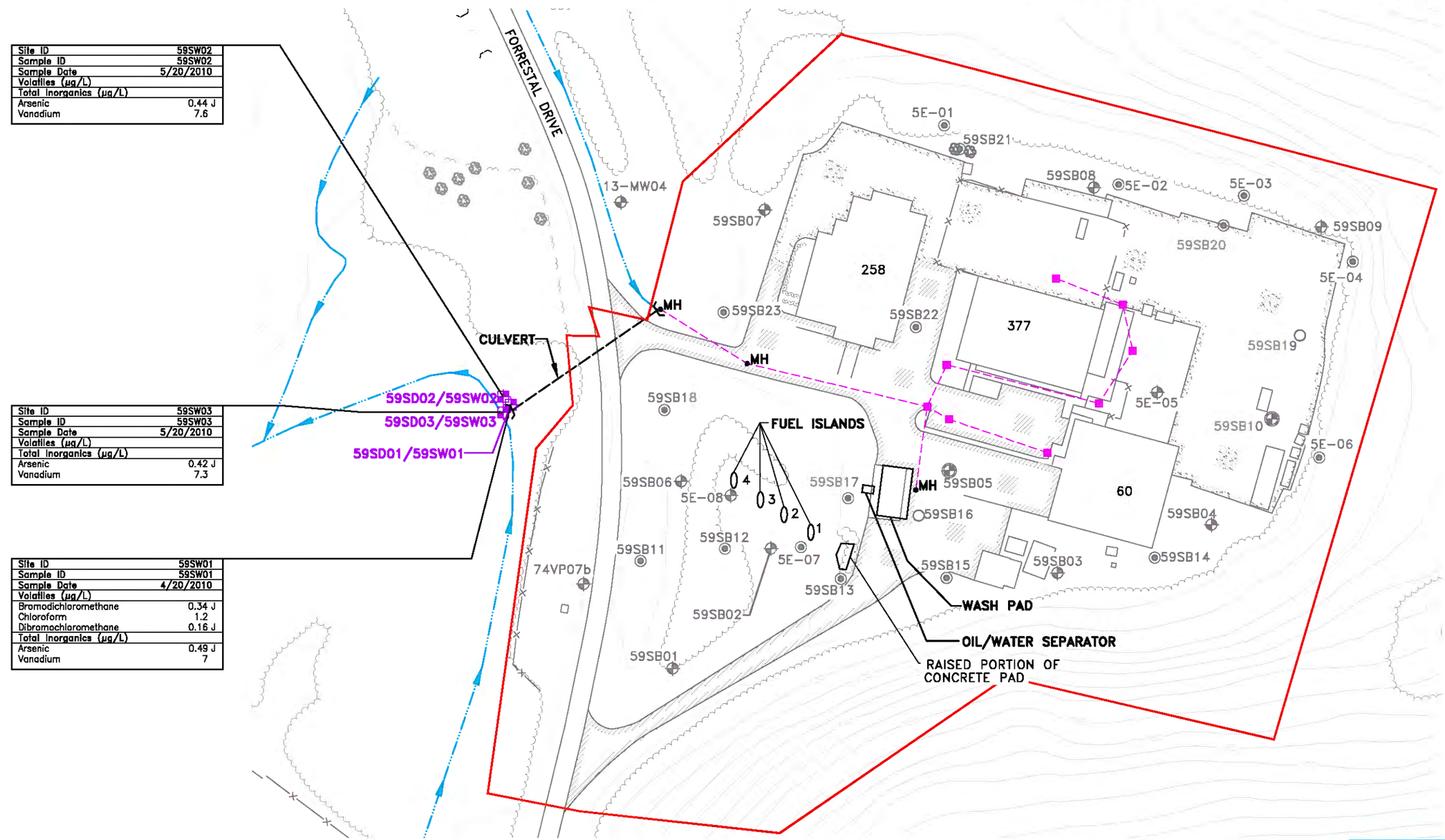
LEGEND

- –SWMU BOUNDARY
- –SURFACE AND/OR SUBSURFACE SOIL SAMPLE LOCATION (ECP 2004)
- –SURFACE SOIL AND/OR SUBSURFACE SOIL, AND/OR GROUNDWATER SAMPLE LOCATION (ECP 2004)
- –SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- –SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- –SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- –SURFACE, SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- –SURFACE WATER/SEDIMENT SAMPLE LOCATION (CMS 2010)
- –GROUNDWATER SAMPLE LOCATION FROM SWMU 74
- –DRAINAGE DITCH
- –STORM MANHOLE
- –STORM PIPE
- –STORM INLET
- –VEGETATION
- –CONCRETE
- –ASPHALT

FIGURE 8–5
DETECTED CONCENTRATIONS IN GROUNDWATER EXCEEDING TAPWATER REGIONAL SCREENING LEVELS
SWMU 59–FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT

NAVAL ACTIVITY PUERTO RICO

K:_SOUTHNAVFAC\119197 JM01\SWMU 59\Report\CMS\Draft Final Report\FIGURES\119197_CMS59_20.dwg



Site ID	59SW02
Sample ID	59SW02
Sample Date	5/20/2010
Volatiles (µg/L)	
Total Inorganics (µg/L)	
Arsenic	0.44 J
Vanadium	7.6

Site ID	59SW03
Sample ID	59SW03
Sample Date	5/20/2010
Volatiles (µg/L)	
Total Inorganics (µg/L)	
Arsenic	0.42 J
Vanadium	7.3

Site ID	59SW01
Sample ID	59SW01
Sample Date	4/20/2010
Volatiles (µg/L)	
Bromodichloromethane	0.34 J
Chloroform	1.2
Dibromochloromethane	0.16 J
Total Inorganics (µg/L)	
Arsenic	0.49 J
Vanadium	7

TAPWATER REGIONAL SCREENING LEVELS	
Volatiles (µg/L)	
Bromodichloromethane	0.12
Chloroform	0.19
Dibromochloromethane	0.15
Total Inorganics (µg/L)	
Arsenic	0.045
Vanadium	6.3

LEGEND

- -SWMU BOUNDARY
- -SURFACE AND/OR SUBSURFACE SOIL SAMPLE LOCATION (ECP 2004)
- -SURFACE SOIL AND/OR SUBSURFACE SOIL, AND/OR GROUNDWATER SAMPLE LOCATION (ECP 2004)
- -SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- -SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- -SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- -SURFACE, SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- -SURFACE WATER/SEDIMENT SAMPLE LOCATION (CMS 2010)
- -GROUNDWATER SAMPLE LOCATION FROM SWMU 74
- -DRAINAGE DITCH
- -STORM MANHOLE
- -STORM PIPE
- -STORM INLET
- -VEGETATION
- -CONCRETE
- -ASPHALT

Baker

FIGURE 8-6
DETECTED CONCENTRATIONS IN SURFACE WATER EXCEEDING TAPWATER REGIONAL SCREENING LEVELS
SWMU 59-FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT

NAVAL ACTIVITY PUERTO RICO

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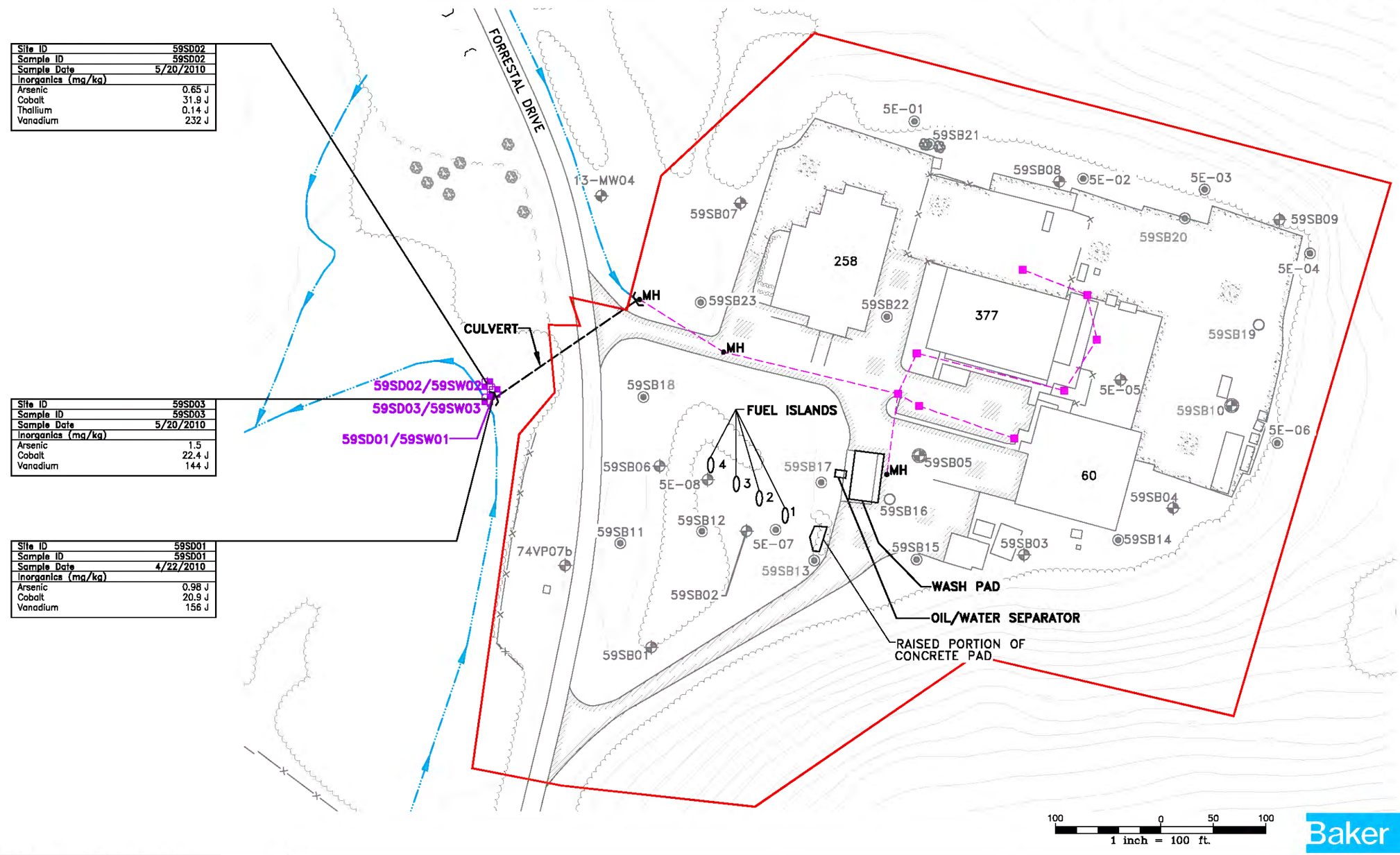


Site ID	59SD02
Sample ID	59SD02
Sample Date	5/20/2010
Inorganics (mg/kg)	
Arsenic	0.65 J
Cobalt	31.9 J
Thallium	0.14 J
Vanadium	232 J

Site ID	59SD03
Sample ID	59SD03
Sample Date	5/20/2010
Inorganics (mg/kg)	
Arsenic	1.5
Cobalt	22.4 J
Vanadium	144 J

Site ID	59SD01
Sample ID	59SD01
Sample Date	4/22/2010
Inorganics (mg/kg)	
Arsenic	0.98 J
Cobalt	20.9 J
Vanadium	156 J

RESIDENTIAL SOIL REGIONAL SCREENING LEVELS	
Inorganics (mg/kg)	
Arsenic	0.61
Cobalt	2.3
Thallium	0.078
Vanadium	39

LEGEND

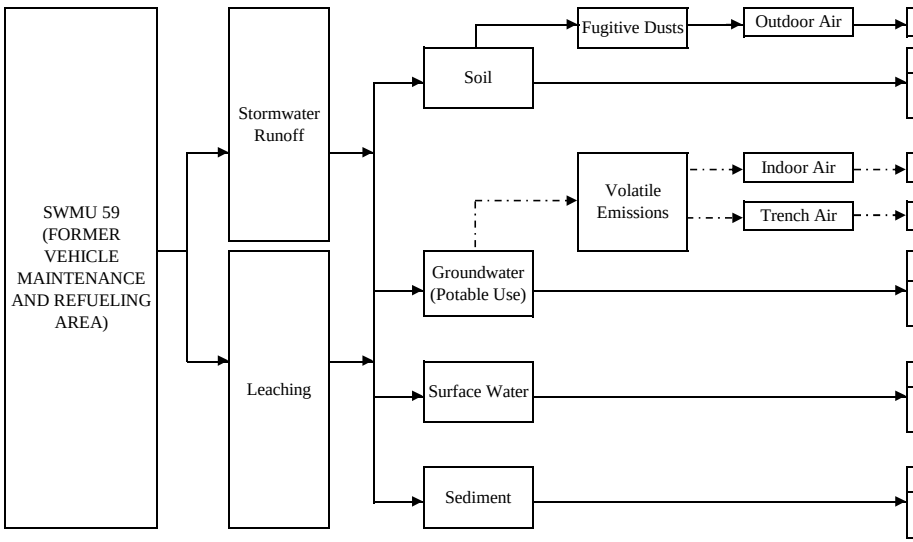
- -SWMU BOUNDARY
- -SURFACE AND/OR SUBSURFACE SOIL SAMPLE LOCATION (ECP 2004)
- -SURFACE SOIL AND/OR SUBSURFACE SOIL, AND/OR GROUNDWATER SAMPLE LOCATION (ECP 2004)
- -SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- -SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- -SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- -SURFACE, SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- -SURFACE WATER/SEDIMENT SAMPLE LOCATION (CMS 2010)
- -GROUNDWATER SAMPLE LOCATION FROM SWMU 74
- -DRAINAGE DITCH
- -STORM MANHOLE
- -STORM PIPE
- -STORM INLET
- -VEGETATION
- -CONCRETE
- -ASPHALT

FIGURE 8-7
DETECTED CONCENTRATIONS IN SEDIMENT EXCEEDING RESIDENTIAL SOIL REGIONAL SCREENING LEVELS
SWMU 59-FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT

NAVAL ACTIVITY PUERTO RICO

FIGURE 8-8

CONCEPTUAL SITE MODEL
SWMU 59 (FORMER VEHICLE MAINTENANCE AND REFUELING AREA)
CORRECTIVE MEASURES STUDY INVESTIGATION
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

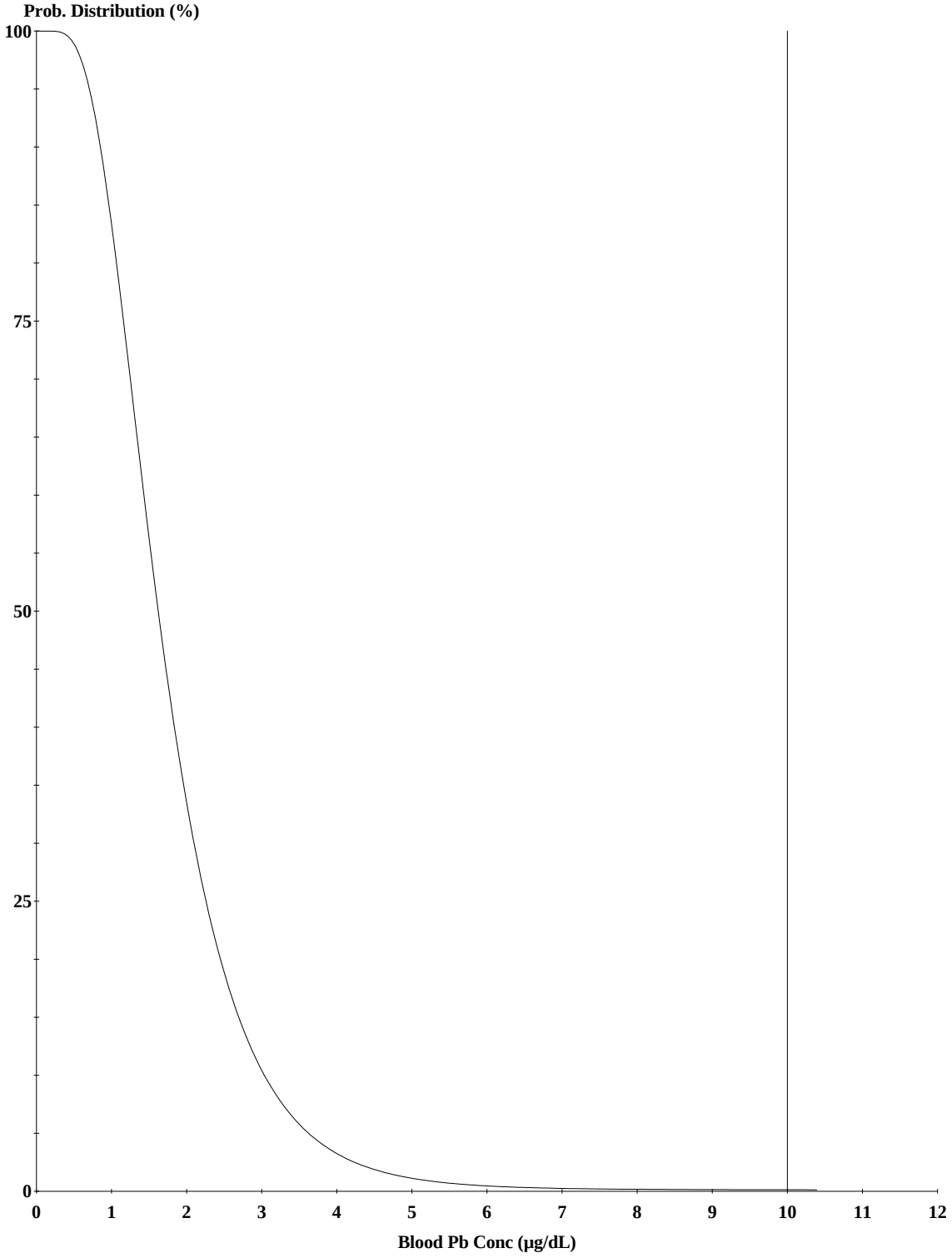


Exposure Route	Potential Human Receptors						
	Current and Future Adult Trespassers	Current and Future Youth Trespassers	Current and Future Adult On-Site Workers	Future Adult Residents	Future Young Child Residents	Future Adult Industrial / Commercial Workers	Future Adult Construction Workers
Inhalation	*CF*	*CF*	*CF*	F	F	F	F
Ingestion	*CF*	*CF*	*CF*	F	F	F	F
Dermal Contact	*CF*	*CF*	*CF*	F	F	F	F
Inhalation							
Inhalation							
Ingestion				F	F	F	F
Dermal Contact				F	F		F
Ingestion	*CF*	*CF*	*CF*	F	F		
Dermal Contact	*CF*	*CF*	*CF*	F	F		
Ingestion	*CF*	*CF*	*CF*	F	F		
Dermal Contact	*CF*	*CF*	*CF*	F	F		

Legend

F	Future Exposure Pathway	——→	Complete Exposure Pathway
CF	Current and Future Exposure Pathway	-·-·→	Incomplete Exposure Pathway

FIGURE 8-9
PROBABILITY DENSITY FUNCTION
BLOOD LEAD CONCENTRATIONS, SOIL
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



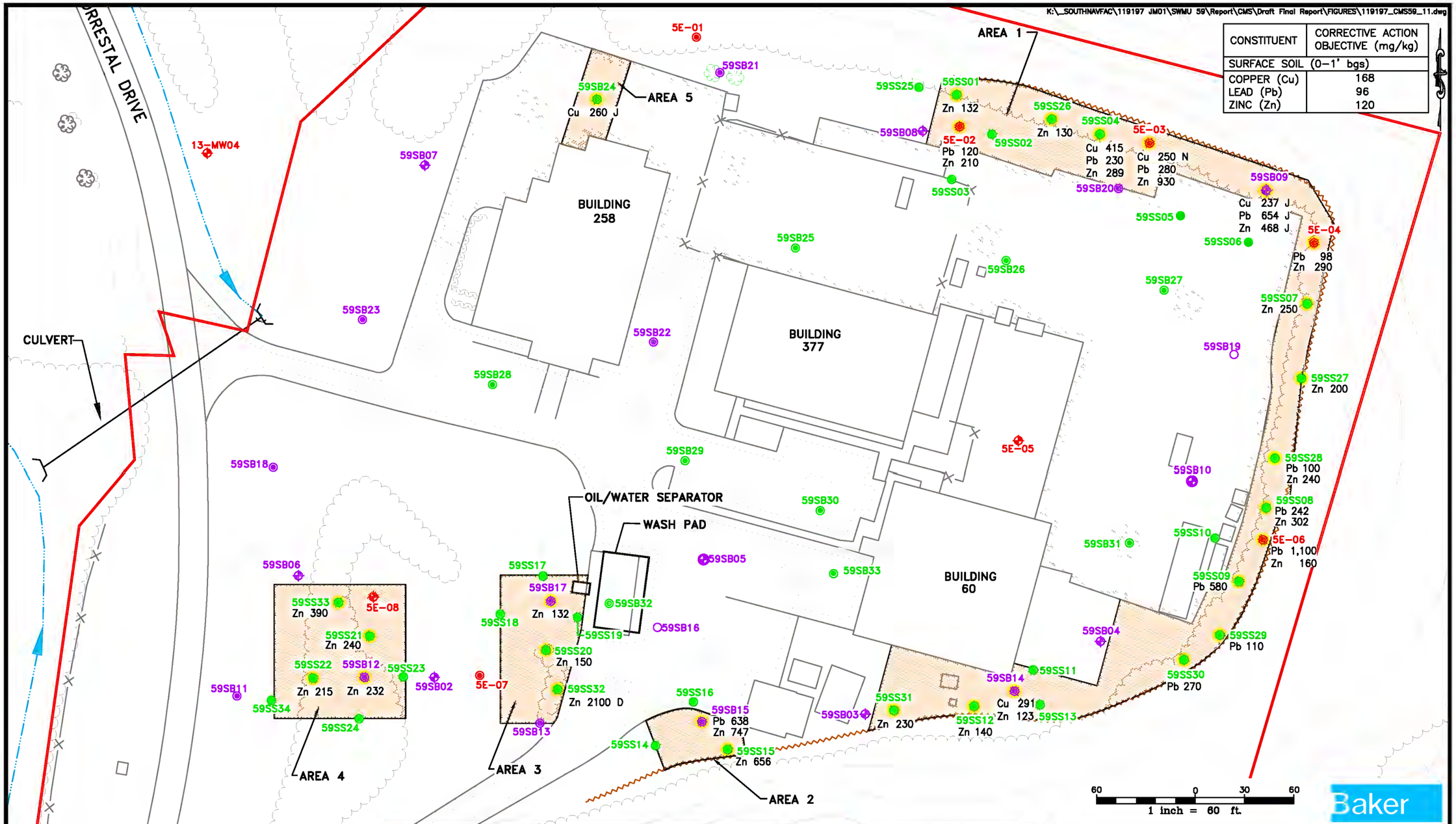
Cutoff = 10.000 µg/dl
Geo Mean = 1.700
GSD = 1.600
% Above = 0.008

Age Range = User Designated: Ages 12 - 72 months

Run Mode = Research

K:_SOUTHNAVFAC\119197 JM01\SWMU 59\Report\CMS\Draft Final Report\FIGURES\119197_CMS59_11.dwg

CONSTITUENT	CORRECTIVE ACTION OBJECTIVE (mg/kg)
SURFACE SOIL (0–1' bgs)	
COPPER (Cu)	168
LEAD (Pb)	96
ZINC (Zn)	120



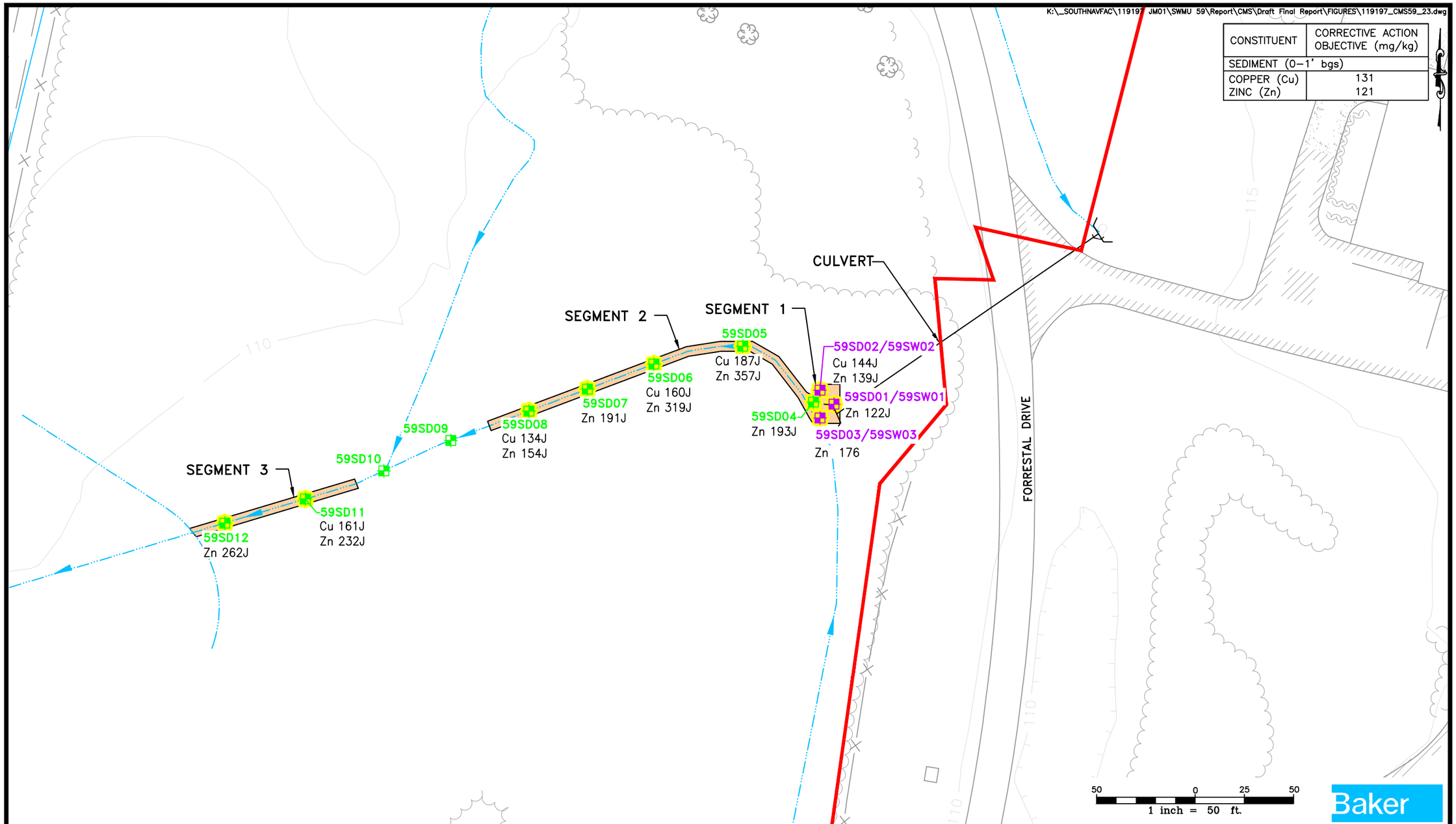
NOTES:
ALL VALUES SHOWN ARE IN MILLIGRAMS PER KILOGRAM (mg/kg)
D –THE REPORTED VALUE IS FROM A DILUTION
J –ESTIMATED VALUE
N –THE MATRIX SPIKE RECOVERY WAS NOT WITHIN CONTROL LIMITS

LEGEND
- –SURFACE AND/OR SUBSURFACE SOIL SAMPLE LOCATION (ECP 2004)
- –SURFACE SOIL AND/OR SUBSURFACE SOIL AND/OR GROUNDWATER SAMPLE LOCATION (ECP 2004)
- –SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- –SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- –SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- –SURFACE, SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- –SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (CMS 2012)
- –PRE-EXCAVATION DELINEATION SURFACE SOIL SAMPLE LOCATION (2012)
- –SWMU 59 BOUNDARY
- –DRAINAGE DITCH
- –VALUE EXCEEDS ESTABLISHED CAO
- –APPROXIMATE EDGE OF SLOPE
- –VEGETATION
- –CONCRETE
- –ASPHALT
- –EXTENT OF METALS EXCEEDING CAOs

FIGURE 9–1
DISTRIBUTION OF METALS IN SURFACE SOIL EXCEEDING CAOs
SWMU 59–FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO

K:_SOUTHNAVFAC\119197 JM01\SWMU 59\Report\CMS\Draft Final Report\FIGURES\119197_CMS59_23.dwg

CONSTITUENT	CORRECTIVE ACTION OBJECTIVE (mg/kg)
SEDIMENT (0–1' bgs)	
COPPER (Cu)	131
ZINC (Zn)	121



NOTES:
- ALL VALUES SHOWN ARE IN MILLIGRAMS PER KILOGRAM (mg/kg)
- J –ESTIMATED VALUE

LEGEND
- –SWMU 59 BOUNDARY
- –DRAINAGE DITCH
- –VALUE EXCEEDS ESTABLISHED CAO
- –APPROXIMATE EDGE OF SLOPE
- –VEGETATION
- –CONCRETE
- –ASPHALT
- –EXTENT OF METALS EXCEEDING CAOs
- –SURFACE WATER/SEDIMENT SAMPLE LOCATION (CMS 2010)
- –SEDIMENT SAMPLE LOCATION (CMS 2012)

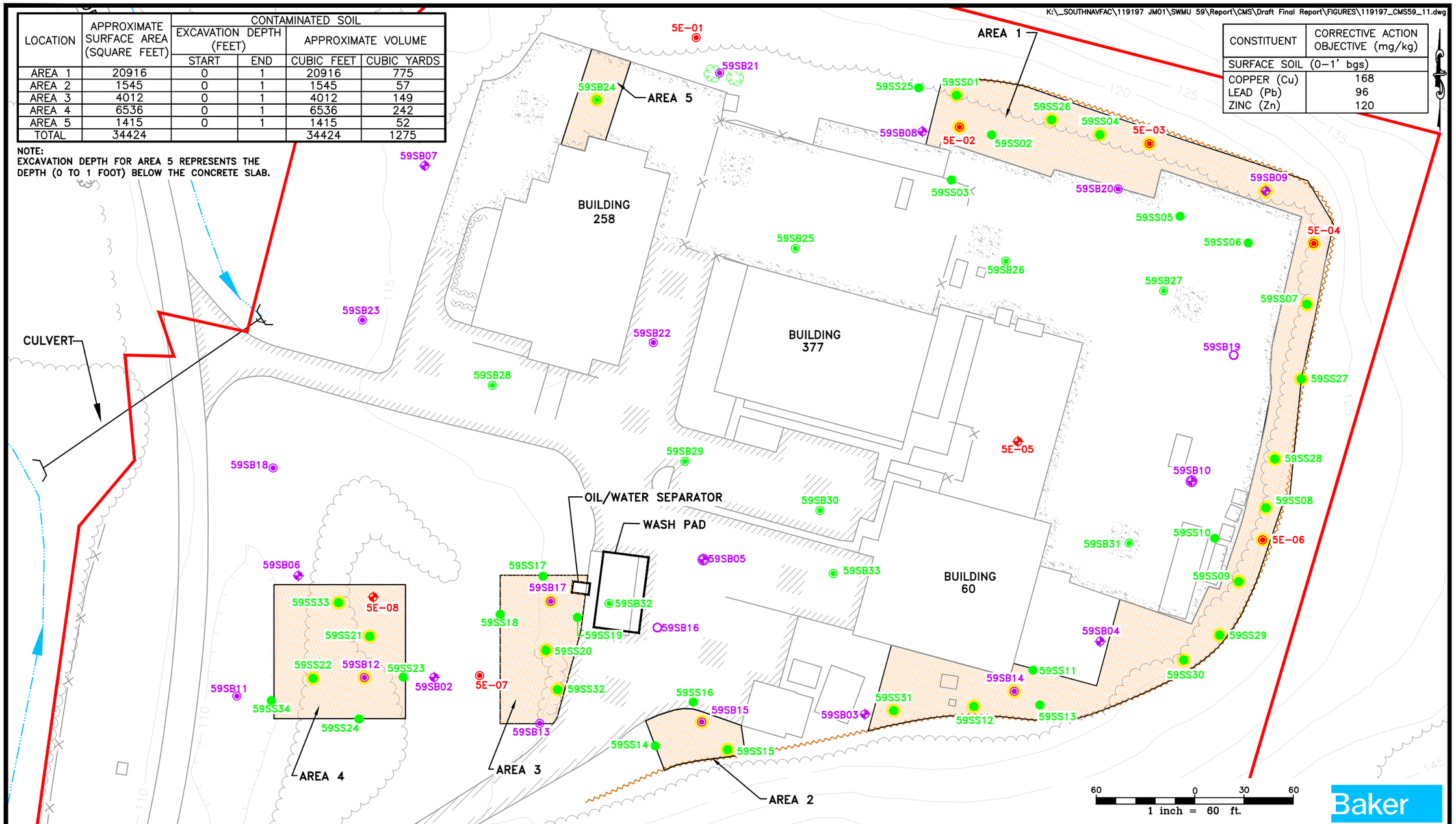
FIGURE 9–2
DISTRIBUTION OF METALS IN SEDIMENT EXCEEDING CAOs
SWMU 59–FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO

LOCATION	APPROXIMATE SURFACE AREA (SQUARE FEET)	CONTAMINATED SOIL			
		EXCAVATION DEPTH (FEET)		APPROXIMATE VOLUME	
		START	END	CUBIC FEET	CUBIC YARDS
AREA 1	20916	0	1	20916	775
AREA 2	1545	0	1	1545	57
AREA 3	4012	0	1	4012	149
AREA 4	6536	0	1	6536	242
AREA 5	1415	0	1	1415	52
TOTAL	34424			34424	1275

NOTE:
EXCAVATION DEPTH FOR AREA 5 REPRESENTS THE DEPTH (0 TO 1 FOOT) BELOW THE CONCRETE SLAB.

K:_SOUTHNAVFAC\119197 JM01\SWMU 59\Report\CMS\Draft Final Report\FIGURES\119197_CMS59_11.dwg

CONSTITUENT	CORRECTIVE ACTION OBJECTIVE (mg/kg)
SURFACE SOIL (0–1' bgs)	
COPPER (Cu)	168
LEAD (Pb)	96
ZINC (Zn)	120



GENERAL NOTES

1. THE CONCRETE SLAB AT AREA 5 SHALL BE REMOVED PRIOR TO EXCAVATION OF CONTAMINATED SOIL.
2. CONTAMINATED SURFACE SOIL SHALL BE EXCAVATED TO ONE FOOT BELOW GROUND SURFACE AS INDICATED.
3. FOLLOWING EXCAVATION TO THE INDICATED LIMITS, THE NAVY'S ON-SITE REPRESENTATIVE WILL COLLECT CONFIRMATORY SOIL SAMPLES AS SPECIFIED TO VERIFY REMOVAL OF CONTAMINATED SOIL HAS BEEN COMPLETED. EXCAVATION SHALL CONTINUE UNTIL THE CORRESPONDING CAOs FOR EACH AREA ARE MET.

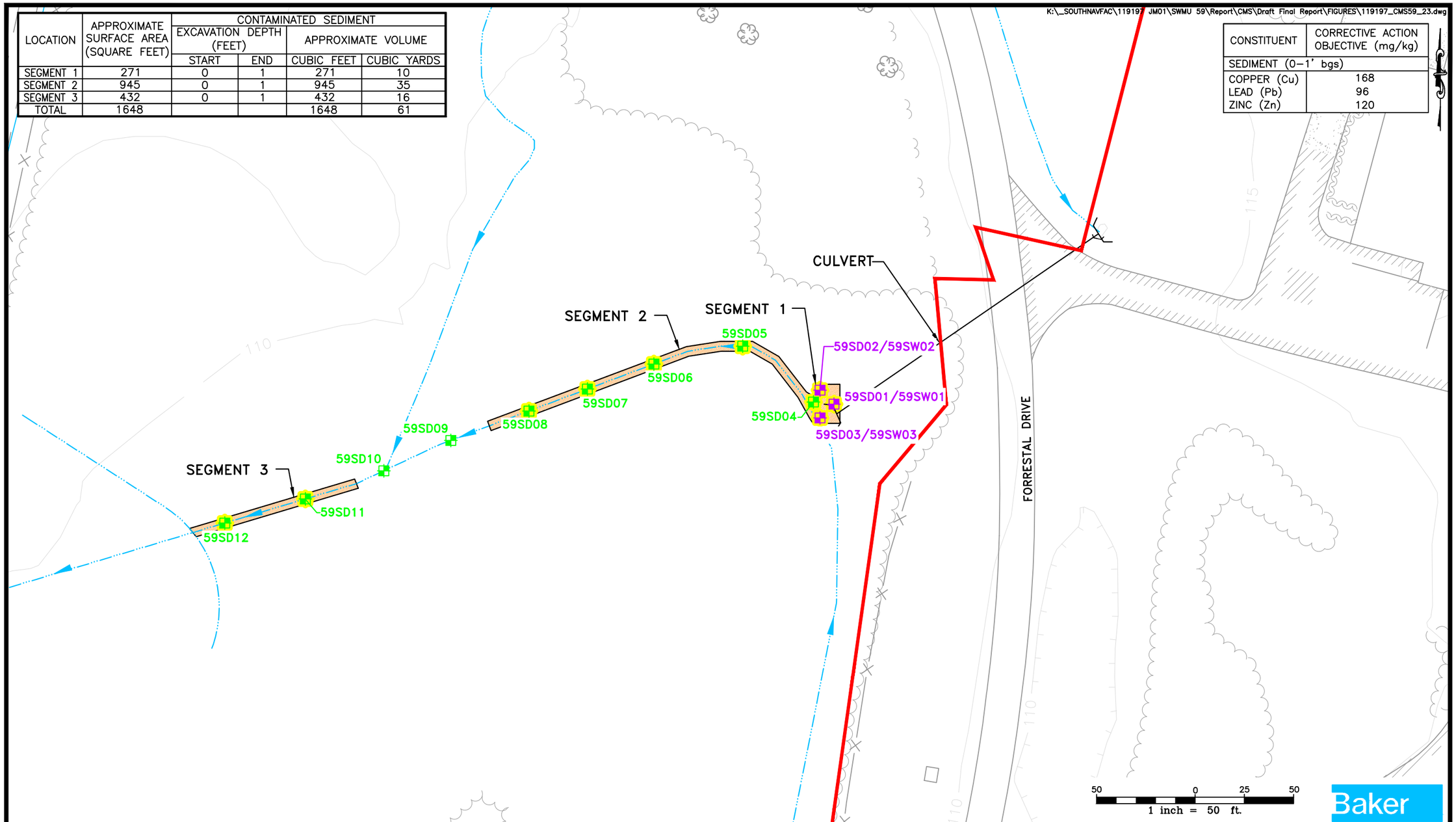
LEGEND

- –SURFACE AND/OR SUBSURFACE SOIL SAMPLE LOCATION (ECP 2004)
- –SURFACE SOIL AND/OR SUBSURFACE SOIL AND/OR GROUNDWATER SAMPLE LOCATION (ECP 2004)
- –SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- –SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (CMS 2010)
- –SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- –SURFACE, SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (CMS 2010)
- –SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION (CMS 2012)
- –PRE-EXCAVATION DELINEATION SURFACE SOIL SAMPLE LOCATION (2012)
- –SWMU 59 BOUNDARY
- –DRAINAGE DITCH
- –VALUE EXCEEDS ESTABLISHED CAO
- –APPROXIMATE EDGE OF SLOPE
- –VEGETATION
- –CONCRETE
- –ASPHALT
- –EXCAVATION AREA (0–1' BGS)

FIGURE 10–1
CONCEPTUAL REMOVAL ACTION PLAN – SOIL
SWMU 59–FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO

LOCATION	APPROXIMATE SURFACE AREA (SQUARE FEET)	CONTAMINATED SEDIMENT			
		EXCAVATION DEPTH (FEET)		APPROXIMATE VOLUME	
		START	END	CUBIC FEET	CUBIC YARDS
SEGMENT 1	271	0	1	271	10
SEGMENT 2	945	0	1	945	35
SEGMENT 3	432	0	1	432	16
TOTAL	1648			1648	61

CONSTITUENT	CORRECTIVE ACTION OBJECTIVE (mg/kg)
SEDIMENT (0–1' bgs)	
COPPER (Cu)	168
LEAD (Pb)	96
ZINC (Zn)	120



GENERAL NOTES

1. CONTAMINATED SEDIMENT SHALL BE EXCAVATED TO ONE FOOT BELOW GROUND SURFACE AS INDICATED.
2. FOLLOWING EXCAVATION TO THE INDICATED LIMITS, THE NAVY'S ON-SITE REPRESENTATIVE WILL COLLECT CONFIRMATORY SEDIMENT SAMPLES AS SPECIFIED TO VERIFY REMOVAL OF CONTAMINATED SEDIMENT HAS BEEN COMPLETED. EXCAVATION SHALL CONTINUE UNTIL THE CORRESPONDING CAOs FOR EACH AREA ARE MET.

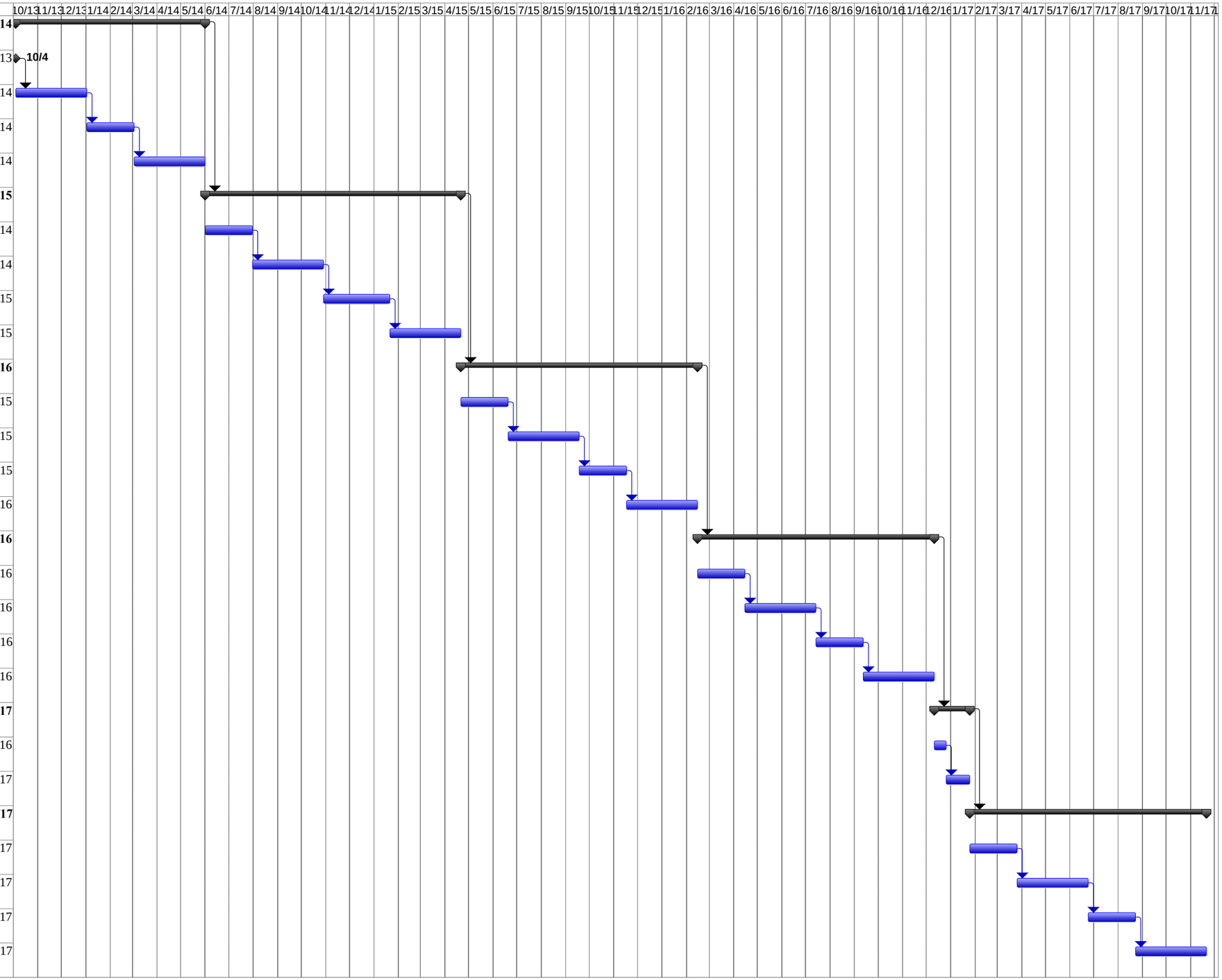
LEGEND

- –SWMU 59 BOUNDARY
- –DRAINAGE DITCH
- –VALUE EXCEEDS ESTABLISHED CAO
- –APPROXIMATE EDGE OF SLOPE
- –VEGETATION
- –CONCRETE
- –ASPHALT
- –EXTENT OF METALS EXCEEDING CAOs
- –SURFACE WATER/SEDIMENT SAMPLE LOCATION (CMS 2010)
- –SEDIMENT SAMPLE LOCATION (CMS 2012)

FIGURE 10–2
CONCEPTUAL REMOVAL ACTION PLAN – SEDIMENT
SWMU 59–FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO

FIGURE 11-1
CONCEPTUAL CMI SCHEDULE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

ID	Task Name	Duration	Start	Finish
1	**Corrective Measures Study (CMS) Final Report**	**171 days**	**10/4/13**	**6/1/14**
2	Draft CMS Report	0 edays	10/4/13	10/4/13
3	Regulator Review	90 edays	10/4/13	1/2/14
4	Final CMS Report	60 edays	1/2/14	3/3/14
5	Regulator Review and Approval	90 edays	3/3/14	6/1/14
6	**Statement of Basis (SoB)**	**231 days**	**6/1/14**	**4/20/15**
7	Draft SoB	60 edays	6/1/14	7/31/14
8	Regulator Review	90 edays	7/31/14	10/29/14
9	Final SoB	60 days	10/29/14	1/20/15
10	Regulator Review and Approval	90 edays	1/20/15	4/20/15
11	**Corrective Measures Implementation (CMI) Design Package (BoD and Specs)**	**214 days**	**4/20/15**	**2/14/16**
12	Draft BoD and 100% design	60 edays	4/20/15	6/19/15
13	Regulator Review	90 edays	6/19/15	9/17/15
14	Final BoD and 100% Design	60 edays	9/17/15	11/16/15
15	Regulator Review and Approval	90 edays	11/16/15	2/14/16
16	**Contractor Planning Documents**	**215 days**	**2/14/16**	**12/10/16**
17	Draft CMI Work Plan	60 edays	2/14/16	4/14/16
18	Regulator Review	90 edays	4/14/16	7/13/16
19	Final CMI Work Plan	60 edays	7/13/16	9/11/16
20	Regulator Review and Approval	90 edays	9/11/16	12/10/16
21	**Corrective Measures Implementation**	**32 days**	**12/10/16**	**1/24/17**
22	Mobilization	15 edays	12/10/16	12/25/16
23	Removal Action	30 edays	12/25/16	1/24/17
24	**Construction Closeout Report**	**214 days**	**1/24/17**	**11/20/17**
25	Draft Closeout Report	60 edays	1/24/17	3/25/17
26	Regulator Review	90 edays	3/25/17	6/23/17
27	Final Closeout Report	60 edays	6/23/17	8/22/17
28	Regulator Review and Approval	90 edays	8/22/17	11/20/17



APPENDIX A
FIELD ACTIVITIES

SITE PHOTOGRAPHS

Photo 1
Site overview and Building 258. View looking northwest.
2010 CMS Investigation.

Photo 2
Site overview and Building 377. View looking northeast.
2010 CMS Investigation.

Photo 3
Site overview and Building 60. View looking southeast.
2010 CMS Investigation.

Photo 4
SWMU 59 wash pad. Oil/water separator in the upper left corner. View looking west.
2010 CMS Investigation.

Photo 5
Site overview with Buildings 258 and 377 in background. View looking east.
2010 CMS Investigation.

Photo 6
Maintenance area and miscellaneous storage structures. View looking southeast.
2010 CMS Investigation.

Photo 7
Soil boring advancement using Geoprobe® rig.
2010 CMS Investigation.

Photo 8
Completed groundwater monitoring well at 59SB04.
2010 CMS Investigation.

Photo 9
Small freshwater pool at end of culvert (surface water/sediment sample collection). Freshwater drainage ditch in background. 2010 CMS Investigation.

Photo 10
Small freshwater pool (right). Aquatic vegetation (left) and adjacent freshwater drainage ditch in background. 2010 CMS Investigation.

Photo 11
Soil sampling beneath concrete slab using Geoprobe® rig.
2012 CMS Investigation.

Photo 12
Soil sampling using Geoprobe® rig.
2012 Pre-excavation delineation sampling.

Photo 13
Freshwater drainage ditch west of SWMU 59.
2012 CMS Investigation.

Photo 14
Freshwater drainage ditch sediment sample location 59SD04.
2012 CMS Investigation.

Photo 15
Freshwater drainage ditch sediment sample location 59SD05.
2012 CMS Investigation.

Photo 16
Freshwater drainage ditch sediment sample location 59SD06.
2012 CMS Investigation.

Photo 17
Freshwater drainage ditch sediment sample location 59SD07.
2012 CMS Investigation.

Photo 18
Freshwater drainage ditch sediment sample location 59SD08.
2012 CMS Investigation.

Photo 19
Freshwater drainage ditch sediment sample location 59SD09.
2012 CMS Investigation.

Photo 20
Freshwater drainage ditch sediment sample location 59SD10.
2012 CMS Investigation.

Photo 21
Freshwater drainage ditch sediment sample location 59SD11.
2012 CMS Investigation.

Photo 22
Freshwater drainage ditch sediment sample location 59SD12.
2012 CMS Investigation.

FIELD LOG BOOK NOTES

Environmental Geologist – Robert Roselius (April/May 2010)

Forestry Suppliers, Inc.
1-800-647-5368
#49352 Field Book

SWMU59
APR/MAY 2010

SITE 1738
SEPT 2010

ROSELIUS

CONTENTS

PAGE NO.	REFERENCE	DATE

SUN. (4/18/10)

ROSELINS/GOILEY MODE (1136 ET PITT, DRIVE SAN JUAN 1720 ET, GET RENTAL, DRIVE PALMAS DE MAR 1915). PREP

MON. (4/19/10)

0750 ONSITE, PREP/GLOVES/EQUIP.
0735 CALIBRATE PID to 100 ppm
ROBBIN DECON - TUBES.
0835 @ SUMMA 59, ANCHORS/PVC.
SCREEN/RISER ONSITE

0845 DRILLERS ONSITE (WILLIAM/RAF
KICK OFF/ N&S MEETING, DRILLERS
UNLOAD/BUILD DECON

0930 COLLECT 59FB01 (SEE GOILEY LOG)
0935 ~~DRILLING~~ DRILLERS MOVING to
595B01 (WILL USE 5' SAMPLER)

— 595B01 (PID BKG 0.0) —

0-5 0.0-0.3 CLAY to ~~DARK~~ FINE SAND, TRACE MED SAND, GREY,
5.0 & ORANGE CL., DAMP, SLIGHT PLASTICITY.
BKL MED STIFF to STIFF (SEE NEXT PAGE)

59SE01 (CON'T) [FEW SPRINKLES]

0-5 0.3-5.0 CLAY, TRACE SILT,
5.0 YELLOWISH TAN & ORANGE (MARL?) W/
BKG + DAP SOME/VARYING BLK & WHITE
59SB01-00 MOTTLING, HIGH TO VERY HIGH.
@0950 PLASTICITY, SOFT, DAMP. (WEATHERED
59SB01-01 & BEDROCK)
@1000
5-10 SAME AS ABOVE (SAA).
5.0 5-7' SIMILAR BUT INCREASE
BKG IN GRAINSIZE, AND MORE RUST
7-10 COLOR.
CLAY, SOME SILT, DAMP, LOW
59SB01-03 PLASTICITY, MED STIFF
@1015 W/ ZONES (0.1') OF LESS
WEATHERING - MED SAND SIZED
"PIECES". STILL SOME BLK & WHITE
MOTTLING (WEATHERED BEDROCK)
10-15 10-12.5 CLAY, LITTLE SILT,
BKG LT GRAY, WHITE AND ORANGE, W/
4.4. BLK MOTTLING, SLIGHT PLASTICITY,
MED STIFF, DAMP
12.5-15.0 LESS WEATHERED,
SAA W/ UP TO MED SIZED GRAINS
NON TO SLIGHT PLASTICITY, MED
STIFF, DAMP TO MOIST.

WILL BUILD WELL W/ 15' TD.
CONSIDERING SURROUNDING WELLS.
SWL FROM 3/26/10
- 13MW04 8±' bgs
- NE OF PIT 7 4.35± bgs
- S OF 59 8.4± bgs

● 59GW01 ●
TD 15' bgs
SCREEN 5-15' bgs
SAND TO 3.5' bgs
BENTONITE TO 1.5' bgs
COMPLETE 59GW01
1105 MOVING TO 59SB03 (MOVING DRILL
W/ DECON

59SB03 (PID BKG) BEGIN @1130

0-5 0.0-1.7 FILL 0-0.2 F. GRAVEL, GRAY
4.8 0.2-1.7 CLAY TO MET F. SAND, SOME
BKG MED SAND. DRY TO DAMP, NON
COHES GRAVEL
59SB03-00 PLASTIC, LOOSE. (FILL)
@1135
1.7-5.0 SILT & F SAND, SOME
59SB03-01 CLAY (WEATHERED BEDROCK) TAN &
@1140 LT GRAY, LITTLE ORANGE W/ WHITE
& TRACE BLACK MOTTLING, NON PLASTIC
LOOSE, DAMP

595803 (CON'T).

Ø

5-10 SAME AS ABOVE

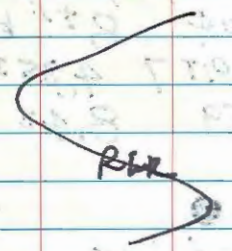
4.9

BKG

595803-04

@1150

7-9'



10-15 10-12.5 SAA

4.4 12.5-12.9 ROCK GRAVEL SIZED

BKG BEDROCK, GREY, NON PLASTIC HARD

TAN, WHITE BLK.

12.9 - 13.2.

SILT ORANGE, NON-PLASTIC, LOOSE

13.2 - 13.5 SAME AS 12.5-12.9.

13.5-15.0 SILT, SOME CLAY, LITTLE F. SAND, TAN & GREY, NON PLASTIC DENSE, DAMP TO MOIST.

WILL PUSH 3+ FT.

15-18. SAA W/ COUPLE 0.1' LENSES/VEINS

2.7 OF HARD BEDROCK, MOIST-

BKG BOTTOM 0.3' WET/SATURATED.

WILL BUILD WELL TO 17' BASED ON ELEVATION, MONITOR WATER LEVEL.

1200 DRILLERS DEPART / LUNCH

- MANIFOLD SAMPLES, EVALUATE
- STORM WATER OUTFALL WEST SIDE OF ROAD, NO SIGN, WILL REMOVE MANHOLE COVER TO VIEW PIPING.
- GPS 595802, WILL MOVE SOUTH JUST OFF OF CONCRETE DUE TO POTENTIAL OF USTS. (TANK VENT ON ISLAND W/ OFF LOCATIONS, ISLAND #2 FROM EAST)

1300 DRILLERS RETURN - DECON BAILER / INSTALL 59GW03

1330 COLLECT 59ER01 FROM NEW LINER.

● 59GW03 ●

TD 17' bgs

SCREEN 7-17' bgs

SAND to 5' bgs

BENTONITE to 3' bgs

ADAM & I CONTINUE SEWER / STORM WATER EVAL (SEE GAILEY LOG FOR DETAILS. (LATE ENTRY - DRILLERS DEPART 1505)

1550 DEPART NAPR, STORM WATER EVAL / SKETCHES, ETC. @ CONDO.

TUES (4/20/10)

ONSITE, PREP FOR DAY - RAINING

0700 CAL PID to 100 ppm

0715 @ SWMU 57 STILL RAINING

0725 56GW01 11.64' TOC } TEMPORARY WILL BE CUT
3.2' STICKUP
~ 8.44' bgs.

0740 56GW03 17.54' TOC } TEMP
2.6' STICKUP
15 ± bgs

0745 CHECK STORMWATER OUT FALL (RAIN LIGHTENS to SPRINKLES) - FLOWING GOOD - CONFIRMS LOCATION, WILL COLLECT ONE SURFACE WATER SAMPLE & FROM POOL (ADAM GETS GLASSWARE.) - AWAITING DRILLERS, RAIN MUST HAVE DELAYED.

0800 COLLECT. 59SW01 (ONLY LIGHT/FEW SPRINKLES to STOPPED).

0810 DRILLERS ONSITE. PREP TO SAMPLE 595B02.

PLOT

VERY HUMID - SURPRISED

— 595B02 (PID BKG 0.0) @ 0825

0-5 BK 4.9 BKG — 0 - 0.8 CLAY TO F. GRAVEL (FILL), GREY & BR NON PLASTIC, LOOSE, DAMP

0.8 - 2.6 CLAY, SOME SILT, LT GREY, ORANGE, & MAROON (~~ORANGE~~) W/ BLK MOTTLING, SLIGHT PLASTICITY, STIFF, DAMP.

595B02-00 +MS/MSD

@0835 2.6 - 5.0 CLAY, VARIGATED LITTLE SILT, LT GREY & MAROON/RUST (~~ORANGE~~), BLK MOTTLING MOD PLASTICITY, STIFF, DAMP.

595B02-01 +DUP +MS/MSD @0840

NOTE - MS + MSD (2 VOL) FOR VOCs
MS/MSD (1 VOL) FOR OTHERS

— LIGHT RAIN @ 0850

5-10 4.9 BKG — 5.0 - 7.0 SAA

7.0 - 10.0 CLAY, LITTLE SILT (SOME AREAS LESS WEATHERED W/ F. SAND SIZED) ~~GR~~, TAN, GREY, WHT & ORANGE, SLIGHT to MOD PLASTICITY, STIFF, DAMP.

595B02-04 @0855

10-15 4.7 BKG — 10-15 SAA, BUT LESS WEATHERED - COARSER - SOME F. SAND SIZED, MOD PLASTICITY, SOFT, MOIST.

15-16 1.0 BKG. — 15-16 SAA.

WILL BUILD WELL TO 16' TD.

● 59GW02 ● pm

TD 16' ~~TD~~ bgs

SCREEN 6-16' bgs

SAND to 4' bgs

BENTONITE 2' bgs

1000 COMPLETE 59GW02, MOVE DRILL. DECON, CLEAR 595B06 LOCATION FROM FORRESTALL Rd.

1055 BEGIN @ 595B06.

— 595B06 (PID BKG 0.0) —

0-5 0-0.2 TOPSOIL
3.9 0.2-0.6 FILL CLAY TO COARSE SAND.
BKG BR/LT GRAY, NON PLASTIC, LOOSE, DRY to DAMP.

595B06-00
@1105 0.6-5.0 CLAY, SOME SILT, BR ORANGE
595B06-01 SLIGHT PLASTICITY, STIFF, DAMP
@1110 — COLOR GRADES TO DK BROWN W/ BLK & TAN MOTTLING @ 4.0'

LITTLE BLK & TAN MOTTLING

595B06 (CON'T)

5-9.5

5-10 VCLAY, LITTLE SILT, VARIGATED LT GREY & MAROON (MAL)
4.6 ~~SLIGHT to~~ MED PLASTICITY, STIFF (5-7.5')
BKG SOFT (7.5-9.5). DAMP

595B06-03 CLAY MATRIX (GREY, ORANGE)
@1115 9.5-10 SAA W/ AND 50% ± BLK
(5-7') MOTTLING OF COARSE SANDY SIZED GRAINS., NON PLASTIC, STIFF, DAMP

MARBLED vs. "LINTCLAY"

10-15 10-14.8 SAA.
4.6 14.8-15. CLAY, OLIVE, TAN, ORANGE, GREY
BKG HIGHLY PLASTIC. MED STIFF to STIFF, DAMP to MOIST?

WILL BUILD WELL W/ 15' TD BASED ON ELEV./VICINITY.

● 59GW06 ●

TD 15' bgs

SCREEN 5-15' bgs

SAND to 3.5' bgs

BENTONITE to 1.5' bgs

1330 RETURN TO 59, COMPLETE SAMPLE MGTM / PACKAGE / SHIPPING. DRILLER COMPLETES DECON, ANGER / CUT THROUGH ASPHALT @ 59SB05.
1345 BEGIN SAMPLING

— 59SB05 (PID BKG 0.0) —

OKE = 0.5' ASPHALT.

0-5 ~~@ 0.5~~

2.4/4.5 BKG — 0-5 FILL - CLAY TO COARSE SAND, SOME GRAVEL, GREY TO BR, NON PLASTIC LOOSE, DRY.

59SB05-01 @1355

↳ SWL @ 59GW03 STILL 17.54' TOC

5-10 4.6 BKG — 5-10 CLAY, SOME SILT, TAN, OLIVE, BR. & BLK, SLIGHT PLASTICITY, STIFF DAMP.

59SB05-05

10-15 3.9 BKG — 10-12.5 SAA. IVORY & 12.5-15 SAA BUT PRIMARILY WHITE W/ LITTLE ORANGE, OLIVE & TRACE BLACK.
— 0.1' THICK HARD GREY BEDROCK @ 14' DAMP TO MOIST

59SB05 (CONT)

15-20 4.1 BKG — SAA. BUT MOIST. AND LESS WHITE.

20-24 3.6/4.0 BKG — REFUSAL @ 24' bgs. / SAA
20-24 SAA

— WILL BUILD WELL TO 22' bgs. CONSIDERING VICINITY, ELEVATION AND 59GW03 SWL @ 15 bgs

1430 COLLECT & 59EROL FROM NEW LINER.

15	SWMM 57	SWL
1341	57GW05	19.43
1344	57GW07	22.55
1335	57GW02	23.30
1340	57GW04	17.82
1343	57GW01	16.90
1337	13GW07	20.30
1347	13GW11	15.20
1338	74VP6Cb	19.43

● 59GW05 ●
TD 22' bgs
SCREEN 12-22' bgs
SAND to 10' bgs
BENTONITE to 8' bgs

1600 RETURN 59, 59GW05 COMPLETED DRILLERS DEPART. MANTA SAMPLE REPAIR CANOPY. 1700 DEPART NAPR.

WED. (4/21/10)

0650 ONSITE, PREP

0715 CALIBRATE PID TO 101 ppm

0740 59GW05 SWL 13.08' TOC
(FLUSHMOUNT) STICKUP -0.4'
13.48' bgs

0750 59GW02 SWL 13.15' TOC
STICKUP 3.0±
10.15' bgs

0753 59GW06 SWL 10.63' TOC
3.0±
7.63' bgs

0815 DRILLERS ONSITE [WITH NORDY, HE'S GOING TO AIRPORT TO CLEAR UTILITIES FOR ANOTHER JOB, DISCUSS THIS WEEK SCHEDULE (IE. MAYBE NOT WORK SAT.), HE DOESN'T KNOW CREWS SCHEDULE - WILL CALL JUAN (HE'S IN DOMINICAN REPUBLIC)]

LATE ENTRY: CLEARED NEW LOCATION FOR 59SB07 (APPROX 50' SW OF ORIGINAL, OFF OF CONCRETE & DOWNGRADIENT OFF CONCRETE PAD - NEAR FIRE HYDRANT - CLEAR)

DRILLERS BEGIN ANCHORS AND SET UP @ 59SB07

59SB07 (PID BKG = 0.0) 0850

0-5
4.9
BKG.

0-0.2 TOPSOIL

0.2-1.4 FILL CLAY to GRAVEL, GREY & BROWN, NON PLASTIC, LOOSE DRY.

59SB07-00
@0855

1.4-4.8 FILL - SILT & CLAY, SOME F. SAND, COMPLEX F. GRAVEL, ORANGE & BR, GREY, SLIGHT PLASTICITY SOFT, DAMP

59SB07-01
+ DUP
@1000

0900 4.8-5.0 CLAY, LITTLE SILT, OLIVE ~~wh~~ AND BR W/ TRACE + BLK MOTTLING MED PLASTICITY, MED STIFF, DAMP

PID
10

5-10
4.4
BKG

5-8 SAA

8-10 SAA BUT LESS WEATHERED - COARSER, F to COARSE SAND, OLIVE SOME CLAY

59SB07-05
@0910

SLIGHT to NON PLASTIC, SOFT to LOOSE. DAMP.

~~[illegible]~~ RLR

59SB07 (CON'T)

10-13.4

10-15 SAA BUT. SIMILAR TO 4.8-8.0 FINE
4.5 GRAINED, SLIGHT TO MED PLASTICITY,
BKG SOFT, MOIST.

13.4-15.0 SAA BUT ORANGE BR, SOFT WHITISH/
IVORY VEIN ≈ 14.5

15-19 4' RAN - SLEEVE OVER PACKED
3.8 15-19 - SAA ≈ SILT AND CLAY, ORANGE
(NATIVE) BR W/ WHITE/IVORY, NON TO SLIGHT PLASTICITY
BKG. STIFF (V STIFF @ 17.5), MOIST?

WILL BUILD WELL @ 18 BASED ON
ELEVATION, GRADIENT, & 13MW04 SWL.
(ie. 8± bgs)

1020 COMPLETE 59GW07, MOVE TO
DECON, ADAM/RLR CLEARS
59SB08 LOCATION
● 59GW07 ●
TD 18' bgs
SCREEN 8-18' bgs
SAND to 1½ 6' bgs
BENTONITE 4' bgs

59SB08 (PID BKG 0.0) @ 1045

0-5 0-0.3 TOPSOIL
5.0 0.3-0.6 GRAVEL (GREY) FILL
BKG. 0.6-1.0 FILL SILT & CLAY, TO AND
CONT 1.0 - 5.0. CLAY, SOME SILT; TAN &
59SB08-00 YELLOW ORANGE, W/ SAND BLK & WHITE/
@ 1055 IVORY MOTTLING. SLIGHT PLASTICITY,
59SB08-01 SOFT, DRY TO DAMP.
@ 1100 * VOCs COLLECTED 0.6-1.0 * FOR OO/SURFACE

5-10 5-10 SAA ~~CLAY~~ BR SILT & CLAY,
4.8 SAND COLOR, NON TO SLIGHT PLASTICITY.
BKG. MED DENSE TO SOFT, DAMP.
59SB08-05
@ 1110 RLR

10-15. SAA
4.5 RLR
BKG.

15-20 & 15-18.5 SAA. DAMP TO MOIST?
18.5-19.1 MED SAND & SILT W/ QUARTZ.
COARSE SAND TO F. GRAVEL SIZE BETWEEN
19.6-19.9 (0.3' THICK) SATURATED.
NON PLASTIC, LOOSE. TAN. WHITE QUARTZ.
* REFUSAL @ ~~[illegible]~~ PUSHING 20-25 - ≈1.0 FOOT
OF SATURATED SILT, F to C. SAND, COARSE GRAVEL.
≈ 21.0 RLR

WILL ATTEMPT TO BURGER TO 23' FOR 59GW08 WELL. — BURGER REFUSAL @ 22' — DRILLERS LUNCH 1230. (BUILD WELL AFTER)

● 59GW08 ●

TD 22' bgs

SCREEN 12-22' bgs

SAND to 10' bgs

BENTONITE to 8' bgs.

1300 COLLECT 59ER03 FROM NEW DPT LINER.

1330 DRILLERS RETURN, COMPLETE WELL 59GW08 CONSTRUCTION

~~1430~~ ADAM & I CLEAR 59SB009 LOCATION (JUST OF 6 CONCRETE PAD @ NE CORNER.

1430 DRILLING MOVE TO ~~59SB~~ 59SB10 - EAS. GET THROUGH CONCRETE EASILY ("CONCRETE BREAKER - 4½" DIA) SAME AS AT 59SB05 - REACH W/ HSA.

— 59SB10 (PID BKG 0.0) @1440

0-5

4.5/4.5 BKG — 0.5' CONCRETE.

0.5 - 5.0 CLAY AND SILT, LITTLE F. SAND, TON of YELLOW CRACKS, W/ BLK of WHITE/IVORY MOTTLING (SIMILAR TO 59SB08, SLIGHT PLASTICITY, SOFT DAY-10 DAMP. (NO SURFACE SOIL SAMPLE DUE TO CONCRETE.)

59SB10-01 @1455

5-10 SAA + SOME IRON/RUST MOTTLING

4.3 BKG DAMP.

59SB10-05 @1500

10-15 SAA.

4.3 BKG

15-20 SAA MOISTE @ ~~10'~~ 17', STIFF @ 17.5

4.1 BKG

20-24.5 — REFUSAL @ 24.5

3.0/4.5 BKG 3' OF WEATHERED BEDROCK SAA W/ SATURATED SOIL IN THE TOP 2' OF LINER.

1525 William Widens hole w/ concrete breaker (i.e. for NSA.)

1545 Complete removing concrete for NSA, drillers decon; will wait for Hardy to arrive. Depart for security. - Manage samples, repair canopy tarp - (will build 59GW10 tomorrow)

1640 Depart NAPR. (MW sum tbl, logs at condo).

Thurs (4/22/10) P. Cloudy

0645 Onsite, prep, sample mgmt.

0715 Calibrate PID to 102 ppm.

0740 @ Sump 59, 59SB10 samples. Borehole collapsed and blocked due to yesterday's widening of concrete w/ "concrete breaker" therefore cannot check SWL for screen interval

0755 59GW08 SWL 17.52' TOC
approx. temp stickup 3.2'
≈14.3' bgs.

0802 59GW07 SWL 16.26' TOC
2.9
≈13.36' bgs

0805 59GW05 SWL 13.10' TOC
(Page 12) flush stickup -0.40.
≈13.5' bgs

0812 59GW03 SWL 17.52' TOC
(Page ~~12~~ 6) approx stickup 2.6'
≈14.92 bgs.

LATE ~~TODAY~~: 0810 ADAM COMPLETES 59ERL04
0830 DRILLERS ONSITE W/ HARDY (AS YESTERDAY, SEE PG 12)

0845 DRILLER PREP TO AUGER 59GW10 DIRECT TO AUGER / CONSTRUCT WELL W/ 23' TD.

0905 COLLECT 59SD01 FROM OUTFALL ACROSS FORRESTAL Rd, WASHOUT HOLE APPROX. 3' DEEP (SEE GRILLEY LOG FOR ADDITIONAL DETAIL)

0955 COMPLETE 59GW10 CONSTRUCTION MOVE TO 59SB09. & DECON

1020 BEGIN @ 59SB09

● 59GW10 ●
TD. 23' TD bgs
Sand to 11' bgs
Screen 13-23' bgs
Bentonite to 9' bgs

— 59SB09 (PID BKG 0.0.) —

0-5 / 4.6 BKG
0-0.2 TOPSOIL
0.2-2.3 FILL; CLAY TO COARSE SAND, ORANGE BR, NON PLASTIC, LOOSE, DRY.
2.3-2.6 GRAVEL (COARSE SAND TO F GRAVEL SIZED), GREY, NON PLASTIC, LOOSE, DRY. (MOSTLY SILT/F SAND)

59SB09-00 @1030
MAYBE BEDROCK

2.6-5.0 SILT - CLAY TO COARSE SAND, LITTLE GRAVEL, ORANGE BR AND GREY, NON PLASTIC, LOOSE TO MOD DENSE, DRY

59SB09-01 @1035
MAYBE BEDROCK

NO RECOVERY

5-10 / NA / NA.
SLEEVE STUCK IN SAMPLER VERY HARD PUSHING. — COLLECT SAMPLE (VOCS FROM MATERIAL IN NOSE, OTHER FROM MATERIAL BEAT OUT OF SAMPLER)

59SB09-05 @1045 PM
LOOKS LIKE FILL (BROWN CLAY TO SAND)
MAYBE SLOUGH. - DRILLER FIGHT TO REMOVE SLEEVE FOR 25 MIN. - CONTINUE.

SEE NEXT PAGE
1125

10-15 / 4.3 / 10KB.
10-12.8 BEDROCK - SILT AND F SAND, SOME CLAY, GREY OLIVE AND ORANGE BR, ~~LOOSE~~. NON PLASTIC, LOOSE TO MOD DENSE, DRY TO DAMP.
(0.4' THICK) 12.8-13.2 GREY HARD BEDROCK, FRACTURED
13.2-13.2-15.0 SAA 12.8.
12.8-13.4

595B09 (CONT)

— RECOVERY 595B09-05 @ 1125 FROM WEATHERED MATERIAL (WEATHERED BEDROCK - @ 10-11' INTERVAL) SEE PG 21.

— TERMINATE SAMPLING, DUE TO DIFFICULTIES AND HARD BEDROCK. WILL ATTEMPT TO AUGER TO 22±' bgs

— LATE ENTRY: 10-15' SAMPLE, STUCK IN BORE HOLE, NOT HANGUP LIKE CAUGHT ON ROCK, VERY SLOW RETRIEVAL LIKE ~~SUCKSTON~~ SUCTION? VERY STRANGE.

— GRAVEL/COBBLES FROM BORE HOLE THROWN 0-5' AUGERING

— OBSERVED HARD ZONE ≈ 13.5 WHILE AUGERING AS OBSERVED IN DPT SAMPLE. "ALIEN HOLE" ⇒ PER JOHN!

— ~~ALIEN~~

1220 @ 18±' bgs RIG OVERHEATS — LET COOL / TAKE LUNCH

— HEAD TO SUBCONTRACTOR TO MANIFEST / PACK / SHIP SAMPLES

1350 RETURN TO 59, DRILLERS PULLING AUGERS FROM 22' TD, DRILLERS

● 59GW09 ● TD 22' bgs SCREEN 12-22' SAND to 10' bgs BENTONITE to 8 bgs.

INFORMS THAT IT WAS / CONTINUED TO BE TOUGH / SLOW AUGERING — PREP TO BUILD WELL.

1420 CLEARING 595B04, SET UP TO DRILL.

— 595B04 (PID BKG 0.0) —

0-5 0-0.2 TOPSOIL

4.8 0.2-1.6 FILL - CLAY TO COARSE GRAVEL. COBBLES GRAVEL, ORANGE BR AND GREY, DAMP NON TO SLIGHT PLASTICITY, LOOSE ~~AND~~ AND SOFT.

BKG

595B04-00 @1440 1.6-2.0 CLAY, SOME SILT, TRACE F. SAND, ORANGE BR, TRACE BLK & WHITISH MOTTLING, SLIGHT PLASTICITY, SOFT, DAMP

595B04-01 @1445. 2.0-5.0 SILT, SOME CLAY AND F. SAND TAN AND YELLOW (ORANGE), DAMP, NON PLASTIC, LOOSE (SALT & PEPPER?)

5-10 SAA (M. DENSE to DENSE ≈ 8.5' bgs

4.2

BKG

595B04-05 @1450

595B04 (con't)

10-15 SAA.
4.6
BKG

15-19 REFUSAL @ 19' SAA DAMP TO MOIST?
4.0
BKG
1510 SWL @ 59GW10 ≈ 15±' bgs.
WILL ATTEMPT TO ~~DAGRES~~ AUGER AND BUILD WELL WITH 22' TD TOMORROW FOR 59GW04.

- DRILLER PREP TO GROUT BOREHOLES IN PREP FOR COMPLETION AT SURFACE.

- BAKER CLEANS UP LINERS/TRASH, ETC.
- SAMPLE MGMT, EQUIP/OFFICE

1620 BAKER/DRILLERS DEPART 59/MOPA MATRIX/PLANNING @ CMDO

FRI (4/23/10)

0720 ONSITE, PREP, WORK ON WATER LEVEL METERS.

0800 59GW10 SWL 14.43' TOC
FLUSHMOUNT — -0.5'
14.93' bgs

0802 59GW09 SWL 18.30' TOC
STICKUP 2.8'
15.50' bgs

0815 DRILLERS ONSITE. (w/ HARDY AS LAST TWO DAYS - SEE PG 12)
PREP TO AUGER AND INSTALL 59GW04 to 22' bgs.

0830 DEVELOP 59GW01 1821 TD (TEMP)
11.68 SWL
6.53 x 0.163
1.1 GAL/VOL.

0835 ABRAHAM/NOSSER ONSITE TO COMPLETE WELLS AT SURFACE, CONDUCT KICKOFF & H&S MEETING.

~~17.90~~ RAF

0905 BAIL/SURGE ≈ 3+ GAL FROM 59GW01 FOR 14± MIN TO NEAR DRY – WL 17.90' TOC AND RISING – GOOD (SLIGHTLY TURBID/TAN)

0945 – ALLOW TO RECHARGE FOR 40± MIN WL @ 14.05' TOC (3.85' RISE).

1000 – SURGE/BAIL <2 GALS FOR 10± MIN TO NEAR DRY – WL 17.95' TOC AND RISING (TD 18.22' TOC HARD AND TEMP HIGHT – MAY BE BUT WHEN PRO-TOP INSTALLED. DECON BAILER – ASSIST ADAM IN DRAINAGE I.D./EVAL WEST OF FORRESTAL + GPS! (SEE GOILEY LOG).

1235 DEVELOP 59GW06 – 18.18' TO TOC (SOFT)
10.66' TOC.
7.52 – 1.2 GAL/VOL

1325 SURGE/BAIL 9+ GAL OVER 40± MIN WL 15.2 AND RISING, TD 18.19' TOC (HARD) HIGHLY TURBID AND BROWN @ START AND CLEARING TO TURBID. DECON BAILER

LATE ENTRY: 1100 DRILLERS COMPLETE 59GW04

● 59GW04 ●
TD 22' bgs
SCREEN 12-22' bgs
SAND to 10'
BENTONITE to 8'

(RAFFA STAYED TO HELP W/ PODS)

1335 WILLIAM & RAFFA RETURN FROM STAGING DRUMS @ DRUM STORAGE. (5 SOIL DRUMS, LEAVE WATER ONSITE FOR DEVELOPMENT, WILL MOVE IN MAY).
ABRAHAM & NASSER @ 59GW04, WILL COMPLETE 59GW10 FLUSHMOUNT AND DEPART – HARDY & RAF WILL RETURN TO COMPLETE (01, 02, 03, 06, 07). THEY COMPLETED 05, 08, 09 TODAY.

1355 DEVELOP 59GW02 – ~~SWL~~ TD 19.55' TOC
~~STICKUP~~ RAF 13.15'
SWL 6.40' – 1+ GAL/VOL

1555 SURGE/BAIL 9+ GALS OVER 50 MINS WL 15.9 AND RISING, TD 19.56' TOC (HARD) MED TURBIDITY AND CLEARING THROUGHOUT DECON BAILER.

LATE ENTRY: DRILLERS (ABRAHAM, NASSER & RAFFA

19.56
15.9

19.98 20.77
20.26 20.90

1525 DEVELOP 59GW07 TD 20.89' TOC
RLR STICKUP 1.28'
SWL 4.61' — 0.75 GAL/VOL.

1552 SURGE/BAIL 2.5+ GAL OVER 15+ MIN
TO NEAR DRY - WL 20.77 AND RISING.
TD 20.90' TOC.
DECON BAILER

1600 DEVOP 59GW03 TD 20.03 VERY SOFT SONDY OF WATER LEVEL PROBE
RLR STICKUP 1.67
SWL 2.36 — 0.38 GAL/VOL

SURGE/BAIL 0.5+ GAL OVER 5+ MIN
TO DRY - WL 19.98 AND RISING
SLOWLY TD 20.35' TOC.
DECON BAILER

1645 DEPART NAPR.
MW SUM TAL & CAMDO

RLR

SAT. (4/24/10) 25.32 21.93

0650 ONSITE, PREP. - OVERCAST 78 /CLOUDY.

0745 DEVELOP 59MW05 TD 21.92' TOC
FLUSHMOUNT STICKUP 1.13.15
SWL 8.78 — 1.4 GAL/VOL.
HARD BOTTOM BUT SOUND ON WL PROBE

0835 SURGE/BAIL 10+ GAL OVER 40 MIN
WL 14.70 AND RISING, TD
DECON BAILER

0845 DEVELOP 59MW08 - 24.94' TOC TD (SOFT)
17.74' TOC SWL
7.20 — 1.2 GAL/VOL.
HIGHLY TURBID (BR)

0907 SURGE/BAIL 1.9+ GAL OVER 10+ MIN
TO NEAR DRY - WL 25.05 AND RISING
TD 25.32' TOC (HARD). DECON BAILER

0917 RETURN TO 59GW03 - 20.35' TOC TD
(SEE PG 28) 17.56' TOC SWL
2.79 — 0.45 GAL/VOL

SURGE/BAIL & 0.5+ GAL OVER < 5 MIN
TO NEAR DRY - WL 20.05 AND RISING,
TD 20.35' TOC (HARD) SLIGHTLY TURBID (LT GRAY)
DECON BAILER.

RLR

0945 DEVELOP 59GW09 — 25.24' TOC (SOFT) TD
18.32' TOC SWL
6.92' — 1.1+ GAL/VOL

1025 SURGE/BAIL <5 GAL OVER 35 MIN TO NEAR DRY - WL 24.80 AND RISING
TD - 25.30' TOC (HARD)
MOD TURBID

1045 DEVELOP 59GW10 — 22.80' TOC TD (HARD)
14.47 - 14.47' TOC SWL
8.33 - 1.35 GAL/VOL
OVER 45± MINS

1140 SURGE/BAIL: 10+ GAL, WL 17.55 AND RISING, TD 22.80' TOC (HARD)
MOD. TURBID, DOWN BOILER.

1250 DEVELOP 59GW04 — 25.48' TOC TD (HARD)
18.20' TOC SWL
7.28 — 1.2 GAL/VOL

✓ SPRINKLERS @ 1310±

1317 BAIL/SURGE 4.5 GAL. OVER 20 MIN TO NEAR DRY - WL 24.95+' TOC
TD 25.49' bgs. (HARD)
DOWN BOILER

(SEE PG 29)

1325 ✓ RAINING - RETURN TO 59GW08 ✓
WL 18.90' TOC.

1335 SURGE/BAIL 1.5+ GALS TO NEAR DRY (<5 min), WL - 24.95' TOC AND RISING
DOWN BOILER.

1342 RETURN TO 59GW03 (SEE PGS 28 & 29)
WL 17.58.

1348 BAIL/SURGE <0.5 GALS (<5 min) TO NEAR DRY - WL 19.95 AND RISING.

1430 DEPART NAPR (STILL RAINING)

SUN. (4/25/10)

0720 ONSITE, PROP., CLEAR/SUNNY

0800 RETURN TO 59GW07 SWL 16.29' TOC
(PG 28)
SURGE/BAIL 2.3+ GAL OVER 10 MIN
TO NEAR DRY - WL 20.60 AND RISING,
DECON BAILER

0824 RETURN TO 59GW01 SWL 11.63' TOC
(pg 25)
SURGE/BAIL 2.8+ GAL OVER 10+ MINS.
TO NEAR DRY - WL 17.8± ' TOC.
SLIGHTY TURBID TO CLEAR, RISING GOOD
DECON BAILER.

0845 RETURN TO 59GW04 SWL 18.16' TOC
(PG. 30)
SURGE/BAIL 3+ GAL OVER 10+ MINS TO
NEAR DRY - WL 24.8± TOC & RISING,
SLIGHTY TURBID, DECON BAILER.

0907 RETURN TO 59GW08 SWL 17.74' TOC
(pg 31)
SURGE/BAIL 1.4± GAL OVER 5+ MIN
TO NEAR DRY - WL 24.75± ' TOC
MOD TO SLIGHT TURBID, DECON BAILER.

0925 RETURN TO 59GW09 - 18.31' TOC
(pg 30)
SURGE/BAIL 3+ GAL OVER 10+ MIN TO
NEAR DRY - WL 24.7 & RISING GOOD, SLIGHTLY
TURBID - DECON BAILER

0950 RETURN TO 59GW03 - 17.86' TOC
(Pg. 28, 29, 31)
BAIL/SURGE 0.5+ GAL OVER <5 MIN TO NEAR
DRY WL - 20.00' TOC & RISING, SLIGHTLY
TURBID, DECON BAILER.

1023 @ SWMU 61 TO COLLECT.
SWLs (SEE 61 LOGBOOK)

RCR

MON (4/26/10)
DEMOBE NAPR (PHASE I OF
SWMU 59 INVEST.)

RCR

MON (5/17/10) [PHASE II OF SAMPLING]
MOBE TO NAPR (0740 PITT FLT), DRIVE @ NAPR 1500 HRS, RAINING, FLOOD FLOODS; PREP EQUIP / GLOVES, COORD W/ JUAN — GEOENTECH, DEPART NAPR. 1615 HRS.

RLK

RLK
~~1185~~

TUES (5/18/10) HEAVY RAIN @ PALMYRA, SPINKLES TO LIGHT @ NAPR.

0700 ONSITE, PREP, ORDER DISPOSABLE BLADDERS,

0720 CALIBRATE PID to 104

	WELL	SWL
0809	~~59~~ GW01	11.85
0811	06	10.87
0814	07	16.50
0816	02	13.38
0818	03	17.78
0823	05	13.32
0826	08	17.93
0829	09	18.50
0833	10	14.64
0836	04	18.36

0830 DRILLERS ONSITE (WILLIAM & RAFAEL) UNLOAD, PREP, SET UP @ 595B13

595B13 (PID BKG 0.0) @ 0920
— NOT RAINING, CLOUDY W/ SOME SUN.

0-5 0-0.2 TOPSOIL
5.0 0.2-0.9 CLAY TO COARSE GRAVEL, BROWN & GREY, DAMP
BKG NON PLASTIC, LOOSE (FILL)

595B13-00 0.9-5.0 CLAY, SOME SILT AND
+MS/MSD F. SAND, ORANGE BROWN, W/ LITTLE
@0935 OLIVE, DAMP, SLIGHT PLASTICITY, MOD
STIFF (FILL?)

595B13-01
+DUP
+MS/MSD
@0945

RLK

(RECALL
2 VOA VIALS
FOR MS+MSD)

5-10 5-~~10.0~~ 7.4 SAA. (SAPROLITE)
3.9 7.4-10.0 (WEATHERED BEDROCK?) CLAY
BKG. AND SILT, BROWN & RUST, TAN, SLIGHT
595B13-05 PLASTICITY, MOD STIFF to STIFF (ANGLED)
@0955 ? ROCK VEIN @ 9.5 LITTLE WHITISH MOTTLING
QUARTZ? DAMP.

1120

59SB13 (CONT)

10-12 SAPROLITE - CLAY, SOME F to MED SIZE
2.0 SAND, BL ORANGE, GREY, W/ BLACK AND
BKG. WHITISH, SLIGHT PLASTICITY, ~~MOIST~~
SOFT, ~~SOFT~~ MOIST.

59SB16 (PID BKG - 0.0) @ 1015

0-5 0-0.3 ASPHALT
4.4 0.3-1.5 CLAY TO GRAVEL, BROWN
BKG. AND GREY, NON PLASTIC, LOOSE, DAMP.
FILL) pm
59SB16-01 1.5 - 4.0 CLAY, SOME SILT, LITTLE
@1020 F. SAND, ORANGE, RUST, TAN, OLIVE.
NO SURFACE SOIL SOME. WHITISH MOTTLED, DAMP,
ASPHALT SLIGHT PLASTICITY, MED STIFF TO
STIFF
4.0 - 5.0 SAPROLITE? — CLAY, SOME
F. to MED SAND, ORANGE, GREY W/ BLK
AND WHITISH SPECS, SLIGHT PLASTICITY, STIFF
DAMP.

5-10 SAA - RNT. MORE OLIVE TINT
~~4.2~~ 3.1 7.6 - 8.0
BKG CLOSED 8.5 - 8.6 } HARD ROCK, GREY W/
SOME RUST MOTTLY. VEINS.
59SB16-05
@1030

59SB16 (CONT)

10-12 SAA (SAPROLITE) MOIST, SOFT.
2.0 ~~REF.~~
BKG

59SB17 (PID BKG - 0.0) @ 1050

0-5 0-0.2 TOPSOIL.
3.3 0.2 - 3.5. FILL - CLAY to COARSE SAND
BKG COMPLD/TRACE GRAVEL, BL/MAROON/GRAY.
SLIGHT PLASTICITY TO LOOSE., MED STIFF
59SB17-00 to SOFT, DAMP.
+DUP 3.5 - 5.0 NATIVE - ~~ORA~~ CLAY, ~~SOME~~ LITTLE
@1055 SILT, ORANGE & GREY, W/ RUST AND BLK
MOTTLING, SLIGHT PLASTICITY, ~~VERY~~
STIFF, DAMP.
59SB17-01
@1100 ~~REF.~~

5-10 5-10 ~~SAA~~ - CLAY, LITTLE SILT, RUST
4.8 LT GREY, LITTLE OLIVE (VARIGATED) SLIGHT
BKG to MOD PLASTICITY, ~~MOD~~ ~~STIFF~~ to DAMP.
59SB17-05 INCREASE IN LT GREY / WHITISH. ≈ 9.0'
@1110

595B17 (cont'd)

10-12 SAA.
BKG
2.0

1130 EVALNOTE LOCATING 595B15 and 12.

595B15 - MOVE APPROX 35'± SW OFF OF CONCRETE PADS (MAYBE FORMER FLOOR OF STRUCTURE DUE TO RAISED FOOTERS.)

595B12 - MOVE APPROX 20'± SW, DUE TO MOVING SAGW02 (SEE PG 5), AND NOW ADJACENT TO PILED SOIL.

CLEAR ACCESS TO 595B12.

595B12 (PID BKG - 0.0)

0-0.2 TOPSOIL

0-5
4.1
BKG
595B12-00
@1220

0.2-4.0 (FILL) - CLAY to GRAVEL, ROOTS, BROWN, ORANGE, GREY, DAMP, NON PLASTIC, LOOSE.

595B12-01
@1225

4.0-5.0. CLAY, LITTLE SILT, ~~ORANGE~~ ~~RUST (ORANGE)~~ MAROON, LT GREY, LITTLE BLK MOTTLING, DAMP. V. STIFF to HARD. HIGH PLASTICITY.

5-10
4.3
BKG
595B12-05
@1230

SAA — BUT MAROON AND LT GREY (VARIGATED) W/ TRACE WHITE MOTTLES. SLIGHT SLIGHT PLASTICITY, V. STIFF, DAMP COLOR GRADES TO LIGHTER - YELLOW, ORANGE AND GREY. ≈ 8.0±

10-12
2.0
BKG

SAA BUT YELLOW, ORANGE, TAN, LT GREY, LITTLE OLIVE, HIGHLY PLASTIC, SOFT, MOIST.

1250 COLLECT ERO5 FROM NEW DPT LINER.

1310 COLLECT FB02 USING STORE BOUGHT DISTILLED H_2O.

@1250/ FB02
ERO5/1310

595B15 (PID BKG @ 0.0) @ 1310

0-5 0-0.2 TOPSOIL
4.2 0.2-5.0 SILT to COARSE SAND (FILL)
BKG SOME CLAY, COMPLE GRAVEL,
BROWN, LT GREY, SHELLS FOUND
595B15-00 TOP 0.8', DAMP, NON PLASTIC,
@ 1315 LOOSE.

595B15-01
@ 1320

5-10 5-10 5.0-6.5 SAA (FILL) GRAVEL
~~4.7~~ ~~5-5.5~~ PID
BKG 6.5-10.0 LITTLE
595B15-05 SILT, ~~SOME~~ CLAY, ~~BRG~~ GREY, BR.
@ 1330 OLIVE, DAMP, NON PLASTIC, LOOSE.
(NATIVE?) ORANGE/BR ZONE 8.5-9.0'
INCREASE IN CLAY - SLIGHT PLASTICITY.

10-12 SAA. W/ ORANGE/BR ZONE 11.6-12.0
2.0
BKG

595B22 (PID BKG - 0.0) @ 1335.

0-5 0-0.3 TOPSOIL
2.2 0.3-5.0 LOW RECOVERY (FILL) SILT to
BKG GRAVEL, LITTLE CLAY; BR, GREY, NON
PLASTIC, LOOSE.

595B22-00
@ 1345

595B22-01
@ 1350

5-10 5-10. CLAY, LITTLE SILT, [GLUE PER ODOR]
3.7 GREY OLIVE, MOIST, HIGHLY
BKG PLASTICITY, SOFT.
595B22-05 REFUSAL @ 10' - TERMINATE 595B22
@ 1400 (BEDROCK / BLDG?)

595B21 (PID BKG - 0.0)

MOVE NORTH JUST OFF OF PAD

0-0.2 TOPSOIL
0-5 0.2-1.8 FILL CLAY TO GRAVEL, DK GREY
4.4 OLIVE, GREY (GRAVEL), DAMP, NON
BKG PLASTIC, LOOSE. LITTLE COARSE SAND
595B21-00 1.0-4.0 SILT AND F. SAND, ORANGE
@ 1430 BR, ~~DK~~ DAMP, NON PLASTIC, LOOSE
595B21-01 + DUP
@ 1435

↗ 3' RNG. (HARD PUSHING)

5-8 SAA.
2.5
BKG.

8-11 REFUSAL @ 11' bgs. RLC
3.5
BKG SAA - BECOMES DENSE ~~10.5~~ 9.5' bgs.
595321-05 RLC
@1245 - DRILLERS DEPART ~~1450~~ HRS.

RETURN TO OFFICE MANAGE SAMPLES
RETURN TO 59 to SLUG TEST.
- CONNECTOR FROM TRANSDUCER AND COMPUTER PRB ~~FEMALE~~ MALE - CALL FIELD TO CONFIRM THAT A FEMALE ADAPTER IS ALL THAT WE NEED. FIELD CONFIRMS. (MIKE)

1550 HEAD TO SWMU 57 to CHECK SWLS — OIL/WATER PROBE MALFUNCTIONS, CHECK/CHANGE BATTERY — CALL FIELD (NIEL), CHECK A FEW THINGS — THEY WILL SEND ANOTHER —
1700 DEPART NAPR — TRY TO FIND ADAPTOR (9 PIN VS 15 PIN) FIND 15 PIN USB —

WED (5/19/10)

0650 ONSITE, PREP, COOLERS FOR YR 8 QTR 2 MWA,
0735 CALIBRATE PID to 105
0750 @ 59 PREP GLASSWARE / SHELTER / TABLE
0810 DRILLERS ONSITE.

595823 (PID BKG - 0.0) @ 0825
SMALL GRAVEL COVER - NO TOPSOIL.

0-5 0-1.1 (FILL) CLAY, ~~AND~~ SOME SILT, BROWN,
4.7 MED PLASTICITY, MED STIFF, DAMP.
BKG 1.1 - 3.0 (FILL) GRAY to COARSE SAND,
595823-00 BROWN AND GRAY, NON PLASTIC, LOOSE
@0835 DAMP.
30
595823-01 3.0 - 5.0 NATIVE, CLAY, LITTLE SILT,
@0835 ORANGE / GREY / BLACK (BANDED), ~~SLT~~ MED PLASTICITY, MED STIFF DAMP.
- GRADES TO DK BROWN / ~~BLK~~ BROWN @ 4.5'

5-10 SAA DK BROWN AND BROWN.
4.4
BKG
595823-05
@0845

10-12 SAA W/ OLIVE TINT, HIGH PLASTICITY,
BKG SOFT, MOIST.
2.0

595B18 (PID BKG - 0.0) @ 0855

0-5 BKG 4.6

0-0.2 TOPSOIL.

0.2-5.0 FILL CLAY TO COARSE SAND, BR, GRAVEL (0.1') @ ≈ 2.6', NON PLASTIC, LOOSE, - GRADES TO CLAY, INCREASE IN DAMP 4.0'±

595B18-00 @ 0900

595B18-01 @ 0905

595B18-02 @ 0915 ← SHALLOWER DEEP SUBSURFACE DUE TO GW (≈ 6±' bgs) FOR 595B18 AND 11

5-10 3.5 BKG

5-9 CLAY, SOME SILT, ORANGE, BR, LITTLE OLIVE, MED PLASTICITY, MED STIFF. DAMP TO MOIST.

9-10 GRAVEL (BEDROCK?) SATURATED, NON PLASTIC, LOOSE, DK GREY

10-12 BKG 2.0

10-11 SAA (SATURATED GRAVEL)

11-12 CLAY, LITTLE SILT, ORANGE BR, MOIST, HIGH PLASTICITY, SOFT.

595B11

595B11 (PID BKG - 0.0) @ 0930

0-5 4.5 BKG

0-0.3 - TOPSOIL

0.3-0.8 GRAVEL (FILL) GREY, DRY NON P. LOOSE

0.8-4.5 (FILL) CLAY TO COARSE SAND, COMPLE GRAVEL, BR/ORANGE/GREY, NON PLASTIC, LOOSE TO MED ~~DENSE~~ STIFF. DAMP TO SLIGHT

595B11-00 + DMP @0935

595B11-01 + DMP + MS/MSD @0945

4.5-5.0 GRAVEL (FILL). BEDROCK PIECES OF COBBLES?

595B11-02 @0955

5-10 BKG 4.8

5-10 CLAY, LITTLE SILT, MAROON AND GREY (MOTTLED) DAMP TO MOIST, HIGH PLASTICITY, MED ~~SFT~~ STIFF.

10-12 BKG 2.0.

SAA. 10-11

GRADES TO GREY AND OLIVE @ 11

11-12 (STILL CLAY, LITTLE SILT), MED PLASTICITY, STIFF

595B20 (PID BKG - 0.0) @ 1035.

0-5
4.5
BKG
595B20-00
@1045

0-0.2 TOPSOIL
0.2-0.3 GRAVEL
0.3-3.5 (WEATHERED BEDROCK) SILT & FINE SAND, SOME COARSE SAND, LT AND DK GREY (MOTTLED/SALT & PEPPER?) DRY TO DAMP, NON PLASTIC, LOOSE.

595B20-01
@1050

3.5-5.0 SILT, LITTLE CLAY, DK ORANGE/TAN, (BLOCKY) DRY TO DAMP. NON PLASTIC, LOOSE

5-10
4.4
BKG.
595B20-05
@1100

SAA. BECOMES STIFF ≈ 9.5'

10-15
4.2
BKG

SAA

RCR

1100 BEGIN BREAKING CONCRETE @ 595B19

595B19 (PID BKG - 0.0)

0-5
BKG
3.0
595B19-01
@1110

CONCRETE SURFACE (0.5') NO SS.
0.5-5.0 CLAY, LITTLE SILT, ~~WHITISH~~ PALE LT GREY, BUST W/ LITTLE OLIVE (MOTTLED) DAMP, ~~SLIGHT~~ MED PLASTICITY, SOFT to MED STIFF (≈ 3.5')

5-10
BKG
4.2
595B19-05
@1120

5-10 SAA (SOFT).

RCR

10-15
3.4
BKG

10-15 SAA. (AND MOIST)

RCR

595B14 (PID BKG - 0.0)

0-5 0-0.2 TOPSOIL.
4.6 BKG 0.2-4.0 (FILL) CLAY TO F. SAND.
BR/ORANGE/GREY, DAMP, MIN TO SLIGHT
595B14-00 PLASTICITY, LOOSE, (PIECE OF ALUMINUM CAN
@1145 @ 2.0' bgs, GRAVEL ≈ 4.0' bgs)
(FORMER SURFACE?)

595B14-01 4.0-5.0 CLAY, LITTLE SILT, WHITISH/
@1150 LT GREY, ORANGE, LITTLE OLIVE (MOTTLED)
~~SITE~~ DAMP, MOD PLASTICITY, SOFT.

5-10 — 5-10 SAA. (MAYBE "TALC" LIKE)
4.9 BKG

595B14-05
@1200

10-15 - 10-15 SAA
4.2 BKG

1305 SWL/4.61 -- 576W10

1310 COLLECT 59 EROG FROM NEW DPT LINER

DRILLERS MOVE DRILL/DEVELOP WATER DRUM TO STORAGE AREA AND GROUT BOREHOLES

PREP FOR HYDRAULIC CONDUCTIVITY (SLUG) TESTING. TROUBLES LOADING SOFTWARE FOR USB-to-SERIAL PORTABLE ADAPTER (NO 9 PIN on COMPUTER — TRANSDUCER IS 9 PIN — ONLY 15 PIN ON COMPUTER) FAIL TO LOAD USB ADAPTOR, CALL FIELD ENVIRON (MITCH) MIKE — CARLEY'S COMPUTER HAS 9 PIN ADAPTOR on COMPUTER. LOAD DIVER 4 PLUS — RESUME SLUG TESTING. - RUN TESTS.

— RISING HEAD TEST 59GW10 R-3

1630 DEBRIEF NAPL SAMPLING
V MATRIX FOR SB10 - 23 @ CAMPO-
DRY DOCK PHOTOS/EMAIL

THURS (5/20/10)

0845 ONSITE PREP FOR SWMU 57 SS GRO RESAMPLE, 59 CONDUCTIVITY TESTING, AND SEDIMENT/SURFACE SOIL SAMPLING.
— HUPE & OLIVER ONSITE FOR MNA SAMPLING

0740 @ SWMU 57 — SEE GAILEY LOG FOR SS AND ER SAMPLING DETAILS.

— CHECK SWLs @ 57GW02 & 04
0822 57GW02 SWL - 23.39
0825 57GW04 SWL - 1793

57GW02	57GW04
— TOC 24.62	19.26
— SWL 23.39	17.93
1.23 MSL	1.33 MSL.

∴ 57GW04 STILL HIGHER THAN 57GW02.

SWMU 57.

0920 59GW06 SWL 10.80' TOC
0925 — INSERT SLUG; AWAIT EQUILIBRATION.
RISING HEAD TEST 59GW06 R-3
SWL 10.80
0944 - START RISING HEAD TEST.
1003 - TERMINATE 59GW06-R3
DECON TRANSDUCER & SLUG.

1016 59GW01 SWL 11.84' TOC
1016 INSERT SLUG, AWAIT EQUILIBRATION
RISING HEAD TEST 59GW01 R-3
1100 - START RISING HEAD TEST (SWL 11.68)
1200 - TERMINATE 59GW01 R-3 (SWL 11.88)

ASSIST GAILEY W/ SEDIMENT AND SURFACE WATER SAMPLING DURING 59GW01 R-3 RISING TEST (SEE GAILEY LOG FOR SAMPLING DETAILS.)
— DECON TRANSDUCER AND SLUG.

1015 59GW09 SWL 18.51
1018 INSERT SLUG, AWAIT EQUILIBRATION
— SAMPLE MANAGEMENT/PACKING/SHIPPING
1435 59GW09 SWL 18.49
RISING HEAD TEST 59GW09 R-3
1440 START RISING HEAD TEST
1503 - TERMINATE 59GW09 R-3 (SWL 18.65)

DECON TRANSDUCER AND SLUG

RM

RM
USEPA

1515 59GW05 SWL 13.31
1518 INSERT SLUG, AWAIT EQUILIBRATION
RISING HEAD TEST 59GW05 R-3
1530 START RISING HEAD TEST (SWL 13.28)
1541 TERMINATE 59GW05 R-3 (WL 13.32)

DECON TRANSDUCER AND SLUG.

1555 59GW02 SWL 13.37
1559 INSERT SLUG, AWAIT EQUILIBRATION
RISING HEAD TEST 59GW02 R-3
1616 START RISING HEAD TEST (SWL 13.36)
1631 TERMINATE 59GW02 R-3 (WL 13.40)

DECON TRANSDUCER AND SLUG.

1642 — 59GW04 SWL 18.37
1644 INSERT SLUG, AWAIT EQUILIBRATION.
~~1706~~ RISING HEAD TEST 59GW04 R-3
1714 START RISING HEAD TEST (WL 18.27)
1735 TERMINATE 59GW04 R-3 (18.45)

DECON TRANSDUCER AND SLUG

1750 59GW08 SWL 17.95
1753 INSERT SLUG, ALLOW TO EQUILIBRATE
OVERNIGHT (SLOW RECHARGE BASED
ON DEVELOPMENT) WILL RUN
59GW08 R-3 RISING HEAD TEST
TOMORROW MORNING.

1825 DEPART NOPR.

- DUMP/REVIEW SLUG DATA, MAY
RERUN 59GW10 R-3

RGL

FRI (5/21/10)

0650 ONSITE, PREP

0730 59GW08 SWL 17.95' (EQUILIBRATED)
0739 START RISING HEAD TEST
0819 TERMINATE 59GW08 R-3

0810 CALIBRATE TURBIDITY METER (HANNA HI 98703 TURBIDIMETER) to 0.1, 15.0, & 100 NTU SOLUTIONS

ASSIST SET UP @ 59GW07 FOR GW SAMPLING.
- DECON TRANSDUCER AND SLING

0858 59GW10 SWL 14.61
0901 SET SLING, AWAIT EQUILIBRATION.
- HEAD to 59GW07 to ASSIST.

0930 59GW10 SWL 14.61 - EQUILIBRATED
59GW10 R-3b
0934 START RISING HEAD TEST
0957 TERMINATE 59GW10 R-3b.
(LOST CONNECTION, CHECK GRAPH - TEST OK)

RGR

ASSIST SAMPLING 59GW07
■ COLLECT 59GW07 (SEE SAMPLING RECORDS FOR DETAILS). GW SAMPLE ■

- DECON BLADDER PUMP, REPLACE BLADDER.

1135 PUMP ON @ 59GW06 (SEE SAMPLING RECORDS FOR DETAILS)
1315 ■ COLLECT 59GW06 RGR 06 GW SAMPLE ■
3/14/12 SAMPLE Actually collected on 5/22/10 FROM Teflon-lined Tubing
- DECON BLADDER PUMP, REPLACE BLADDER
* LATE ENTRY: COLLECT 59GR09 @ 1145 FROM TEFLON BLADDER.
1430 PUMP ON @ 59GW09 (SEE SAMPLING RECORDS FOR DETAILS)
1510 ■ COLLECT 59GW09 GW SAMPLE ■

- DECON BLADDER PUMP, REPLACE BLADDER, MONITOR SAMPLES (DAILY)

1630 DEPART NAPR.
MATRIX @ OMAHA

RGR

RGR 3/7/12

SAT (5/22/10)

0645 ONSITE, PREP.
0710 CALIBRATE TURBIDITY METER TO 0.1, 15 & 100 NTU SOLUTIONS
0720 @ 59GW01, PREP TO SAMPLE
0740 PUMP ON AT 59GW01 (SEE
0835 SAMPLING RECORDS FOR DETAILS)
0835 COLLECT 59GW01 GW SAMPLE

→ 59GW01 IS A VERY SLOW LOW YIELD WELL (< 30 ml/min), ACCORDING TO USEPA LOW STRESS (LOW FLOW) PURGING AND SAMPLING GUIDANCE (GW SAMPLING SOP, FINAL MARCH 16, 1998) PURGE RATES SHOULD BE BETWEEN 200 AND 500 ml/min AND SAMPLING RATES BETWEEN 100 AND 250 ml/min. CONSEQUENTLY, LOW YIELD WELLS (i.e., 59GW03, 59GW08) WILL BE PURGED DRY, AND SAMPLED UPON RECOVERY. THE LOW YIELD WELLS ARE DETERMINED BASED ON DEVELOPMENT RESULTS AND CURRENT REVIEW OF HYDRAULIC CONDUCTIVITY (SLUG) TESTING RESULTS.

- DECON BLADDER PUMP; REPLACE BLADDER.

0936 59GW03 SWL 17.82' TOC / TD 20.36
BAIL < 0.5 GAL TO NEAR DRY
0945 ~~SEE~~ WL 20.20' TOC, WILL ALLOW
(*) TO RECHARGE AND SAMPLE W/ BLADDER PUMP (ONE TO LOW YIELD AND LITTLE WATER COLUMN). DECON BAILER.
1005 PUMP ON AT 59GW10 (SEE SAMPLING RECORDS FOR DETAILS) GAILEY PURGES
1015 59GW08 SWL 17.92' TOC / SWL 25.30' TOC
1030 BAIL 2.0+ GALS TO NEAR DRY WL 24.7± AND RISING, ALLOW TO RECHARGE, WILL ATTEMPT LOW FLOW.
1035 WL 18.4± AND RISING @ 59GW08
DECON BAILER.
RETURN TO 59GW10, ASSIST GAILEY,
1135 COLLECT 59GW10 GW SAMPLE.

DECON BLADDER PUMP, REPLACE BLADDER.

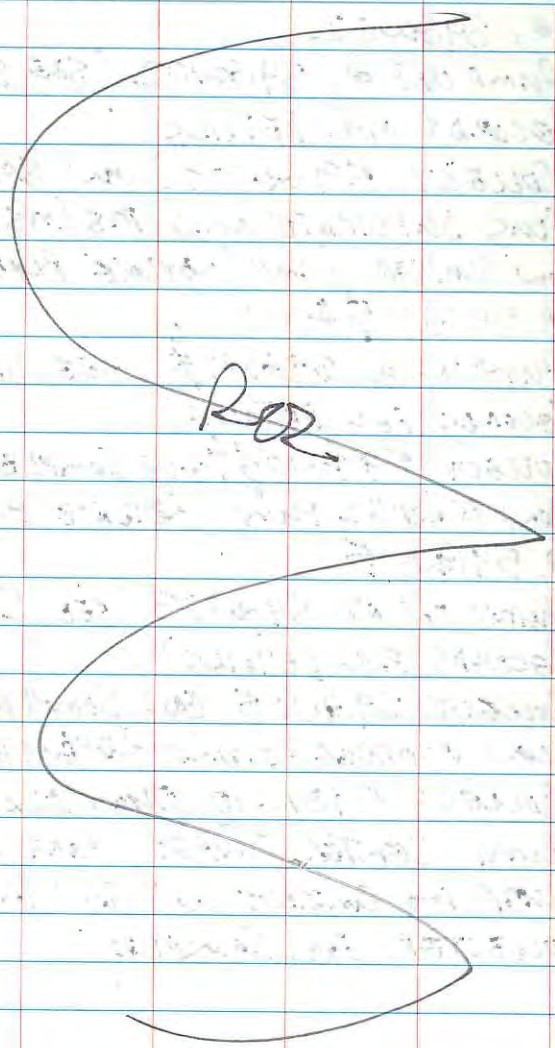
1305 59GW03 WL 17.84' TOC
NEAR COMPLETE RECHARGE, WILL
1315 SAMPLE - WATER LEVEL AFTER
PUMP. 17.63' TOC.
- PUMP SET 0.5' OFF BOTTOM
- WATER LEVEL BELOW TOP OF PUMP, CANNOT PURGE
COLLECT 59GW03 GW SAMPLE
1325 DRY ALLOW TO RECHARGE (COLLECTED 3 VOA VIAL AND 2 AMBERS)
1420 WL 17.86 (59GW03)
1434 WL 18.8 " (OR TOP OF PUMP)
1438 COMPLETE SAMPLING 59GW03.
1443 20.26' TD
DECON BLADDER PUMP, REPLACE BLADDER.

1502 PUMP ON AT 59GW08 (SEE SAMPLING RECORDS FOR DETAILS)
1625 COLLECT 59GW08 GW SAMPLE
Dec 4625
to OFFICE TO MANAGE SAMPLES / ORG. (DAILY)
1705 DECON BLADDER PUMP, REPLACE BLADDER.
1730 DEPART NAPR
SAMPLE MATRIX NC CONDO
GW SAMP RECORDS

SUN. (5/23/10)
0650 ONSITE, PERP
0720 CALIBRATE TURBIDITY METER TO 0.1, 15, & 100 NTU SOLUTIONS.

0745 @ 59GW02
0757 PUMP ON @ 59GW02 (SEE SAMPLING RECORDS FOR DETAILS)
0910 COLLECT 59GW02 GW SAMPLE PLUS DUPLICATE AND MS/MSD
DECON BLADDER PUMP / REPLACE BLADDER
1100 @ 59GW0~~3~~4
1113 PUMP ON @ 59GW0~~3~~4 (SEE SAMPLING RECORDS FOR DETAILS)
1205 COLLECT 59GW0~~3~~4 GW SAMPLE
DECON BLADDER PUMP / REPLACE BLADDER
1250 @ 59GW05
1258 PUMP ON AT 59GW05 (SEE SAMPLING RECORDS FOR DETAILS)
1450 COLLECT 59GW05 GW SAMPLE
DECON BLADDER PUMP / REPLACE BLADDER
1535 COLLECT 59GR10 FROM BLADDER PUMP CENTER TUBE (PART OF PUMP IN CONTACT W/ GW THAT IS COLLECTED FOR SAMPLE)

1605 @ OFFICE MANAGER SAMPLES/EQUIP
1630 DEPART NAPR
TIMESHEET, MATRIX, C-O-Cs @
CONDO.



MON (5/24/10)

0645 ONSITE, PREP, MANAGER/ICE SAMPLES.
0720 @ 59SB11 to COLLECT VOC SAMPLE FROM 3-5' INTERVAL (PREVIOUS SAMPLE DID NOT ARRIVE AT LAB ???) DWG TO 2.5' W/ POSTHOLE DIGGERS OVER THE LAST TWO DAYS. WILL CONTINUE W/ DECONTAMINATED HAND AUGER (FILL MATERIAL W/ COBBLES OF BEDROCK W/ CLAY MATRIX).
0740 COLLECT 59SB11-02 @ 3.5'
COULD NOT GET DEEPER W/ HAND AUGER DUE TO COBBLES

0755 MEET SURVEYORS (PJDC) AT ENTRANCE (FELIX & HENRY) RETURN TO 59 DISCUSS SCOPE/GIVE MAP./KICKOFF AND H/S MEETING
0845 COLLECT 59IDW02 FROM DECON/DEVELOPMENT WATER DRUM

0850 COLLECT 59IDW01 (COMPOSITE FROM 5 DRILL CUTTING/SOIL DRUMS

	WELL	SWL	Ref
0945	59GW01	11.90	59GW01
0954	02	13.43	59GW02
1000	05	13.36	
1004	03	17.85	
1007	07	16.53	
1010	13MW04	10.72	
1014	59GW06	10.91	
1018	PIT 7 NE	6.62	74VP07D
1019	PIT 7 SW	6.05	74SB151
1029	59GW08	17.99	
1031	59GW09	18.56	
1036	59GW10	14.68	59GW10
1038	59GW04	18.42	

1100 COLLECT 59ER11 FROM DECONED HAND DUGER BUCKET (3 VOA VIAL)

— MANIFEST/PACKAGE/SHIP SAMPLES AND EQUIPMENT, ORG/CLEAN OFFICE.

INSPECT/VIEW SUMM 9, DISCASS OPTIONS, PHOTOGRAPH.

1655 DEPARTED NAPR

MATRIX

Environmental Technician – Adam Gailey (April/May 2010)

Sunday April 18, 2010

Field Team: A. Gainey (ADG)
R. Roselius (RGR)

Field Team Departs PIT at 1130 for SJU.

1730 arrive at SJU. Rental Vehicles and travel to Palmas Del Mar.

1845 Arrive at Palmas

APG

Monday April 19, 2010

0650 Arrive at MAPR for SWMU 59 Field Investigation

upack cooler / Equipment and Prep for Day's events.

0845 - Drivers arrive at SWMU 59. Kick-off Meeting Health + Safety.

0900 - Pick up Gatorade / H_2O from Mariana.

0910 - Arrive at SWMU 59.

0930 - Collect 59FB01
3 VOA Vials (HCl) - VOC
2 1L Amber - Pesticides
2 1L Amber - LLSOVC
1 500 mL Poly (HNO_3) - Metals

0940 - Assist with Soil Boring / Sampling at 59SB01 - See R. Roselius logs for add'l details.

4-19-10

1100 - Assist with SESB03 Boring / Sampling.

1210 Break for lunch.

1300 - Evaluate Stormwater outfall features across Road - West of SWMU 59.

1330 - Collect 59ER01 - Macro-core liner
3 VOA Vials (HCL) - VOC
2 L Amber - SVOC
2 L Amber - Pesticides
1 500 ml Poly - Metals
ATM 4/14/10

1350 - Investigate (Additional) Stormwater Features.

1500 - Depart NAPR

APG

APG

NOT TO SCALE

N ↑

Wooded Area

Ditch

DRAINAGE Ditch

Wooded Area

DRAINAGE Ditch

Forestal Pond

Forestal Pond

13AW04

Manhole (sewer)

59GW07

Building # 258

59SB23

culvert

59GW01

Site Entrance

Outfall to Freshwater Drainage Channel / Wetland

Manhole (sewer)

SB18

Grass/Scrub Area

Fuel Islands

oil water separator

59SB17

SB11

Scrub/Shrubs

GW06

Site Entrance

59SB13

59GW01

grass area

gate

Grass Area

Building # 377

grass Area

Inlet

Inlet

59GW05

Loading Ramp

Building # 60

Drop Inlet

Refueling Bay

SB16

59SB21

59GW08

59SB20

59GW09

59SB19

59GW10

Vehicle Maintenance area

59GW04

59SB14

59SB15

59GW03

93

94

Tuesday April 20, 2010

0640 - Arrive at NAPR and prep for Day's events.

0640 - Raining as we arrive at NAPR.

0720 - Arrive at SWMU 59. Check water levels from yesterday's installation.

0800 - Collect 59SW01
3 VOA vials (HCL) - VOC
2 1L Ambers - KSVOC
2 1L Ambers - PEST
1 500 ml Poly (HNO_3) Metals
1 500 ml Poly (HNO_3) Metals (Field Filtered)

59SW01 was collected form an outfall across the street (Forrestal Road) from SWMU 59. This outfall discharges to a small pool. The pool was approx. 3 ft. deep and 10 ft X 10 ft. wide. A small outlet associated with the pool then discharges to

an adjacent freshwater ditch. Weather conditions during sample collection include a slight drizzle. No aquatic life observed during collection. A sediment sample will be collected from this location later in this investigation.

→ Assist with soil borings/sampling at 59SB02 and 59SB06

Weather Conditions: (1115)
Cloudy and Humid. Rain/drizzle has stopped.

1130 - Break for lunch and prep/pack samples for FEDEX shipment.

1330 - Back on site - Assist with 59SB05.

4-20-10

1430 - Collect 59ER02 by pumping DI H_2O through an un-used Macro-core liner.
3 VOA vials (VOC) [HCl]
2 1L Ambers - 4 SVOC
2 1L Ambers - Pest
1 500 mL Poly (HNO_3) Metals

1445 - Drop samples off at Security Building at Purchase Gatorade and water from Marina.

1510 - Return to Sumu 59 - Recon proposed samples for future drilling.

1530 - Depart Sumu 59 to Sumu 57 for another round of H_2O levels - See K. Roselins log book for information.

1600 - Back at Security - ADL

1635 - FedEx Arrives.
1700 - Depart NAPR.

Wednesday April 21, 2010

0650 - Arrive at NAPR and prep for soil boring collection, FB, ER, etc.

0740 - Arrive at Sumu 59.
0815 - Drillers arrive

0840 - Assist with soil boring / sampling at 59SB07.

0945 - Leave NAPR for hardware shop in Ninguabo, PR. for supplies.

1024 - Back at NAPR - Sumu 59.

1045 - Assist with soil boring / sampling at 59SB08.

1145 - Break for lunch.
1250 - Return to Sumu 59.

1300 - Collect 59ER03 of pumping DI H_2O through an un-used Macro-core liner.

4-21-10

1315 - Minor Site clearing for 59SB09. And assist with 59SB10.

1455 - Begin Collecting samples ~~at~~ For 59SB10-01.

1550 - Depart SWMU 59 and Refuel Vehicle at NAPR Marina.

1610 - Back at Security - Regroup for Next day.

1640 - Depart NAPR

Thursday April 22, 2010

0645 - Arrive at NAPR and Prep for day's events.

0745 - Depart Security Bldg.

0750 - Arrive at SWMU 59.

0810 - Collect 59 ER04 by running DI H_2O Through an un-used Macro-Core Liner.

- Photo Documentation of SWMU 59.

0830 - Drillers arrive on site. Start Building well at 59SB10.

0905 - Collect 59SD01. Sample Collected from Small pool where 59SW01 was collected on 4-20-10. Mostly Silt - Some Clay. Dark brown. No Aquatic species observed.

4-22-10

59SD01:
3 VOA Vials (MeOH, NaHSO4) - VOC
1 8oz. Jar - 11 SVOC
1 2oz. Jar - Metals
1 2oz. Jar - TOC

Weather Conditions: Mostly sunny and Warm - Mid 80's. Slight Breeze.

1020 - Assist with Soil Boring and Sampling at 59SB09.

1140 - Pick up Lunch at Marina and head back to Swmu 59.

1230 - Arrive at Security Building to Prep and Pack Samples for FeDEX Pick up.

1350 - Finish Packing Samples for FeDex. Depart Security for Swmu 59.

1405 - Back at Swmu 59.

4-22-10

1415 - Assist with 59SB04 soil boring/Sampling.

Depart Swmu 59 1520 and Back to security.

1620 - Depart NAPR.

ADG

Friday April 23, 2010

0720 - Arrive at MAPR.
Prep for day's events.
Also, Begin Organizing / Prep
for Fedex Shipment.

0830 - Arrive at SWMU 59.
Begin Vegetative Survey -
Dominant Species:

White Indigo Bean - Rondia Acuculata
White Lead tree - Leucaena Leucocephala
Climbing dal flower - Commelina Diffusa
Guinea grass - Urochloa Maxima
Light blue Snakewood - Stachytarpheta Jamaicensis
Gumbo Limbo - Bursera Simaruba
Bretonica Prieta - Melochia Nodiflora
Fringed windmill grass - Chloris Ciliata
Barrelier's Woodsorrel - Oxalis barrelieri
Ocean Blue Morning Glory - Ipomea Indica
Tropical Sedge - Fimbristylis Cymosa

1010 - Recon drainage Ditch
West of Site across Forestal
Road. GPS data Corrected.

1100 - Break for lunch, download
GPS data, Prep / Pack FedEX
Shipment, and organize
Supply Room.

1430 - FedEX Arrives.

1445 - On Site at SWMU 59 -
assist R. Roselins with
Well development at
59GW02 and 59GW07,
and 59GW03.

1645 - Depart MAPR

ACh

Saturday April 24, 2010

0650 - ~~Report~~ ADG Arrive at NAPR. Supply Room clean-up and Equipment Inventory.

1100 - Assist with Well dev. at Sumu 59 - GW10.

1130 - Back at Security Building and prepare for Second Phase of Sumu 59 Field Investigation.

1230 - Assist well Dev. - see R. Roseius log Book.

1330 - Weather Conditions: Rain.

1430 - Depart NAPR

ADG.

Sunday April 25, 2010

0720 - Arrive at NAPR Prep for day's events.

Purchase Field Supplies in Ceiba, PR.

0940 - Refuel Rental Vehicle at NAPR Marina.

1023 - Water levels at Sumu 61.

1130 - Water levels at Sumu 67.

1200 - Lunch and Pack/FedEx Equipment out Security Bldg.

1415 - Depart NAPR.

ADG

Tuesday May 18, 2010

Second phase of SWMU 59 CMS Investigation

[Field Team]

Robert Roscoe - Site Geologist.
Adam Garret - Env. Scientist.

0700 - Arrive at NAPR. Rain - Heavy at times in the A.M. at Pumas Del Mar. Light Rain at NAPR. Prep for day's events.

0800 - Arrive at SWMU 59 - Water levels see R. Roscoe's Log Book.

0830 - Drillers arrive.

Assist with soil Boring and Sampling at 59SB 13, 16, and 17.

1130 - Manage Samples at NAPR Env. Support Room. Lunch.

1210 - Back at 59.

5-18-10

1250 - Collect 59ER05 by running DI. Water through an un-used Macro - Core Liner:

- 3 VOA Vials (HCl) VOC
- 2 1L Amber " SVOC
- 2 1L Amber PEST
- 1 500 mL Poly (HNO_3) METALS

1310 - Collect FB02 using Store-bought Distilled Water.

Bottles:
" "

1315 - Assist with Soil Borings at 59SB15, 59SB22.

Depart SWMU 59 - Manage Samples.

1700 - Depart NAPR.

176

Wednesday May 19, 2010

0650 - Arrive at NAPR and prep for day's events. Move Equip/coolers into Env. Supply Room from last Night's UPS Shipment.

0750 - Arrive at SWMU 59.
Assist with Soil boring Sampling at:
59SB23
59SB18
59SB11
59SB20
59SB19
59SB14

1230 - Back at Sec. Room - Manage Samples and Break for Lunch.
1240 - Return to SWMU 59.
1310 - COLLECT 59EROG
3 VOA Vials [40 ml] - VOC
2 1L Amber - PEST
2 1L Amber - 1LSVOC
1 500 ml Poly [HNO3] - METALS

5-19-10

1335 - Return to security Room. Re-Ice Samples.

1410 - FedEx Arrives with additional Equipment From Field Environmental.

1435 - Assist with Slug Test at SWMU 59.

Meet with MNA Field Team and head back to Sec. to organize Equip. Room for Following day's events.

1630 - Depart NAPR

MC

Thursday May 20, 2010

0645 - Arrive at MAPR
Decon stainless steel
Bucket Augers for
recollection of Surf.
(GRO) Soil Samples 575508-575512
at SWMU 57. Recollection
Necessary due to
inadvertant laboratory
Mistake.

0735 - Arrive at SWMU 57.
0745 - Collect 57ERO8 by pouring
DI water through an un-used,
Decontaminated SS bucket Auger.

0755 - Collect 575508 (TPH GRO)

0800 - Collect 574509 (575509 D) - TPH GRO

0805 - Collect 575510 (TPH-GRO)

0810 - Collect 575511 (TPH-GRO)

0815 - Collect 575512 (TPH-GRO)

5-20-10

For Additional Surface Soil
details from original Surface
Soil Collection - See pages
8-10. For this Re-collection
of GRO - The 1 ft. depth
interval was obtained for
all Samples.

Weather Conditions: Mostly
Cloudy. Warm and Humid, mid
60's. Slight Breeze.

0925 - Depart SWMU 57.

ABG

5-20-10

0835 - Back at Sec. bldg. to begin processing samples for Fedex shipment today. Also, prep for additional Surf. H_2O / Sed samples at Sample 59 - Ditch.

1115 - Collect 59SW02
3 VOA's (40 mL - HCl) VOC
2 1L Ambers - PEST
2 1L Ambers - USVOC
1 500 mL Poly (HNO_3) - Metals
1 500 mL Poly (HNO_3) - Dissolved Metals.

1120 - Collect 59SW03 (same as above)

1130 - Collect 59SD02.
3 VOA's (40 mL - MeOH + 2 Nalgene) VOC's
1 8oz glass Jar - USVOC + PEST
1 2oz. glass Jar - Metals
1 4oz. glass Jar (amber) - TOC
1 4oz. glass Jar (amber) - AVS/SEM

1150 - Collect 59SD03. (same)

5-20-10

[59SW02 / 59SD02] - Samples taken on the North side of small pool across Forestdale Road - See add'l description on page 95 - of the small pool. However, this sampling event, small aquatic species were observed. Also, one small (2.5 inches in length) Freshwater Fish was also observed. Sediment sample SD02 taken to a depth of 0.5' in sediment. Saturated. Silty Clay. 2" dark brown, 2"-6" gleyed (light grey). No Floating or Submerged Aquatic Vegetation is present in this pool / sample location.

[59SW03 / 59SD03] - Sample taken on the South side of the pool. 0-6" dark brown. Sandy Silt and Clay. Saturated.

ADG

5-20-10

1215 - Back to Security Building to Finish Processing samples and Preparing for Fedex Shipment.

1540 - Fedex Arrives.

1600 - Assist with Slug tests at Sumu 59. ADC 5/21/10

1715 - Collect 59 ~~ER09~~ ER07 by Running D.I. Water through an un-used core liner.

1815 - Depart NAPR

ADC

Friday May 21, 2010

0650 - Arrive at NAPR. Prep for day's events (groundwater Sampling).

0720 - Calibrate YSI Meter. See Daily Meter Calibration Record for details.

0810 - Arrive at sumu 59.

0815 - Start Purge at 59GW07. See Low-flow Purge data Sheets for additional details.

1025 Sample 59GW07

1150 - Depart Sumu 59 - Refuel Vehicle and Purchase Site Liquids at base Marina ADC 5/21/10

LATE ENTRY: 1145 Collect ~~59ER10~~ 59ER08

1210 - Process Samples and Equipment for Fedex Shipment.

5-21-10

1430 - GW Purging and Sampling at 59GW09 - See Roselius Logbook and low-flow Purge Data Sheets.

Weather Conditions: Partly Cloudy and Warm, Mid 80's, Slight Breeze.

1510 - Collect 59GW09.

1545 - Depart SWMU 59.

1630 - Depart NAPR

AP

SATURDAY May 22, 2010

0645 - Arrive at NAPR Prep for groundwater Sampling at SWMU 59.

0705 - Calibrate YSI Meter - see Daily Meter Calibration Sheet for Details.

0740 - Arrive at SWMU 59 Assisting Roselius on GW well 59GW01. See Purge Data sheets and Roselius Log book for additional details.

59GW01 Sample Time 0835

0800 - Collect 59ER09 by Running D.I. water Through un-used Teflon-lined PolyEthylene Tubing.

0930 Back to Sec. bldg. to re-ICE Samples.

1005 - Set-up at 59GW10. Purge Data sheets for additional Information.

5-22-10

1135 - Sample 59GW10. See Purge/Sample data sheets for Details.

Depart SWMU 59 at 1220. - Re-Ice Samples at Sec. Bldg.

1305 - Arrive at SWMU 59 at 59GW03.
See Purge and Sample data Sheets for additional Information.
Slow Recharge - Will Return to Collect Rinsing Sample.

1370 - Purchase Post-Hole digging tool at local hardware store.

1405 - Return to SWMU 59 to finish 59GW03.

5-22-10

1500 - Purge and Sample at 59GW08. See Purge and Sample data Sheets for additional Info. ↓

1625 - Collect 59GW08.

1650 - Depart SWMU 59. Back to Sec. Bldg. to manage / re-ice Samples

1730 - Depart UAPR.

ADG

Sunday May 23, 2010

0650 - Arrive at NAPR.
Calibrat YSI and Turbidity Meters - See Calibration sheets.
Prep for GW sampling today.

0750 - Arrive at Sumu 59 - GW02. Prep for Purge and Sample - See data sheets for details.

0910 - Collect 59GW02 (D, MS, MSD)

1130 - Arrive at Sec. bldg. to re-ice and manage samples.

1145 - Assist with 59GW04.
1205 Collect 59 GW04.

1250 - Purge and Sample at 59 GW05. See Purge and Sample data sheets for additional details. →

1450 - cover 59GW05

(1345)

Weather Conditions: Cloudy, overcast Rain to the North of the Site.

1600 - Back at Sec. Bldg to Re-Ice Samples.

1630 - Depart NAPR

AEW

Late entry: Collect 59ER10 by Running D.I. water through a decontaminated Stainless Steel Bladder Pump.

Monday May 24, 2010

0645 - Arrive at NAPR.
Decontaminate bucket Augers for Collection of 59 SB11-02. Laboratory did NOT Receive this Sample last week. VOC's only.

(0735)
Arrive at SWMU 59.

0740 - Collect 59SB11-02
VOC's only.

0800 - Meet PUDC Survey Crew - Felix and Henry at Gate #3.

0810 - Tailgate meeting at SWMU 59 - Summary of Survey needs, etc.

0820 - Sec. Bldg. to get Supplies and Manage Samples.

Weather: Warm and Humid, 80's. ~~Partly Cloudy~~ Mostly Sunny.

5-24-10

0845 - Collect 59 IDW02
From Decon / Dev. Water.
2 1L Ambers (TCLP VOC, TCLP RCRA Metals, RIC)

0850 - Collect 59 IDW01
Composite Soil Samples from 5 drums from drill cuttings.
8oz. Jar - TCLP VOC's
8oz. Jar - 6010b, 7470A
16oz. Poly - 9012A, 9034, 6030, 9056.

0915 - Sec. Bldg. Manage Samples.

0940 - Arrive at SWMU 59.
Stake/flag boring locations for Surveyors - and get A round of water levels. (see Baseline log)

1100 - Collect 59 ER11.
3 VOA vials - VOC's by running D.I. Water through a Decontaminated Stainless Steel Bucket Auger for Sub Surface Soil Sample 59SB11-02.

5-24-10

- Back To Security to Pack Equipment and Samples:

1530 - Fedex arrives.

1545 - Reconnaissance at SWMU 9. evaluate site conditions for eventual upcoming investigation.

1610 - Sec. bldg. to organize, camp., clean-up, etc.

1700 - Depart MAPR

MRa

January 13, 2011

0700 - Arrive at MAPR and prep for day's events.

0900 - Assist set-up on 9SBSB + 9SBSA.

0900 - Professional Surveyors arrive on-site - PJDC, Inc. Tailgate Meeting and a brief walk around the site and explain what needs accomplished.
- Make sure all wells/Borings are labeled for Surveyors.

1010 - Manage samples at MAPR security Room.

1250 - Collect 9IDW01-11
2 ic Amber - RCI

1300 - Collect 9IDW02 -
1 40z. Jar (TCLP VOC)
1 8oz. Jar (TCLP METALS)
1 8oz. Jar (RCI)

1/13/11

SWMU 59 Water Levels

59GW10	-	1335	-	10.41
59GW09	-	1340	-	14.24
59GW08	-	1344	-	13.80
59GW04	-	1347	-	14.15
59GW05	-	1350	-	9.17
59GW03	-	1352	-	13.40
59GW02	-	1355	-	9.43
59GW01	-	1358	-	8.05
59GW06	-	1400		7.11
59GW07	-	1407	-	12.52
13MW04	-	1410	-	6.89
74VP070	-	1414	-	5.81
74SB151	-	1415	-	5.25

AP

Environmental Scientist – Jay Oliver (August 2011)

Sonny 803

Sonny 74 SB/B T - 8/30/11

1645 - take quick inventory of supplies that we will need for next mobilization

- Inventory glass was in bad

1700 - Wrap up for day -

Joel NABR

122,750

56

Sonny 803

DATE T - 8/30/11 PROJECT # 74 SB/B WEATHER

SB5 / 06 m / 59 / 10

- Could not get no training - for 74 VP20 / 1982

2 mw 05 -	8.17	59 SB 05 -	5.53
1995 mw 09 -	5.36	59 SB 06 -	3.79
1995 mw 05 -	8.51	59 SB 07 -	9.01
74 SB 710 -	5.90	59 SB 08 -	9.79
74 VP 10a / 10m	11.25	59 SB 09 -	9.47
74 VP 10b / 10m	13.29	59 SB 10 -	6.61
1995 mw 06	9.88	13 mw 04	3.66
74 VP 8a	9.21	1995 mw 01 -	22.22
74 VP 8b	8.68	1995 mw 08 -	21.47
74 SB 697	5.71	1995 mw 07 -	22.65
74 SB 696	9.07		
74 SB 695	4.50	- no measurable	
1995 mw 02	6.02	product detected	
74 SB 711	3.98	in any of the	
74 SB 689	2.32	wells.	
74 SB 688	0.86		
74 VP 7b	5.28		
74 SB 151	4.71		
59 SB 01	4.75		
59 SB 02	6.00		
59 SB 03	9.01		
59 SB 04	10.47		

DURABLE DOCUMENTS

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Environmental Geologist – Robert Roselius (September 2012)

CONTENTS

PAGE NO.	REFERENCE	DATE
1,2,	SWMU 71	
3-19	SWMU 59	
3, 20-23	SWMU 61	
4.	SWMU 60	

SEPT. 10, 2012 (MON.) P. CLONDY ① LAW 90C

0500 DS ET MEET DARREN WADDELL @ PITT AIRPORT FOR 0640 DEPARTURE.
1310 AT DRIVE SANDMAN, GET RENTAL JEEP. TRAVEL TO NAPR.
1515 ARRIVE NAPR OFFICE MOVE EQUIP / SAMPLE GLASSWARE FROM SECURITY BLDG 2439 TO OFFICE BLDG 2339, INSPECT SWMU 71, MAY HAVE TROUBLE CLEARING DUE TO STEEP SLOPES.
1700 DEPART NAPR, CHECK IN AT PALMAS DEL MAR (CRESCENT COVE 94)
1900 HRS UPLOAD, SNP FILES TO GPS AND DRAFT DAILY RPT. AT CAMPO.

RLR

② SEPT 11, 2012 (TUES) P. CLOUDY 90±

0710 ONSITE, GATE GUARD DIRECTS TO GO TO SECURITY AND ADVISE DENODO OF OUR WORK LOCATIONS TODAY - AWAIT ARRIVAL OF TNG.

0730 TNG ONSITE GO TO SECURITY TALK W/ DONOTO. GET UPDATE

0800 @ 71, H&S KICKOFF MEETING DISCUSS SCOPE / APPROACH., HIGHLY VEGITATED, AWAIT RIGHTWAY

0900 RIGHT WAY ONSITE, WORK WESTERN AREA ~~ABOVE~~ OF THREE TRANSECTS., SLOW GOING, THICK UNLEVEL BOULDERS.

1400 WORKING 4th TRANSECT (FROM N) SLOW GOING, THICK, BOULDERS, DRAINAGE AREAS, UNLEVEL, INACCESSIBLE TO SKIDSTEER W/ MULCHER.

1415 CALL RICARDO (ON-SITE) THEY WILL BE HERE ≈ 1530 - 1600 HRS WILL CALL)

1545 RICARDO CALLS, MEET RIG, & SIMON. RICARDO ARRIVES, HAVE KICKOFF (H&S & PROJECT) SIMON AND ABNER WILL BE ON SITE TOMORROW & THURS (SIMON AND LUIS ? FRIDAY),

1705 DEPART NAPR COMPLETE DAILY REPORT AND PLAN FOR TOMORROW @ CONDO.

SEPT 12, 2012 (WED.) P. CLOUDY 90± ③

0625 ONSITE, PREP, HEAD TO MARK SAMPLE LOCATIONS ON CONCRETE/ASPHALT @ SWMU 59. (26 to 29" ACCURACY W/GPS)

0735 LUIS (RIGHT WAY) CALL @ OFFICE HEADING TO NEAR ENTRANCE W/ ONSITE'S TRAILER TO MOVE SKID-STEER.

0750 TNG @ SWMU 71 PREP TO CONTINUE SURVEY.

0800 AT OFFICE LOADING RIG PREP TO GO TO SWMU ~~61~~ 59., KICKOFF W/ ABNER/SIMON, DISCUSS SCOPE SHOW LOCATIONS, - HEAD TO OFFICE @ 0830. GO TO SWMU 61 TO CLEAR FOR PASSIVE SOIL GAS

1100 RICARDO CALLS UPDATES THAT ON-SITE (ABNER AND SIMON) HAS COMPLETED 6 CONCRETE CORES. - CONTINUE TO CLEAR SWMU 61 - HIGHLY VEGITATED EVEN WHERE WE HAD PREVIOUS ROADS, CLEARING THE PATHS/ROADS + SOME AREAS NEAR SOIL GAS POINTS, SOME/MOST LOCATION ARE ACCESSIBLE W/ MINOR CLEARING, HEAVY CANOPY = POOR GPS RECEPTION. WILL USE TAPE/COMPASS WHERE LOCATION SOIL GAS LOCATIONS.

1140 ABNER CALLS, PLANNING TO TAKE LUNCH, RIGHT WAY TAKES LUNCH ALSO. — HEAD TO SWMU 59 INSPECT ~~A~~ CONCRETE CORES OK. STILL HAVE 7 to COMPLETE, DARREN AND I LOCATE SURFACE SOIL SAMP LOCATIONS NEAR OIL/WATER SEPARATOR, SOUTH OF FUELING AREA AND AT SOUTHERN PORTION OF SITE, ABNER/SIMON RETURN FROM LUNCH DISCUSS ACTIVITIES, 1300 RETURN TO SWMU 61 RIGHT WAY CLEARING CONTINUE TO DIRECT/ID SOIL GAS SAMP LOCATIONS.

1510 DEPART SWMU 61 (ABNER/SIMON Gone to GATE)

1525 THG @ SWMU 60 - DEPARTING WILL RETURN TOMORROW.

1535 @ GATE, LET DRILLERS/THG THROUGH. HEAD TO OFFICE, CHECK SAMPLE GLASSWARE.

1600 DEPART NAPA SHOP @ ROUPNS FOR WATER/GATORADE/BOGGIE DEPART. ROUPNS 1680.

— @ CONDO - DAILY RPT, SAMPLE PREP, COC, FEDEX LABELS, SAMPLE LABEL ORG, PARAMETER CLARIFICATION, ETC.

SEPT 13, 2012 (THURS) PCLOUDY 90±

0625 ONSITE, PREP FOR SWMU 59 SAMPLING SIMON @ OFFICE, 0710 ABNER ONSITE THROUGH GATE.

0725 CALIBRATE PID to 100 ppm ISOBUTYLENE READ 100.2 ppm (MINI RAE 3000)

0740 SET UP @ 595B32 (WASH PAD)

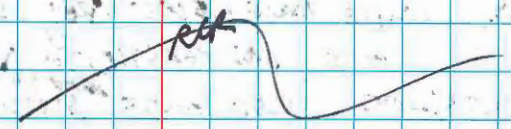
595B32 (PID BKG 0.0)

0 to 0.5 - CONCRETE (WASH PAD)

3.3 BKG 0.5 - 4.5 CLAY, LITTLE SILT ORANGE BROWN, LOW to MED PLASTICITY, MED STIFF, DAMP.

595B32-00 @0750

595B32-01 @0755



— CALL TESTAMERICA RE: SAMPLE VOLUME & VOC SOIL MOISTURE BOTTLE. - VOC SOIL MOISTURE BOTTLE ~~TO~~ NOT REQUIRED SINCE WE HAVE 2 8 OZ. FOR SVOCs & METALS.

— COORDINATE FEDEX PICKUP. (#29).

ON-SITE USING 1.25" LINER (SMALLER THAN TYPICAL) MULTIPLE PUSH TO OBTAIN VOLUME.

— 595B24 (PID BKG 0.0) —

0-0.5 CONCRETE.

2.4 0.5-4.5 CLAY, TRACE TO LITTLE SILT.
BKG. LT GREY, ORANGE, LITTLE OLIVE, SLIGHT PLASTICITY, MED. STIFF, DAMP. (FILL?).

595B24-00 + DUP, MS/MSD (4 SETS)
@ 0850

595B24-01 + DUP. (2 SETS)
@ 0855.

— 595B25 (PID BKG 0.0) —

0-0.5 CONCRETE.

2.1 0.5-4.5 (FILL) CLAY w/ FINE SAND,
BKG. COMPLE COARSE PIECES, GREY, OLIVE GREY, BLACK (ORANGE), MED PLASTIC TO NON; SOFT TO

595B25-00 MED DENSE, DAMP TO MOIST.
@ 0945

595B25-01
@ 0950.

— 595B26 (PID BKG 0.0) —

0-0.5 CONCRETE.

3.4 0-3.5 CLAY, TRACE SILT, ORANGE, SOME
BKG. BLACK MOTTLING, PLASTIC, MED STIFF,

595B26-00 DAMP.
@ 1010

595B26-01 3.5-4.0. CLAY, ORANGE, LT GREY,
@ 1015 POND. PALE (WHITISH), HIGH PLASTICITY MED STIFF.

— 595B27 (PID BKG 0.0) —

0-0.5 CONCRETE.

3.3 0.5-4.5 CLAY, ORANGE BR. W/ OLIVE
BKG. AND LT GREY MOTTLING, (MOTTLE)

595B27-00 HIGHLY PLASTIC, SOFT TO MED
@ 1030 STIFF, DAMP.

595B27-01
@ 1035

— 595B31 (PID BKG 0.0) —

0-0.5 CONCRETE

3.2 0.5-1.3 (0.8) SILT TO COARSE SAND. DK GREY
BKG + 1.1-5.0 AND DK OLIVE. (SLIGHT PETRO ODOR
~~595B27~~ w/ PID 1.1 ppm) LOOSE TO MED DENSE,

595B31-00 NON PLASTIC, DAMP.
@ 1100 1.3-4.5. AS SB27 - CLAY

595B31-01 ORANGE BR. W/ OLIVE AND LT GREY
@ 1105 MOTTLING, HIGHLY PLASTIC, SOFT TO MED STIFF. DAMP. +

— 595B28 (PID BKG) —

0.0-0.2 ASPHALT / 0.2-0.5 (0.3) GRAVEL.

2.8 0.5-4.2 FILL - CLAY TO FINE SAND
BKG SOME COARSE SAND. SIZED PIECES, DK GREY

595B28-00 , ORANGE, LT GREY; LOOSE TO SOFT TO
@ 1125 MED STIFF, NON PLASTIC; DAMP

595B28-01
@ 1130

— 595B29 (PID BKG 0.0) —
0-0.2 ASPHALT / 0.2 - 0.7 FILL to CONTRA SOIL ?
2.8 GRAVEL
BKG 0.7 - 4.2 CLAY, DK MAROON AND
595B29-00 DK GREEN, HIGHLY PLASTIC, SOFT
@1150 TO MED STIFF, DAMP.
595B29-01
@1155.

— 595B30 (PID BKG 0.0) —
0-0.2 ASPHALT / 0.2 - 0.5 GRAVEL.
3.0 0.5 - 4.2 (FILL) CLAY, LITTLE SAND
BKG ORANGE, DK BLUE GREY; MOD STIFF
595B30-00 TO MOD DENSE, NON TO SLIGHT PLASTIC
@1220 DAMP.
595B30-01
@1225

(IN DRAINAGE TRENCH) BLDG 2349
— 595B33 (PID BKG 0.0) —
0-0.4 CONCRETE. / 0.4 - 0.6 WHITE SAND.
4.0 0.6 - 4.4 NOTHING AS. SB31
BKG
595B33-00
@1235
595B33-01.
@1240

1340 COLLECT 59FB03 (FIELD BLANK W/ LAB GROUP DI) - VOCs, SVOCs & METALS

1350 COLLECT 59ER12 (RINSATE OF NEW DISPOSABLE 1 1/4" DPT LINER. VOCs, SVOCs AND METALS.

59TB07 - TRIP BLANK THIS SHIPMENT. (VOCs ONLY)

PACKAGE SAMPLES, RELINQUISH @ 1500, FEDEX PICKS UP @ 1530, CONFIRM W/ PICKUP DRIVER CORRECT LABELING.

- ABNER CALLS @ GATE, COMPLETED GROUTING, MUST AT GATE LET THEM THROUGH, WILL BE ONSITE @ 0700 TOMORROW (ABNER WILL NOT BE WITH SIMON, SOMEONE ELSE WILL — ~~LUIS~~ LUIS?

RETURN TO SWMU 59 TO CHECK GPS AND REMOVING SURFACE SOIL SAMPLES.

1625* DEPART NARR

- DAILY REPORT, MATRIX, SURFACE SOIL SAMP PLANNING @ GMDD.

Pickuppy to [illegible] 90E

SEPT. 14, 2012 (FRI)

0620 ONSITE PREP FOR SS SAMP @ SMWU 59. (ON-SITE @ OFFICE

0705 TALK W/ PETE / [illegible] OF TNG. - HE WILL CALL SCOTT RE: NECESSITY OF SURVEYING / MARKING ALL SURFACE DEBRIS. (SHORT SHOWER DURING DISCUSSION.)

0725 @ SWMU 59 PREP TO SAMPLE. ON-SITE - SIMON, LUIS

— 59SS19 (PID BKG 0.0) —

1.0 0-0.4 Brn topsoil, trace silt + gravel, + organic matter

0.4-1.0 Brown clay w/ little sand, stiff, dry.

59SS19 @0755

— 59SS17 (PID BKG 0.0) —

1.0 0-0.3 Brn topsoil w/ gravel + OM

0.3-1.0 Lt Brn clay w/ coarse sand, stiff, dry

59SS17 @0805

— 59SS20 (PID BKG 0.0) —

0.8 0-0.3 Brn topsoil w/ gravel + little sand

0.3-1.0 Brn coarse sand + gravel fill

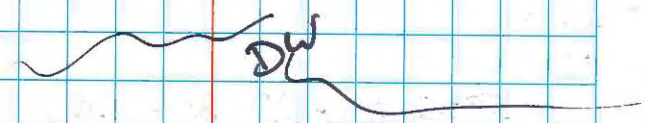
59SS20 @0825

— 59SS18 (PID BKG 0.0) —

1.0 0-0.4 Brown gravel + sand fill

0.4-1 Brown silty clay w/ sand + gravel throughout, stiff, dry

59SS18 @0835



0840 TNG DEPARTS - AFTER SUMMARY OF SURVEY TRIPS, AND DISCUSSION OF SURVEY (NOT NEEDED) - ALSO TALK W/ SCOTT M. RE: NO SURVEY OF 60/71, HE WILL CALL SURVEYOR

— 59SS14 (PID BKG 0.0) —

1.0 0-0.6 Poorly sorted sand + gravel mix w/ silt fines

0.6-1.0 Brn silty clay w/ sand + gravel. stiff, dry.

59-SS14 @ 0855

59-SS14D @0900

59SS14MS @0905

59-SS14MSD @ 0910

— 59SS15 (PID BKG 0.0) —
(*0-0.5 Concrete)

1.0 0-0.4 Brown topsoil w/ OM + gravel
0.4-1.0 Lt Brn silty clay w/ gravel

59SS15 @
0915

— 59SS16 (PID BKG 0.0) —

1.0 0-0.4 Brn topsoil w/ OM
0.4-1.0 Lt Brn, med soft silty clay

59SS16
@ 0920

— 59SS12 —

1.0 0-0.3 Brn topsoil w/ OM + gravel
0.3-1.0 Lt Brn med soft silty clay w/ sand + gravel

59SS12 @
1000

* Terminate PID field screening

— 59SS11 —

0.8 0-0.5 Brn clay, med stiff w/ OM + gravel
0.5-0.8 Concrete
0.8-1.0 Brn clay w/ trace silt.

59SS11 @
1015

— 59SS13 —

1.0 0-0.4 Brn silty clay w/ gravel fragments
0.4-1.0 Brn silty clay w/ sand + gravel, med stiff

59SS13 @
1025

— 59SS08 —

1.0 0-0.6 Brown silty clay w/ OM
0.6-1.0 Lt Brn clayey silt w/ sand + gravel

59SS08 @
1040

— 59SS10 —
(* 0-0.5 Concrete)

0.8 0-0.8 Concrete over sand + gravel Fill w/ trace silt
0.8-1.0 Lt Brown clayey silt

59SS10 @
1050

— 59SS06 —
(* 0-0.5 Concrete)

1.0 0-0.3 Sand + gravel fill
0.3-1.0 Lt Brn silty clay w/ gravel frags, med stiff, dry.

59SS06 @
1100

— 595505 —

1.0 0-0.4 (* 0-0.5 Concrete) Sand + gravel fill
0.4-1.0 silty clay w/ sand + gravel

595505 @
1110

1130 Head to office get saw spoons.
For SS samp @ inaccessible locations.
1220 Clear ill locations

— 595503 —

1.0 0-0.2 (* Concrete 0-0.5) Sand + gravel Fill
0.2-0.5 Lt brown clay w/ sand + OM
0.5-1 Red/Brown silty clay w/ sand
Soft, damp.

595503 @
1250

— 595502 —

0.9 0-0.2 Brn clay w/ gravel + OM.
0.2-1.0 Gravel + sand fill w/ trace silt, dry

595502
1305

— 595523 —

1.0 0-0.2 Brn clay w/ OM
0.2-1 Brn, stiff, silty clay w/ little coarse sand

595523 @ 1345

— 595524 —

1.0 0-0.3 Brn topsoil w/ OM + gravel
0.3-1.0 Lt Brn silty clay w/ sand + gravel

595524 @ 1400

— 595521 —

1.0 0-0.3 Brown topsoil w/ loose gravel + O.M.
0.3-1.0 Poorly sorted sand w/ gravel and trace silt

595521 @ 1410

595521 @ 1415

— 595522 —

0.9 0-0.3 Brn topsoil w/ OM + gravel
0.3-0.8 Brn clayey silt w/ gravel
0.8-1.0 Lt brn silty clay w/ gravel

595522 @ 1440

1445 Call Pedro Da Vila 787 273 6702 (o)
787 410 7443 (c)
Natividad will be onsite Monday
@ 0830 hrs
787 529 0659

— 59SS08 —

* Collected w/ SS spoon
0-0.4 Brn topsoil w/ OM
0.4-1.0 Fine sand + silt dry

59SS08 @ 1500

— 59SS07 —

* Collected w/ SS spoon
0-0.3 Brn topsoil w/ OM + shells
0.3-1.0 Lt Brn Fine sand + silt

59SS07 @ 1510

1515 Onsite Env. still onsite grouting boreholes

— 59SS04 —

* Collected w/ SS spoon
0-0.2 Topsoil w/ gravel frags + OM
0.2-1.0 Fine sand / silt w/ gravel throughout

59SS04 @ 1540

— 59SS01 —

* Collected w/ SS spoon
0-0.2 Topsoil w/ OM
0.2-1.0 Lt Brn fine sand + silt

59SS01 @ 1600

late entry On-Site Env. off site @ 1530

1605 COLLECT 59ER13 FROM NEW BAGGIE USED TO HOMOGENIZE METALS SAMPLES.

SEPT 15 2012 (SAT.) P. CLOUDY UP 80's

0630 ONSITE, PREP FOR SED SAMPLING @ SWMU 59 DITCH #1, ICE SURFACE SOIL SAMPLES.

0730 @ DITCH BEGIN RECON, 40' INTERVALS FROM POOL, DITCH BED HIGHLY / THICK VEGITATED (OBSERVED, CRAB HOLE, MOLUSKS THREE SMALL DRAINAGES ENTER DITCH FROM N (INCLUDING THE MAPPED FROM SWMU).

— PRIMARY N. DRAINAGE LOCATED ≈ 80' WEST OF SED SAMP 59SD12.

— LATE ENTRY: RETURN FROM RECON @ 0930. HEAD TO OFFICE, PREP, BACKPACK, HYDRATE,

1025 RETURN TO DITCH #1, HEAD TO DOWN STREAM MOST LOCATION 59SD12

1045 COLLECT 59SD12

~~1050~~

1055 COLLECT 59SD11

1100 " 59SD10 (UNDER WATER)

1110 " 59SD09

1115 " 59SD08

1125 COLLECT 59SD07

1130 " 59SD06

1135 " 59SD05

1140 " 59SD04 (+DUP & MS/MSD)

59SD04 IS 14' FROM 59 OUTFALL STAKE. 59SD05 IS 41' FROM 59SD04.

1155 COLLECT $\boxed{59ER14}$ FROM, NEW STAINLESS STEEL SPOON. (METALS ONLY)

— MANAGE SAMPLES, CLEAN, LABEL, ICE.

1310 HEAD TO SWMU 61 to LOCATE PASSIVE SOIL GAS LOCATIONS. (GPS, TAPE MEASURE, COMPASS.) — HAVING TROUBLES — GPS

RCL

Environmental Scientist – Jay Oliver (November 2012)

Sunny - partly cloudy mid 80's

Sumo 28/59 Sa - 10 Nov 2012

0715 on site @ Bldg 2339 - Begin setup for day.

0800 - DH run out to check SB06 at Sumo 28 - will prep for sampling at 59 & do some general organization of room since we'll probably ship out some of the equipment.

0930 - No observable recharge in SB06 - no sample to be collected - heading up to make out to Sumo 59.

0950 - on site @ 59 - preparing for entry

1010 - at location at 59SS26 -

0-.2 dark brown silty/sandy top soil/roots

.2-1' - angular gravel in brown silty sand matrix

59SS26 taken @ 1015 for Zinc, Copper, lead

59SS26D / 59SS26MS/MSD @ 1015

1030 - 59SS25

0-.2 dark brown sandy top soil/roots

.2-1 - angular gravel in brown silty sand matrix

59SS25 taken @ 1030 for Zinc

1040 - 59SS27

0-.2 dark brown sandy top soil/roots

.2-.6 brown silty sand w/ some gravel

.6-1 light brown silty sand with gravel

59SS27 taken @ 1040 for Pb, Zn

Partly cloudy mid 80's

Sumo 28 Sa - 10 Nov 2012

1050 - 59SS28

0-.2 - dark brown sandy top soil/roots

.2-1 brown silty sand w/ some gravel & scattered cobbles, some shelly fragments

59SS28 taken @ 1050 for Zn, Pb

1100 - 59SS29

0-.2 dark brown silty top soil -

.2-1 - dark brown clayey silt w/ some sand & gravel - moist

59SS29 taken @ 1100 for Pb

1110 - 59SS30

0-.2' dark brown silty top soil

.2- dark brown-black clayey silt with some sand and gravel - moist

59SS30 taken @ 1110 for Pb

1125 - 59SS31 -

- location moved ~15' to east - proposed location on map on concrete pad in back

0-.2 - brown sandy top soil some silt

.2-1 brown silty sand w/ some clay - abundant small angular gravel - dry

59SS31 taken @ 1125 for Zn

1135 59SS32

0-.2 - dark brown silty top soil/roots

.2-1 brown gravelly sand w/ some silt - gravel small angular

59SS32 taken @ 1135 for Zn

Partly cloudy mid 80s

Summ 56/70 Sa - 10 - Nov 2012

1145 - 59SS33

- moved location slightly to west - proposed location location in gravel pile - off of Diel Island

0-.2' - dark brown sandy top soil.

.2-1 brown med-fine sand with some silt, shelly material / fragments -

59SS33 taken @ 1145 for Zn

1155 - 58SS34

0-.2' dark brown silty sand top soil / roots

.2-1 brown med-fine sand w/ some silt, abundant shelly material & fragments, some gravel - sparse cobble -

59SS34 taken @ 1155 for Zn

1215 - take ER for 59

59ER15 taken @ 1215 for Cu, Pb, Zn on Stainless Steel Spoon using lab grade DI water

Field Blank - 59FB05 taken @ 1220 for Cu, Pb, Zn using lab grade DI

1230 - depart Summ 59 - will go to 70 to pick up synoptic set of gw readings -

1300 - on site @ 70 to take synoptic set of water levels - refer to DH logbook for water levels

Partly cloudy mid 80s

Summ 56/61 Sa 10 - Nov 2012

1400 - Completed synoptic water levels for Summ 70 -

1410 - Return to 2339 - will load up for IDW sampling for 28 - 8 inventory drums

1425 - load up for IDW sample depart 2339

1450 - Collected one IDW soil sample - composite of four drums - soil cuttings - no liquid IDW drums, but soil in 1 drum very wet - decon fluids may have been mixed into solid drum - Collect sample

28IDW01 @ 1450 for - App IX metals, PCBs, TCLP metal, / volatiles & RCI

1510 - Dropped off samples in room - will check out some of the 61 Bldgs locations

1540 - on location at FwBlk - SW02 - location dry - no water in ditch or channels under grasses further out -

1600 - at FwBlk - SW02 - location dry - no water found in surrounding area - refer to DH logbook for photos

1635 - back at vehicle - packing out

1645 - run back to 2339 -

1700 - on site at airfields background location - stopped at GS to drop off some trash

DAILY METER CALIBRATION RECORDS

DAILY METER CALIBRATION RECORD

Date: 5-21-10 Time: 0720

Model: YSI 556 MPS	Model: RAE 2000
Serial #: 04F11468 AE	Serial #:

		Initial	Adjusted
pH (Std. Units)			
Buffer:	4	3.98	4.00
Buffer:	7	7.11	7.00
Buffer:	10	9.60	10.00
ORP (mV's)			
Std.:	237.5	243.1	237.5
Sp.Cond. (mS/cm)			
Std.:	1.409	1.360	1.409
D.O. (mg/l)			
Baro. Pressure (mm/Hg):	762.4	8.43	8.26
Temp. (Celsius)		23.68	N/A

	Initial	Adjusted
Isobutylene (100ppm)		

Model:
Serial #:

		Initial	Adjusted
Turbidity (NTU's)			
Std.:	10		

DAILY METER CALIBRATION RECORD

Model: YSI 556 MPS
Serial #:

Date: 5-22-10
Time: 0705

		Initial	Adjusted
pH (Std. Units)			
Buffer:	4	4.04	4.00
Buffer:	7	7.15	7.00
Buffer:	10	9.86	9.98
ORP (mV's)			
Std.:	237.5	236.9	237.0
Sp.Cond. (mS/cm)			
Std.:	1.409	1.399	1.409
D.O. (mg/l)			
Baro. Pressure (mm/Hg):	760.0	8.15	8.40
Temp. (Celsius)		24.81	N/A

Model: RAE 2000
Serial #:

Date:
Time:

	Initial	Adjusted
Isobutylene (100ppm)		

Model: Lamotte 2020
Serial #:

(Pre-Sampling Calibration) -Sampling Calibration)
Date:
Time:

		Initial	Adjusted
Turbidity (NTU's)			
Std.:	10		

DAILY METER CALIBRATION RECORD

Date: 5-23-10 Time: 0710

Model: YSI 556 MPS
Serial #: 04F11468

Model: RAE 2000
Serial #:

		Initial	Adjusted
pH (Std. Units)			
Buffer:	4	4.01	4.00
Buffer:	7	7.08	7.00
Buffer:	10	9.72	10.00
ORP (mV's)			
Std.:	237.5	236.0	237.0
Sp.Cond. (mS/cm)			
Std.:	1.409	1.368	1.409
D.O. (mg/l)			
Baro. Pressure (mm/Hg):	761.8	8.41	8.39
Temp. (Celsius)		23.75	N/A

	Initial	Adjusted
Isobutylene (100ppm)		

Model:
Serial #:

		Initial	Adjusted
Turbidity (NTU's)			
Std.:	10		

SOIL BORING AND MONITORING WELL LOGS

Baker

Michael Baker Jr., Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	Naval Activity Puerto Rico SWMU 59		
PROJ. NO.:	119197, 7.2	BORING NO.:	59SB01
COORDINATES:	EAST: 781435.468	NORTH:	147772.057
ELEVATION:	SURFACE: 111.8	TOP OF PVC CASING:	115.16

Rig:	Geoprobe 6610DT				Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
	MC Sampler	Casing	Augers	Core Barrel				
Size (ID)	1-5/8"	--	3 1/4"	--	4/19/2010	0.0 - 15.0	Overcast/few spinkles,	
Length	5'	--	5'	--			mid+ 80s	
Type	Acetate	--	HSA	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: PID background (BKG) - 0.0.

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Schedule 40 PVC Riser	2"	~+2.5	5.0
Schedule 40 PVC Screen	2"	5.0	15.0

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Well Installation Detail	Elevation (Ft. Datum)
1, 2, 3, 4, 5 (5.0)	D-1	5.0 100%		59SB01-00 +duplicate 59SB01-01	BKG	CLAY to Fine Sand, trace med sand; gray, orange brown; damp; slight plasticity; med stiff to stiff (fill) (0.3) CLAY' trace silt; yellow tan, orange with black and white mottling; damp; high to very high plasticity, soft (weathered bedrock)	cemente grout to surface; Bentonite 1.5 to 3.5'; 2" PVC Riser	111.5
6, 7, 8, 9, 10 (10.0)	D-2	5.0 100%		59SB01-03	BKG	similar to above with increase in grain size and more rust color (7.0) CLAY, some silt; black and white mottling; damp; low plasticity; med stiff; 0.1' zones of less weathering - med sand sized rock pieces	Sand 3.5 to 15'; 2" PVC Screen 5 to 15'	104.8

See next page

DRILLING CO.:	GeoEnviroTech, Inc.	BAKER REP.:	Robert Roselius
DRILLER:	William Rodrigez	BORING NO.:	59SB01

Baker

Michael Baker Jr., Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

PROJ. NO.: 119197, 7.2 BORING NO.: 59SB01

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. Datum)
11						CLAY, little silt; light gray, white and orange with black mottling; damp; slight plasticity; med stiff	Sand 3.5 to 15'	
12	D-3	4.4 88%			BKG	12.5		99.3
13						similar to above but less weathered; damp to moist; med sand sized pieces to slight plasticity; med stiff	2" PVC Screen 5 to 15'	
14								
15	15.0							96.8
16						End of Boring at 15.0'		
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB01 SHEET 2 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	Naval Activity Puerto Rico SWMU 59		
PROJ. NO.:	119197, 7.2	BORING NO.:	59SB02
COORDINATES:	EAST: 781526.040	NORTH:	147882.566
ELEVATION:	SURFACE: 113.6	TOP OF PVC CASING:	116.75

Rig:	Geoprobe 6610DT				Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
	MC Sampler	Casing	Augers	Core Barrel				
Size (ID)	1-5/8"	--	3 1/4"	--	4/20/2010	0.0 - 16.0	Sunny, mid+ 80s	
Length	5'	--	5'	--				
Type	Acetate	--	HSA	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: PID background (BKG) - 0.0.

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Schedule 40 PVC Riser	2"	~+2.5	6.0
Schedule 40 PVC Screen	2"	6.0	16.0

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description		Well Installation Detail	Elevation (Ft. Datum)
1		D-1	4.9 98%		59SB02-00 +MS/MSD	BKG	CLAY to GRAVEL; gray, brown; damp; non plastic; loose (fill)	0.8	cemente grout to surface	112.8
2					59SB02-01 +Duplicate +MS/MSD		CLAY, some silt; light gray, orange, maroon with black mottling; damp; slight plasticity; stiff	2.6	Bentonite 2 to 4'	111.0
3							CLAY, little silt; light gray, maroon, rust with black motting; damp; med plasticity; stiff			
4									2" PVC Riser	
5	5.0									
6		D-2	4.9 98%		59SB02-04	BKG		6.0	Sand 4 to 16'	107.6
7							CLAY, little silt; tan, gray, white, orange; damp; slight to med plasticity; stiff	7.0		106.6
8										
9									2" PVC Screen 6 to 16'	
10	10.0									

see next page

DRILLING CO.:	GeoEnviroTech, Inc.	BAKER REP.:	Robert Roselius
DRILLER:	William Rodrigez	BORING NO.:	59SB02

Baker

Michael Baker Jr., Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

PROJ. NO.: 119197, 7.2 BORING NO.: 59SB02

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. Datum)
11							similar to above but less weathered; coarser - some fine grained sand size pieses; moist; med plasticity, soft	Sand 4 to 16'	
12		D-3	4.7 94%			BKG			
13									
14								2" PVC Screen 6 to 16'	
15	15.0								
		D-4	1.0 100%			BKG			
16	16.0						16.0		97.6
							End of Boring at 16.0'		
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB02 SHEET 2 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	Naval Activity Puerto Rico SWMU 59		
PROJ. NO.:	119197, 7.2	BORING NO.:	59SB03
COORDINATES:	EAST: 781789.861	NORTH:	147860.116
ELEVATION:	SURFACE: 118.4	TOP OF PVC CASING:	121.05

Rig:	Geoprobe 6610DT				Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
	MC Sampler	Casing	Augers	Core Barrel				
Size (ID)	1-5/8"	--	3 1/4"	--	4/19/2010	0.0 - 18.0	Sunny, mid+ 80s	
Length	5'	--	5'	--				
Type	Acetate	--	HSA	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: PID background (BKG) - 0.0.

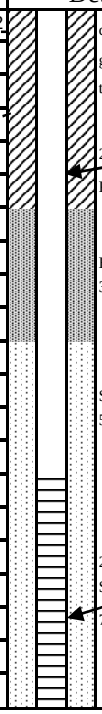
SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Schedule 40 PVC Riser	2"	~+2.5	7.0
Schedule 40 PVC Screen	2"	7.0	17.0

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Well Installation Detail	Elevation (Ft. Datum)
1, 2, 3, 4, 5 (5.0)	D-1	4.8 96%		59SB03-00, 59SB03-01	BKG	GRAVEL 0.2; CLAY to FINE SAND, some med sand; dry to damp; non plastic; loose (fill) 1.7; SILT and FINE SAND, some clay; tan, light gray, little orange with white and trace black mottling; damp; non plastic; loose (weathered bedrock)	cemente grout to surface; 2" PVC Riser; Bentonite 3 to 5'	118.2; 116.7
6, 7, 8, 9, 10 (10.0)	D-2	4.9 98%		59SB03-04	BKG		Sand 5 to 17'; 2" PVC Screen 7 to 17'	



DRILLING CO.:	GeoEnviroTech, Inc.	BAKER REP.:	Robert Roselius
DRILLER:	William Rodrigez	BORING NO.:	59SB03 SHEET 1 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

PROJ. NO.: 119197, 7.2 BORING NO.: 59SB03

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description		Well Installation Detail	Elevation (Ft. Datum)
11							Continued from Sheet 1		Sand 5 to 17'	
12		D-3	4.4 88%			BKG		12.5		105.9
13							Gravel sized bedrock; gray, tan, white, black; non platic; hard; SILT lense 12.9 to 13.2;orange; non plastic; loose	13.5	2" PVC Screen 7 to 17'	104.9
14										
15	15.0						SILT , some clay, little fine sand; tan, gray; damp to moist; non plastic; dense	15.0		103.4
16		D-4	2.7 90%			BKG	similar to above with a couple 0.1' veins of hard bedrock, moist			
17								17.0		101.4
18	18.0						wet/saturated 17.7 to 18.0		soil	100.4
19							End of Boring at 18.0'			
20										
21										
22										
23										
24										
25										
26										
27										
28										
29										
30										

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB03 SHEET 2 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	Naval Activity Puerto Rico SWMU 59		
PROJ. NO.:	119197, 7.2	BORING NO.:	59SB04
COORDINATES:	EAST: 781931.741	NORTH:	147904.380
ELEVATION:	SURFACE: 118.8	TOP OF PVC CASING:	121.68

Rig:	Geoprobe 6610DT				Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
	MC Sampler	Casing	Augers	Core Barrel				
Size (ID)	1-5/8"	--	3 1/4"	--	4/22/2010	0.0 - 22.0	Sunny, mid+ 80s	
Length	5'	--	5'	--				
Type	Acetate	--	HSA	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: PID background (BKG) - 0.0.

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Schedule 40 PVC Riser	2"	~+2.5	12.0
Schedule 40 PVC Screen	2"	12.0	22.0

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Well Installation Detail	Elevation (Ft. Datum)
1				59SB04-00		TOPSOIL (organics) 0.2	cemente grout to surface	118.6
2				59SB04-01		CLAY to COARSE GRAVEL; orange, brown, gray; damp; non to slight plasticity; loose to soft (fill) 1.6		117.2
3		D-1	4.8 96%		BKG	CLAY, some silt, trace fine sand; orange, brown, trace black and ivory mottling;damp; slight plasticity, soft 2.0	2" PVC Riser	116.8
4								
5	5.0					SILT, some clay and fine sand; tan, yellow (salt and pepper); damp; non plastic; loose		
6								
7		D-2	4.2 84%		BKG			
8								
9						similar to above but med dense to dense at 8.5'	Bentonite 8 to 10'	
10	10.0			59SB04-05			Sand 10 to 22'	

DRILLING CO.:	GeoEnviroTech, Inc.	BAKER REP.:	Robert Roselius
DRILLER:	William Rodrigez	BORING NO.:	59SB04 SHEET 1 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

PROJ. NO.: 119197, 7.2 BORING NO.: 59SB04

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. Datum)
11						Continued from Sheet 1		
12							Sand 10 to 22'	
13		D-3	4.6 92%			BKG		
14							2" PVC Screen 12 to 22'	
15	15.0							
16								
17		D-4	4.0 100%			BKG		
18								
19	19.0					similar to above but moist DPT sampler refusal at 19.0" attempt to auger to 22.0'		
20								
21		N-A				BKG		
22	22.0							96.8
23						End of Boring at 22.0'		
24								
25								
26								
27								
28								
29								
30								

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB04 SHEET 2 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	Naval Activity Puerto Rico SWMU 59		
PROJ. NO.:	119197, 7.2	BORING NO.:	59SB05
COORDINATES:	EAST: 781690.111	NORTH:	147954.247
ELEVATION:	SURFACE: 117.1	TOP OF PVC CASING:	116.76

Rig: Geoprobe 6610DT								
	MC Sampler	**Casing**	**Augers**	**Core Barrel**	**Date**	**Progress (Ft.)**	**Weather**	**Depth to Water (Ft.)**
Size (ID)	1-5/8"	--	3 1/4"	--	4/20/2010	0.0 - 22.0	Sunny, mid+ 80s	
Length	5'	--	5'	--				
Type	Acetate	--	HSA	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: PID background (BKG) - 0.0.

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Schedule 40 PVC Riser	2"	~+2.5	12.0
Schedule 40 PVC Screen	2"	12.0	22.0

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Well Installation Detail	Elevation (Ft. Datum)
	N-A					Asphalt 0.5	cemente grout to surface	116.6
1, 2, 3, 4, 5 (5.0)	D-1	2.4 53%		59SB05-01	BKG	CLAY to COARSE SAND, some gravel; gray to brown; dry; non plastic; loose (fill) 5.0	2" PVC Riser	112.1
6, 7, 8, 9, 10 (10.0)	D-2	4.6 92%		59SB05-05	BKG	CLAY, some silt; tan, olive, brown, black; damp; slight plasticity; stiff	Bentonite 8 to 10'; Sand 10 to 22'	

DRILLING CO.:	GeoEnviroTech, Inc.	BAKER REP.:	Robert Roselius
DRILLER:	William Rodrigez	BORING NO.:	59SB05 SHEET 1 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

PROJ. NO.: 119197, 7.2 BORING NO.: 59SB05

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. Datum)
11						Continued from Sheet 1		
12	D-3	3.9 78%			BKG	12.5	Sand 10 to 22'	104.6
13						similar to above but primarily ivory with little orange, olive and trace black; damp to moist; 0.1' gray, hard bedrock vein at 14.0'	2" PVC Screen 12 to 22'	
14								
15	15.0							
16						similar to above but less ivory and moist		
17	D-4	4.1 103%			BKG			
18								
19								
20	20.0							
21								
22	D-5	3.6 90%			BKG	22.0		95.1
23							soil	
24	24.0					refusal at 24.0'; terminate boring		93.1
25						End of Boring at 24.0'		
26								
27								
28								
29								
30								

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB05 SHEET 2 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	Naval Activity Puerto Rico SWMU 59		
PROJ. NO.:	119197, 7.2	BORING NO.:	59SB06
COORDINATES:	EAST: 781443.299	NORTH:	147944.418
ELEVATION:	SURFACE: 111.1	TOP OF PVC CASING:	114.14

Rig:	Geoprobe 6610DT				Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
	MC Sampler	Casing	Augers	Core Barrel				
Size (ID)	1-5/8"	--	3 1/4"	--	4/20/2010	0.0 - 15.0	Sunny, mid+ 80s	
Length	5'	--	5'	--				
Type	Acetate	--	HSA	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: PID background (BKG) - 0.0.

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Schedule 40 PVC Riser	2"	~+2.5	5.0
Schedule 40 PVC Screen	2"	5.0	15.0

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Well Installation Detail	Elevation (Ft. Datum)
				59SB06-00		TOPSOIL (organics) 0.2	cemente grout to surface	110.9
1						CLAY to COARSE SAND; 0.6 brown and light gray; dry to		110.5
2				59SB06-01		damp; non plastic; loose (fill)		
		D-1	3.9 78%		BKG	CLAY , some silt; brown, orange	Bentonite 1.5 to 3.5'	
3						with little black and tan mottling;		
						damp; slight plasticity; stiff		
4						color grades to dark brown with	2" PVC Riser	
						black and tan mottling		
5	5.0					5.0		106.1
6				59SB06-03		CLAY , some silt; light gray, maroon; damp; med plasticity; stiff (5.0 - 7.5'), soft (7.5 - 9.5')	Sand 3.5 to 15'	
7								
		D-2	4.6 92%		BKG			
8								
9							2" PVC Screen 5 to 15'	
						9.5		101.6
10	10.0					similar to above with gray, orange clay matrix with black mottling and		

DRILLING CO.:	GeoEnviroTech, Inc.	BAKER REP.:	Robert Roselius
DRILLER:	William Rodrigez	BORING NO.:	59SB06 SHEET 1 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

PROJ. NO.: 119197, 7.2 BORING NO.: 59SB06

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. Datum)
11						coarse sand size grains; damp; non plastic; stiff	Sand 3.5 to 15'	
12		D-3	4.6 92%			BKG		
13								
14						CLAY; olive, tan, orange, gray; damp to moist; highly plastic; med stiff to stiff 14.8	2" PVC Screen 5 to 15'	96.3
15	15.0							96.1
						End of Boring at 15.0'		
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB06 SHEET 2 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	Naval Activity Puerto Rico SWMU 59		
PROJ. NO.:	119197, 7.2	BORING NO.:	59SB07
COORDINATES:	EAST: 781520.354	NORTH:	148194.052
ELEVATION:	SURFACE: 116.8	TOP OF PVC CASING:	119.82

Rig:	Geoprobe 6610DT				Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
	MC Sampler	Casing	Augers	Core Barrel				
Size (ID)	1-5/8"	--	3 1/4"	--	4/21/2010	0.0 - 19.0	Sunny, mid+ 80s	
Length	5'	--	5'	--				
Type	Acetate	--	HSA	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: PID background (BKG) - 0.0.

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Schedule 40 PVC Riser	2"	~+2.5	8.0
Schedule 40 PVC Screen	2"	8.0	18.0

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Well Installation Detail	Elevation (Ft. Datum)
				59SB07-00		TOPSOIL (organics) 0.2	cemente grout to surface	116.6
1						CLAY to GRAVEL; gray, brown; dry; non plastic; loose (fill) 1.4		115.4
2				59SB07-01 +Duplicate		SILT and CLAY,some fine sand,		
3		D-1	4.9 98%		BKG	couple fine gravel; orange, brown, gray; damp; slight plasticity; soft (fill)	2" PVC Riser	
4								
5	5.0					4.8	Bentonite 4 to 6'	112.0
6						CLAY, little silt; olive, brown with trace black mottling; damp; med plasticity; med stiff	Sand 6 to 18'	
7								
8		D-2	4.4 88%		BKG	8.0		108.8
9						similar to above but less weathered; coarser - fine to coarse sand, some clay; olive; damp; slight to non	2" PVC Screen 8 to 18'	
10	10.0			59SB07-05		plastic; soft to loose 10.0		106.8
						see next page		

DRILLING CO.:	GeoEnviroTech, Inc.	BAKER REP.:	Robert Roselius
DRILLER:	William Rodrigez	BORING NO.:	59SB07 SHEET 1 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

PROJ. NO.: 119197, 7.2 BORING NO.: 59SB07

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. Datum)
11						similar to 4.8 to 8.0 zone but moist; slight plasticity; soft	Sand 6 to 18'	
12		D-3	4.5 90%		BKG			
13						13.4	2" PVC Screen 8 to 18'	103.4
14						similar to above but orange, brown and soft		
15	15.0					soft, ivory vein at 14.5' 15.0		101.8
16						similar to above; SILT and CLAY; orange, brown with ivory; moist; non to slight plasticity; stiff		
17		D-4	3.8 95%		BKG	very stiff at 17.5'		
18						18.0		98.8
19	19.0					4' run - over packed DPT liner	soil	97.8
20						End of Boring at 19.0'		
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB07 SHEET 2 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	Naval Activity Puerto Rico SWMU 59		
PROJ. NO.:	119197, 7.2	BORING NO.:	59SB08
COORDINATES:	EAST: 781823.512	NORTH:	148214.881
ELEVATION:	SURFACE: 117.9	TOP OF PVC CASING:	121.17

Rig:	Geoprobe 6610DT				Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
	MC Sampler	Casing	Augers	Core Barrel				
Size (ID)	1-5/8"	--	3 1/4"	--	4/21/2010	0.0 - 22.0	Sunny, mid+ 80s	
Length	5'	--	5'	--				
Type	Acetate	--	HSA	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: PID background (BKG) - 0.0.

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Schedule 40 PVC Riser	2"	~+2.5	12.0
Schedule 40 PVC Screen	2"	12.0	22.0

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Well Installation Detail	Elevation (Ft. Datum)
				59SB08-00		TOPSOIL (organics) 0.3	cemente grout to surface	117.6
1						GRAVEL 0.6		117.3
						SILT and CLAY (fill) 1.0		116.9
2				59SB08-01		CLAY, some silt; tan, yellow, orang		
	D-1	5.0 100%			BKG	with some black and ivory mottling;	2" PVC Riser	
3						dry to damp; slight plasticity; soft		
4								
5	5.0							
6						similar to above but damp; non to slight plasticity; med dense to soft		
7								
	D-2	4.8 96%			BKG			
8								
9							Bentonite 8 to 10'	
10	10.0			59SB08-05			Sand 10 to 22'	

DRILLING CO.:	GeoEnviroTech, Inc.	BAKER REP.:	Robert Roselius
DRILLER:	William Rodrigez	BORING NO.:	59SB08 SHEET 1 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

PROJ. NO.: 119197, 7.2 BORING NO.: 59SB08

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. Datum)
11							Continued from Sheet 1		
12		D-3	4.5 90%			BKG		Sand 10 to 22'	
13									
14								2" PVC Screen 12 to 22'	
15	15.0								
16							similar to above but damp to moist		
17		D-4	4.0 80%			BKG			
18									
19							18.5 MED SAND and SILT with quartz; coarse sand to fine gravel sized		99.4
20	20.0						between 19.6 and 19.9'; tan, white;		
21	21.0	D-4	1.0 100%			BKG	saturated; non plastic; loose DPT sampler refusal at 21'		
22	22.0	N-A					attempt to auger to 23 '; refusal at 22'		95.9
23							End of Boring at 22.0'		
24									
25									
26									
27									
28									
29									
30									

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB08 SHEET 2 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	Naval Activity Puerto Rico SWMU 59		
PROJ. NO.:	119197, 7.2	BORING NO.:	59SB09
COORDINATES:	EAST: 782032.685	NORTH:	148178.66
ELEVATION:	SURFACE: 118.7	TOP OF PVC CASING:	121.50

Rig:	Geoprobe 6610DT				Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
	MC Sampler	Casing	Augers	Core Barrel				
Size (ID)	1-5/8"	--	3 1/4"	--	4/22/2010	0.0 - 22.0	Sunny, mid+ 80s	
Length	5'	--	5'	--				
Type	Acetate	--	HSA	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: PID background (BKG) - 0.0.

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Schedule 40 PVC Riser	2"	~+2.5	12.0
Schedule 40 PVC Screen	2"	12.0	22.0

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Well Installation Detail	Elevation (Ft. Datum)
				59SB09-00		TOPSOIL (organics) 0.2	cemente grout to surface	118.5
1						CLAY to COARSE SAND; orange, brown; dry; non plastic; loose (fill)		
2				59SB09-01		2.3		116.4
3	D-1	4.6 92%			BKG	coarse sand to gravel; gray; dry; non plastic; loose (fill) 2.6	2" PVC Riser	116.1
4						CLAY to COARSE SAND, mostly silt and fine sand, little gravel; orange brown, gray; dry; non plastic; loose to med dense (fill)		
5	5.0							
6						no recovery 5.0 to 10.0' - liner stuck in sampler		
7								
8	D-2	0.0 0%						
9							Bentonite 8 to 10'	
10	10.0			59SB09-05		10.0	Sand 10 to 22'	108.7
						see next page		

DRILLING CO.:	GeoEnviroTech, Inc.	BAKER REP.:	Robert Roselius
DRILLER:	William Rodrigez	BORING NO.:	59SB09 SHEET 1 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

PROJ. NO.: 119197, 7.2 BORING NO.: 59SB09

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. Datum)
11, 12, 13, 14, 15	D-3	4.3 86%			BKG	SILT and FINE SAND' some clay (bedrock); gray, olive, orange, brown; dry to damp; non plastic; loose to med dense 12.8 BEDROCK; gray; hard 13.2 similar to above 12.8'	Sand 10 to 22' 2" PVC Screen 12 to 22'	105.9 105.5
15.0						terminate DPT soil sample at 15.0' due to hard bedrock and retrieving sampler; attempt to auger to 22.0'		
16, 17, 18, 19, 20, 21, 22	N-A					tough drilling; rig overheats at 18.0' tough/slow augering to depth		96.7
22.0						End of Boring at 22.0'		
23, 24, 25, 26, 27, 28, 29, 30								

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB09 SHEET 2 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	Naval Activity Puerto Rico SWMU 59		
PROJ. NO.:	119197, 7.2	BORING NO.:	59SB10
COORDINATES:	EAST: 781987.523	NORTH:	148001.914
ELEVATION:	SURFACE: 118.5	TOP OF PVC CASING:	118.04

Rig:	Geoprobe 6610DT				Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
	MC Sampler	Casing	Augers	Core Barrel				
Size (ID)	1-5/8"	--	3 1/4"	--	4/21/2010	0.0 - 24.5	Sunny, mid+ 80s	
Length	5'	--	5'	--				
Type	Acetate	--	HSA	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: PID background (BKG) - 0.0. Build well on 4/22/10.

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Schedule 40 PVC Riser	2"	~+2.5	13.0
Schedule 40 PVC Screen	2"	13.0	23.0

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Well Installation Detail	Elevation (Ft. Datum)
						CONCRETE 0.5	cement grout to surface	118.0
1, 2, 3, 4, 5 (5.0)	D-1	4.5 100%		59SB10-01	BKG	CLAY and SILT, little fine sand; tan, yellow, orange with black and ivory mottling, dry to damp; slight plasticity; soft	2" PVC Riser	
6, 7, 8, 9, 10 (10.0)	D-2	4.3 86%		59SB10-05		similar to above with some rust mottling	Bentonite 9 to 11'	

DRILLING CO.:	GeoEnviroTech, Inc.	BAKER REP.:	Robert Roselius
DRILLER:	William Rodrigez	BORING NO.:	59SB10 SHEET 1 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

PROJ. NO.: 119197, 7.2 BORING NO.: 59SB10

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. Datum)
11						Continued from Sheet 1	Sand 11 to 23'	
12								
13		D-3	4.3 86%			BKG		
14							2" PVC Screen 13 to 23'	
15	15.0							
16								
17						moist at 17.0'		
18		D-4	4.1 82%			BKG stiff at 17.5'		
19								
20								
21								
22		D-5	3.0 66%			BKG		
23						23.0		95.5
24							soil	
	24.5					DPT sampler refusal at 24.5'		94.0
25						End of Boring at 24.5'		
26								
27								
28								
29								
30								

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB10 SHEET 2 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

PROJ. NO.: 119197, 7.2 BORING NO.: 59SB11

COORDINATES: EAST: 781405.909 NORTH: 147871.143

ELEVATION: SURFACE: 109.8

Rig:	Geoprobe Track Rig 6610 DT				Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
	Macro Sampler	Casing	Augers	Core Barrel				
Size (ID)	1-5/8"	--	--	--	5/19/2010	0.0 - 12.0	sunny, mid+ 80s	
Length	5'	--	--	--				
Type	Acetate	--	--	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: PID background (BKG) is 0.0.

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
BKG/PS = Background/Point Source
ppm = parts per million

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. Datum)
				59SB11-00		Topsoil 0.3	109.5
1				+ duplicate		GRAVEL; gray; dry; non plastic; loose (fill) 0.8	109.0
2				59SB11-01		CLAY to COARSE SAND' couple gravel; brown, orange, gray; damp; non to slight plasticity; loose to	
		D-1	4.5	+ duplicate	BKG	med stiff (fill)	
3			90%	+MS/MSD			
4				59SB11-02		CLAY, little silt; orange, gray with rust and black	
						4.5	105.3
5	5.0					GRAVEL (fill - pieces of bedrock cobbles?) 5.0	104.8
6						CLAY, little silt; maroon and gray (varigated); damp to moist; high plasticity; med stiff	
7							
		D-2	4.8		BKG		
8			96%				
9							
10	10.0						

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB11 SHEET 1 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

SO NO.: 119197, 7.2 BORING NO.: 59SB11

SAMPLE TYPE	DEFINITIONS
S = Split Spoon A = Auger	SPT = Standard Penetration Test (ASTM D1586)
T = Shelby Tube W = Wash	PID = Photo Ionization Detector Measurement
R = Air Rotary C = Core	MSL = Mean Sea Level
D = Denison P = Piston N = No Sample	ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. Datum)
11		D-3	2.0 100%			BKG	Similar to above, grades to gray and olive at 11.0'	
12	12.0							97.8
							End of Boring at 12.0'	
13								
14								
15								
16								
17								
18								
19								
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DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB11 SHEET 2 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

PROJ. NO.: 119197, 7.2 BORING NO.: 59SB12

COORDINATES: EAST: 781483.551 NORTH: 147882.386

ELEVATION: SURFACE: 113.2

Rig:	Geoprobe Track Rig 6610 DT				Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
	Macro Sampler	Casing	Augers	Core Barrel				
Size (ID)	1-5/8"	--	--	--	5/18/2010	0.0 - 12.0	sunny, mid+ 80s	
Length	5'	--	--	--				
Type	Acetate	--	--	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: PID background (BKG) is 0.0.

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
BKG/PS = Background/Point Source
ppm = parts per million

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. Datum)
				59SB12-00		asphalt 0.3	112.9
1						CLAY to GRAVEL, roots; brown, orange, gray; damp; non plastic; loose (fill)	
2				59SB12-01			
3	D-1	4.1 82%			BKG		
4						4.0	109.2
5	5.0					CLAY, little silt; maroon, light gray with black mottling; damp; high plasticity; very stiff to hard (saprolite)	
6						Similar to above but maroon and light gray with trace white mottling; very stiff	
7							
8	D-2	4.3 86%			BKG		
9						Color grades to lighter - yellow, orange, and gray around 8.0'	
10	10.0			59SB12-05			

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB12 SHEET 1 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

SO NO.: 119197, 7.2 BORING NO.: 59SB12

SAMPLE TYPE	DEFINITIONS
S = Split Spoon A = Auger	SPT = Standard Penetration Test (ASTM D1586)
T = Shelby Tube W = Wash	PID = Photo Ionization Detector Measurement
R = Air Rotary C = Core	MSL = Mean Sea Level
D = Denison P = Piston N = No Sample	ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. Datum)
11		D-3	2.0 100%			BKG	Similar to above but yellow, orange, tan, light gray, little olive; moist; highly plastic; soft	
12	12.0							101.2
							End of Boring at 12.0'	
13								
14								
15								
16								
17								
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19								
20								
21								
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28								
29								
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DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB12 SHEET 2 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

PROJ. NO.: 119197, 7.2 BORING NO.: 59SB13

COORDINATES: EAST: 781590.415 NORTH: 147854.487

ELEVATION: SURFACE: 114.9

Rig:	Geoprobe Track Rig 6610 DT				Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
	Macro Sampler	Casing	Augers	Core Barrel				
Size (ID)	1-5/8"	--	--	--	5/18/2010	0.0 - 12.0	sunny, mid+ 80s	
Length	5'	--	--	--				
Type	Acetate	--	--	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: PID background (BKG) is 0.0.

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
BKG/PS = Background/Point Source
ppm = parts per million

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description		Elevation (Ft. Datum)
					59SB13-00		Topsoil	0.2	114.7
1					+MS/MSD		CLAY to COARSE GRAVEL; brown & gray; damp; non plastic; loose (fill)	0.9	114.0
2					59SB13-01		CLAY, some silt and fine sand; orange brown with little olive; damp; slight plasticity; med stiff		
		D-1	5.0		+ duplicate	BKG			
3			100%		+MS/MSD				
4									
5	5.0								
6									
7									
		D-2	3.9			BKG		7.4	107.5
8			78%				CLAY and SILT; brown, rust, tan with little white mottling; damp; slight plasticity, med stiff; quartz vein around 9.5' (weathered bedrock/saprolite)		
9									
10	10.0				59SB13-05				

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB13 SHEET 1 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

SO NO.: 119197, 7.2 BORING NO.: 59SB13

SAMPLE TYPE	DEFINITIONS
S = Split Spoon A = Auger	SPT = Standard Penetration Test (ASTM D1586)
T = Shelby Tube W = Wash	PID = Photo Ionization Detector Measurement
R = Air Rotary C = Core	MSL = Mean Sea Level
D = Denison P = Piston N = No Sample	ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. Datum)
11		D-3	2.0 100%			BKG	Similar to above; CLAY, some fine to med sand; orange gray with black and white specs, moist, slight plsticity; moist	
12	12.0							102.9
							End of Boring at 12.0'	
13								
14								
15								
16								
17								
18								
19								
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21								
22								
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29								
30								

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB13 SHEET 2 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

PROJ. NO.: 119197, 7.2 BORING NO.: 59SB14

COORDINATES: EAST: 781879.434 NORTH: 147874.032

ELEVATION: SURFACE: 118.8

Rig:	Geoprobe Track Rig 6610 DT				Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
	Macro Sampler	Casing	Augers	Core Barrel				
Size (ID)	1-5/8"	--	--	--	5/19/2010	0.0 - 15.0	sunny, mid+ 80s	
Length	5'	--	--	--				
Type	Acetate	--	--	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: PID background (BKG) is 0.0.

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
BKG/PS = Background/Point Source
ppm = parts per million

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. Datum)
					59SB14-00		Topsoil 0.2	118.6
1							CLAT to FINE SAND; brown, orange, gray; damp; non to slight plasticity; loose; piece of aluminum can at 2.0' (fill)	
2					59SB14-01			
3		D-1	4.6 92%			BKG		
4							Gravel at 4.0' (former surface?) 4.0	114.8
5	5.0						CLAY, little silt; whitish, light gray, orange, little olive mottles; damp; med plasticity; soft	
6								
7								
8		D-2	4.9 98%			BKG		
9								
10	10.0				59SB14-05			

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB14 SHEET 1 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

SO NO.: 119197, 7.2 BORING NO.: 59SB14

SAMPLE TYPE	DEFINITIONS
S = Split Spoon A = Auger	SPT = Standard Penetration Test (ASTM D1586)
T = Shelby Tube W = Wash	PID = Photo Ionization Detector Measurement
R = Air Rotary C = Core	MSL = Mean Sea Level
D = Denison P = Piston N = No Sample	ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. Datum)
11							Continued from Sheet 1	
12		D-3	4.2 84%			BKG		
13								
14								
15	15.0							103.8
							End of Boring at 15.0'	
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB14 SHEET 2 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

PROJ. NO.: 119197, 7.2 BORING NO.: 59SB15

COORDINATES: EAST: 781689.065 NORTH: 147855.417

ELEVATION: SURFACE: 117.9

Rig:	Geoprobe Track Rig 6610 DT				Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
	Macro Sampler	Casing	Augers	Core Barrel				
Size (ID)	1-5/8"	--	--	--	5/18/2010	0.0 - 12.0	sunny, mid+ 80s	
Length	5'	--	--	--				
Type	Acetate	--	--	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: PID background (BKG) is 0.0.

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
BKG/PS = Background/Point Source
ppm = parts per million

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. Datum)
					59SB15-00		asphalt 0.3	117.6
1							SILT to COARSE SAND; some clay, couple gravel; shells and roots in top 0.8"; brown ,light gray; damp; non plastic; loose (fill)	
2					59SB15-01			
3		D-1	4.2 84%			BKG		
4								
5	5.0							
6								
							6.5	111.4
7							SILT, little clay; gray,brown, olive; damp; non plastic; loose	
8		D-2	4.7 94%			BKG		
9							orange, brown zone 8.5 to 9.0' with increase in clay; slight plasticity	
10	10.0				59SB15-05			

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB15 SHEET 1 OF 1

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

SO NO.: 119197, 7.2 BORING NO.: 59SB15

SAMPLE TYPE	DEFINITIONS
S = Split Spoon A = Auger	SPT = Standard Penetration Test (ASTM D1586)
T = Shelby Tube W = Wash	PID = Photo Ionization Detector Measurement
R = Air Rotary C = Core	MSL = Mean Sea Level
D = Denison P = Piston N = No Sample	ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. Datum)
11		D-3	2.0 100%			BKG	Similar to above with an orange, brown zone 11.6 to 12.0'	
12	12.0							104.6
							End of Boring at 12.0'	
13								
14								
15								
16								
17								
18								
19								
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21								
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23								
24								
25								
26								
27								
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30								

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB15 SHEET 2 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

PROJ. NO.: 119197, 7.2 BORING NO.: 59SB16

COORDINATES: EAST: 781662.012 NORTH: 147912.903

ELEVATION: SURFACE: 116.6

Rig:	Geoprobe Track Rig 6610 DT				Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
	Macro Sampler	Casing	Augers	Core Barrel				
Size (ID)	1-5/8"	--	--	--	5/18/2010	0.0 - 12.0	sunny, mid+ 80s	
Length	5'	--	--	--				
Type	Acetate	--	--	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: PID background (BKG) is 0.0.

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
BKG/PS = Background/Point Source
ppm = parts per million

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. Datum)
							asphalt 0.3	116.3
1							CLAY to GRAVEL; brown and gray; damp; not plastic; loose (fill) 1.5	115.1
2					59SB16-01		CLAY, some silt, little fine sand; orange, tan, olive with	
		D-1	4.4			BKG	some white mottling; damp; slight plasticity; med stiff	
3			88%				to stiff (saprolite)	
4							4.0	112.6
							CLAY, some fine to med sand; orange gray with black	
5	5.0						and white specs; damp; slight plasticity; stiff	
6								
7								
		D-2	3.1			BKG		
8			62%				hard viens; grey with some rust mottling 7.6 to 8.0'	
9							hard viens; grey with some rust mottling 8.5 to 8.6'	
10	10.0				59SB16-05			

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB16 SHEET 1 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

SO NO.: 119197, 7.2 BORING NO.: 59SB16

SAMPLE TYPE	DEFINITIONS
S = Split Spoon A = Auger	SPT = Standard Penetration Test (ASTM D1586)
T = Shelby Tube W = Wash	PID = Photo Ionization Detector Measurement
R = Air Rotary C = Core	MSL = Mean Sea Level
D = Denison P = Piston N = No Sample	ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. Datum)
11		D-3	2.0 100%			BKG	Similar to above but moist and soft	
12	12.0							104.6
							End of Boring at 12.0'	
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB16 SHEET 2 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

PROJ. NO.: 119197, 7.2 BORING NO.: 59SB17

COORDINATES: EAST: 781597.078 NORTH: 147928.837

ELEVATION: SURFACE: 115.7

Rig:	Geoprobe Track Rig 6610 DT				Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
	Macro Sampler	Casing	Augers	Core Barrel				
Size (ID)	1-5/8"	--	--	--	5/18/2010	0.0 - 12.0	sunny, mid+ 80s	
Length	5'	--	--	--				
Type	Acetate	--	--	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: PID background (BKG) is 0.0.

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
BKG/PS = Background/Point Source
ppm = parts per million

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. Datum)
				59SB17-00 + duplicate		Topsoil 0.2	115.5
1, 2, 3	D-1	3.3 66%		59SB17-01	BKG	CLAY to COARSE SAND, trace gravel; brown, maroon, gray; damp; slight plasticity to loose; med stiff to soft (fill)	
						3.5	112.2
4, 5	5.0					CLAY, little silt; orange, gray with rust and black mottling; damp; slight plasticity; very stiff (saprolite) 5.0	110.7
6, 7, 8, 9, 10	D-2	4.8 96%		59SB17-05	BKG	similar to above but orange, light gray with little olive (varigated); damp; slight to med plasticity; stiff increase in light gray around 9.0'	

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB17 SHEET 1 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

SO NO.: 119197, 7.2 BORING NO.: 59SB17

SAMPLE TYPE	DEFINITIONS
S = Split Spoon A = Auger	SPT = Standard Penetration Test (ASTM D1586)
T = Shelby Tube W = Wash	PID = Photo Ionization Detector Measurement
R = Air Rotary C = Core	MSL = Mean Sea Level
D = Denison P = Piston N = No Sample	ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. Datum)
11		D-3	2.0			BKG		
12	12.0		100%					103.7
13							End of Boring at 12.0'	
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB17 SHEET 2 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

PROJ. NO.: 119197, 7.2 BORING NO.: 59SB18

COORDINATES: EAST: 781427.931 NORTH: 148010.031

ELEVATION: SURFACE: 111.3

Rig:	Geoprobe Track Rig 6610 DT				Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
	Macro Sampler	Casing	Augers	Core Barrel				
Size (ID)	1-5/8"	--	--	--	5/19/2010	0.0 - 12.0	sunny, mid+ 80s	
Length	5'	--	--	--				
Type	Acetate	--	--	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: PID background (BKG) is 0.0.

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
BKG/PS = Background/Point Source
ppm = parts per million

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. Datum)
				59SB18-00		Topsoil 0.2	111.1
1						CLAY to COARSE SAND, 0.1' gravel layer at 2.6'; brown; damp; non plastic; loose (fill)	
2				59SB18-01			
	D-1	4.6 92%			BKG		
3							
4				59SB18-02		increase in clay around 4.0'	
5	5.0					5.0	106.3
6						CLAY, some silt; orange, brown, little olive; damp to moist; med plasticity; med stiff	
7							
	D-2	3.5 70%			BKG		
8							
9						9.0	102.3
10	10.0					GRAVEL (bedrock); dark gray; saturated; non plastic; loose	

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB18 SHEET 1 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

SO NO.: 119197, 7.2 BORING NO.: 59SB18

SAMPLE TYPE	DEFINITIONS
S = Split Spoon A = Auger	SPT = Standard Penetration Test (ASTM D1586)
T = Shelby Tube W = Wash	PID = Photo Ionization Detector Measurement
R = Air Rotary C = Core	MSL = Mean Sea Level
D = Denison P = Piston N = No Sample	ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. Datum)
11							Continued from Sheet 1 11.0	100.3
		D-3	2.0			BKG	CLAY, little silt;orange,brown, moist; high plasticity;	
12	12.0		100%				soft	99.3
13							End of Boring at 12.0'	
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB18 SHEET 2 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

PROJ. NO.: 119197, 7.2 BORING NO.: 59SB19

COORDINATES: EAST: 782013.085 NORTH: 148078.775

ELEVATION: SURFACE: 118.5

Rig:	Geoprobe Track Rig 6610 DT				Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
	Macro Sampler	Casing	Augers	Core Barrel				
Size (ID)	1-5/8"	--	--	--	5/19/2010	0.0 - 15.0	sunny, mid+ 80s	
Length	5'	--	--	--				
Type	Acetate	--	--	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: PID background (BKG) is 0.0.

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
BKG/PS = Background/Point Source
ppm = parts per million

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. Datum)
							CONCRETE 0.2	118.3
1							CLAY, little silt; light gray, rust with little olive mottles; damp; med plasticity; soft (saprolite)	
2		D-1	3.0 67%		59SB19-01	BKG		
3							similar to above but med stiff at 3.5'	
4								
5	5.0							
6							similar to above but soft	
7		D-2	4.2 84%			BKG		
8								
9								
10	10.0				59SB19-05			
							similar to above and moist	

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB19 SHEET 1 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

SO NO.: 119197, 7.2 BORING NO.: 59SB19

SAMPLE TYPE	DEFINITIONS
S = Split Spoon A = Auger	SPT = Standard Penetration Test (ASTM D1586)
T = Shelby Tube W = Wash	PID = Photo Ionization Detector Measurement
R = Air Rotary C = Core	MSL = Mean Sea Level
D = Denison P = Piston N = No Sample	ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. Datum)
11							Continued from Sheet 1	
12		D-3	3.4 68%			BKG		
13								
14								
15	15.0							103.5
							End of Boring at 15.0'	
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB19 SHEET 2 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

PROJ. NO.: 119197, 7.2 BORING NO.: 59SB20

COORDINATES: EAST: 781942.782 NORTH: 148179.869

ELEVATION: SURFACE: 118.1

Rig:	Geoprobe Track Rig 6610 DT				Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
	Macro Sampler	Casing	Augers	Core Barrel				
Size (ID)	1-5/8"	--	--	--	5/19/2010	0.0 - 15.0	sunny, mid+ 80s	
Length	5'	--	--	--				
Type	Acetate	--	--	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: PID background (BKG) is 0.0.

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
BKG/PS = Background/Point Source
ppm = parts per million

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. Datum)
					59SB20-00		Topsoil 0.2	117.9
1							GRAVEL; gray; dry; non plastic; loose (fill) 0.3	117.8
2					59SB20-01		SILT and FINE SAND, some coarse sand; light and dark gray (mottles/salt and pepper structure); dry to damp; non plastic; loose (weathered bedrock)	
		D-1	4.5 90%			BKG		
3							3.5	114.6
4							SILT, little clay (blocky); orange, tan; dry to damp; non plastic; loose	
5	5.0							
6								
7								
		D-2	4.4 88%			BKG		
8								
9								
							become stiff at 9.5'	
10	10.0				59SB20-05			

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB20 SHEET 1 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

SO NO.: 119197, 7.2 BORING NO.: 59SB20

SAMPLE TYPE	DEFINITIONS
S = Split Spoon A = Auger	SPT = Standard Penetration Test (ASTM D1586)
T = Shelby Tube W = Wash	PID = Photo Ionization Detector Measurement
R = Air Rotary C = Core	MSL = Mean Sea Level
D = Denison P = Piston N = No Sample	ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. Datum)
11							Continued from Sheet 1	
12		D-3	4.2 84%			BKG		
13								
14								
15	15.0							103.1
							End of Boring at 15.0'	
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB20 SHEET 2 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

PROJ. NO.: 119197, 7.2 BORING NO.: 59SB21

COORDINATES: EAST: 781700.000 NORTH: 148250.435

ELEVATION: SURFACE: 117.9

Rig:	Geoprobe Track Rig 6610 DT				Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
	Macro Sampler	Casing	Augers	Core Barrel				
Size (ID)	1-5/8"	--	--	--	5/18/2010	0.0 - 11.0	sunny, mid+ 80s	
Length	5'	--	--	--				
Type	Acetate	--	--	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: PID background (BKG) is 0.0.

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
BKG/PS = Background/Point Source
ppm = parts per million

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. Datum)
					59SB21-00		Topsoil 0.2	117.7
1							CLAY to GRAVEL; dark gray, olive; damp; non plastic; loose (fill) 1.0	116.9
2					59SB21-01 + duplicate		SILT and FINE SAND; orange brown; damp; non plasticity; loose	
3		D-1	4.4 88%			BKG		
4								
5	5.0							
6							similar to above; three foot run, hard push/drill	
7		D-2	2.5 83%			BKG		
8	8.0							
9							similar to above; three foot run, hard push/drill	
10					59SB21-05		Become dense at 9.5'	

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB21 SHEET 1 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

SO NO.: 119197, 7.2 BORING NO.: 59SB21

SAMPLE TYPE	DEFINITIONS
S = Split Spoon A = Auger	SPT = Standard Penetration Test (ASTM D1586)
T = Shelby Tube W = Wash	PID = Photo Ionization Detector Measurement
R = Air Rotary C = Core	MSL = Mean Sea Level
D = Denison P = Piston N = No Sample	ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. Datum)
11	11.0						Refusal at 11.0'; terminate boring	106.9
							End of Boring at 11.0'	
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB21 SHEET 2 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

PROJ. NO.: 119197, 7.2 BORING NO.: 59SB22

COORDINATES: EAST: 781659.599 NORTH: 148086.346

ELEVATION: SURFACE: 117.8

Rig:	Geoprobe Track Rig 6610 DT				Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
	Macro Sampler	Casing	Augers	Core Barrel				
Size (ID)	1-5/8"	--	--	--	5/18/2010	0.0 - 10.0	sunny, mid+ 80s	
Length	5'	--	--	--				
Type	Acetate	--	--	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: PID background (BKG) is 0.0.

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
BKG/PS = Background/Point Source
ppm = parts per million

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. Datum)
					59SB22-00		asphalt 0.3	117.5
1							SILT to COARSE SAND; some clay, couple gravel; shells and roots in top 0.8"; brown ,light gray; damp; non plastic; loose (fill)	
2					59SB22-01			
		D-1	2.2 44%			BKG		
3								
4								
5	5.0						5.0	112.8
							CLAY, little silt; gray, olive; moist; highly plastic; soft	
6								
7								
		D-2	3.7 74%			BKG		
8								
9								
10	10.0				59SB22-05		Refusal at 10'; terminate boring	107.8
							End of Boring at 10.0'	

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB22 SHEET 1 OF 1

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

PROJ. NO.: 119197, 7.2 BORING NO.: 59SB23

COORDINATES: EAST: 781482.341 NORTH: 148099.995

ELEVATION: SURFACE: 114.1

Rig:	Geoprobe Track Rig 6610 DT				Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
	Macro Sampler	Casing	Augers	Core Barrel				
Size (ID)	1-5/8"	--	--	--	5/19/2010	0.0 - 12.0	sunny, mid+ 80s	
Length	5'	--	--	--				
Type	Acetate	--	--	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: PID background (BKG) is 0.0.

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
BKG/PS = Background/Point Source
ppm = parts per million

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description		Elevation (Ft. Datum)
					59SB23-00		CLAY, some silt; damp; med plasticity; med stiff; thin gravel cover at surface (fill)	1.1	114.1 113.0
1 2		D-1	4.7 94%		59SB23-01	BKG	CLAY to COARSE SAND; brown, gray; damp; non plastic; loose (fill)	3.0	111.1
3 4 5	5.0						CLAY, little silt; orange, gray, black (banded); damp; med plasticity; med stiff grades to dark brown around 4.5'		
6 7 8 9		D-2	4.4 88%			BKG	Color grades to lighter - yellow, orange, and gray around 8.0'		
10	10.0				59SB23-05				

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB23 SHEET 1 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: Naval Activity Puerto Rico SWMU 59

SO NO.: 119197, 7.2 BORING NO.: 59SB23

SAMPLE TYPE	DEFINITIONS
S = Split Spoon A = Auger	SPT = Standard Penetration Test (ASTM D1586)
T = Shelby Tube W = Wash	PID = Photo Ionization Detector Measurement
R = Air Rotary C = Core	MSL = Mean Sea Level
D = Denison P = Piston N = No Sample	ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. Datum)
11		D-3	2.0 100%			BKG	Similar to above with olive tint; moist; high plasticity; soft	
12	12.0							102.1
							End of Boring at 12.0'	
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								

DRILLING CO.: GeoEnviroTech, Inc. BAKER REP.: Robert Roselius

DRILLER: William Rodrigez BORING NO.: 59SB23 SHEET 2 OF 2

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: SWMU 59 - September 2012 CMS Investigation

PROJ. NO.: 129344 BORING NO.: 59SB24

COORDINATES: EAST: 937927.78 NORTH: 803687.67

ELEVATION: SURFACE: 118.8

Rig:	Geoprobe Track Rig 6620 DT							
	Macro Sampler	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	1-1/4"				9/13/2012	0.0 - 4.5	Mostly Sunny, 80s	
Length	4'							
Type	Acetate							
Hammer Wt.								
Fall								

Remarks:

SAMPLE TYPE

S = Split Spoon; A = Auger
T = Shelby Tube; W = Wash
R = Air Rotary; C = Core
D = Direct Push; P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photoionization Detector Measurement
ppm = parts per million
msl = mean sea level

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. Datum)
0.5	A-N				Concrete 0.5	118.3
1	D-1	2.4 60%	59SB24-00 Dup, MS/MSD (0.5 - 1.5')	<1	CLAY, trace to little silt; light grey, orange, little olive; slight plasticity; medium stiff; damp	
2				<1		
3			59SB24-01 (1.5 - 3.5') Dup	<1		
4						
4.5					4.5	114.3
5					End of boring at 4.5'	
6						
7						
8						
9						
10						

DRILLING COMPANY: On-Site Environmental, Inc. BAKER REP.: Robert Roselius

DRILLER: Simon Ojeda BORING NO.: 59SB24 SHEET 1 OF 1

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: SWMU 59 - September 2012 CMS Investigation

PROJ. NO.: 129344 BORING NO.: 59SB25

COORDINATES: EAST: 938048.68 NORTH: 803597.17

ELEVATION: SURFACE: 118.1

Rig:	Geoprobe Track Rig 6620 DT				Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
	Macro Sampler	Casing	Augers	Core Barrel				
Size (ID)	1-1/4"				9/13/2012	0.0 - 4.5	Mostly Sunny, 80s	
Length	4'							
Type	Acetate							
Hammer Wt.								
Fall								

Remarks:

SAMPLE TYPE

S = Split Spoon; A = Auger
T = Shelby Tube; W = Wash
R = Air Rotary; C = Core
D = Direct Push; P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photoionization Detector Measurement
ppm = parts per million
msl = mean sea level

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. Datum)
0.5	A-N				Concrete 0.5	117.6
1	D-1	2.1 53%	59SB25-00 (0.5 - 1.5')	<1	CLAY w/fine sand; grey, olive grey, black, medium plastic to non plastic; soft to medium dense; damp to moist	
2				<1		
3			59SB25-01 (1.5 - 3.5')			
4						
4.5					4.5	113.6
5					End of boring at 4.5'	
6						
7						
8						
9						
10						

DRILLING COMPANY: On-Site Environmental, Inc. BAKER REP.: Robert Roselius

DRILLER: Simon Ojeda BORING NO.: 59SB25 SHEET 1 OF 1

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: SWMU 59 - September 2012 CMS Investigation

PROJ. NO.: 129344 BORING NO.: 59SB26

COORDINATES: EAST: 938176.90 NORTH: 803589.49

ELEVATION: SURFACE: 118.6

Rig:	Geoprobe Track Rig 6620 DT							
	Macro Sampler	**Casing**	**Augers**	**Core Barrel**	**Date**	**Progress (Ft.)**	**Weather**	**Depth to Water (Ft.)**
Size (ID)	1-1/4"				9/13/2012	0.0 - 4.0	Mostly Sunny, 80s	
Length	4'							
Type	Acetate							
Hammer Wt.								
Fall								

Remarks:

SAMPLE TYPE

S = Split Spoon; A = Auger
T = Shelby Tube; W = Wash
R = Air Rotary; C = Core
D = Direct Push; P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photoionization Detector Measurement
ppm = parts per million
msl = mean sea level

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	Lab ID	PID (ppm)	Visual Description		Elevation (Ft. Datum)
	0.5	A-N				Concrete	0.5	118.1
1				59SB26-00 (0.5 - 1.5')	<1	CLAY, trace silt; orange, some black mottling; plastic; medium stiff; damp		
2					<1			
		D-1	3.4 97%	59SB26-01 (1.5 - 3.5')				
3					<1			
							3.5	115.1
4	4.0				<1	CLAY; orange, light grey, pale; high plasticity; medium stiff	4.0	114.6
5						End of boring at 4.0'		
6								
7								
8								
9								
10								

DRILLING COMPANY: On-Site Environmental, Inc. BAKER REP.: Robert Roselius

DRILLER: Simon Ojeda BORING NO.: 59SB26 SHEET 1 OF 1

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: SWMU 59 - September 2012 CMS Investigation

PROJ. NO.: 129344 BORING NO.: 59SB27

COORDINATES: EAST: 938273.06 NORTH: 803571.37

ELEVATION: SURFACE: 117.8

Rig:	Geoprobe Track Rig 6620 DT							
	Macro Sampler	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	1-1/4"				9/13/2012	0.0 - 4.5	Mostly Sunny, 80s	
Length	4'							
Type	Acetate							
Hammer Wt.								
Fall								

Remarks:

SAMPLE TYPE

S = Split Spoon; A = Auger
T = Shelby Tube; W = Wash
R = Air Rotary; C = Core
D = Direct Push; P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photoionization Detector Measurement
ppm = parts per million
msl = mean sea level

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	Lab ID	PID (ppm)	Visual Description		Elevation (Ft. Datum)
	0.5	A-N				Concrete	0.5	117.3
1				59SB27-00 (0.5 - 1.5')	<1	CLAY; orange brown with olive and light grey mottling; highly plastic; soft to medium stiff; damp		
2					<1			
		D-1	3.3 83%	59SB27-01 (1.5 - 3.5')				
3					<1			
4					<1			
	4.5						4.5	113.3
5						End of boring at 4.5'		
6								
7								
8								
9								
10								

DRILLING COMPANY: On-Site Environmental, Inc. BAKER REP.: Robert Roselius

DRILLER: Simon Ojeda BORING NO.: 59SB27 SHEET 1 OF 1

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: SWMU 59 - September 2012 CMS Investigation

PROJ. NO.: 129344 BORING NO.: 59SB28

COORDINATES: EAST: 937864.06 NORTH: 803513.93

ELEVATION: SURFACE: 118.0

Rig:	Geoprobe Track Rig 6620 DT							
	Macro Sampler	**Casing**	**Augers**	**Core Barrel**	**Date**	**Progress (Ft.)**	**Weather**	**Depth to Water (Ft.)**
Size (ID)	1-1/4"				9/13/2012	0.0 - 4.2	Mostly Sunny, 80s	
Length	4'							
Type	Acetate							
Hammer Wt.								
Fall								

Remarks:

SAMPLE TYPE

S = Split Spoon; A = Auger
T = Shelby Tube; W = Wash
R = Air Rotary; C = Core
D = Direct Push; P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photoionization Detector Measurement
ppm = parts per million
msl = mean sea level

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. Datum)
0.5	A-N				Asphalt/Gravel 0.5	117.5
1	D-1	2.8 70%	59SB28-00 (0.5 - 1.5')	<1	CLAY to FINE SAND, some coarse sand pieces; dark grey, orange, light grey; loose to soft to medium stiff; non plastic; damp	
2				<1		
3			59SB28-01 (1.5 - 3.5')	<1		
4						
4.2					4.2	113.8
5					End of boring at 4.2'	
6						
7						
8						
9						
10						

DRILLING COMPANY: On-Site Environmental, Inc. BAKER REP.: Robert Roselius

DRILLER: Simon Ojeda BORING NO.: 59SB28 SHEET 1 OF 1

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: SWMU 59 - September 2012 CMS Investigation

PROJ. NO.: 129344 BORING NO.: 59SB29

COORDINATES: EAST: 937981.32 NORTH: 803467.60

ELEVATION: SURFACE: 117.4

Rig:	Geoprobe Track Rig 6620 DT							
	Macro Sampler	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	1-1/4"				9/13/2012	0.0 - 4.2	Mostly Sunny, 80s	
Length	4'							
Type	Acetate							
Hammer Wt.								
Fall								

Remarks:

SAMPLE TYPE

S = Split Spoon; A = Auger
T = Shelby Tube; W = Wash
R = Air Rotary; C = Core
D = Direct Push; P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photoionization Detector Measurement
ppm = parts per million
msl = mean sea level

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. Datum)
0.7	A-N				Asphalt/Gravel 0.7	116.7
1	D-1	2.8 70%	59SB29-00 (0.7 - 1.7')	<1	CLAY; dark maroon and green; highly plastic; soft to medium stiff; damp	
2				<1		
3			59SB29-01 (1.7 - 3.7')	<1		
4						
4.2					4.2	113.2
5					End of boring at 4.2'	
6						
7						
8						
9						
10						

DRILLING COMPANY: On-Site Environmental, Inc. BAKER REP.: Robert Roselius

DRILLER: Simon Ojeda BORING NO.: 59SB29 SHEET 1 OF 1

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: SWMU 59 - September 2012 CMS Investigation

PROJ. NO.: 129344 BORING NO.: 59SB30

COORDINATES: EAST: 938063.68 NORTH: 803437.68

ELEVATION: SURFACE: 117.8

Rig:	Geoprobe Track Rig 6620 DT							
	Macro Sampler	**Casing**	**Augers**	**Core Barrel**	**Date**	**Progress (Ft.)**	**Weather**	**Depth to Water (Ft.)**
Size (ID)	1-1/4"				9/13/2012	0.0 - 4.2	Mostly Sunny, 80s	
Length	4'							
Type	Acetate							
Hammer Wt.								
Fall								

Remarks:

SAMPLE TYPE

S = Split Spoon; A = Auger
T = Shelby Tube; W = Wash
R = Air Rotary; C = Core
D = Direct Push; P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photoionization Detector Measurement
ppm = parts per million
msl = mean sea level

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. Datum)
0.5	A-N				Asphalt/Gravel 0.5	117.3
1	D-1	3.0 75%	59SB30-00 (0.5 - 1.5')	<1	CLAY, little sand; orange, dark and light grey; medium stiff to medium dense; non to slightly plastic; damp	
2				<1		
3			59SB30-01 (1.5 - 3.5')	<1		
4						
4.2					4.2	113.6
5					End of boring at 4.2'	
6						
7						
8						
9						
10						

DRILLING COMPANY: On-Site Environmental, Inc. BAKER REP.: Robert Roselius

DRILLER: Simon Ojeda BORING NO.: 59SB30 SHEET 1 OF 1

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: SWMU 59 - September 2012 CMS Investigation

PROJ. NO.: 129344 BORING NO.: 59SB31

COORDINATES: EAST: 938252.00 NORTH: 803417.90

ELEVATION: SURFACE: 118.6

Rig:	Geoprobe Track Rig 6620 DT							
	Macro Sampler	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	1-1/4"				9/13/2012	0.0 - 4.5	Mostly Sunny, 80s	
Length	4'							
Type	Acetate							
Hammer Wt.								
Fall								

Remarks:

SAMPLE TYPE

S = Split Spoon; A = Auger
T = Shelby Tube; W = Wash
R = Air Rotary; C = Core
D = Direct Push; P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photoionization Detector Measurement
ppm = parts per million
msl = mean sea level

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. Datum)
0.5	A-N				Concrete 0.5	118.1
1			59SB31-00 (0.5 - 1.5')	5.0	SILT TO COARSE SAND; dark grey and olive; loose to medium dense; non plastic; damp; slight petroleum odor 1.3	117.3
2				<1		
	D-1	3.2 80%	59SB31-01 (1.5 - 3.5')		CLAY; orange brown with olive and light grey mottling; highly plastic; soft to medium stiff; damp	
3				<1		
4				<1		
4.5					4.5	114.1
5					End of boring at 4.5'	
6						
7						
8						
9						
10						

DRILLING COMPANY: On-Site Environmental, Inc. BAKER REP.: Robert Roselius

DRILLER: Simon Ojeda BORING NO.: 59SB31 SHEET 1 OF 1

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: SWMU 59 - September 2012 CMS Investigation

PROJ. NO.: 129344 BORING NO.: 59SB32

COORDINATES: EAST: 937935.14 NORTH: 803381.04

ELEVATION: SURFACE: 115.7

Rig:	Geoprobe Track Rig 6620 DT							
	Macro Sampler	**Casing**	**Augers**	**Core Barrel**	**Date**	**Progress (Ft.)**	**Weather**	**Depth to Water (Ft.)**
Size (ID)	1-1/4"				9/13/2012	0.0 - 4.5	Mostly Sunny, 80s	
Length	4'							
Type	Acetate							
Hammer Wt.								
Fall								

Remarks:

SAMPLE TYPE

S = Split Spoon; A = Auger
T = Shelby Tube; W = Wash
R = Air Rotary; C = Core
D = Direct Push; P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photoionization Detector Measurement
ppm = parts per million
msl = mean sea level

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. Datum)
0.5	A-N				Concrete 0.5	115.2
1	D-1	3.3 83%	59SB32-00 (0.5 - 1.5')	<1	CLAY, little silt; orange brown; low to medium plasticity; medium stiff; damp	
2				<1		
3			59SB32-01 (1.5 - 3.5')	<1		
4				<1		
4.5					4.5	111.2
5					End of boring at 4.5'	
6						
7						
8						
9						
10						

DRILLING COMPANY: On-Site Environmental, Inc. BAKER REP.: Robert Roselius

DRILLER: Simon Ojeda BORING NO.: 59SB32 SHEET 1 OF 1

Baker

Michael Baker Jr., Inc.

TEST BORING RECORD

PROJECT: SWMU 59 - September 2012 CMS Investigation

PROJ. NO.: 129344 BORING NO.: 59SB33

COORDINATES: EAST: 938072.93 NORTH: 803398.91

ELEVATION: SURFACE: 115.8

Rig:	Geoprobe Track Rig 6620 DT							
	Macro Sampler	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	1-1/4"				9/13/2012	0.0 - 4.4	Mostly Sunny, 80s	
Length	4'							
Type	Acetate							
Hammer Wt.								
Fall								

Remarks:

SAMPLE TYPE

S = Split Spoon; A = Auger
T = Shelby Tube; W = Wash
R = Air Rotary; C = Core
D = Direct Push; P = Piston
N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photoionization Detector Measurement
ppm = parts per million
msl = mean sea level

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	Lab ID	PID (ppm)	Visual Description		Elevation (Ft. Datum)
	0.4	A-N				Concrete	0.4	115.4
1				59SB33-00	<1	SAND; white	0.6	115.2
				(0.6 - 1.6')		CLAY; orange brown with olive and light grey		
2					<1	mottling; highly plastic; soft to medium stiff; damp		
		D-1	4.0	59SB33-01				
3			100%	(1.6 - 3.6')	<1			
4					<1			
	4.4						4.4	111.4
5						End of boring at 4.4'		
6								
7								
8								
9								
10								

DRILLING COMPANY: On-Site Environmental, Inc. BAKER REP.: Robert Roselius

DRILLER: Simon Ojeda BORING NO.: 59SB33 SHEET 1 OF 1

GROUNDWATER SAMPLING FORMS

WELL DETAIL AND SAMPLING LOG

Well ID #: 59GW01 DATE: 5/22/10

PROJECT: NAPR SWMU 59 CMS WEATHER: P. CLOUDY, 80s

WELL DATA

(CONDITIONS): (G = Good, F = Fair, P = Poor)

Pad G Well Cap G PVC Locking Cap/Plug G

Cap Lock G Cover Bolts N/A Water over PVC? Y / (N)

Casing (outer) G Casing (inner) 2" SWL Reference Mark Y Reference Mark Location? NIGN PA.

Casing Dia.: 3" SQUARE Casing Material: PVC Flushmount / (Stickup)

Comments:

(OTHER): Static Water Level (ft.): 11.85 Time: 0734 (Pre-Pump Installation)

Depth to Product (ft.): N/A

Water Level (ft.): 11.70 Time: 0738 (Post-Pump Installation, Pre-Purge)

Total Well Depth (ft.) - Post Sampling: 18.25 Time: 0915

PID Reading (PPM) - Unopened: BKG (0.0) Opened: BKG (0.0)

PURGE DATA

Pump Type: BLADDER

From Boring Log: Total Depth (ft.): 15 Screened Interval (ft.): 5-15

Pump Intake Set @ (ft.): 12.5 Controller Settings / Pressure: 10±

Comments:

SAMPLE DATA

Sample ID #: 59GW01 Dup.: Y / (N) (ID#:)

Sample Time: 0835 MS / MSD: Y / (N) Field Filtered: (Y) / N

Sampled By: ROBERT ROSELINS Signature: [signature]

Sample Description: CLEAR

SAMPLE CONTAINERS

Bottle Type	Qty.	Preservative	Analysis
40 ml VOA VIAL	3	HCL	VOCs
1 L AMBER	2	—	PESTICIDES
1 L AMBER	2	—	LL SVOCS
500 ml POLY	1	HNO_3	METALS
500 ml POLY	1	HNO_3	DISSOLVED METALS

GENERAL COMMENTS

LOW FLOW PURGE DATA SHEET

WELL ID: 59GW01

DATE: ~~5/20/10~~ RGR 5/22/10

PROJECT: NAPR SWMU 59

SAMPLER (s): Robert Roselius

SAMPLE ID: 59GW01

TIME [3-5 min.]	DEPTH TO WATER (ft) [<0.3 ft.]	VOL (ml)	PURGE RATE (ml/min) [250-500 ml/min]	TEMP. (°C)	SP. COND. (mS/cm) [+/- 3%]	D.O. (mg/l) [+/- 10%]	pH (S.U.) [+/- 0.1]	ORP (mV) [+/- 10]	TURBIDITY (NTU) [+/- 10%]	COMMENTS (Sample descrip.: color, clarity, odor - issues and adjustments, etc.)
0738	11.70	- (Water Level : Post-Pump Installation, Pre-Start)								
0740	- (Start of Purging)									ADJUST PUMP
0745	12.07	800	160	28.21	12.24	5.32	6.55	15.3	47.8	ADJUST PUMP
0750	12.22	400	80	28.79	12.19	2.57	6.50	-17.6	35.7	ADJUST PUMP
0755	12.25	200	40	29.10	12.07	2.04	6.51	-21.8	27.6	ADJUST PUMP - VERY LOW YIELD
0800	12.26	150	30	29.45	12.05	1.95	6.51	-21.6	17.2	
0805	12.29	150	30	29.74	12.06	1.93	6.51	-18.8	16.7	
0810	12.32	150	30	29.66	12.09	1.81	6.50	-15.6	11.8	
0815	12.33	150	30	29.50	12.09	1.70	6.50	-11.7	9.89	
0820	12.35	150	30	29.25	12.07	1.70	6.50	-9.8	8.40	
0825	12.37	150	30	29.16	12.07	1.66	6.50	-7.2	7.78	
0830	12.39	150	30	29.03	12.10	1.68	6.50	-6.8	8.43	
0835	- Sample Time (Note: Flow rate to be btwn. 100 - 250 ml/min.)									Sampler Signature: [signature]

Note: Stability achieved when 3 consecutive readings fall within specific parameter ranges shown in the above header.

WELL DETAIL AND SAMPLING LOG

Well ID #: 59GW02 DATE: 5/23/10

PROJECT: NAPR SWMU 59 CMS WEATHER: P. CLOUDY, MID 80s

WELL DATA

(CONDITIONS): (G = Good, F = Fair, P = Poor)

Pad G Well Cap G PVC Locking Cap/Plug G

Cap Lock G Cover Bolts N/A Water over PVC? Y / (N)

Casing (outer) G Casing (inner) 2" SWL Reference Mark Y Reference Mark Location? HIGH POINT

Casing Dia.: 3" SQUARE Casing Material: PVC Flushmount / (Stickup)

Comments:

(OTHER): Static Water Level (ft.): 13.40 Time: 0750 (Pre-Pump Installation)

Depth to Product (ft.): N/A

Water Level (ft.): 13.40 Time: 0757 (Post-Pump Installation, Pre-Purge)

Total Well Depth (ft.) - Post Sampling: 19.60 Time: 1055 1295

PID Reading (PPM) - Unopened: BKG (0.0) Opened: BKG (0.0)

PURGE DATA

Pump Type: BLADDER

From Boring Log: Total Depth (ft.): 16 Screened Interval (ft.): 6 - 16

Pump Intake Set @ (ft.): 13.5 Controller Settings / Pressure: < 20±

Comments:

SAMPLE DATA

Sample ID #: 59GW02 Dup. (Y) N - (ID#: 59GW02D)

Sample Time: 0910 MS / MSD: (Y) N Field Filtered: (Y) N

Sampled By: ROBERT ROSELINS Signature: [signature]

Sample Description: CLEAR

SAMPLE CONTAINERS

Bottle Type	Qty.	Preservative	Analysis
40 ml VOA VIAL	3	HCL	VOCs
1L AMBER	2	—	PEST
" "	2	—	LL SVOCs
500 ml POLY	1	HNO_3	METALS
" " "	1	HNO_3	DISS METALS

GENERAL COMMENTS

LOW FLOW PURGE DATA SHEET

WELL ID: 59GW02
DATE: 5/23/10
PROJECT: NAPR SWMU 59 CMS

SAMPLER (s): Robert Roselins
SAMPLE ID: 59GW02

TIME [3-5 min.]	DEPTH TO WATER (ft) [<0.3 ft.]	VOL. (ml)	PURGE RATE (ml/min) [250-500 ml/min]	TEMP. (°C)	SP. COND. (mS/cm) [+/- 3%]	D.O. (mg/l) [+/- 10%]	pH (S.U.) [+/- 0.1]	ORP (mV) [+/- 10]	TURBIDITY (NTU) [+/- 10%]	COMMENTS (Sample descrip.: color, clarity, odor - issues and adjustments, etc.)
0757	13.40	- (Water Level : Post-Pump Installation, Pre-Start)								
0757	- (Start of Purging)									
0800	13.63	1000	333	27.88	3.876	2.29	6.80	14.4	452	ADJUST PUMP
0805	13.82	900	180	28.37	3.976	0.99	6.78	-2.6	398	ADJUST PUMP
0810	13.90	750	150	28.56	3.966	0.55	6.78	-11.9	366	ADJUST PUMP.
0815	13.86	550	110	28.73	3.889	0.42	6.80	-21.9	259	
0820	13.86	550	110	28.85	3.801	0.38	6.82	-28.3	143	
0825	13.87	550	110	28.90	3.759	0.38	6.82	-31.4	87.7	
0830	13.86	550	110	28.97	3.722	0.40	6.82	-36.9	54.5	
0835	13.86	550	110	28.98	3.685	0.37	6.83	-34.7	34.8	
0840	13.86	550	110	29.04	3.645	0.35	6.84	-36.8	25.6	
0845	13.87	550	110	29.04	3.613	0.34	6.84	-36.4	20.4	
0850	13.86	550	110	29.06	3.561	0.32	6.85	-37.0	16.7	
0855	13.87	550	110	29.03	3.533	0.30	6.86	-35.8	12.3	
0900	13.87	550	110	29.09	3.506	0.31	6.86	-36.0	11.4	
0903	13.87	550	110	29.09	3.485	0.30	6.87	-36.6	9.64	
0906	13.87	550	110	29.05	3.475	0.30	6.87	-35.8	8.88	
0910	- **Sample Time** (Note: Flow rate to be btwn. 100 - 250 ml/min.)									Sampler Signature:

Note: Stability achieved when 3 consecutive readings fall within specific parameter ranges shown in the above header.

WELL DETAIL AND SAMPLING LOG

Well ID #: 59GW03 DATE: 5/22/10

PROJECT: NAPR SWMU 59 CMS WEATHER: P. Cloudy, 80s

WELL DATA

(CONDITIONS): (G = Good, F = Fair, P = Poor)

Pad G Well Cap G PVC Locking Cap/Plug G

Cap Lock G Cover Bolts N/A Water over PVC? Y / (N)

Casing (outer) G Casing (inner) 2" SWL Reference Mark Y Reference Mark Location? HIGH PT.

Casing Dia.: 3" SQUARE Casing Material: PVC Flushmount / (Stickup)

Comments:

(OTHER): Static Water Level (ft.): 17.82 Time: 0936 (Pre-Pump Installation)

Depth to Product (ft.): N/A

Water Level (ft.): 20.20 Time: 0945 ~~(Post-Pump Installation, Pre-Purge)~~ RER POST BAIL

Total Well Depth (ft.) - Post Sampling: 20.36 Time: 1443

PID Reading (PPM) - Unopened: BKG (0.0) Opened: BKG (0.0)

PURGE DATA

Pump Type: NA

From Boring Log: Total Depth (ft.): 17 Screened Interval (ft.): 7-17

Pump Intake Set @ (ft.): NA Controller Settings / Pressure: NA

Comments: BAIL DRY DUE TO LOW YIELD

SAMPLE DATA

Sample ID #: 59GW03 Dup.: Y / (N) (ID#:)

Sample Time: 1315 MS / MSD: Y / (N) Field Filtered: Y / N

Sampled By: ROBERT ROSELIUS Signature: [signature]

Sample Description: SAMPLE WITH BLADDER PUMP UPON RECHARGE FROM PURGE DRY VIA BAILING. SAMPLE CLEAR

SAMPLE CONTAINERS

Bottle Type	Qty.	Preservative	Analysis
40 ml VOA VIAL	3	HCL	VOCS
1 L AMBER	2	—	PEST
" "	2	—	LL SVOCS
500 ml POLY	1	HNO_3	METALS
" " "	1	HNO_3	DISS METALS

GENERAL COMMENTS

WELL DETAIL AND SAMPLING LOG

Well ID #: 59GW04 DATE: 5/23/10

PROJECT: NAPR SWMU 59 CMS WEATHER: SUNNY, MID 80s

WELL DATA

(CONDITIONS): (G = Good, F = Fair, P = Poor)

Pad G Well Cap G PVC Locking Cap/Plug G

Cap Lock G Cover Bolts N/A Water over PVC? Y / (N)

Casing (outer) G Casing (inner) 2" SWL Reference Mark Y Reference Mark Location? HIGH PT.

Casing Dia.: 3" SQUARE Casing Material: PVC Flushmount / (Stickup)

Comments:

(OTHER): Static Water Level (ft.): 18.38 Time: 1107 (Pre-Pump Installation)

Depth to Product (ft.): N/A

Water Level (ft.): 18.21 Time: 1113 (Post-Pump Installation, Pre-Purge)

Total Well Depth (ft.) - Post Sampling: 25.52 Time: 1240

PID Reading (PPM) - Unopened: BKG (0.0) Opened: BKG (0.0)

PURGE DATA

Pump Type: BLADDER

From Boring Log: Total Depth (ft.): 22 Screened Interval (ft.): 12 - 22

Pump Intake Set @ (ft.): 19 Controller Settings / Pressure:

Comments:

SAMPLE DATA

Sample ID #: 59GW04 Dup.: Y / (N) - (ID#:)

Sample Time: 1205 MS / MSD: Y / (N) Field Filtered: (Y) / N

Sampled By: ROBERT ROSELINS Signature: [signature]

Sample Description: CLEAR

SAMPLE CONTAINERS

Bottle Type	Qty.	Preservative	Analysis
40 ml VOA VIAL	3	HCL	VOCs
1L AMBER	2	—	PEST
" "	2	—	LL SVOCs
500 ml POLY	1	HNO_3	METALS
" " "	1	HNO_3	DISS METALS

GENERAL COMMENTS

LOW FLOW PURGE DATA SHEET

WELL ID: 59GW04
DATE: 5/23/10
PROJECT: NAPR SWMU 59 CMS

SAMPLER (s): ROBERT ROSELIUS
SAMPLE ID: 59GW04

TIME [3-5 min.]	DEPTH TO WATER (ft) [<0.3 ft.]	VOL. (ml)	PURGE RATE (ml/min) [250-500 ml/min]	TEMP. (°C)	SP. COND. (mS/cm) [+/- 3%]	D.O. (mg/l) [+/- 10%]	pH (S.U.) [+/- 0.1]	ORP (mV) [+/- 10]	TURBIDITY (NTU) [+/- 10%]	COMMENTS (Sample descrip.: color, clarity, odor - issues and adjustments, etc.)
1113	18.21	- (Water Level : Post-Pump Installation, Pre-Start)								
1113	- (Start of Purging)									
1117	18.79	1100	220	29.58	6.625	2.22	6.82	-20.2	48.3	ADJUST PUMP
1120	18.81	150	50	29.90	6.693	1.96	6.82	-16.8	40.4	ADJUST PUMP
1125	18.84	200	40	30.19	6.640	1.76	6.82	-13.5	32.3	ADJUST PUMP
1130	18.92	250	50	29.88	7.063	1.51	6.79	-13.5	26.4	ADJUST PUMP
1135	18.84	125	25	29.96	7.197	1.26	6.79	-13.1	20.1	ADJUST PUMP
1140	18.90	250	50	30.81	7.293	1.24	6.79	-9.7	20.4	
1145	18.92	250	50	30.94	8.219	0.80	6.79	-10.0	15.7	
1150	18.92	250	50	31.17	8.138	0.72	6.78	-9.1	11.6	
1155	18.93	250	50	30.84	8.090	0.75	6.79	-8.8	11.2	
1200	18.93	250	50	3.067	8.071	0.69	6.79	-9.0	13.6	
1205	- **Sample Time** (Note: Flow rate to be btwn. 100 - 250 ml/min.)									Sampler Signature:

Note: Stability achieved when 3 consecutive readings fall within specific parameter ranges shown in the above header.

WELL DETAIL AND SAMPLING LOG

Well ID #: 59GW05 DATE: 5/23/10

PROJECT: NAPR SWMU 59 CMS WEATHER: SUNNY, MID 80s

WELL DATA

(CONDITIONS): (G = Good, F = Fair, P = Poor)

Pad G Well Cap G PVC Locking Cap/Plug G

Cap Lock G Cover Bolts G Water over PVC? Y / (N)

Casing (outer) ____ Casing (inner) 2" SWL Reference Mark Y Reference Mark Location? HIGH PT.

Casing Dia.: ____ Casing Material: PVC (Flushmount) / Stickup

Comments: ____

(OTHER): Static Water Level (ft.): 13.34 Time: 1252 (Pre-Pump Installation)

Depth to Product (ft.): N/A

Water Level (ft.): 13.24 Time: 1257 (Post-Pump Installation, Pre-Purge)

Total Well Depth (ft.) - Post Sampling: ____ Time: ____

PID Reading (PPM) - Unopened: BKG (0.0) Opened: BKG (0.0)

PURGE DATA

Pump Type: BLADDER

From Boring Log: Total Depth (ft.): 22 Screened Interval (ft.): 12-22

Pump Intake Set @ (ft.): 18.5 Controller Settings / Pressure: ____

Comments: ____

SAMPLE DATA

Sample ID #: 59GW05 Dup.: Y / (N) (ID#:)

Sample Time: 1450 MS / MSD: Y / (N) Field Filtered: (Y) / N

Sampled By: ROBERT ROSELINS Signature: [signature]

Sample Description: CLEAR

SAMPLE CONTAINERS

Bottle Type	Qty.	Preservative	Analysis
40 ml VOA VIAL	3	HCL	VOCs
1L AMBER	2	–	PEST
" "	2	–	LL SVOCs
500 ml POLY	1	HNO_3	METALS
" " "	1	"	DISS. METAL

GENERAL COMMENTS

400

LOW FLOW PURGE DATA SHEET

WELL ID: 59GW05
DATE: 5/23/10
PROJECT: NAPR SWMU 59 CMS

SAMPLER (s): Robert Roselius
SAMPLE ID: 59GW05

TIME [3-5 min.]	DEPTH TO WATER (ft) [<0.3 ft.]	VOL. (ml)	PURGE RATE (ml/min) [250-500 ml/min]	TEMP. (°C)	SP. COND. (mS/cm) [+/- 3%]	D.O. (mg/l) [+/- 10%]	pH (S.U.) [+/- 0.1]	ORP (mV) [+/- 10]	TURBIDITY (NTU) [+/- 10%]	COMMENTS (Sample descrip.: color, clarity, odor - issues and adjustments, etc.)
1257	13.24	- (Water Level : Post-Pump Installation, Pre-Start)								
1258	- (Start of Purging)									
1300	13.41	300	150	30.48	0.028	7.35	8.11	90.4	—	ADJUST PUMP, PROBE NOT SUBMERGED
1305	13.47	900	180	32.94	4.815	1.54	6.95	6.5	968	ADJUST PUMP
1310	13.48	550	110	33.47	4.857	0.60	6.92	-4.9	948	
1315	13.47	500	100	33.49	4.835	0.43	6.91	-6.7	888	
1320	13.47	500	100	33.50	4.818	0.36	6.91	-8.0	685	
1330	13.50	1300	130	33.18	4.822	0.40	6.91	-1.5	320	
1335	13.50	500	100	33.25	4.837	0.33	6.91	-3.3	285	
1340	13.50	500	100	33.27	4.846	0.28	6.91	-6.7	209	
1345	13.50	500	100	33.22	4.846	0.27	6.91	-8.5	184	
1355	13.49	1000	100	33.28	4.822	0.25	6.91	-9.8	69.7	
1400	13.51	500	100	33.28	4.816	0.24	6.91	-10.6	52.6	
1405	13.51	500	100	33.26	4.816	0.23	6.91	-10.9	37.2	
1410	13.50	500	100	33.25	4.803	0.23	6.91	-11.5	31.8	
1415	13.50	500	100	33.25	4.793	0.21	6.92	-12.3	22.9	
1420	13.50	500	100	33.29	4.793	0.22	6.92	-12.3	21.0	
1425	13.50	500	100	33.31	4.790	0.21	6.92	-12.6	21.3	
1430	13.51	500	100	33.28	4.788	0.21	6.92	-12.7	18.1	
1435	13.51	500	100	33.30	4.788	0.20	6.92	-13.0	15.7	
1440	13.50	500	100	33.43	4.782	0.20	6.92	-13.0	13.6	
1445	13.50	500	100	33.50	4.780	0.20	6.92	-13.2	13.2	
1450	- **Sample Time** (Note: Flow rate to be btwn. 100 - 250 ml/min.)									Sampler Signature:

Note: Stability achieved when 3 consecutive readings fall within specific parameter ranges shown in the above header.

WELL DETAIL AND SAMPLING LOG

Well ID #: 59GW06 DATE: 5/21/10

PROJECT: NAPR SWMU 59 CMS WEATHER: SUNNY, MID 80s

WELL DATA

(CONDITIONS): (G = Good, F = Fair, P = Poor)

Pad G Well Cap G PVC Locking Cap/Plug G

Cap Lock G Cover Bolts N/A Water over PVC? Y / N

Casing (outer) G Casing (inner) 2" SWL Reference Mark Y Reference Mark Location? HIGH PT.

Casing Dia.: 3" SQUARE Casing Material: PVC Flushmount / Stickup

Comments:

(OTHER): Static Water Level (ft.): 10.84 Time: 1120 (Pre-Pump Installation)

Depth to Product (ft.): N/A

Water Level (ft.): 10.85 Time: 1133 (Post-Pump Installation, Pre-Purge)

Total Well Depth (ft.) - Post Sampling: Time:

PID Reading (PPM) - Unopened: BKG (0.0) Opened: BKG (0.0)

PURGE DATA

Pump Type: BLADDER

From Boring Log: Total Depth (ft.): 15 Screened Interval (ft.): 5-15

Pump Intake Set @ (ft.): 12 Controller Settings / Pressure: 10±

Comments:

SAMPLE DATA

Sample ID #: 59GW06 Dup.: Y / N (ID#:)

Sample Time: 1315 MS / MSD: Y / N Field Filtered: Y / N

Sampled By: ROBERT ROSELIUS Signature:

Sample Description: CLEAR

SAMPLE CONTAINERS

Bottle Type	Qty.	Preservative	Analysis
40 ml VOA VIAL	3	HCL	VOCs
1L AMBER	2	—	PEST
" "	2	—	LL SVOCs
500 ml POLY	1	HNO_3	METALS
" " "	1	"	DISS METALS

GENERAL COMMENTS

LOW FLOW PURGE DATA SHEET

WELL ID: 59GW06
DATE: 5/21/10
PROJECT: NAPR SWMU 59 CMS

SAMPLER (s): ROBERT ROSELIUS
SAMPLE ID: 59GW06

TIME [3-5 min.]	DEPTH TO WATER (ft) [<0.3 ft.]	VOL. (ml)	PURGE RATE (ml/min) [250-500 ml/min]	TEMP. (°C)	SP. COND. (mS/cm) [+/- 3%]	D.O. (mg/l) [+/- 10%]	pH (S.U.) [+/- 0.1]	ORP (mV) [+/- 10]	TURBIDITY (NTU) [+/- 10%]	COMMENTS (Sample descrip.: color, clarity, odor - issues and adjustments, etc.)
	10.85	- (Water Level : Post-Pump Installation, Pre-Start)								
1135	- (Start of Purging)									ADJUST PUMP
1140	11.11	900	180	30.13	6.559	1.78	6.79	-21.0	814	TURBID ADJUST PUMP
1145	11.12	400	80	30.51	6.569	0.96	6.76	-10.6	680	ADJUST PUMP
1150	11.09	300	60	30.88	6.614	0.63	6.76	-2.9	428	ADJUST PUMP
1155	11.11	250	50	30.90	6.634	0.65	6.77	0.7	368	
1200	11.16	250	50	30.18	6.627	0.43	6.77	3.8	290	
1205	11.17	300	60	30.22	6.619	0.34	6.76	9.4	217	
1210	11.16	300	60	30.54	6.620	0.32	6.77	13.8	190	
1215	11.14	275	55	30.84	6.620	0.31	6.78	14.0	144	
1220	11.14	300	60	30.28	6.627	0.33	6.78	14.6	128	
1225	11.16	300	60	30.26	6.625	0.39	6.78	13.5	139	
1230	11.18	325	65	30.27	6.600	0.32	6.78	13.9	113	
1235	11.19	350	70	30.26	6.609	0.26	6.78	16.1	87.7	
1240	11.20	350	70	30.46	6.615	0.24	6.79	18.4	67.5	
1245	11.22	350	70	29.57	6.630	0.25	6.79	16.7	50.4	
1250	11.23	350	70	29.11	6.607	0.27	6.76	16.1	61.3	
1255	11.22	350	70	29.03	6.599	0.24	6.75	14.7	55.1	
1300	11.24	350	70	29.15	6.593	0.23	6.76	15.1	37.8	
1305	11.24	350	70	29.02	6.619	0.21	6.77	14.8	29.4	
1310	11.23	350	70	28.86	6.603	0.20	6.76	13.4	33.0	
										TURBIDITY 36.4 @ 1320 DURING SAMPLING
1315	- Sample Time (Note: Flow rate to be btwn. 100 - 250 ml/min.)									Sampler Signature:

Note: Stability achieved when 3 consecutive readings fall within specific parameter ranges shown in the above header.

WELL DETAIL AND SAMPLING LOG

Well ID #: 59GW07 DATE: 5-21-10

PROJECT: SWMU 59 CMS Investigation WEATHER: Partly Cloudy - Mid 90's Slight Breeze

WELL DATA

(CONDITIONS): (G = Good, F = Fair, P = Poor)

Pad G Well Cap G PVC Locking Cap/Plug G

Cap Lock G Cover Bolts G Water over PVC? Y / (N)

Casing (outer) ____ Casing (inner) G SWL Reference Mark Y Reference Mark Location? High Point

Casing Dia.: ____ Casing Material: G Flushmount / (Stickup)

Comments: ____

(OTHER): Static Water Level (ft.): 16.48 Time: 0830 (Pre-Pump Installation)

Depth to Product (ft.): /

Water Level (ft.): 16.33 Time: 0833 (Post-Pump Installation, Pre-Purge)

Total Well Depth (ft.) - Post Sampling: ____ Time: ____

PID Reading (PPM) - Unopened: Background Opened: Background

PURGE DATA

Pump Type: Bladder Pump

From Boring Log: Total Depth (ft.): 20.95 Screened Interval (ft.): ____

Pump Intake Set @ (ft.): 19.50 Controller Settings / Pressure: CPMU 5.0

Comments: Based on Total H_2O in well - Pump set 1.5' from Bottom of well.

SAMPLE DATA

Sample ID #: 59GW07 Dup.: Y / (N) - (ID#:)

Sample Time: 1025 MS / MSD: Y / (N) Field Filtered: (Y) N

Sampled By: A. Guiley Signature: [signature]

Sample Description: Prep bottles after 1013. Sample at 1025

SAMPLE CONTAINERS

Bottle Type	Qty.	Preservative	Analysis
(3) 40 mL VOA Vials	3	HCL	VOC
1 L Amber	2	—	Pest
1 L Amber	2	—	LL SVOC
500 mL Poly	1	HNO_3	Metals
500 mL Poly	1	HNO_3	Dissolved Metals

GENERAL COMMENTS

LOW FLOW PURGE DATA SHEET

WELL ID: 59GW07
DATE: 5-21-10
PROJECT: SWMU 59

SAMPLER (s): A. Gailey
SAMPLE ID: 59GW07

TIME [3-5 min.]	DEPTH TO WATER (ft) [<0.3 ft.]	VOL. (ml)	PURGE RATE (ml/min) [250-500 ml/min]	TEMP. (°C)	SP. COND. (mS/cm) [+/- 3%]	D.O. (mg/l) [+/- 10%]	pH (S.U.) [+/- 0.1]	ORP (mV) [+/- 10]	TURBIDITY (NTU) [+/- 10%]	COMMENTS (Sample descrip.: color, clarity, odor - issues and adjustments, etc.)
0833	16.33	- (Water Level : Post-Pump Installation, Pre-Start)								
0842	- (Start of Purging)			~~30.26~~						
0847	16.81	200	40	30.26	3.953	1.25	7.13	-53.0	322	Slightly Turbid - No odor
0852	16.83	200	40	30.70	3.958	0.86	7.13	-39.6	274	Clearing slightly
0857	16.80	150	30	30.91	3.968	0.83	7.12	-31.7	216	" "
0902	16.83	200	40	31.09	3.973	0.79	7.12	-25.2	165	Clearing - No odor
0907	16.82	190	36	31.10	3.982	0.76	7.12	-21.8	112	" "
0912	16.80	150	30	31.20	3.987	0.73	7.12	-19.4	98.5	" "
0917	16.90	250	50	31.04	3.994	0.71	7.12	-17.1	74.0	" "
0922	16.93	150	30	30.94	3.987	0.49	7.12	-17.6	42.3	" "
0927	16.94	150	30	31.15	3.991	0.45	7.12	-16.8	25.3	" "
0932	17.01	275	55	30.96	4.004	0.42	7.12	-15.9	24.0	" "
0937	17.03	200	40	30.63	4.011	0.37	7.12	-16.9	18.2	" "
0942	17.03	200	40	30.67	4.014	0.31	7.12	-17.9	18.1	" "
0947	17.04	200	40	30.64	4.026	0.34	7.12	-17.7	17.0	" "
0952	17.05	200	40	30.72	4.026	0.32	7.12	-17.2	14.1	" "
0957	17.06	200	40	30.94	4.024	0.32	7.12	-16.7	12.2	Clear - No odor
1002	17.07	200	40	31.04	4.022	0.33	7.12	-16.3	11.7	" "
1007	17.08	240	48	30.58	4.021	0.32	7.12	-14.8	10.6	" "
1010	17.98	250	50	30.54	4.017	0.30	7.13	-15.0	9.4	" "
1013	17.31	100	33.3	30.51	4.014	0.31	7.13	-15.4	8.9	" "
1025	- Sample Time (Note: Flow rate to be btwn. 100 - 250 ml/min.)									Sampler Signature:

Note: Stability achieved when 3 consecutive readings fall within specific parameter ranges shown in the above header.

WELL DETAIL AND SAMPLING LOG

Well ID #: 59GW08 DATE: 5/22/10

PROJECT: NAPR SWMU 59 CMS WEATHER: P. CLOUDY, MID 80s

WELL DATA

(CONDITIONS): (G = Good, F = Fair, P = Poor)

Pad G Well Cap G PVC Locking Cap/Plug G

Cap Lock G Cover Bolts N/A Water over PVC? Y (N)

Casing (outer) G Casing (inner) 2" SWL Reference Mark Y Reference Mark Location? NICK PT.

Casing Dia.: 4" SQUARE Casing Material: PVC Flushmount / (Stickup)

Comments:

(OTHER): Static Water Level (ft.): 17.96 Time: 1452 (Pre-Pump Installation)

Depth to Product (ft.): N/A

Water Level (ft.): 17.96 Time: 1458 (Post-Pump Installation, Pre-Purge)

Total Well Depth (ft.) - Post Sampling: Time: 1645

PID Reading (PPM) - Unopened: BKG (0.0) Opened: BKG (0.0)

PURGE DATA

Pump Type: BLADDER

From Boring Log: Total Depth (ft.): 22 Screened Interval (ft.): 12 - 22

Pump Intake Set @ (ft.): 19' Controller Settings / Pressure: <20±

Comments:

SAMPLE DATA

Sample ID #: 59GW08 Dup.: Y / (N) (ID#:)

Sample Time: 1625 MS / MSD: Y / (N) Field Filtered: (Y) / N

Sampled By: ROBERT ROSELIUS Signature: [signature]

Sample Description: CLEAR

SAMPLE CONTAINERS

Bottle Type	Qty.	Preservative	Analysis
40 ml VOA VIAL	3	HCL	VOCs
1 L AMBER	2	–	PEST
" "	2	–	LL SVOCs
500 ml POLY	1	HNO_3	METALS
" " "	1	HNO_3	DISS METALS

GENERAL COMMENTS

LOW FLOW PURGE DATA SHEET

WELL ID: 59GW08
DATE: 5/22/10
PROJECT: NOPR SWMU 59 CMS

SAMPLER (s): Robert Roselius
SAMPLE ID: 59GW08

TIME [3-5 min.]	DEPTH TO WATER (ft) [<0.3 ft.]	VOL. (ml)	PURGE RATE (ml/min) [250-500 ml/min]	TEMP. (°C)	SP. COND. (mS/cm) [+/- 3%]	D.O. (mg/l) [+/- 10%]	pH (S.U.) [+/- 0.1]	ORP (mV) [+/- 10]	TURBIDITY (NTU) [+/- 10%]	COMMENTS (Sample descrip.: color, clarity, odor - issues and adjustments, etc.)
1458	17.96	- (Water Level : Post-Pump Installation, Pre-Start)								
1502	- (Start of Purging)									
1505	18.04	900	300	30.78	1.979	15.05	7.39	-42.4	377	Turbidity @ 1508, adjust pump
1510	18.03	300	60	30.50	2.033	1.78	7.24	-27.4	362	adjust pump
1515	18.04	300	60	30.35	2.046	1.27	7.27	-23.7	382	adjust pump
1525	18.10	1500	150	30.05	2.027	0.58	7.27	-28.8	235	
1530	18.10	700	140	30.04	2.022	0.49	7.27	-33.1	183	
1535	18.11	750	150	30.06	2.029	0.41	7.27	-35.3	128	
1540	18.10	700	140	30.04	2.032	0.62	7.28	-36.6	99.8	
1545	18.11	700	140	30.01	2.037	0.71	7.28	-42.7	69.6	
1550	18.13	750	150	29.90	2.047	0.51	7.27	-44.2	46.1	
1555	18.13	800	160	29.84	2.050	0.40	7.26	-44.9	26.6	
1600	18.13	800	160	29.85	2.054	0.36	7.26	-46.8	18.6	
1605	18.15	900	180	29.82	2.056	0.32	7.27	-47.6	14.3	
1610	18.13	900	180	29.81	2.058	0.42	7.25	-47.8	11.8	
1615	18.15	900	180	29.83	2.061	0.32	7.25	-48.0	8.36	
1620	18.15	900	180	29.79	2.068	0.30	7.25	-47.5	7.50	
1625	- **Sample Time** (Note: Flow rate to be btwn. 100 - 250 ml/min.)									Sampler Signature:

Note: Stability achieved when 3 consecutive readings fall within specific parameter ranges shown in the above header.

WELL DETAIL AND SAMPLING LOG

Well ID #: 59GW09 DATE: 5/21/10

PROJECT: NAPR SWMU 59 WEATHER: P. CLOUDY, MID 80s

WELL DATA

(CONDITIONS): (G = Good, F = Fair, P = Poor)

Pad G Well Cap G PVC Locking Cap/Plug G

Cap Lock G Cover Bolts N/A Water over PVC? Y / (N)

Casing (outer) G Casing (inner) 2" SWL Reference Mark Y Reference Mark Location? HIGH PT.

Casing Dia.: 3" SQUARE Casing Material: PVC Flushmount / Stickup

Comments:

(OTHER): Static Water Level (ft.): 18.50 Time: 1415 (Pre-Pump Installation)

Depth to Product (ft.): NA

Water Level (ft.): 18.37 Time: 1425 (Post-Pump Installation, Pre-Purge)

Total Well Depth (ft.) - Post Sampling: Time: 1545

PID Reading (PPM) - Unopened: BKG (0.0) Opened: BKG (0.0

PURGE DATA

Pump Type: BLADDER

From Boring Log: Total Depth (ft.): 22.0 Screened Interval (ft.): 12 - 22

Pump Intake Set @ (ft.): 19 Controller Settings / Pressure: 10±

Comments:

SAMPLE DATA

Sample ID #: 59GW09 Dup.: Y / (N) - (ID#:)

Sample Time: 1510 MS / MSD: Y / (N) Field Filtered: (Y) / N

Sampled By: ROBERT ROSELINS Signature:

Sample Description: CLEAR

SAMPLE CONTAINERS

Bottle Type	Qty.	Preservative	Analysis
40 ml VOA VIAL	3	HCL	VOCs
1 L AMBER	2	—	PEST
" "	2	—	LL SVOCs
500 ml POLY	1	HNO3	METALS
" " "	1	"	DISS METALS

GENERAL COMMENTS

LOW FLOW PURGE DATA SHEET

WELL ID: 59GW09
DATE: 5/21/10
PROJECT: NAPR SWMU 59

SAMPLER (s): ROBERT ROSELINS
SAMPLE ID: 59GW09

TIME [3-5 min.]	DEPTH TO WATER (ft) [<0.3 ft.]	VOL. (ml)	PURGE RATE (ml/min) [250-500 ml/min]	TEMP. (°C)	SP. COND. (mS/cm) [+/- 3%]	D.O. (mg/l) [+/- 10%]	pH (S.U.) [+/- 0.1]	ORP (mV) [+/- 10]	TURBIDITY (NTU) [+/- 10%]	COMMENTS (Sample descrip.: color, clarity, odor - issues and adjustments, etc.)
1425	1837	- (Water Level : Post-Pump Installation, Pre-Start)								
1430	- (Start of Purging)									ADJUST PUMP
1435	18.80	1000	200	29.49	1.816	2.54	7.30	-11.3	40.6	ADJUST PUMP
1440	18.82	200	40	29.34	1.806	1.45	7.24	2.2	24.3	ADJUST PUMP
1445	18.85	300	60	29.35	1.801	1.19	7.23	8.1	15.2	
1450	18.87	300	60	29.26	1.799	1.02	7.23	8.8	11.8	
1455	18.90	300	60	29.25	1.795	1.00	7.23	9.2	7.7	
1500	18.92	300	60	29.22	1.794	0.96	7.24	9.0	6.97	
1505	1893	300	60	29.17	1.789	0.89	7.24	8.8	5.50	
1510	- **Sample Time** (Note: Flow rate to be btwn. 100 - 250 ml/min.)									Sampler Signature:

Note: Stability achieved when 3 consecutive readings fall within specific parameter ranges shown in the above header.

WELL DETAIL AND SAMPLING LOG

Well ID #: 59GW10 DATE: 5/22/10

PROJECT: NAPR SWMU 59 CMS. WEATHER: SUNNY, MID 80s

WELL DATA

(CONDITIONS): (G = Good, F = Fair, P = Poor)

Pad G Well Cap G PVC Locking Cap/Plug G

Cap Lock G Cover Bolts G Water over PVC? Y / (N)

Casing (outer) ____ Casing (inner) 2" SWL Reference Mark Y Reference Mark Location? NIGN PT.

Casing Dia.: ____ Casing Material: PVC (Flushmount) / Stickup

Comments: ____

(OTHER): Static Water Level (ft.): 14.66 Time: 0955 (Pre-Pump Installation)

Depth to Product (ft.): N/A

Water Level (ft.): 1460 Time: 1000 (Post-Pump Installation, Pre-Purge)

Total Well Depth (ft.) - Post Sampling: 22.80 Time: 1215

PID Reading (PPM) - Unopened: BKG(0.0) Opened: BKG(0.0)

PURGE DATA

Pump Type: BLADDER

From Boring Log: Total Depth (ft.): 23 Screened Interval (ft.): 13-23

Pump Intake Set @ (ft.): 19.5 Controller Settings / Pressure: ____

Comments: ____

SAMPLE DATA

Sample ID #: 59GW10 Dup.: Y / (N) - (ID#:)

Sample Time: 1135 MS / MSD: Y / (N) Field Filtered: (Y) / N

Sampled By: A. Gaind | R. Roseius Signature: [signature]

Sample Description: CLEAR

SAMPLE CONTAINERS

Bottle Type	Qty.	Preservative	Analysis
40 ml VOA	3	HCL	VOCs
1L AMBER	2	—	PEST
" "	2	—	LLSVOCs
500 ml POLY	1	HNO_3	METALS
" " "	1	"	DISS METALS

GENERAL COMMENTS

LOW FLOW PURGE DATA SHEET

WELL ID: 59GW10
DATE: 5/22/10
PROJECT: NAPR SWMU 59 CMS

SAMPLER (s): A. Gailey / R Roselius
SAMPLE ID: 59GW10

TIME [3-5 min.]	DEPTH TO WATER (ft) [<0.3 ft.]	VOL. (ml)	PURGE RATE (ml/min) [250-500 ml/min]	TEMP. (°C)	SP. COND. (mS/cm) [+/- 3%]	D.O. (mg/l) [+/- 10%]	pH (S.U.) [+/- 0.1]	ORP (mV) [+/- 10]	TURBIDITY (NTU) [+/- 10%]	COMMENTS (Sample descrip.: color, clarity, odor - issues and adjustments, etc.)
1000	14.60	- (Water Level : Post-Pump Installation, Pre-Start)								
1005	- (Start of Purging)									
1010	14.78	—	—	32.64	2.436	2.55	7.24	-40.3	793	Turbid, Pump Adjust. Slight Sulfur odor
1015	14.73	200	40	32.55	2.361	0.94	7.18	-68.1	668	" "
1020	14.74	200	40	32.65	2.361	0.76	7.17	-77.7	528	Turbid. Slight Sulfur odor
1025	14.76	200	40	32.77	2.358	0.63	7.17	-77.2	489	Turbid but Starting to Clear. Pump Adjust
1030	14.77	250	50	32.60	2.432	0.51	7.16	-68.6	451	Turbid - Clearing. Slight Sulfur odor.
1035	14.77	350	70	32.55	2.318	0.39	7.15	-45.3	289	" " . Pump Adjust Slight.
1040	14.80	450	90	32.58	2.307	0.36	7.15	-33.6	254	Turbid. Slight Pump Adjust.
1045	14.80	470	94	32.43	2.889	0.29	7.14	-22.6	237	Turbid, But Clearing.
1050	14.80	450	90	32.41	2.281	0.27	7.14	-16.8	163	" "
1055	14.77	400	80	32.42	2.265	0.25	7.14	-12.8	86.1	" " . Slight Pump Adjust
1100	14.81	500	100	32.38	2.246	0.24	7.14	-10.5	58.2	Clearing.
1105	14.80	500	100	32.36	2.238	0.22	7.14	-9.9	45.9	" "
1110	14.80	475	95	32.43	2.225	0.20	7.14	-8.7	27.7	" "
1115	14.78	460	92	32.51	2.219	0.20	7.14	-7.7	20.2	
1120	14.80	500	100	32.57	2.215	0.20	7.14	-7.8	14.7	Clear.
1125	14.80	500	100	32.58	2.217	0.20	7.14	-7.9	15.0	Clear
1130	14.80	500	100	32.65	2.218	0.20	7.14	-7.8	15.4	Clear
1135	- Sample Time (Note: Flow rate to be btwn. 100 - 250 ml/min.)									Sampler Signature:

Note: Stability achieved when 3 consecutive readings fall within specific parameter ranges shown in the above header.

CHAIN-OF-CUSTODY FORMS

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CompuChem
a division of Liberty Analytical Corp.

CHAIN OF CUSTODY

501 Madison Ave.
Cary, NC 27513
Phone: 919-379-4100 Fax 919-379-4040

Courier: Fed Ex
Airbill No. 8685 9528 4950
Sampling Complete? Y or (N)

Client/Reporting Information

Company Name: Baker Environmental, Inc.
Address: 100 Airside Drive
City: Moon Twp. State: PA Zip: 15108
Project Contact: Mark Kimes
Phone #: 412-269-2009
Sampler's Name: A. Gailey/R. Roselius

Project Information

Project Name: SWMU 59
Sampling Location: Puerto Rico
Turnaround time: Standard
Batch QC or Project Specific? If Specific, which Sample ID?
Are aqueous samples field filtered for metals? Y or N
Are high concentrations expected? Y or (N) If yes, which ID(s)?

Requested Analysis (include method and bottle type)

CompuChem No. (Lab Use)	Field ID	Collection Date	Collection Time	Matrix	# of bottles	HCl	NaOH	HNO3	H2SO4	MEOH	Other N/A SO4	APP IX VOC (3-40ml)	APP IX Low-Level SVOC (2-AL)	APP IX Pesticides (2-AL) Share 8oz.	APP IX Metals (Total) (1-500ml) (1-2oz.)	APP IX Metals (Dissolved) (N/A)	Total Metals	pH/Sample Info (Lab Use)
1004194-02	59SB01-00	4/19/10	0950	SO	5					1	2	3	1	✓	1		✓	
1004194-03	59SB01-00 D		0950		5					1	2	3	1	✓	1		✓	
1004195-03	59SB01-01		1000		5					1	2	3	1	✓	1		✓	
-04	59SB01-03		1015		5					1	2	3	1	✓	1		✓	
1004194-04	59SB03-00		1135		5					1	2	3	1	✓	1		✓	
1004195-05	59SB03-01		1140		5					1	2	3	1	✓	1		✓	
-06	59SB03-04		1150	SO	5					1	2	3	1	✓	1		✓	
1004193-02	59 FB01		0930	O	8	3		1				3	2*	2*	1			<2
-03	59 ER01		1330	RI	8	3		1				3	2*	2*	1			<2
-04	59TB01	4/19/10		TB	2	2						2					✓	

Lab Use Only

Sample Unpacked By: K. Manning
Sample Order Entry By: [illegible]
Samples Received in Good Condition? (Y) or N
If no, explain:

Cyanide samples checked for sulfide & chlorine? Y or (NA)
625 & Phenol samples checked for chlorine? Y or (NA)
608 samples checked for pH between 5.0-9.0? Y or (NA) EM 4/20/10

Comments

* All 3 40ml soils for 59SB01-00@0950/04.19.10 have 59SB01 written on their labels. (is 59SB01-00 D) 4/21/10
* 1-AL recd. for 4/19/10@1330/PEST w/o an ID on its label. but date & time match other containers & COC.

Sample Custody

Relinquished by: [signature]	Date/Time: 4/20/10 1700	Received by: K. Manning	Date/Time: 4.21.10 0905
Relinquished by:	Date/Time:	Received by:	Date/Time:

Subcontact? Y or (N) If yes, where?
Custody Seal(s) intact? (Y) or N
On Ice? (Y) or N
Cooler Temp: 0.7, 3.1 °C

Samples stored 60 days after date report mailed at no extra charge.

White & Yellow copy to lab • Pink copy for customer

SN0010

10150

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CHAIN OF CUSTODY

CompuChem
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501 Madison Ave.
Cary, NC 27513
Phone: 919-379-4100 Fax 919-379-4040

Courier: Fed Ex
Airbill No. 8685 9528 4950
Sampling Complete? Y or N

Client/Reporting Information

Company Name: Baker Environmental, Inc.
Address: 100 Airside Drive
City: Moon Twp. State: PA Zip: 15108
Project Contact: Mark Kimes
Phone #: 412-269-2009
Sampler's Name: A. Gailey/R. Roselius

Project Information

Project Name: SWMU 59
Sampling Location: Puerto Rico
Turnaround time: Standard
Batch QC or Project Specific? If Specific, which Sample ID?
Are aqueous samples field filtered for metals? Y or N
Are high concentrations expected? Y or N? If yes, which ID(s)?

Requested Analysis (include method and bottle type)

Matrices: GW - Ground water; WW - Waste water; SW - Surface water; SO - Soil/Sediment; TB - Trip Blank; RI - Rinsate; WP - Wipe; O - Other

CompuChem No (Lab Use)	Field ID	Collection Date	Collection Time	Matrix	# of bottles	HCl	NaOH	HNO3	H2SO4	MEOH	Other Na2S2O3	APP IX VOC	APP IX Low-Level SVOC	APP IX Pesticides	APP IX Metals (Total)	APP IX Metals (Dissolved)	pH / Sample Info (Lab Use)
1004194-01	59SB02-00	4/20/10	0835	SO	5					1	2	3	1	✓	1		
	59SB02-00 MS				3					1	2	3					
	59SB02-00 MSD				3					1	2	3					
	59SB02-00 MS/MSD				2								1	✓	1		
1004195-01	59SB02-01		0840		5					1	2	3	1	✓	1		
-09	59SB02-01 D				5					1	2	3	1	✓	1		
1004195-0	59SB02-01 MS				3					1	2	3					
	59SB02-01 MSD				3					1	2	3					
	59SB02-01 MS/MSD				2								1	✓	1		
1004195-02	59SB02-04	4/20/10	0855	SO	5					1	2	3	1	✓	1		

Lab Use Only

Sample Unpacked By: K. Manning
Sample Order Entry By: [illegible]
Samples Received in Good Condition? Y or N
If no, explain:

Cyanide samples checked for sulfide & chlorine? Y or NA
625 & Phenol samples checked for chlorine? Y or NA
608 samples checked for pH between 5.0-9.0? Y or NA

KM 4/21/10

Comments

*3-40ml soils recd. for 59SB02-01@0855/4.20.10 but not listed on COC; same applies for MS/MSD (40mls) on this ID; 3-40mls & MS/MSD 40mls missing from 59SB02-01@0840.
*3-40ml soils recd. for 59SB02-04@0855/4.20.10 but not on COC; 8-40mls for 59SB02-04@0855/4.20.10 missing.

Sample Custody

Relinquished by: [signature]	Date/Time: 4/20/10 1700	Received by: K. Manning	Date/Time: 4.21.10 0905
Relinquished by:	Date/Time:	Received by:	Date/Time:

Subcontact? Y or N If yes, where? Custody Seal(s) intact? Y or N On Ice? Y or N Cooler Temp: 0.7 °C

Samples stored 60 days after date report mailed at no extra charge.

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10149

76

Courier: Fed Ex
Airbill No. 8685 9528 4950
Sampling Complete? Y or N

Client/Reporting Information

Company Name: Baker Environmental, Inc.
Address: 100 Airside Drive
City: Moon Twp. State: PA Zip: 15108
Project Contact: Mark Kimes
Phone #: 412-269-2009
Sampler's Name: A. Gailey/R. Roselius

Project Information

Project Name: SWMU 59
Sampling Location: Puerto Rico
Turnaround time: Standard
Batch QC or Project Specific? If Specific, which Sample ID?
Are aqueous samples field filtered for metals? Y or N
Are high concentrations expected? Y or N If yes, which ID(s)?

Requested Analysis (include method and bottle type)

Matrices: GW - Ground water; WW - Waste water; SW - Surface water; SO - Soil/Sediment; TB - Trip Blank; RI - Rinsate; WP - Wipe; O - Other

CompuChem No (Lab Use)	Field ID	Collection Date	Collection Time	Matrix	# of bottles	HCl	NaOH	HNO3	H2SO4	MEOH	Other Na2S2O3	APP IX VOC (3-40ml)	APP IX Low-Level SVOC (2-AL)	APP IX Pesticides (2-AL)	APP IX Metals (Total) (1-500ml)	APP IX Metals (Dissolved) (1-500ml)	pH / Sample Info (Lab Use): Total Metals	pH / Sample Info (Lab Use): Diss. Metals
1004194-05	59SB06-00	4/20/10	1105	SO	5					1	2	3	1	✓	1			
1004195-07	59SB06-01	↓	1110	SO	5					1	2	3	1	✓	1			
↓ -08	59SB06-03	↓	1115	SO	5					1	2	3	1	✓	1			
~~1004193-01~~ 1004196-01	59SW01	4/20/10	0800	SW	9	3		2				3	2	2	1	1	<2	<2

Lab Use Only

Sample Unpacked By: K. Manning
Sample Order Entry By: [illegible]
Samples Received in Good Condition? Y or N
If no, explain:

Cyanide samples checked for sulfide & chlorine? Y or NA
625 & Phenol samples checked for chlorine? Y or NA
608 samples checked for pH between 5.0-9.0? Y or NA

Comments

Sample Custody

Relinquished by:	Date/Time: 4/20/10 1700	Received by: K. Manning	Date/Time: 4.21.10 0905
Relinquished by:	Date/Time:	Received by:	Date/Time:

Subcontact? Y or N If yes, where?
Custody Seal(s) intact? Y or N
On Ice? Y or N
Cooler Temp: 0.7 °C

Samples stored 60 days after date report mailed at no extra charge.

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Page 1 of 2

Courier Fed Ex
Airbill No. 8685 9528 4960
Sampling Complete? Y or (N)

Client/Reporting Information

Company Name: Baker Environmental, Inc.
Address: 100 Airside Drive
City: Moon Twp. State: PA Zip: 15108
Project Contact: Mark Kimes
Phone #: 412-269-2009
Sampler's Name: A. Gailey/R. Roselius

Project Information

Project Name: SWMU 59
Sampling Location: Puerto Rico
Turnaround time: Standard
Batch QC or Project Specific? If Specific, which Sample ID?
Are aqueous samples field filtered for metals? Y or (N)
Are high concentrations expected? Y or (N)? If yes, which ID(s)?

Requested Analysis (include method and bottle type)

Matrices: GW - Ground water; WW - Waste water; SW - Surface water; SO - Soil/Sediment; TB - Trip Blank; RI - Rinsate; WP - Wipe; O - Other

CompuChem No (Lab Use)	Field ID	Collection Date	Collection Time	Matrix	# of bottles	HCl	NaOH	HNO3	H2SO4	MEOH	Other 2oz jar Preserve	APP IX VOC (3-40mL)	APP IX Low-Level SVOC (Share 8oz.)	APP IX Pesticides	APP IX Metals (Total) (1-2oz.)	APP IX Metals (Dissolved) (N/A)	pH / Sample Info. (Lab Use)
1004194-06	59SB07-00	4/21/10	0855	SO	5					1	2	3	1	✓	1		
1004195-10	59SB07-01		~~0900~~														
-11	59SB07-01 D		~~0900~~														
-12	59SB07-05		0910														
1004194-07	59SB08-00		1055														
1004195-13	59SB08-01		1100														
-14	59SB08-05		1110														
-15	59SB10-01		1455														
-16	59SB10-05		1500														
1004194-08	59SB09-00	4/22/10	1030	SO	5					1	2	3	1	✓	1		

Lab Use Only

Sample Unpacked By: K. Manning
Sample Order Entry By:
Samples Received in Good Condition? (Y) or N
If no, explain:

Cyanide samples checked for sulfide & chlorine? Y or (NA)
625 & Phenol samples checked for chlorine? Y or (NA)
608 samples checked for pH between 5.0-9.0? Y or (NA)

Comments

① 8oz. for 59SB08-05/1110/4-21-10 does not have sample date on its label.

Sample Custody

Relinquished by:	Date/Time: 4/22/10 1630	Received by: K. Manning	Date/Time: 4-23-10 0905
Relinquished by:	Date/Time:	Received by:	Date/Time:

Subcontact? Y or (N) If yes, where?
Custody Seal(s) intact? (Y) or N
On Ice? (Y) or N
Cooler Temp: 1.7; 1.9 °C

Samples stored 60 days after date report mailed at no extra charge.

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Residual Chlorine Present?
Yes _____ No ✓

10145

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Courier Fed Ex
Airbill No. 8685 9528 4960
Sampling Complete? Y or (N)

Client/Reporting Information

Company Name: Baker Environmental, Inc.
Address: 100 Airside Drive
City: Moon Twp. State: PA Zip: 15108
Project Contact: Mark Kimes
Phone #: 412-269-2009
Sampler's Name: A. Gailey/R. Roselius

Project Information

Project Name: SWMU 59
Sampling Location: Puerto Rico
Turnaround time: Standard
Batch QC or Project Specific? If Specific, which Sample ID?
Are aqueous samples field filtered for metals? Y or (N)
Are high concentrations expected? Y or (N)? If yes, which ID(s)?

Requested Analysis (include method and bottle type)

Matrices: GW - Ground water; WW - Waste water; SW - Surface water; SO - Soil/Sediment; TB - Trip Blank; RI - Rinsate; WP - Wipe; O - Other

CompuChem No (Lab Use)	Field ID	Collection Date	Collection Time	Matrix	# of bottles	HCl	NaOH	HNO3	H2SO4	MEOH	Other Specify Bottle Type	APP IX VOC (3-40ml)	APP IX Low-Level SVOC (2-AL)	APP IX Pesticides (2-AL) X Share 8oz.	APP IX Metals (Total) (1-500ml)	APP IX Metals (Dissolved) (N/A)	TOC (1-2oz.)					pH / Sample Info (Lab Use) Metals
1004195-17	59SB09-01	4/22/10	1035	SO	5					1	2	3	1	✓	1							/
-18	59SB09-05	4/22/10	1125	SO	5					1	2	3	1	✓	1							/
1004193-05	59ER02	4/20/10	1430	RI	8	3		1				3	2	2 ①	1							2
-06	59ER03	4/21/10	1300	RI	8	3		1				3	2	2	1							2
-07	59ER04	4/22/10	0810	RI	8	3		1				3	2	2	1							2
1004208-01	59SD01	4/22/10	0905	SO						1	2	3	1	✓	1		1					/
1004193-08	59TB02	4/20/10		TB	2	2						2										/

Lab Use Only

Sample Unpacked By: K. Manning
Sample Order Entry By: [signature]
Samples Received in Good Condition? Y or (N)
If no, explain: * see comments - KM 4.23.10

Cyanide samples checked for sulfide & chlorine? Y or (N)
625 & Phenol samples checked for chlorine? Y or (N)
608 samples checked for pH between 5.0-9.0? Y or (N)

Comments

① AL rec'd. broken for 59ER02 @ 1430/PEST.
② Rec'd. 1-8oz., 1-2oz., 2-40ml (NaHSO4) & 1-40ml (MeOH) for sample IDs: 59SB05-05 & 59SB05-01; not listed on COC. 4/20 @ 1405 1004195-20 4/20 @ 1315 1004195-19

Sample Custody

Relinquished by: [signature] Date/Time: 4/22/10 1630 Received by: K. Manning Date/Time: 4.23.10 0905
Relinquished by: Date/Time: Received by: Date/Time:
Subcontact? Y or (N) If yes, where? Custody Seal(s) intact? (Y) or N On Ice? (Y) or N Cooler Temp: 2.7; 1.7; 1.9 °C

Samples stored 60 days after date report mailed at no extra charge.

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Page 1 of 1

Courier: Fed Ex
Airbill No. 8685 9528 4971
Sampling Complete? Y or (N)

Client/Reporting Information

Company Name: Baker Environmental, Inc.
Address: 100 Airside Drive
City: Moon Twp. State: PA Zip: 15108
Project Contact: Mark Kimes
Phone #: 412-269-2009
Sampler's Name: A. Gailey/R. Roselius

Project Information

Project Name: SWMU 59
Sampling Location: Puerto Rico
Turnaround time: Standard
Batch QC or Project Specific? If Specific, which Sample ID?
Are aqueous samples field filtered for metals? Y or (N)
Are high concentrations expected? Y or (N) If yes, which ID(s)?

Requested Analysis (include method and bottle type)

Matrices: GW - Ground water; WW - Waste water; SW - Surface water; SO - Soil/Sediment; TB - Trip Blank; RI - Rinsate; WP - Wipe; O - Other

CompuChem No (Lab Use)	Field ID	Collection Date	Collection Time	Matrix	# of bottles	HCl	NaOH	HNO3	H2SO4	MEOH	Other Sodium Bisulfate	APP IX VOC	APP IX Low-Level SVOC	APP IX Pesticides	APP IX Metals (Total)	APP IX Metals (Dissolved)	pH/Sample Info (Lab Use)
1004194-09	59SB04-00	4/22/10	1440	SO	5					1	2	3	1	✓	1		
-10	59SB04-01		1445	SO	5					1	2	3	1	✓	1		
-11	59SB04-05		1450	SO	5					1	2	3	1	✓	1		
1004193-09	59TB03	4/22/10		TB	2	2						2					

Lab Use Only

Sample Unpacked By:
Sample Order Entry By:
Samples Received in Good Condition? Y or N
If no, explain:

Cyanide samples checked for sulfide & chlorine? Y or NA
625 & Phenol samples checked for chlorine? Y or NA
608 samples checked for pH between 5.0-9.0? Y or NA

Comments

Sample Custody

Relinquished by:	Date/Time: 4/23/10 1500	Received by:	Date/Time: 4.24.10 1140
Relinquished by:	Date/Time:	Received by:	Date/Time:
Subcontact? Y or (N) If yes, where?	Custody Seal(s) intact? Y or N	On Ice? (Y) or N	Cooler Temp: 3.1 °C

Samples stored 60 days after date report mailed at no extra charge.

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SN0010

Mark Kimes cell (412) 337-7465

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10072

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Phone: 919-379-4100 Fax 919-379-4040

Courier: Fed Ex 8617 8652 7101
Airbill No.
Sampling Complete? Y or N

Client/Reporting Information

Company Name: Baker Environmental, Inc.
Address: 100 Airside Drive
City: Moon Twp. State: PA Zip: 15108
Project Contact: Mark Kimes
Phone #: 412-269-2009
Sampler's Name: A. Gailey/R. Roselius

Project Information

Project Name: SWMU 59
Sampling Location: Puerto Rico
Turnaround time: Standard
Batch QC or Project Specific? If Specific, which Sample ID?
Are aqueous samples field filtered for metals? Y or N
Are high concentrations expected? Y or N If yes, which ID(s)?

Matrices: GW - Ground water; WW - Waste water; SW - Surface water; SO - Soil/Sediment; TB - Trip Blank; RI - Rinsate; WP - Wipe; O - Other

CompuChem No (Lab Use)	Field ID	Collection Date	Collection Time	Matrix	# of bottles	HCl	NaOH	HNO3	H2SO4	MEOH	Other NaHSO4	APP IX VOC (3-40ml)	APP IX Low-Level SVOC (Share 1-8oz)	APP IX Pesticides	APP IX Metals (Total) (1-2oz)	APP IX Metals (Dissolved)	pH/Sample Info (Lab Use)
1005176-02	59SB11-00	5/19/10	0935	SO	5					1	2	3	1	✓	1		
-03	59SB11-00D		0935		5					1	2	3	1	✓	1		
1005176-01	59SB11-01		0945		5					1	2	3	1	✓	1		
1005176-04	59SB11-01D		0945		5					1	2	3	1	✓	1		
1005176-01	59SB11-01 MS		0945		3					1	2	3					
	59SB11-01 MSD		0945		3					1	2	3					
	59SB11-01 MS/MSD		0945		2								1	✓	1		
1005176-05	59SB11-02	5/19/10	0955		5					1	2	3	1	✓	1		
-06	59SB12-00	5/18/10	1220		5					1	2	3	1	✓	1		
-07	59SB12-01	5/18/10	1225	SO	5					1	2	3	1	✓	1		

SO2 has "59SB11-00D" @ 0945 OK per Adam & Robert

containers (3oz/4oz) have "59SB11-05" should be 59SB01-02 per Adam & Robert

Lab Use Only

Sample Unpacked By: K. Manning
Sample Order Entry By:
Samples Received in Good Condition? Y or N
If no, explain:

Cyanide samples checked for sulfide & chlorine? Y or NA
625 & Phenol samples checked for chlorine? Y or NA
608 samples checked for pH between 5.0-9.0? Y or NA

Comments

~~* see discrepancies page - KM 5.21.10~~ 5/21/10
* VOC pre-pres. vials missing for 59SB11-02. contacted Adam, Robert & Mark / may resample by hand augers (did not receive VOC vials) 5/21/10

Sample Custody

Relinquished by:	Date/Time: 5/20/10 1530	Received by: K. Manning	Date/Time: 5.21.10 0915
Relinquished by:	Date/Time:	Received by:	Date/Time:

Subcontact? Y or N If yes, where?
Custody Seal(s) intact? Y or N
On Ice? Y or N
Cooler Temp: 3.2, 0.9, 2.2 °C

Samples stored 60 days after date report mailed at no extra charge.

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5N0010

10071 273

CHAIN OF CUSTODY

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501 Madison Ave.
Cary, NC 27513
Phone: 919-379-4100 Fax 919-379-4040

Courier: Fed Ex
Airbill No.
Sampling Complete? Y or N

Client/Reporting Information

Company Name: Baker Environmental, Inc.
Address: 100 Airside Drive
City: Moon Twp. State: PA Zip: 15108
Project Contact: Mark Kimes
Phone #: 412-269-2009
Sampler's Name: A. Gailey/R. Roselius

Project Information

Project Name: SWMU 59
Sampling Location: Puerto Rico
Turnaround time: Standard
Batch QC or Project Specific? If Specific, which Sample ID?
Are aqueous samples field filtered for metals? Y or N
Are high concentrations expected? Y or N If yes, which ID(s)?

Matrices: GW - Ground water; WW - Waste water; SW - Surface water; SO - Soil/Sediment; TB - Trip Blank; RI - Rinsate; WP - Wipe; O - Other

CompuChem No. (Lab Use)	Field ID	Collection Date	Collection Time	Matrix	# of bottles	HCl	NaOH	HNO3	H2SO4	MEOH	Other Na2S2O4	APP IX VOC	APP IX Low-Level SVOC	APP IX Pesticides	APP IX Metals (Total)	APP IX Metals (Dissolved)	pH / Sample Info (Lab Use)
1005176-08	59SB12-05	5/18/10	1230	SO	5					1	2	3	1	✓	1		
1005177-01	59SB13-00		0935		5					1	2	3	1	✓	1		
	59SB13-00 MS		0935		3					1	2	3					
	59SB13-00 MSD		0935		3					1	2	3					
	59SB13-00 MS/MSD		0935		2								1	✓	1		
1005178-01	59SB13-01		0945		5					1	2	3	1	✓	1		
-02	59SB13-01 D		0945		5					1	2	3	1	✓	1		
1005178-01	59SB13-01 MS		0945		3					1	2	3					
	59SB13-01 MSD		0945		3					1	2	3					
	59SB13-01 MS/MSD	5/18/10	0945	SO	2								1	✓	1		

labeled w/ date & time only

Lab Use Only

Sample Unpacked By: K. Manning
Sample Order Entry By: [illegible]
Samples Received in Good Condition? Y or N
If no, explain:

Cyanide samples checked for sulfide & chlorine? Y or NA
625 & Phenol samples checked for chlorine? Y or NA
608 samples checked for pH between 5.0-9.0? Y or NA

Comments

~~* See discrepancies page. KM 5-21-10~~ 5/21/10
rec'd 3-40ml, 1-8oz, 1-2oz. for 59SB13-05 5/18/10 @0935 not on COC. 1005178-03
5/21/10

Sample Custody

Relinquished by: [signature]	Date/Time: 5/20/10 1530	Received by: K. Manning	Date/Time: 5-21-10 0915
Relinquished by:	Date/Time:	Received by:	Date/Time:

Subcontact? Y or N If yes, where?
Custody Seal(s) intact? Y or N
On Ice? Y or N
Cooler Temp: 3.2, 1.0, 0.9 °C 2.2

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S100010

10163 204

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Courier: Fed Ex
Airbill No.
Sampling Complete? Y or N

Client/Reporting Information

Company Name: Baker Environmental, Inc.
Address: 100 Airside Drive
City: Moon Twp. State: PA Zip: 15108
Project Contact: Mark Kimes
Phone #: 412-269-2009
Sampler's Name: A. Gailey/R. Roselius

Project Information

Project Name: SWMU 59
Sampling Location: Puerto Rico
Turnaround time: Standard
Batch QC or Project Specific? If Specific, which Sample ID?
Are aqueous samples field filtered for metals? Y or N
Are high concentrations expected? Y or N? If yes, which ID(s)?

Matrices: GW - Ground water; WW - Waste water; SW - Surface water; SO - Soil/Sediment; TB - Trip Blank; RI - Rinsate; WP - Wipe; O - Other

CompuChem No (Lab Use)	Field ID	Collection Date	Collection Time	Matrix	# of bottles	HCl	NaOH	HNO3	H2SO4	MEOH	Other Na2S2O3	APP IX VOC	APP IX Low-Level SVOC	APP IX Pesticides	APP IX Metals (Total)	APP IX Metals (Dissolved)	pH / Sample Info (Lab Use)
1005176-09	59SB14-00	5/19/10	1145	SO	5					1	2	3	1	✓	1		
-10	59SB14-01	5/19/10	1150														
-11	59SB14-05	5/19/10	1200														
-12	59SB15-00	5/18/10	1315														
-13	59SB15-01		1320														
-14	59SB15-05		1330														
-15	59SB16-01		1020														
-16	59SB16-05		1030														
-17	59SB17-00		1055														
-18	59SB17-00D	5/18/10	1055	SO	5					1	2	3	1	✓	1		

MeOH vial has "59SB14-01" instead of "-05" @ 1200

~~time on vials 1020~~ all 59SB15-00 containers match 5/21/10

vials have "59SB15-01" @ 1020 VOC OK to use for 59SB16-01 Adam Robert

Lab Use Only

Sample Unpacked By: K. Manning
Sample Order Entry By:
Samples Received in Good Condition? Y or N
If no, explain:

Cyanide samples checked for sulfide & chlorine? Y or N A
625 & Phenol samples checked for chlorine? Y or N A
608 samples checked for pH between 5.0-9.0? Y or N A

Comments

~~* see discrepancies page, KMS-21-10~~ 5/21/10
recd 59SB17-01 5/18/10 @ 1100 1005176-19
& 59SB17-05 5/18/10 1110 1005176-20
not on COC 5/21/10

Sample Custody

Relinquished by: Date/Time: Received by: K. Manning Date/Time: 5.21.10 0915
Relinquished by: Date/Time: Received by: Date/Time:
Subcontact? Y or N If yes, where? Custody Seal(s) intact? Y or N On Ice? Y or N Cooler Temp: 3.2, 1.0, 0.9, 2.2 °C

Samples stored 60 days after date report mailed at no extra charge.

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CHAIN OF CUSTODY

501 Madison Ave.
Cary, NC 27513
Phone: 919-379-4100 Fax 919-379-4040

Courier: Fed Ex
Airbill No.
Sampling Complete? Y or N

Client/Reporting Information

Company Name: Baker Environmental, Inc.
Address: 100 Airside Drive
City: Moon Twp. State: PA Zip: 15108
Project Contact: Mark Kimes
Phone #: 412-269-2009
Sampler's Name: A. Gailey/R. Roselius

Project Information

Project Name: SWMU 59
Sampling Location: Puerto Rico
Turnaround time: Standard
Batch QC or Project Specific? If Specific, which Sample ID?
Are aqueous samples field filtered for metals? Y or N
Are high concentrations expected? Y or N? If yes, which ID(s)?

Matrices: GW - Ground water; WW - Waste water; SW - Surface water; SO - Soil/Sediment; TB - Trip Blank; RI - Rinsate; WP - Wipe; O - Other

CompuChem No (Lab Use)	Field ID	Collection Date	Collection Time	Matrix	# of bottles	HCl	NaOH	HNO3	H2SO4	MEOH	Other Na2S2O3	APP IX VOC	APP IX Low-Level SVOC	APP IX Pesticides	APP IX Metals (Total)	APP IX Metals (Dissolved)	pH / Sample Info (Lab Use)
1005177-02	59SB18-00	5/19/10	0900	SO	5					1	2	3	1	✓	1		
-03	59SB18-01		0905														
-04	59SB18-02		0915														
-05	59SB19-01		1110														
-06	59SB19-05		1120														
-07	59SB20-00		1015														
-08	59SB20-01		1050														
-09	59SB20-05	5/19/10	1100														
-10	59SB21-00	5/18/10	1430														
-11	59SB21-01	5/18/10	1435	SO	5					1	2	3	1	✓	1		

Lab Use Only

Sample Unpacked By: K. Manning
Sample Order Entry By:
Samples Received in Good Condition? Y or N
If no, explain:
Cyanide samples checked for sulfide & chlorine? Y or N/A
625 & Phenol samples checked for chlorine? Y or N/A
608 samples checked for pH between 5.0-9.0? Y or N/A

Comments

~~* See discrepancies page. KM 5-21-10~~ 5/21/10

Sample Custody

Relinquished by:	Date/Time:	Received by: K. Manning	Date/Time: 5.21.10 0915
Relinquished by:	Date/Time:	Received by:	Date/Time:
Subcontact? Y or N If yes, where?	Custody Seal(s) intact? Y or N	On Ice? Y or N	Cooler Temp: 3.2, 1.0, 0.9, 2.2 °C

Samples stored 60 days after date report mailed at no extra charge.

White & Yellow copy to lab • Pink copy for customer

SN0010

Residual Chlorine Present? Yes ____ No ✓

CompuChem
a division of Liberty Analytical Corp.

CHAIN OF CUSTODY

501 Madison Ave.
Cary, NC 27513
Phone: 919-379-4100 Fax 919-379-4040

10152

275

Courier: Fed Ex
Airbill No.
Sampling Complete? Y or (N)

Client/Reporting Information

Company Name: Baker Environmental, Inc.
Address: 100 Airside Drive
City: Moon Twp. State: PA Zip: 15108
Project Contact: Mark Kimes
Phone #: 412-269-2009
Sampler's Name: A. Gailey/R. Roselius

Project Information

Project Name: SWMU 59
Sampling Location: Puerto Rico
Turnaround time: Standard
Batch QC or Project Specific? If Specific, which Sample ID?
Are aqueous samples field filtered for metals? Y or (N)
Are high concentrations expected? Y or (N) If yes, which ID(s)?

Matrices: GW - Ground water; WW - Waste water; SW - Surface water; SO - Soil/Sediment; TB - Trip Blank; RI - Rinsate; WP - Wipe; O - Other

CompuChem No (Lab Use)	Field ID	Collection Date	Collection Time	Matrix	# of bottles	HCl	NaOH	HNO3	H2SO4	MEOH	Other Vol/Sp	APP IX VOC	APP IX Low-Level SVOC	APP IX Pesticides	APP IX Metals (Total)	APP IX Metals (Dissolved)						pH / Sample Info (Lab Use)
1005177-12	59SB21-05	5/18/10	1100	SO	5					1	2	3	1	✓	1		+mean containers 15				1445	
-13	59SB22-00		1345																			
-14	59SB22-01		1350																			
-15	59SB22-05		1400																			
-16	59SB21-01D	5/18/10	1435																			
-17	59SB23-00	5/19/10	0830																			
-18	59SB23-01	5/19/10	0835																			
-19	59SB23-05	5/19/10	0845	SO	5					1	2	3	1	✓	1							
1005175-01	59FB02*	5/18/10	1310	O	8	3		1				3	2	2	1							<2
-02	59ER05	5/18/10	1250	RI	8	3		1				3	2	2	1							<2

Lab Use Only

Sample Unpacked By: K. Manning
Sample Order Entry By:
Samples Received in Good Condition? Y or (N)
If no, explain: * see comments - KMS 5-21-10
Cyanide samples checked for sulfide & chlorine? Y or (N)
625 & Phenol samples checked for chlorine? Y or (N)
608 samples checked for pH between 5.0-9.0? Y or (N)

Comments

*59FB02 - 1 AL (PEST) Received Broken
~~*see discrepancies page, KMS 21-10~~ 5/21/10

Sample Custody

Relinquished by:	Date/Time:	Received by: K. Manning	Date/Time: 5-21-10 0915
Relinquished by:	Date/Time:	Received by:	Date/Time:
Subcontact? Y or (N) If yes, where?	Custody Seal(s) intact? (Y) or N	On Ice? (Y) or N	Cooler Temp: ~~2.2~~ 1.0, 3.2, 0.4, 1.3, 2.2

Samples stored 60 days after date report mailed at no extra charge.

White & Yellow copy to lab • Pink copy for customer

SN0010

CompuChem
a division of Liberty Analytical Corp.

Residual Chlorine Present?
Yes _____ No ✓

CHAIN OF CUSTODY

501 Madison Ave.
Cary, NC 27513
Phone: 919-379-4100 Fax 919-379-4040

10153

114

Courier: Fed Ex
Airbill No.
Sampling Complete? Y or N

Client/Reporting Information

Company Name: Baker Environmental, Inc.
Address: 100 Airside Drive
City: Moon Twp. State: PA Zip: 15108
Project Contact: Mark Kimes
Phone #: 412-269-2009
Sampler's Name: A. Gailey/R. Roselius

Project Information

Project Name: SWMU 59
Sampling Location: Puerto Rico
Turnaround time: Standard
Batch QC or Project Specific? If Specific, which Sample ID?
Are aqueous samples field filtered for metals? Y or N
Are high concentrations expected? Y or N? If yes, which ID(s)?

Requested Analysis (include method and bottle type)

Matrices: GW - Ground water; WW - Waste water; SW - Surface water; SO - Soil/Sediment; TB - Trip Blank; RI - Rinsate; WP - Wipe; O - Other

CompuChem No (Lab Use)	Field ID	Collection Date	Collection Time	Matrix	# of bottles	HCl	NaOH	HNO3	H2SO4	MEOH	Other Na2S2O3	APP IX VOC	APP IX Low-Level SVOC	APP IX Pesticides	APP IX Metals (Total)	APP IX Metals (Dissolved)	TOC (Lab Kathy Method)					pH / Sample Info (Lab Use) Dis. Mtls	Total Mtls			
1005175-06	59TB04	5/19/10		TB	3	3						3														
1005175-03	59ER06**	5/19/10	1310	RI	8	3		1				3	2	2	1									<2		
1005175-04 / 1005179-01	59SW02	5/20/10	1115	SW	9	3		2				3	2	2	1	1										
1005176-05 / 1005179-02	59SW03*	↓	1120	SW	9	3		2				3	2	2	1	1										
1005178-04	59SD02	↓	1130	SO	6					1	2	3	1	✓	1		1					<2	<2			
-05	59SD03	5/20/10	1150	SO	6					1	2	3	1	✓	1		1					<2	<2			

KM 5/21/10

Lab Use Only

Sample Unpacked By: K. Manning
Sample Order Entry By: [illegible]
Samples Received in Good Condition? Y or N
If no, explain: * DB - 5.21.10

Cyanide samples checked for sulfide & chlorine? Y or NA
625 & Phenol samples checked for chlorine? Y or NA
608 samples checked for pH between 5.0-9.0? Y or NA

Comments

* 59SW03 - one AL (PEST) was rec'd. w/ cracked & unscrewed lid, will not use (have 3 other good ones)
** 59ER06 1 AL (SV) received broken - DB 5/21/10
~~* See DISCREPANCIES page. - KM 5/21/10~~ 5/21/10

Sample Custody

Relinquished by:	Date/Time:	Received by: K. Manning	Date/Time: 5.21.10 0915
Relinquished by:	Date/Time:	Received by:	Date/Time:
Subcontact? Y or N If yes, where?		Custody Seal(s) intact? Y or N	On Ice? Y or N

Cooler Temp: ~~2.2~~, 1.0, 1.3, 2.2 °C 5-21-10 KM

Samples stored 60 days after date report mailed at no extra charge.

White & Yellow copy to lab • Pink copy for customer

SN0010

Residual Chlorine Present?
Yes ____ No ✓

CompuChem
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CHAIN OF CUSTODY

501 Madison Ave.
Cary, NC 27513
Phone: 919-379-4100 Fax 919-379-4040

10155

Page 1 of 1

115

Courier Fed Ex
Airbill No. 8617 8652 7097
Sampling Complete? Y or (N)

Client/Reporting Information

Company Name: Baker Environmental, Inc.
Address: 100 Airside Drive
City: Moon Twp. State: PA Zip: 15108
Project Contact: Mark Kimes
Phone #: 412-269-2009
Sampler's Name: A. Gailey/R. Roselius

Project Information

Project Name: SWMU 59
Sampling Location: Puerto Rico
Turnaround time: Standard
Batch QC or Project Specific? If Specific, which Sample ID?
Are aqueous samples field filtered for metals? (Y) or N
Are high concentrations expected? Y or (N)? If yes, which ID(s)?

Requested Analysis (include method and bottle type)

Matrices
GW - Ground water
WW - Waste water
SW - Surface water
SO - Soil/Sediment
TB - Trip Blank
RI - Rinsate
WP - Wipe
O - Other

CompuChem No (Lab Use)	Field ID	Collection Date	Collection Time	Matrix	# of bottles	HCl	NaOH	HNO3	H2SO4	MEOH	Other	APP IX VOC (3-40ml)	APP IX Low-Level SVOC (2-AL)	APP IX Pesticides (2-AL)	APP IX Metals (Total) (1-500ml)	APP IX Metals (Dissolved) (1-500ml)						pH / Sample Info (Lab Use) TOTAL METALS	DISSOLVED METALS
1005175-07 1005175-08	59GW07	5/21/10	1025	GW	9	3		2				3	2	2	1	1						<2	<2
1005175-08	59ER09 07 APP 11/17/10	5/20/10	1715	RI	8	3		1				3	2	2	1							<2	/
-09	59ER10 08 APP 11/17/10	5/21/10	1145	RI	8	3		1				3	2	2	1							<2	/
-10	59TB05	5/21/10		TB	3	3						3										/	/

Lab Use Only

Sample Unpacked By: K. Manning
Sample Order Entry By: [illegible]
Samples Received in Good Condition? (Y) or N
If no, explain:

Cyanide samples checked for sulfide & chlorine? Y or (NA)
625 & Phenol samples checked for chlorine? Y or (NA)
608 samples checked for pH between 5.0-9.0? Y or (NA)

Comments

Sample Custody

Relinquished by: [signature]	Date/Time: 5/21/10 1530	Received by: K. Manning	Date/Time: 5.22.10 1050
Relinquished by:	Date/Time:	Received by:	Date/Time:
Subcontact? Y or N If yes, where?	Custody Seal(s) intact? (Y) or N	On Ice? (Y) or N	Cooler Temp: 3.7, 0.1 °C

Samples stored 60 days after date report mailed at no extra charge.

White & Yellow copy to lab • Pink copy for customer SN0010

10156 116

CHAIN OF CUSTODY

CompuChem
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501 Madison Ave.
Cary, NC 27513
Phone: 919-379-4100 Fax 919-379-4040

Courier: Fed Ex
Airbill No. 8617 8652 7064
Sampling Complete? (Y) or N

Client/Reporting Information

Company Name: Baker Environmental, Inc.
Address: 100 Airside Drive
City: Moon Twp. State: PA Zip: 15108
Project Contact: Mark Kimes
Phone #: 412-269-2009
Sampler's Name: A. Gailey/R. Roselius

Project Information

Project Name: SWMU 59
Sampling Location: Puerto Rico
Turnaround time: Standard
Batch QC or Project Specific? If Specific, which Sample ID?
Are aqueous samples field filtered for metals? (Y) or N
Are high concentrations expected? Y or (N) If yes, which ID(s)?

Matrices: GW - Ground water; WW - Waste water; SW - Surface water; SO - Soil/Sediment; TB - Trip Blank; RI - Rinsate; WP - Wipe; O - Other

CompuChem No (Lab Use)	Field ID	Collection Date	Collection Time	Matrix	# of bottles	HCl	NaOH	HNO3	H2SO4	MEOH	Other	APP IX VOC 3-40 mL	APP IX Low-Level SVOC 2 AL	APP IX Pesticides 2 AL	APP IX Metals (Total) 500ml	APP IX Metals (Dissolved) 500ml					pH/Sample Info Lab Use: Total Metals	Dissolved Metals	Dissolved Metals	Total Metals
1005175-11 / 100517904	59GW09	5/21/10	1510	GW	9	3		2				3	2	2	1	1					½	½	½	½
1005175-12 / 100517905	59GW10	5/22/10	1135																		½	½	½	½
1005175-13 / 100517906	59GW03	5/22/10	1315										①				* rec'd SSV broken for 59GW03 (JD) 5.25.10				½	½	½	½
1005175-14 / 100517907	59GW08	5/23/10	1625																		3	½	½	3
1005175-15 / 100517908	59GW02	5/23/10	0910																		½	½	½	½
1005175-16 / 100517909	59GW04	5/23/10	1205																		½	½	½	½
1005175-17 / 100517910	59GW02 D	5/23/10	0910																		½	½	½	½
1005175-18 / 100517908	59GW02 MS		0910																		½	½	½	½
1005175-19 / 100517908	59GW02 MSD	5/23/10	0910														* rec'd MTL with cracked lid for 59GW02 MSD (JD) 5.25.10				1	½	½	1
1005175-18	59GW06	5/21/10	1315	GW	9	3		2				3	2	2	1	1		will not use MSD container			½	½	½	½

Lab Use Only

Sample Unpacked By: Jennifer Doer
Sample Order Entry By: [signature]
Samples Received in Good Condition? Y or (N)
If no, explain: see comments above (JD) 5.25.10

Cyanide samples checked for sulfide & chlorine? Y or (NA)
625 & Phenol samples checked for chlorine? Y or (NA)
608 samples checked for pH between 5.0-9.0? Y or (NA)

Comments

Residual Chlorine Present?
Yes ____ No ✓
5/20/10

Sample Custody

Relinquished by: [signature]	Date/Time: 5/24/10 1600	Received by: Jennifer Doer	Date/Time: 5.25.10 09:20
Relinquished by:	Date/Time:	Received by:	Date/Time:
Subcontact? Y or (N) If yes, where?		Custody Seal(s) intact? (Y) or N	On Ice (Y) or N	Cooler Temp: 1.3, 0.6, 0.9, 0.4

Samples stored 60 days after date report mailed at no extra charge.

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3.2, 0.7
0.5, 0.1

CHAIN OF CUSTODY

CompuChem
a division of Liberty Analytical Corp.
501 Madison Ave.
Cary, NC 27513
Phone: 919-379-4100 Fax 919-379-4040

Courier: Fed Ex
Airbill No. 8617 8652 7064
Sampling Complete? Y or N

Client/Reporting Information

Company Name: Baker Environmental, Inc.
Address: 100 Airside Drive
City: Moon Twp. State: PA Zip: 15108
Project Contact: Mark Kimes
Phone #: 412-269-2009
Sampler's Name: A. Gailey/R. Roselius

Project Information

Project Name: SWMU 59
Sampling Location: Puerto Rico
Turnaround time: Standard
Batch QC or Project Specific? If Specific, which Sample ID?
Are aqueous samples field filtered for metals? Y or N
Are high concentrations expected? Y or N? If yes, which ID(s)?

Matrices: GW - Ground water; WW - Waste water; SW - Surface water; SO - Soil/Sediment; TB - Trip Blank; RI - Rinsate; WP - Wipe; O - Other

CompuChem No (Lab Use)	Field ID	Collection Date	Collection Time	Matrix	# of bottles	HCl	NaOH	HNO3	H2SO4	MEOH	Other	APP IX VOC 3-40mL	APP IX Low-Level SVOC 2-AL	APP IX Pesticides 2AL	APP IX Metals (Total) 500mL	APP IX Metals (Dissolved) 500mL	TCLP VOC	TCLP SVOC + Metals	RIC			Total Metals	Dissolved Metals	CN	TPH
1005175-19	59GW01	5/22/10	0835	GW	9	3		2				3	2	2	1	1						>2	>2	<2	<2
1005175-20	59GW05	5/23/10	1450	GW	9	3		2				3	2	2	1	1						>2	>2	<2	<2
1005175-21	59ER09	5/22/10	0800	RI		3		1				3	2	2	1							>2	/	/	<2
1005175-22	59ER10	5/23/10	1535	RI		3		1				3	2	2	1							>2	/	/	<2
1005188-01	59ER11	5/24/10	1100	RI		3						3										/	/	/	/
1005191-01 1005191-02	59IDW01	5/24/10	0850	O	3												1	1	1	SOIL		/	/	/	/
1005192-01 1005192-02	59IDW02	5/24/10	0845	O	4												1	2	1	H2O		/	/	/	/
1005188-02	59TB06	5/22/10		TB	3	3						3										/	/		

Lab Use Only

Sample Unpacked By: Jennifer Doles
Sample Order Entry By: [illegible]
Samples Received in Good Condition? Y or N
If no, explain:

Cyanide samples checked for sulfide & chlorine? Y or NA
625 & Phenol samples checked for chlorine? Y or NA
608 samples checked for pH between 5.0-9.0? Y or NA

Comments

Residual Chlorine Present?
Yes ____ No ✓

rec'd VOC soil vials for 59SB11-02 collected 5/24/10 @0740
1005176-21

Sample Custody

Relinquished by: [signature]	Date/Time: 5/24/10 1800	Received by: Jennifer Doles	Date/Time: 5.25.10 09:20
Relinquished by:	Date/Time:	Received by:	Date/Time:

Subcontact? Y or N If yes, where?
Custody Seal(s) intact? Y or N
On Ice? Y or N
Cooler Temp: 1.3, 0.6, 0.9, 0.4 C; 3.2, 0.7, 0.5, 0.1

Samples stored 60 days after date report mailed at no extra charge.

White & Yellow copy to lab • Pink copy for customer

Serial Number 56952

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Savannah
5102 LaRoche Avenue
Savannah, GA 31404

Website: www.testamericainc.com
Phone: (912) 354-7858
Fax: (912) 352-0165

Alternate Laboratory Name/Location

Phone:
Fax:

PROJECT REFERENCE: NAPR SWMU 59	PROJECT NO.: 129344.1.1 ON ISOLATED	PROJECT LOCATION (STATE):
TAL (LAB) PROJECT MANAGER: JERRY LANIER	P.O. NUMBER:	CONTRACT NO.:
CLIENT (SITE) PM: SCOTT MOFFETT	CLIENT PHONE: 412 269 6136	CLIENT FAX:
CLIENT NAME: BAKER	CLIENT E-MAIL: SMOFFETT@MBAKERCORP.COM	
CLIENT ADDRESS: 100 AIRSIDE DR, MOON TWP, PA 15108		
COMPANY CONTRACTING THIS WORK (if applicable):		

PAGE 1 OF 3

STANDARD REPORT DELIVERY (✓)

DATE DUE _____

EXPEDITED REPORT DELIVERY (SURCHARGE) ( )

DATE DUE _____

NUMBER OF COOLERS SUBMITTED PER SHIPMENT:

SAMPLE DATE	SAMPLE TIME	SAMPLE IDENTIFICATION	COMPOSITE (C) OR GRAB (G) INDICATE	AQUEOUS (WATER)	SOLID OR SEMISOLID	AIR	NONAQUEOUS LIQUID (OIL, SOLVENT, ...)	VOCs (APP IV)	SVOCs (+ LL PAHs)	METALS (APP IX)							REMARKS
								MEOH DI	PRESERVATIVE								
								NUMBER OF CONTAINERS SUBMITTED									
9/13/12	0850	59SB24-00	G		✓			3	1	1							
		59SB24-00D															
		59SB24-00MS															
		59SB24-00MSD															
	0855	59SB24-01															
	0855	59SB24-01D															
	0750	59SB32-00															
	0755	59SB32-01															
	0945	59SB25-00															
	0950	59SB25-01															
	1010	59SB26-00															
	1015	59SB26-01															

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME
[signature]	9/13/12	1500						
RECEIVED BY: (SIGNATURE)	**DATE**	**TIME**	**RECEIVED BY: (SIGNATURE)**	**DATE**	**TIME**	**RECEIVED BY: (SIGNATURE)**	**DATE**	**TIME**

LABORATORY USE ONLY

RECEIVED FOR LABORATORY BY: (SIGNATURE)	DATE	TIME	CUSTODY INTACT	CUSTODY SEAL NO.	SAVANNAH LOG NO.	LABORATORY REMARKS
[signature]	9/14/12	0946	YES ( ) NO ( )		680-32907	3.3/3.4°C

TAL 8240-680 (1008)

Serial Number 54711

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Savannah
5102 LaRoche Avenue
Savannah, GA 31404

Website: www.testamericainc.com
Phone: (912) 354-7858
Fax: (912) 352-0165

Alternate Laboratory Name/Location

Phone:
Fax:

PROJECT REFERENCE	PROJECT NO.	PROJECT LOCATION (STATE)
TAL (LAB) PROJECT MANAGER	P.O. NUMBER	CONTRACT NO.
CLIENT (SITE) PM	CLIENT PHONE	CLIENT FAX
CLIENT NAME SEE PAGE 1	CLIENT E-MAIL	
CLIENT ADDRESS		
COMPANY CONTRACTING THIS WORK (if applicable)		

PAGE 2 OF 3

STANDARD REPORT DELIVERY (TAT)

DATE DUE _____

EXPEDITED REPORT DELIVERY (SURCHARGE)

DATE DUE _____

NUMBER OF COOLERS SUBMITTED PER SHIPMENT:

REQUIRED ANALYSIS

	VOCs (8260 IV)	SVOCs (+LL PAHs)	METAL (6010 IX)							
PRESERVATIVE	MeOH DI	-								

SAMPLE DATE	SAMPLE TIME	SAMPLE IDENTIFICATION	COMPOSITE (C) OR GRAB (G) INDICATE	AQUEOUS (WATER)	SOLID OR SEMISOLID	AIR	NONAQUEOUS LIQUID (OIL, SOLVENT, ...)	NUMBER OF CONTAINERS SUBMITTED									REMARKS
9/13/12	1030	595B27-00	G		✓			3	1	1							
	1035	595B27-01															
	1100	595B31-00															
	1105	595B31-01															
	1125	595B28-00															
	1130	595B28-01															
	1150	595B29-00															
	1155	595B29-01															
	1220	595B30-00															
	1225	595B30-01															
	1235	595B33-00															
	1240	595B33-01															

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME
[signature]	9/13/12	1500						
RECEIVED BY: (SIGNATURE)	**DATE**	**TIME**	**RECEIVED BY: (SIGNATURE)**	**DATE**	**TIME**	**RECEIVED BY: (SIGNATURE)**	**DATE**	**TIME**

LABORATORY USE ONLY

RECEIVED FOR LABORATORY BY: (SIGNATURE)	DATE	TIME	CUSTODY INTACT	CUSTODY SEAL NO.	SAVANNAH LOG NO.	LABORATORY REMARKS
[signature]	9/14/12	0946	YES ○ NO ○		680-82907	

TAL 8240-680 (1008)

Serial Number 54712

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Savannah
5102 LaRoche Avenue
Savannah, GA 31404

Website: www.testamericainc.com
Phone: (912) 354-7858
Fax: (912) 352-0165

Alternate Laboratory Name/Location

Phone:
Fax:

PROJECT REFERENCE	PROJECT NO.	PROJECT LOCATION (STATE)
TAL (LAB) PROJECT MANAGER	P.O. NUMBER	CONTRACT NO.
CLIENT (SITE) PM	CLIENT PHONE	CLIENT FAX
CLIENT NAME SEE PAGE 1	CLIENT E-MAIL	
CLIENT ADDRESS		
COMPANY CONTRACTING THIS WORK (if applicable)		

PAGE 3 OF 3

STANDARD REPORT DELIVERY (✓)

DATE DUE _____

EXPEDITED REPORT DELIVERY (SURCHARGE) ( )

DATE DUE _____

NUMBER OF COOLERS SUBMITTED PER SHIPMENT:

SAMPLE DATE	SAMPLE TIME	SAMPLE IDENTIFICATION	COMPOSITE (C) OR GRAB (G) INDICATE	AQUEOUS (WATER)	SOLID OR SEMISOLID	AIR	NONAQUEOUS LIQUID (OIL, SOLVENT, ...)	VOCs (8260 W)	BVOCs (+LL PAHs)	METALS (APP IV)								REMARKS
								HCL		NONE PRESERVATIVE								
								NUMBER OF CONTAINERS SUBMITTED										
9/13/12	LAB	59TB07	G	✓				2										
↓	1340	59FB03	↓	↓				3	2	1								
↓	1350	59ER12	↓	↓				3	2	1								

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME
[signature]	9/13/12	1500						
RECEIVED BY: (SIGNATURE)	**DATE**	**TIME**	**RECEIVED BY: (SIGNATURE)**	**DATE**	**TIME**	**RECEIVED BY: (SIGNATURE)**	**DATE**	**TIME**

LABORATORY USE ONLY

RECEIVED FOR LABORATORY BY: (SIGNATURE)	DATE	TIME	CUSTODY INTACT	CUSTODY SEAL NO.	SAVANNAH LOG NO.	LABORATORY REMARKS
[signature]	9/14/12	0946	YES ( ) NO ( )		680-32907	

TAL 8240-680 (1008)

Serial Number 56965

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Savannah
5102 LaRoche Avenue
Savannah, GA 31404

Website: www.testamericainc.com
Phone: (912) 354-7858
Fax: (912) 352-0165

Alternate Laboratory Name/Location
Phone:
Fax:

PROJECT REFERENCE: NAPR SWMU 59	PROJECT NO.: 129344, 1.1 ON Island	PROJECT LOCATION (STATE):
TAL (LAB) PROJECT MANAGER: Jerry Lanier	P.O. NUMBER:	CONTRACT NO.:
CLIENT (SITE) PM: Scott Moffett	CLIENT PHONE: 412-269-6136	CLIENT FAX:
CLIENT NAME: BAKER	CLIENT E-MAIL: SMoffett@mbakercorp.com	
CLIENT ADDRESS: 100 Airside Dr., Moon Twp, PA 15108		
COMPANY CONTRACTING THIS WORK (if applicable):		

PAGE 1 OF 4

STANDARD REPORT DELIVERY ✓
DATE DUE _____
EXPEDITED REPORT DELIVERY (SURCHARGE) ○
DATE DUE _____
NUMBER OF COOLERS SUBMITTED PER SHIPMENT:

REQUIRED ANALYSIS: Metals (App IX)

PRESERVATIVE

SAMPLE DATE	SAMPLE TIME	SAMPLE IDENTIFICATION	COMPOSITE (C) OR GRAB (G) INDICATE	AQUEOUS (WATER)	SOLID OR SEMISOLID	AIR	NONAQUEOUS LIQUID (OIL, SOLVENT, ...)	NUMBER OF CONTAINERS SUBMITTED	REMARKS
9/14/12	0755	59SS19	G		S			1	~~Pb only~~ Zn only
	0805	59SS17							per table from Shannon Reeb on 9/19/12
	0825	59SS20							
	0835	59SS18							
	0855	59SS14							Pb, Zn only
	0900	59SS14D							
	0905	59SS14MS							
	0910	59SS14MSD							
	0915	59SS15							
	0920	59SS16							
	1000	59SS12							~~Pb, Zn, Cu~~ Cu + Zn per table from Shannon Reeb on 9/19/12
	1015	59SS11							~~Pb, Zn, Cu~~

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME
[signature]	9/17/12	1445						

RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME

LABORATORY USE ONLY

RECEIVED FOR LABORATORY BY: (SIGNATURE)	DATE	TIME	CUSTODY INTACT	CUSTODY SEAL NO.	SAVANNAH LOG NO.	LABORATORY REMARKS
[signature]	9/17/12	0933	YES ○ NO ○		680-82994	5.6°C

TAL 8240-680 (1008)

Serial Number 54724

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Savannah
5102 LaRoche Avenue
Savannah, GA 31404
Website: www.testamericainc.com
Phone: (912) 354-7858
Fax: (912) 352-0165

Alternate Laboratory Name/Location
Phone:
Fax:

PROJECT REFERENCE	PROJECT NO.	PROJECT LOCATION (STATE)
NAPR SWMU 59	129344.1.1 ON Island	
TAL (LAB) PROJECT MANAGER: Jerry Lanier	P.O. NUMBER	CONTRACT NO.
CLIENT (SITE) PM: Scott Moffett	CLIENT PHONE: 412-269-6136	CLIENT FAX
CLIENT NAME: BAKER	CLIENT E-MAIL: SMoffett@mbakercorp.com	
CLIENT ADDRESS: 100 Airside Dr. Moon Twp, PA 15108		
COMPANY CONTRACTING THIS WORK (if applicable)		

PAGE 2 OF 4

STANDARD REPORT DELIVERY ✓
DATE DUE _____
EXPEDITED REPORT DELIVERY (SURCHARGE) ○
DATE DUE _____
NUMBER OF COOLERS SUBMITTED PER SHIPMENT:

REQUIRED ANALYSIS: Metals (Appix)

PRESERVATIVE

SAMPLE DATE	SAMPLE TIME	SAMPLE IDENTIFICATION	COMPOSITE (C) OR GRAB (G) INDICATE	AQUEOUS (WATER)	SOLID OR SEMISOLID	AIR	NONAQUEOUS LIQUID (OIL, SOLVENT, ...)	NUMBER OF CONTAINERS SUBMITTED	REMARKS
9/14/12	1025	59SS13	G		✓			1	~~Pb, Zn, Cu~~ Cu+Zn per table from Shannon Raub. on 9/19/12
	1040	59SS09							Pb, Zn ONLY
	1050	59SS10							Pb, Zn ONLY
	1100	59SS06							Pb, Zn, Cu
	1110	59SS05							Pb, Zn, Cu
	1250	59SS03							Pb, Zn ONLY
	1305	59SS02							Pb, Zn ONLY
	1345	59SS23							~~Pb ONLY~~ Zn Only per table from Shannon Raub. on 9/19/12
	1400	59SS24							
	1410	59SS21							
	1415	59SS21D							
	1440	59SS22							

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME
[signature]	9/17/12	1445						

RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME

LABORATORY USE ONLY

RECEIVED FOR LABORATORY BY: (SIGNATURE)	DATE	TIME	CUSTODY INTACT	CUSTODY SEAL NO.	SAVANNAH LOG NO.	LABORATORY REMARKS
[signature]	9/18/12	0933	YES ○ NO ○		680-82444	

TAL8240-680 (1008)

Serial Number 54725

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

☑ TestAmerica Savannah
5102 LaRoche Avenue
Savannah, GA 31404

Website: www.testamericainc.com
Phone: (912) 354-7858
Fax: (912) 352-0165

○ Alternate Laboratory Name/Location

Phone:
Fax:

PROJECT REFERENCE: NAPR SWMU 59	PROJECT NO.: 129344, 1.1 Island	PROJECT LOCATION (STATE):
TAL (LAB) PROJECT MANAGER: Jerry Lanier	P.O. NUMBER:	CONTRACT NO.:
CLIENT (SITE) PM: Scott Moffett	CLIENT PHONE: 412-269-6136	CLIENT FAX:
CLIENT NAME: BAKER	CLIENT E-MAIL: SMoffett@unbakercorp.com	
CLIENT ADDRESS: 100 Airside Dr, Moon Twp, PA 15108		
COMPANY CONTRACTING THIS WORK (if applicable):		

PAGE 3 OF 4

STANDARD REPORT DELIVERY ☑

DATE DUE _____

EXPEDITED REPORT DELIVERY (SURCHARGE) ○

DATE DUE _____

NUMBER OF COOLERS SUBMITTED PER SHIPMENT:

REQUIRED ANALYSIS: Metals (App IX)

PRESERVATIVE

SAMPLE DATE	SAMPLE TIME	SAMPLE IDENTIFICATION	COMPOSITE (C) OR GRAB (G) INDICATE	AQUEOUS (WATER)	SOLID OR SEMISOLID	AIR	NONAQUEOUS LIQUID (OIL, SOLVENT, ...)	NUMBER OF CONTAINERS SUBMITTED	REMARKS
9/14/12	1500	59SS08	G		✓			1	Pb, Zn ONLY
	1510	59SS07							Pb, Zn, Cu
	1540	59SS04							Pb, Zn, Cu
	1600	59SS01							Pb, Zn, ONLY
	1605	59ER13							Pb, Zn, Cu
9/15/12	1045	59SD12							Pb, Zn, Cu
	1055	59SD11							
	1100	59SD10							
	1110	59SD09							
	1115	59SD08							
	1125	59SD07							
	1130	59SD06							

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME
[signature]	9/17/12	1445						
RECEIVED BY: (SIGNATURE)	**DATE**	**TIME**	**RECEIVED BY: (SIGNATURE)**	**DATE**	**TIME**	**RECEIVED BY: (SIGNATURE)**	**DATE**	**TIME**

LABORATORY USE ONLY

RECEIVED FOR LABORATORY BY: (SIGNATURE)	DATE	TIME	CUSTODY INTACT	CUSTODY SEAL NO.	SAVANNAH LOG NO.	LABORATORY REMARKS
[signature]	9/18/12	0958	YES ○ NO ○		L20-92444	

Serial Number 54722

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Savannah
5102 LaRoche Avenue
Savannah, GA 31404
Website: www.testamericainc.com
Phone: (912) 354-7858
Fax: (912) 352-0165

Alternate Laboratory Name/Location
Phone:
Fax:

PROJECT REFERENCE: NAPR SWMU 59	PROJECT NO.: 129344.1.1 ON Island	PROJECT LOCATION (STATE):
TAL (LAB) PROJECT MANAGER: Jerry Lanier	P.O. NUMBER:	CONTRACT NO.:
CLIENT (SITE) PM: Scott Moffett	CLIENT PHONE: 412-269-6136	CLIENT FAX:
CLIENT NAME: BAKER	CLIENT E-MAIL: SMoffett@mbakercorp.com	
CLIENT ADDRESS: 100 Airside Dr. Moon Twp, PA 15108		
COMPANY CONTRACTING THIS WORK (if applicable):		

PAGE 4 OF 4

STANDARD REPORT DELIVERY ☑
DATE DUE _____
EXPEDITED REPORT DELIVERY (SURCHARGE) ○
DATE DUE _____
NUMBER OF COOLERS SUBMITTED PER SHIPMENT:

SAMPLE DATE	SAMPLE TIME	SAMPLE IDENTIFICATION	COMPOSITE (C) OR GRAB (G) INDICATE	AQUEOUS (WATER)	SOLID OR SEMISOLID	AIR	NONAQUEOUS LIQUID (OIL, SOLVENT, ...)	REQUIRED ANALYSIS: Metals (App IX)	PRESERVATIVE	NUMBER OF CONTAINERS SUBMITTED	REMARKS
9/15/12	1135	59SD05	G		✓			1			Pb, Zn, Cu
	1140	59SD04									
	1140	59SD04D									
	1140	59SD04MS									
	1140	59SD04MSD									
	1155	59ER14									

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME
[signature]	9/17/12	1445						
RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME

LABORATORY USE ONLY

RECEIVED FOR LABORATORY BY: (SIGNATURE)	DATE	TIME	CUSTODY INTACT	CUSTODY SEAL NO.	SAVANNAH LOG NO.	LABORATORY REMARKS
[signature]	9/18/12	0938	YES ○ NO ○		L80-32444	

TA1.8240-680 (1008)

Serial Number 61031

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

for Ex Master Airbill # 8763 3489 8037

TestAmerica Savannah
5102 LaRoche Avenue
Savannah, GA 31404

Website: www.testamericainc.com
Phone: (912) 354-7858
Fax: (912) 352-0165

Alternate Laboratory Name/Location
Phone:
Fax:

PROJECT REFERENCE: NABR Sumo 59	PROJECT NO.: 129344	PROJECT LOCATION (STATE): PR
TAL (LAB) PROJECT MANAGER: Jerry Lanier	P.O. NUMBER:	CONTRACT NO.:
CLIENT (SITE) PM: Scott Moffett	CLIENT PHONE: 912-269-6300	CLIENT FAX:
CLIENT NAME: M. Baker Jr., Inc	CLIENT E-MAIL: smoffett@mbakercorp.com	
CLIENT ADDRESS: 100 Airside Dr. Moon Township, PA 15108		
COMPANY CONTRACTING THIS WORK (if applicable):		

PAGE 1 OF 2

STANDARD REPORT DELIVERY ☒
DATE DUE _____
EXPEDITED REPORT DELIVERY (SURCHARGE) ○
DATE DUE _____
NUMBER OF COOLERS SUBMITTED PER SHIPMENT:

REQUIRED ANALYSIS: Copper, Lead, Zinc

PRESERVATIVE

SAMPLE DATE	SAMPLE TIME	SAMPLE IDENTIFICATION	COMPOSITE (C) OR GRAB (G) INDICATE	AQUEOUS (WATER)	SOLID OR SEMISOLID	AIR	NONAQUEOUS LIQUID (OIL, SOLVENT, ...)	Copper	Lead	Zinc								REMARKS
11/10/12	1030	59SS25	G		X					1								
11/10/12	1015	59SS26	G		X				1									
11/10/12	1015	59SS26D	G		X				1									
11/10/12	1015	59SS26 MS/MSD	G		X				1									
11/10/12	1040	59SS27	G		X				1									
11/10/12	1050	59SS28	G		X				1									
11/10/12	1100	59SS29	G		X				1									
11/10/12	1110	59SS30	G		X				1									
11/10/12	1125	59SS31	G		X					1								
11/10/12	1135	59SS32	G		X					1								
11/10/12	1145	59SS33	G		X					1								
11/10/12	1155	59SS34	G		X					1								

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME
	11/12/12	1500						

RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME

LABORATORY USE ONLY

RECEIVED FOR LABORATORY BY: (SIGNATURE)	DATE	TIME	CUSTODY INTACT	CUSTODY SEAL NO.	SAVANNAH LOG NO.	LABORATORY REMARKS
	11/13/12	0945	YES ○ NO ○		680-84757	3.6°C

TAL8240-680 (1008)

Serial Number 61015

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

FedEx Master Airbill # 8763 3489 8037

TestAmerica Savannah
5102 LaRoche Avenue
Savannah, GA 31404

Website: www.testamericainc.com
Phone: (912) 354-7858
Fax: (912) 352-0165

Alternate Laboratory Name/Location

Phone:
Fax:

PROJECT REFERENCE	PROJECT NO.	PROJECT LOCATION (STATE)	PAGE 2 OF 2
NABR SWMU 59		PR	
TAL (LAB) PROJECT MANAGER: Jerry Lanier	P.O. NUMBER	CONTRACT NO.	STANDARD REPORT DELIVERY ☒
CLIENT (SITE) PM: Scott Moffett	CLIENT PHONE: 412-269-6308	CLIENT FAX	DATE DUE
CLIENT NAME: M. Baker Jr., Inc	CLIENT E-MAIL: smoffett@mbakercorp.com		EXPEDITED REPORT DELIVERY (SURCHARGE) ○
CLIENT ADDRESS: 100 Airside Dr, Moon Township PA 15108			DATE DUE
COMPANY CONTRACTING THIS WORK (if applicable)			NUMBER OF COOLERS SUBMITTED PER SHIPMENT:

MATRIX TYPE (COMPOSITE (C) OR GRAB (G) INDICATE): AQUEOUS (WATER); SOLID OR SEMISOLID; AIR; NONAQUEOUS LIQUID (OIL, SOLVENT, ...)

REQUIRED ANALYSIS / PRESERVATIVE: Copper (HNO3); Lead (HNO3); Zinc (HNO3)

SAMPLE DATE	SAMPLE TIME	SAMPLE IDENTIFICATION	AQUEOUS (WATER)	Copper	Lead	Zinc	REMARKS
11/10/12	1215	59 ER 15	✓	1	1	1	
11/10/12	1220	59 FB 05	✓	1	1	1	

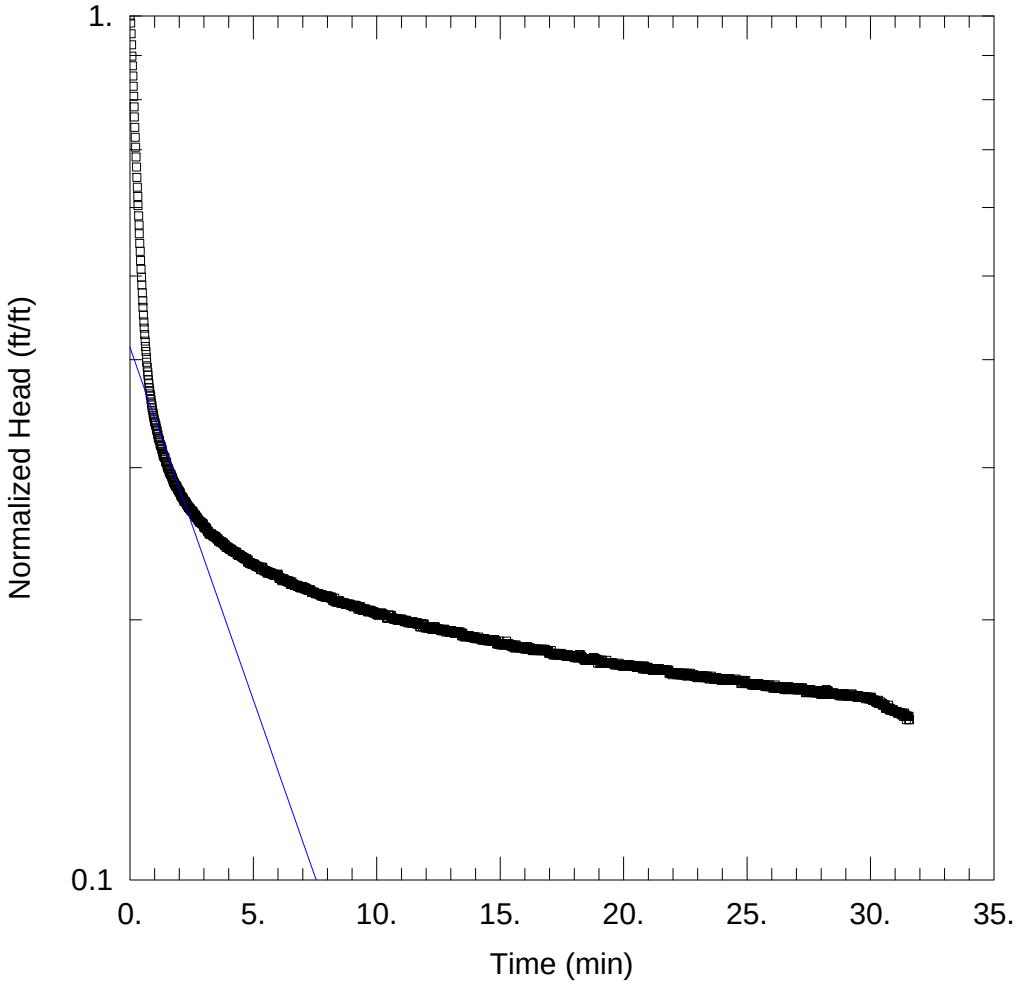
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME
	11/12/12	1500						
RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME

LABORATORY USE ONLY

RECEIVED FOR LABORATORY BY: (SIGNATURE)	DATE	TIME	CUSTODY INTACT	CUSTODY SEAL NO.	SAVANNAH LOG NO.	LABORATORY REMARKS
	11/13/12	0945	YES ○ NO ○		680-84737	

TAL8240-680 (1008)

SLUG TEST RESULTS



RISING HEAD

Data Set: K:\...\59SB01.aqt
Date: 09/09/13 Time: 14:26:07

PROJECT INFORMATION

Client: SWMU 59
Test Well: 59SB01
Test Date: 05/20/10

AQUIFER DATA

Saturated Thickness: 20. ft Anisotropy Ratio (Kz/Kr): 1.

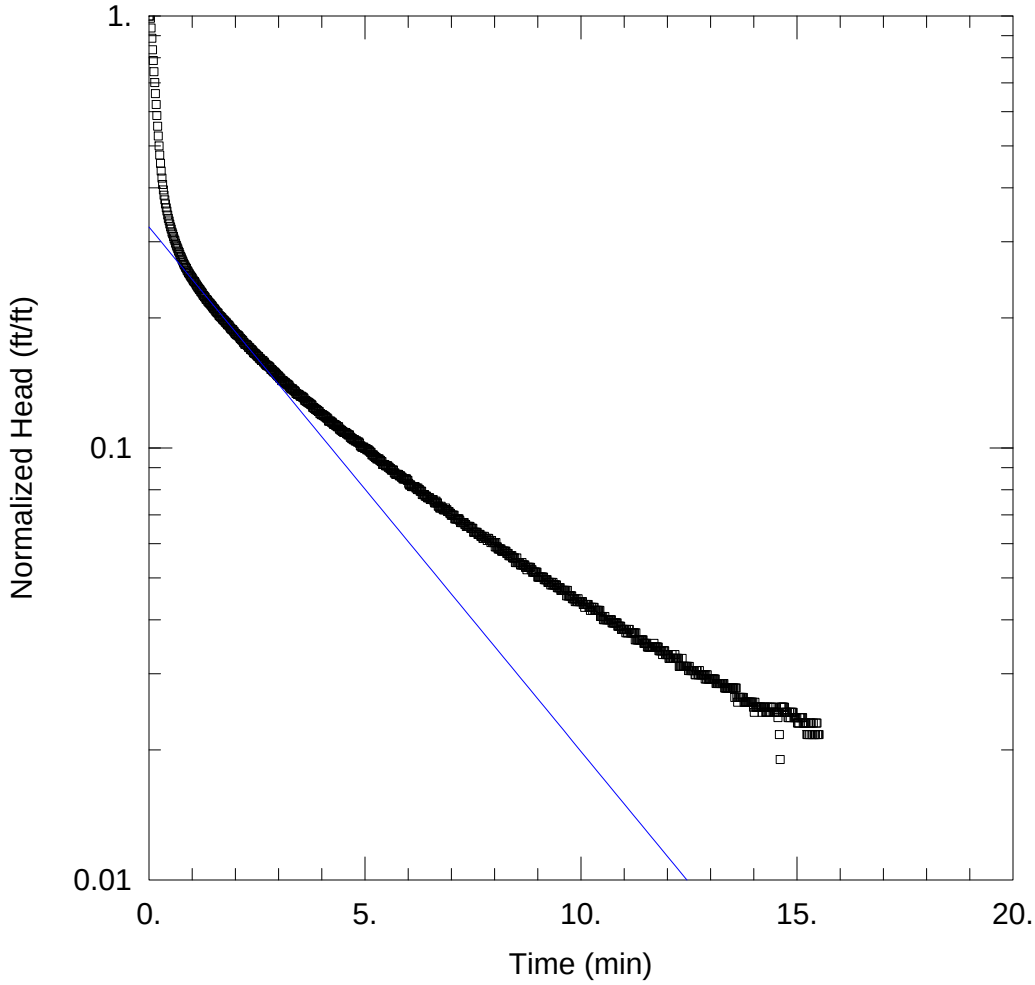
WELL DATA (59SB01)

Initial Displacement: 3.43 ft Static Water Column Height: 6.49 ft
Total Well Penetration Depth: 6.49 ft Screen Length: 6.49 ft
Casing Radius: 0.083 ft Well Radius: 0.3021 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.2717 ft/day y0 = 1.418 ft



RISING HEAD

Data Set: K:\...\59SB02.aqt
Date: 09/09/13 Time: 14:47:16

PROJECT INFORMATION

Client: SWMU 59
Test Well: 59SB02
Test Date: 05/20/10

AQUIFER DATA

Saturated Thickness: 20. ft Anisotropy Ratio (Kz/Kr): 1.

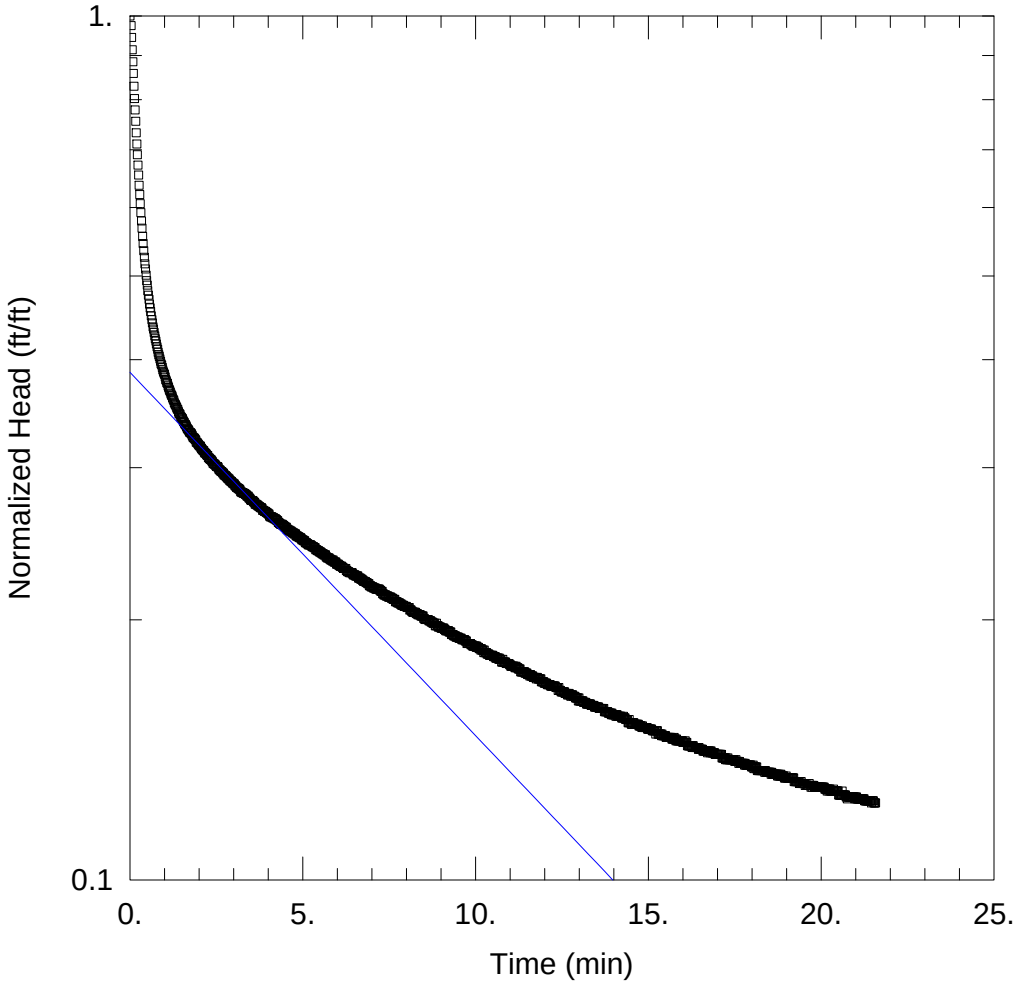
WELL DATA (59SB02)

Initial Displacement: 3.4 ft Static Water Column Height: 5.8 ft
Total Well Penetration Depth: 5.8 ft Screen Length: 5.8 ft
Casing Radius: 0.083 ft Well Radius: 0.3021 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.4292 ft/day y0 = 1.104 ft



RISING HEAD

Data Set: K:\...\59SB04.aqt
Date: 09/09/13 Time: 14:30:25

PROJECT INFORMATION

Client: SWMU 59
Test Well: 59SB04
Test Date: 05/20/10

AQUIFER DATA

Saturated Thickness: 20. ft Anisotropy Ratio (Kz/Kr): 1.

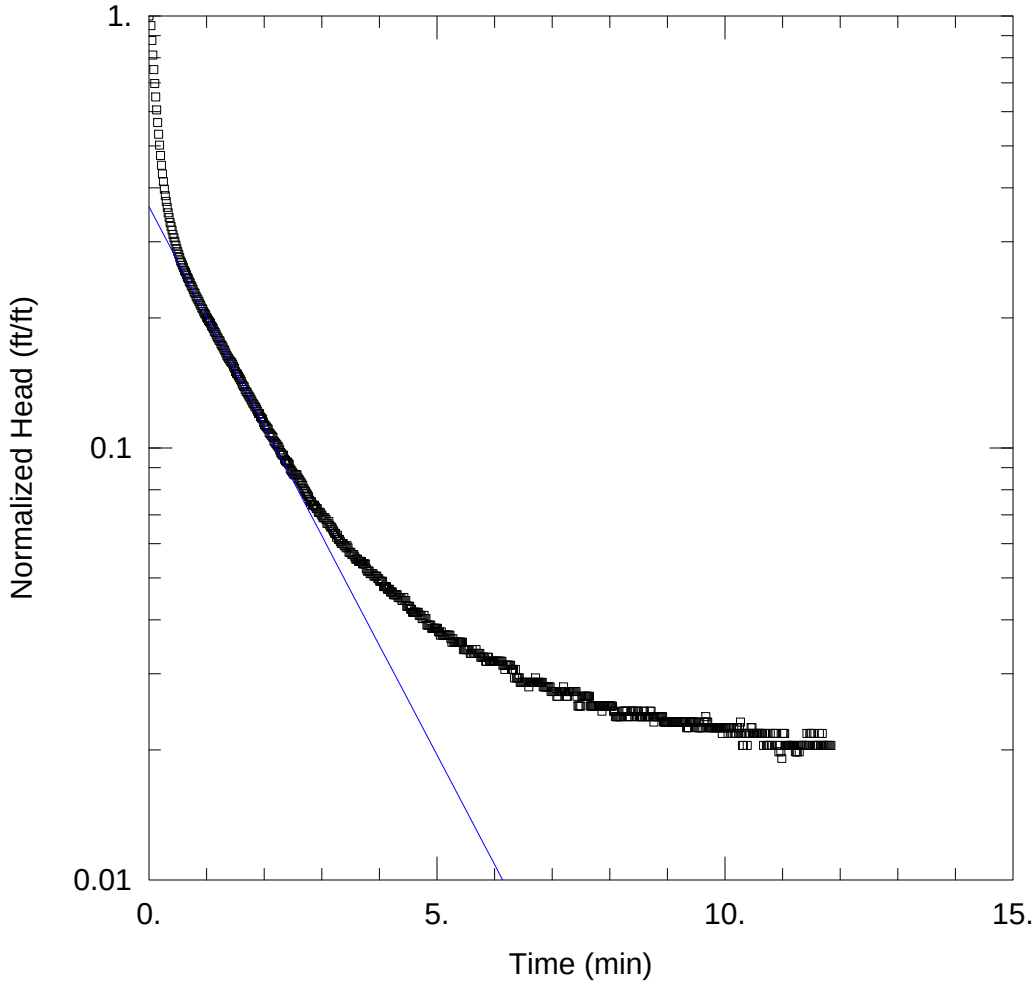
WELL DATA (59SB04)

Initial Displacement: 3.55 ft Static Water Column Height: 5.83 ft
Total Well Penetration Depth: 5.83 ft Screen Length: 5.83 ft
Casing Radius: 0.083 ft Well Radius: 0.3021 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.1483 ft/day y0 = 1.373 ft



RISING HEAD

Data Set: K:\...\59SB05.aqt
Date: 09/09/13 Time: 14:32:27

PROJECT INFORMATION

Client: SWMU 59
Test Well: 59SB05
Test Date: 05/20/10

AQUIFER DATA

Saturated Thickness: 20. ft Anisotropy Ratio (Kz/Kr): 1.

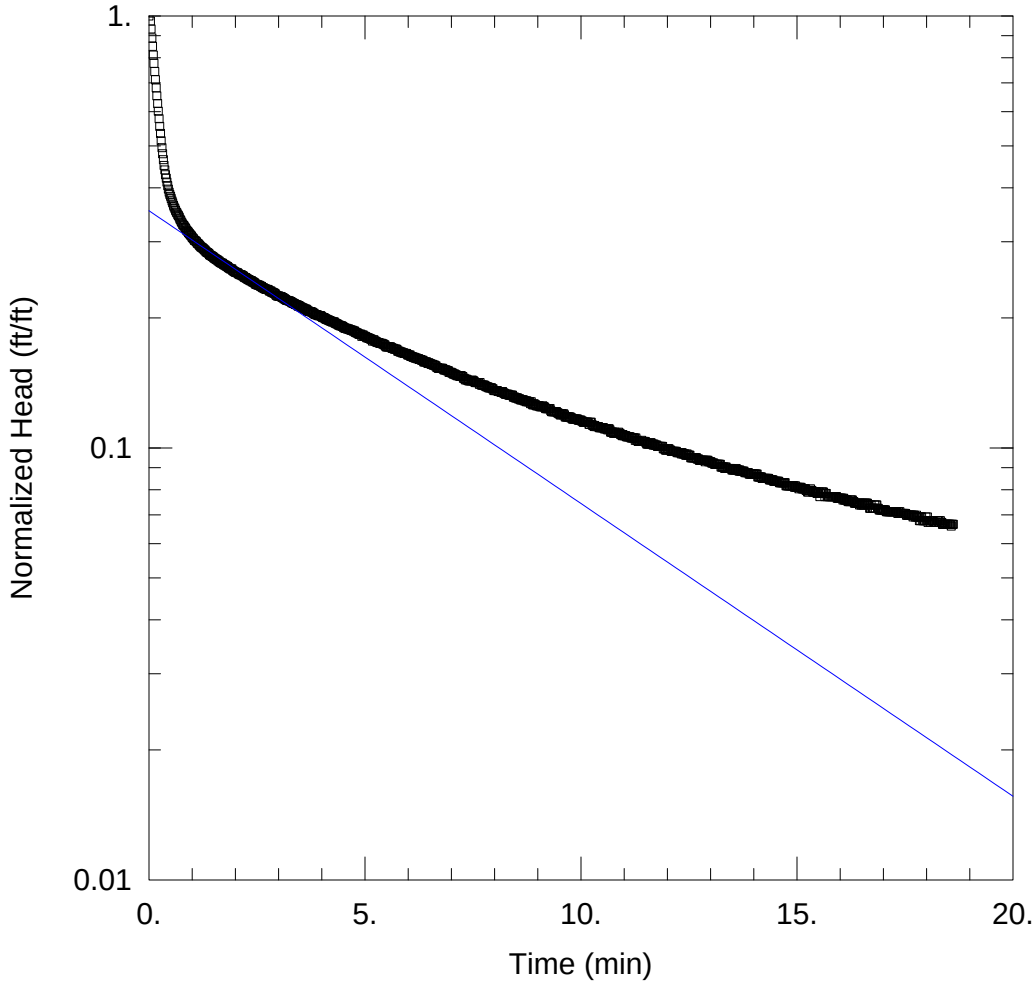
WELL DATA (59SB05)

Initial Displacement: 3.38 ft Static Water Column Height: 8.33 ft
Total Well Penetration Depth: 8.33 ft Screen Length: 8.33 ft
Casing Radius: 0.083 ft Well Radius: 0.3021 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.7333 ft/day y0 = 1.223 ft



RISING HEAD

Data Set: K:\...\59SB06.aqt
Date: 09/09/13 Time: 14:32:52

PROJECT INFORMATION

Client: SWMU 59
Test Well: 59SB06
Test Date: 05/20/10

AQUIFER DATA

Saturated Thickness: 20. ft Anisotropy Ratio (Kz/Kr): 1.

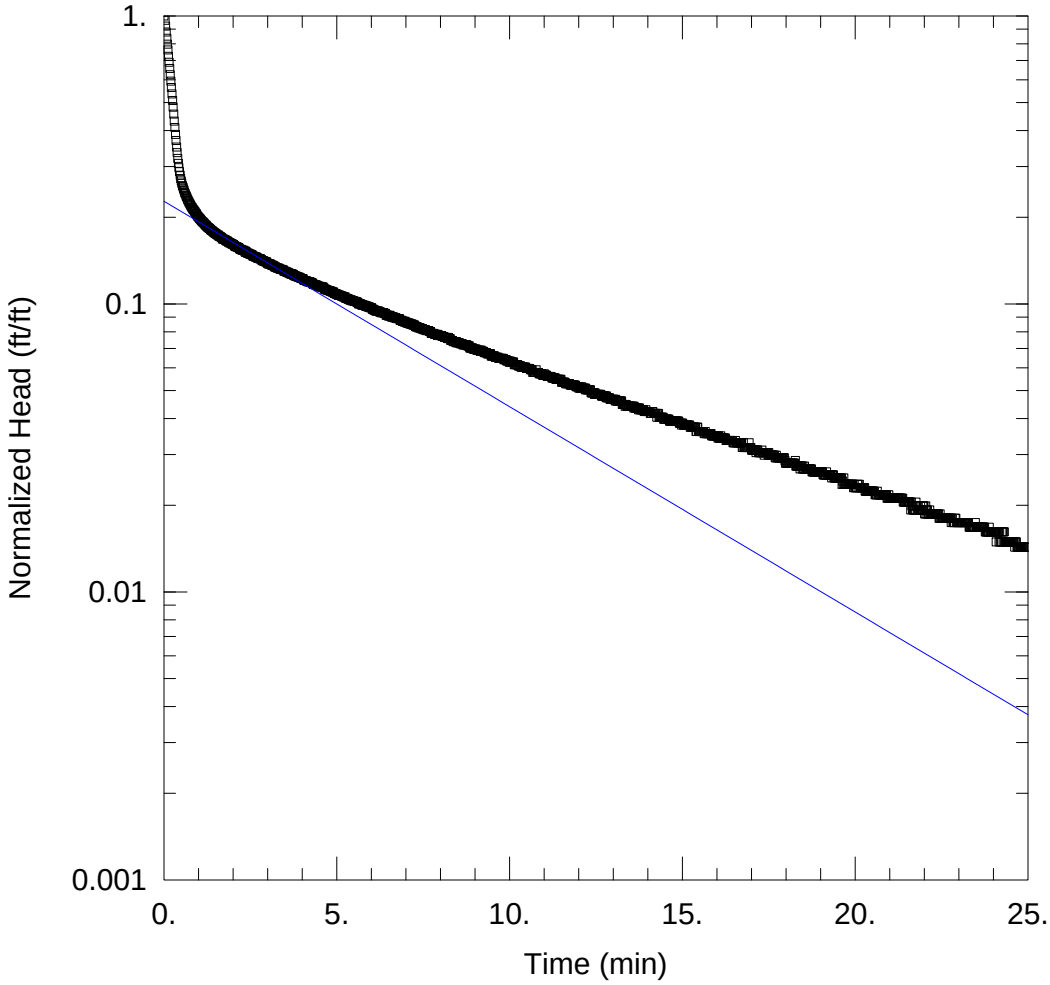
WELL DATA (59SB06)

Initial Displacement: 3.5 ft Static Water Column Height: 7.22 ft
Total Well Penetration Depth: 7.22 ft Screen Length: 7.22 ft
Casing Radius: 0.083 ft Well Radius: 0.3021 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.2125 ft/day y0 = 1.239 ft



RISING HEAD

Data Set: K:\...\59SB08.aqt
Date: 09/09/13 Time: 14:33:25

PROJECT INFORMATION

Client: SWMU 59
Test Well: 59SB08
Test Date: 05/21/10

AQUIFER DATA

Saturated Thickness: 20. ft Anisotropy Ratio (Kz/Kr): 1.

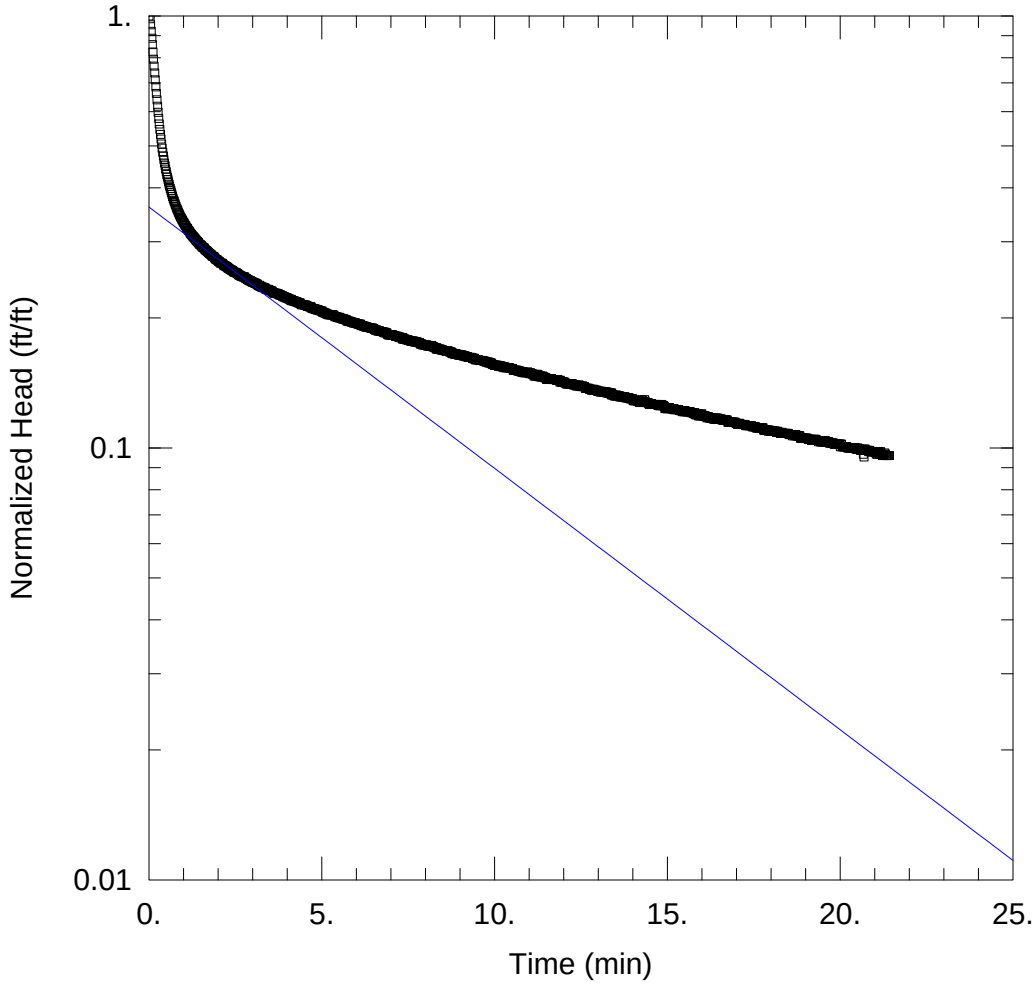
WELL DATA (59SB08)

Initial Displacement: 3.71 ft Static Water Column Height: 7.37 ft
Total Well Penetration Depth: 7.37 ft Screen Length: 7.37 ft
Casing Radius: 0.083 ft Well Radius: 0.3021 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.2211 ft/day y0 = 0.843 ft



RISING HEAD

Data Set: K:\...\59SB09.aqt
Date: 09/09/13 Time: 14:37:04

PROJECT INFORMATION

Client: SWMU 59
Test Well: 59SB09
Test Date: 05/20/10

AQUIFER DATA

Saturated Thickness: 20. ft Anisotropy Ratio (Kz/Kr): 1.

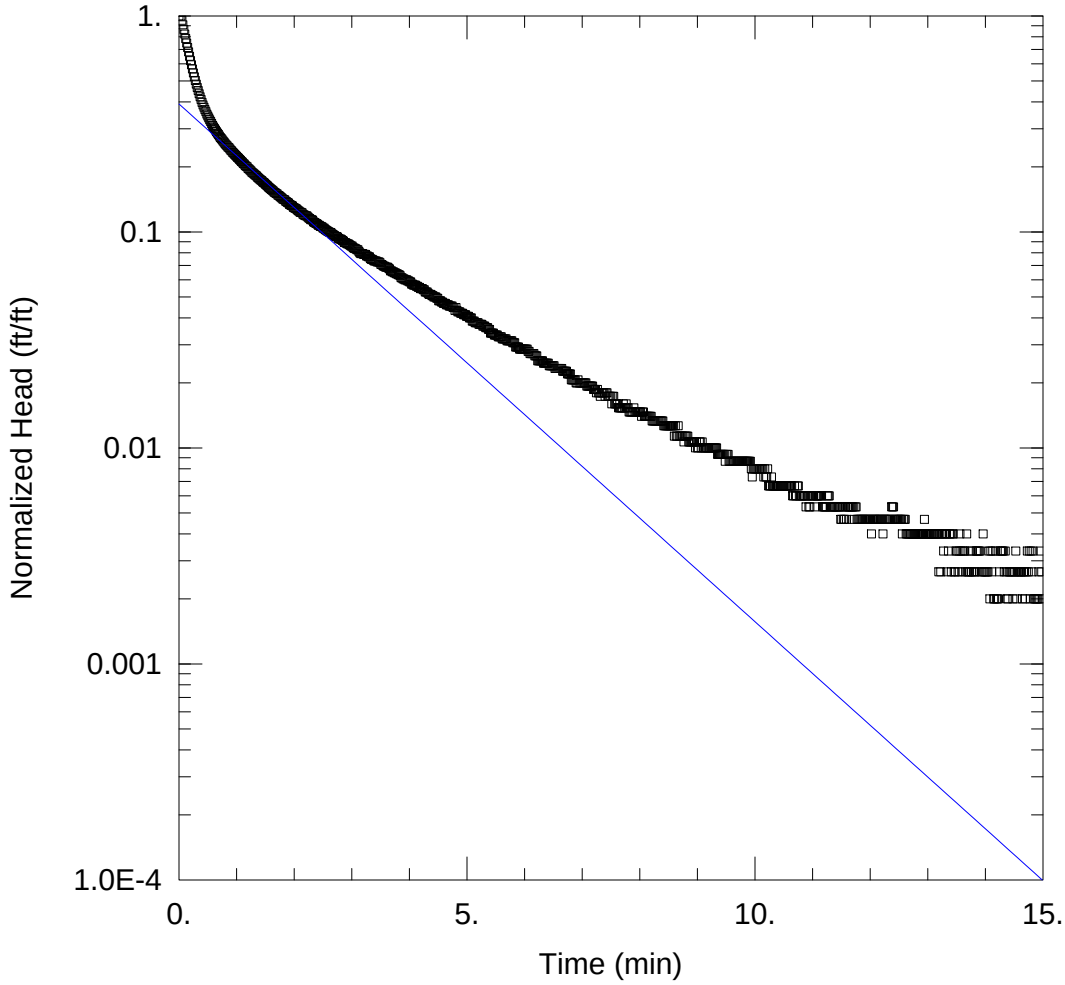
WELL DATA (59SB09)

Initial Displacement: 3.46 ft Static Water Column Height: 6.33 ft
Total Well Penetration Depth: 6.33 ft Screen Length: 6.33 ft
Casing Radius: 0.083 ft Well Radius: 0.3021 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.2041 ft/day y0 = 1.249 ft



RISING HEAD

Data Set: K:\...\59SB10.aqt
Date: 09/09/13 Time: 14:37:51

PROJECT INFORMATION

Client: SWMU 59
Test Well: 59SB10
Test Date: 05/21/10

AQUIFER DATA

Saturated Thickness: 20. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (59SB10)

Initial Displacement: 3.46 ft Static Water Column Height: 7.95 ft
Total Well Penetration Depth: 7.95 ft Screen Length: 7.95 ft
Casing Radius: 0.083 ft Well Radius: 0.3021 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.7116 ft/day y0 = 1.354 ft

IDW DISPOSAL DOCUMENTATION

NON - HAZARDOUS WASTE TRANSPORTATION/ACCEPTANCE DOCUMENT

DATE March 31, 2011

TO:
PEÑUELAS VALLEY LANDFILL
Carr. 385 KM 4.5 Barrio Tallaboa
Peñuelas, Puerto Rico 00624
1-787-836-3535

FACILITY PERMIT NO. IDF-57-0020

FROM:
NAVAL ACTIVITY PR
ROOSEVELT ROADS,
CEIBA, PR

P.O. NO. OPR-11-14

No. of Units & Container Type	DESCRIPTION AND CLASSIFICATION OF WASTE MATERIAL	Waste Profile Sheet Code	TOTAL QUANTITY (Weight, Volume, Gallons, etc.)	WEIGHT (Subject to Correction)	RATE	CHARGES (For Carrier Use Only)
2 2-55 DM	SOIL CUTTING FROM BOREHOLE	0324 SBE	210 Gal			
7-55 DM	WELL DEVELOPMENT WATER	0324 PPR	385 Gal			

GENERATOR'S CERTIFICATION: This is to certify that the above named materials are properly classified, described, marked and labeled and are in proper condition for transportation according to the applicable regulations of the Department of Transportation, U.S. EPA and the Commonwealth of P.R. The waste described above were consigned to the Transporter named. The Treatment, Storage or Disposal Facility can and will accept the shipment of waste, and has a valid permit to do so. I certify that the foregoing is true and correct to the best of my knowledge.

GENERATOR'S SIGNATURE	TITLE	DATE SHIPPED (MO. DAY YR.)	EXPECTED ARRIVAL DATE (MO. DAY YR.)
	Env Eng	03 31 11	03 31 11
TRANSPORTE SIGNATURE	**COMPANY NAME**	**VEHICLE ID. NO.**	**DATE RECEIVED (MO. DAY YR.)**
	AQUA CLEAN	AP12114	03 31 11
FACILITY SIGNATURE			**DATE RECEIVED (MO. DAY YR.)**
			5 4 11

CARRIER

APPENDIX B
LABORATORY ANALYTICAL RESULTS AND SUPPORTING INFORMATION

SURFACE SOIL DATA

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB01	59SB02	59SB03	59SB04	59SB06	59SB07	59SB08	59SB09	59SB11	59SB11
Sample ID	59SB01-00	59SB01-00D	59SB02-00	59SB03-00	59SB04-00	59SB06-00	59SB07-00	59SB08-00	59SB09-00	59SB11-00	59SB11-00D
Sample Date	4/19/2010	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	5/19/2010	5/19/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Volatile Organics (µg/kg)											
1,1,1,2-Tetrachloroethane	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
1,1,1-Trichloroethane	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
1,1,2,2-Tetrachloroethane	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
1,1,2-Trichloroethane	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
1,1-Dichloroethane	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
1,1-Dichloroethene	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
1,2,3-Trichloropropane	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
1,2-Dibromo-3-chloropropane (DBCP)	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
1,2-Dibromoethane (EDB)	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
1,2-Dichloroethane	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
1,2-Dichloroethene (trans)	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
1,2-Dichloropropane	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
1,3-Dichloropropene (cis)	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
1,3-Dichloropropene (trans)	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
1,4-Dichloro-2-butene (trans)	22 U	22 U	21 U	16 U	15 U	18 U	17 U	15 U	19 U	17 U	16 U
1,4-Dioxane (p-)	280 R	270 R	260 R	210 R	190 R	220 R	210 R	190 R	240 R	210 R	200 R
2-Butanone (MEK)	14 UJ	14 UJ	13 UJ	10 UJ	9.4 UJ	11 UJ	11 UJ	9.6 UJ	12 UJ	14 U	9.9 U
2-Chloro-1,3-butadiene (Chloroprene)	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
2-Hexanone (MBK)	14 UJ	14 UJ	13 UJ	10 UJ	9.4 UJ	11 UJ	11 UJ	9.6 UJ	12 UJ	11 U	9.9 U
3-Chloropropene (Allyl Chloride)	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
4-Methyl-2-pentanone (MIBK)	14 UJ	14 UJ	13 UJ	10 UJ	9.4 UJ	11 UJ	11 UJ	9.6 UJ	12 UJ	11 U	9.9 U
Acetone	14 UJ	14 UJ	15 UJ	24 J	25 J	17 UJ	91 J	9.6 UJ	37 J	64	31
Acetonitrile	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
Acrolein	56 R	54 R	53 R	41 R	38 R	45 R	43 R	38 R	47 R	43 R	40 R
Acrylonitrile	56 U	54 U	53 U	41 U	38 U	45 U	43 U	38 U	47 U	43 U	40 U
Benzene	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	0.44 J	4 U
Bromodichloromethane	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
Bromoform	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
Bromomethane	5.6 UJ	5.4 UJ	5.3 UJ	4.1 UJ	3.8 UJ	4.5 UJ	4.3 UJ	3.8 UJ	4.7 UJ	6.3	2 J
Carbon Disulfide	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
Carbon Tetrachloride	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
Chlorobenzene	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
Chloroethane	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 UJ	4 UJ
Chloroform	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
Chloromethane	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	0.99 J	0.36 J
Dibromochloromethane	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB01	59SB02	59SB03	59SB04	59SB06	59SB07	59SB08	59SB09	59SB11	59SB11
Sample ID	59SB01-00	59SB01-00D	59SB02-00	59SB03-00	59SB04-00	59SB06-00	59SB07-00	59SB08-00	59SB09-00	59SB11-00	59SB11-00D
Sample Date	4/19/2010	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	5/19/2010	5/19/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Volatile Organics (µg/kg) (cont.)											
Dibromomethane	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
Ethyl Methacrylate	56 U	54 U	53 U	41 U	38 U	45 U	43 U	38 U	47 U	43 U	40 U
Ethylbenzene	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
Freon 11 (Trichlorofluoromethane)	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
Freon-12 (Dichlorodifluoromethane)	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
Isobutyl Alcohol	280 R	270 R	260 R	210 R	190 R	220 R	210 R	190 R	240 R	210 R	200 R
Methyl Acrylonitrile	56 U	54 U	53 U	41 U	38 U	45 U	43 U	38 U	47 U	43 U	40 U
Methyl Iodide	5.6 U	5.4 U	0.97 J	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	12	2.9 J
Methyl Methacrylate	56 R	54 R	53 R	41 R	38 R	45 R	43 R	38 R	47 R	43 R	40 R
Methylene Chloride	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
Pentachloroethane	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
Propionitrile (Ethyl Cyanide)	280 R	270 R	260 R	210 R	190 R	220 R	210 R	8.1 J	240 R	210 R	200 R
Styrene (Ethenylbenzene)	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
Tetrachloroethene (PCE)	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
Toluene	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
Trichloroethene (TCE)	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
Vinyl Acetate	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
Vinyl Chloride	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
Xylene, m/p-	11 U	11 U	0.32 J	8.2 U	0.15 J	9 U	8.5 U	0.14 J	9.5 U	8.5 U	7.9 U
Xylene, o-	5.6 U	5.4 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4 U
Xylenes, total	5.6 U	5.4 U	0.32 J	4.1 U	0.15 J	4.5 U	4.3 U	0.14 J	4.7 U	4.3 U	4 U
Semivolatile Organics (µg/kg)											
1,2,4,5-Tetrachlorobenzene	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
1,2,4-Trichlorobenzene	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
1,2-Dichlorobenzene (o-)	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
1,3,5-Trinitrobenzene (TNB)	230 UJ	240 UJ	220 UJ	190 UJ	200 UJ	190 UJ	200 UJ	200 UJ	200 UJ	200 UJ	190 UJ
1,3-Dichlorobenzene (m-)	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
1,3-Dinitrobenzene (m-)	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
1,4-Dichlorobenzene (p-)	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
1,4-Naphthoquinone	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
1,4-Phenylenediamine	2300 R	2400 R	2200 R	1900 R	2000 R	1900 R	2000 R	2000 R	2000 R	2000 R	1900 R
1-Naphthylamine	230 U	240 U	220 R	190 U	200 UJ	190 UJ	200 UJ	200 UJ	200 UJ	200 UJ	190 UJ
2,2'-Oxybis[1-chloropropane]	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
2,3,4,6-Tetrachlorophenol	450 U	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	380 UJ
2,4,5-Trichlorophenol	450 U	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	380 UJ

APPENDIX B

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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB01	59SB02	59SB03	59SB04	59SB06	59SB07	59SB08	59SB09	59SB11	59SB11
Sample ID	59SB01-00	59SB01-00D	59SB02-00	59SB03-00	59SB04-00	59SB06-00	59SB07-00	59SB08-00	59SB09-00	59SB11-00	59SB11-00D
Sample Date	4/19/2010	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	5/19/2010	5/19/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Semivolatile Organics (µg/kg) (cont.)											
2,4,6-Trichlorophenol	450 U	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	380 UJ
2,4-Dichlorophenol	450 U	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	380 UJ
2,4-Dimethylphenol	450 U	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	380 UJ
2,4-Dinitrophenol	450 UJ	460 UJ	430 UJ	360 UJ	390 UJ	370 UJ	390 UJ	390 UJ	380 UJ	380 UJ	380 UJ
2,4-Dinitrotoluene (DNT)	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
2,6-Dichlorophenol	450 U	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	380 UJ
2,6-Dinitrotoluene (DNT)	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
2-Acetylaminofluorene	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
2-Chloronaphthalene	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
2-Chlorophenol	450 U	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	380 UJ
2-Methyl-5-nitroaniline	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
2-Methylphenol (o-Cresol)	450 U	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	380 UJ
2-Naphthylamine	230 U	240 U	220 R	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
2-Nitroaniline	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
2-Nitrophenol	450 U	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	380 UJ
2-Picoline	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
3,3'-Dichlorobenzidine	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
3,3'-Dimethylbenzidine	230 U	240 U	220 R	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
3-Methylcholanthrene	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
3-Methylphenol (m-Cresol)	340 U	350 U	320 U	270 U	290 U	280 U	290 U	290 U	290 U	290 UJ	280 UJ
3-Nitroaniline	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
4,6-Dinitro-2-methylphenol	450 U	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	380 UJ
4-Aminobiphenyl	230 U	240 U	220 R	190 UJ	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
4-Bromophenyl-phenylether	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
4-Chloro-3-methylphenol	450 U	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	380 UJ
4-Chloroaniline	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
4-Chlorophenyl-phenylether	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
4-Dimethylaminoazobenzene (p-)	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
4-Methylphenol (p-Cresol)	340 U	350 U	320 U	270 U	290 U	280 U	290 U	290 U	290 U	290 UJ	280 UJ
4-Nitroaniline	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
4-Nitrophenol	450 U	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	380 UJ
4-Nitroquinoline-1-oxide	230 UJ	240 UJ	220 U	190 UJ	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
7,12-Dimethylbenz(a)anthracene	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
a,a-Dimethylphenethylamine	450 UJ	460 UJ	430 UJ	360 UJ	390 UJ	370 UJ	390 UJ	390 UJ	380 UJ	540 UJ	530 UJ
Acetophenone	120 U	120 U	110 U	93 U	100 U	94 U	100 U	100 U	98 U	98 UJ	96 UJ
Aniline	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ

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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

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Sample ID	59SB01-00	59SB01-00D	59SB02-00	59SB03-00	59SB04-00	59SB06-00	59SB07-00	59SB08-00	59SB09-00	59SB11-00	59SB11-00D
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Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Semivolatile Organics (µg/kg) (cont.)											
Aramite	230 UJ	240 UJ	220 U	190 UJ	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Benzyl Alcohol	230 UJ	240 UJ	220 UJ	190 UJ	200 UJ	190 UJ	200 UJ	200 UJ	200 UJ	200 UJ	190 UJ
Bis(2-chloroethoxy)methane	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Bis(2-chloroethyl)ether	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Bis(2-ethylhexyl) Phthalate (BEHP)	230 UJ	630 J	240	190 U	200 U	190 U	48 J	200	200 U	200 UJ	190 UJ
Butyl Benzyl Phthalate	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Diallate (cis)	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Diallate (trans)	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Dibenzofuran	230 U	240 U	220 U	190 U	750	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Diethyl Phthalate (DEP)	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Dimethyl Phthalate	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Di-n-butyl Phthalate (DBP)	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Di-n-octyl Phthalate	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Dinoseb	NA	NA	NA	NA	NA	NA	NA	NA	NA	200 UJ	190 UJ
Ethyl Methane Sulfonate (EMS)	230 UJ	240 UJ	220 UJ	190 UJ	200 UJ	190 UJ	200 UJ	200 UJ	200 UJ	200 UJ	190 UJ
Hexachloro-1,3-butadiene	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Hexachlorobenzene	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Hexachlorocyclopentadiene	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Hexachloroethane	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Hexachloropropene	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Isophorone	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Isosafrole	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Methapyrilene	230 UJ	240 UJ	220 R	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Methyl Methane Sulfonate	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Nitrobenzene	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
n-Nitrosodiethylamine	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
n-Nitrosodimethylamine (NDMA)	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
n-Nitroso-di-n-butylamine	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
n-Nitrosodi-n-propylamine	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
n-Nitrosodiphenylamine	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
n-Nitrosomethylethylamine	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
n-Nitrosomorpholine	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
n-Nitrosopiperidine	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
n-Nitrosopyrrolidine	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
o-Toluidine	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Pentachlorobenzene	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB01	59SB02	59SB03	59SB04	59SB06	59SB07	59SB08	59SB09	59SB11	59SB11
Sample ID	59SB01-00	59SB01-00D	59SB02-00	59SB03-00	59SB04-00	59SB06-00	59SB07-00	59SB08-00	59SB09-00	59SB11-00	59SB11-00D
Sample Date	4/19/2010	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	5/19/2010	5/19/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Semivolatile Organics (µg/kg) (cont.)											
Pentachloronitrobenzene	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Pentachlorophenol	450 U	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	380 UJ
Phenacetin	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Phenol	450 U	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	380 UJ
Pronamide	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Pyridine	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Safrole	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
LLPAHs (µg/kg)											
2-Methylnaphthalene	11 UJ	1.2 J	11 UJ	9.1 UJ	31 J	9.2 UJ	9.8 UJ	9.8 U	9.5 UJ	9.5 UJ	9.4 UJ
Acenaphthene	11 U	12 U	0.82 J	9.1 U	480	9.2 U	9.8 U	9.8 U	1.5 J	9.5 UJ	9.4 UJ
Acenaphthylene	11 U	12 U	11 U	9.1 U	27	9.2 U	9.8 U	9.8 U	16	9.5 UJ	9.4 UJ
Anthracene	11 U	1.9 J	2.3 J	9.1 U	690	0.57 J	0.82 J	0.64 J	12	9.5 UJ	0.6 J
Benzo(a)anthracene	11 U	3.9 J	5.8 J	0.91 J	84 J	1.8 J	0.72 J	1.4 J	46	9.5 UJ	1.1 J
Benzo(a)pyrene (BaP)	11 U	2.5 J	4.1 J	0.89 J	390	9.2 U	0.8 J	0.84 J	57	9.5 UJ	9.4 UJ
Benzo(b)fluoranthene	11 U	2.5 J	3.7 J	0.99 J	750	9.2 U	1.2 J	0.86 J	51	9.5 UJ	1.3 J
Benzo(g,h,i)perylene	11 UJ	2 J	2.5 J	9.1 UJ	220	1.3 J	1.5 J	9.8 UJ	53 J	9.5 UJ	0.53 J
Benzo(k)fluoranthene	11 UJ	2.6 J	5 J	1.2 J	730	9.2 UJ	0.78 J	0.91 J	62 J	9.5 UJ	0.75 J
Chrysene	11 U	3.7 J	3.9 J	0.77 J	1200	1.4 J	0.78 J	1.4 J	39	9.5 UJ	1.4 J
Dibenz(a,h)anthracene	11 U	0.92 J	11 U	9.1 U	92	9.2 U	9.8 U	9.8 UJ	9.5 U	9.5 UJ	9.4 UJ
Fluoranthene	11 U	6.9 J	11	9.1 U	4600	1.8 J	9.8 U	3.1 J	68	9.5 UJ	2.3 J
Fluorene	11 U	0.82 J	0.73 J	9.1 U	580	9.2 U	9.8 U	9.8 U	1.1 J	9.5 UJ	9.4 UJ
Indeno(1,2,3-cd)pyrene	0.58 J	3 J	3.6 J	9.1 UJ	240	1.8 J	9.8 UJ	9.8 UJ	65 J	9.5 UJ	9.4 UJ
Naphthalene	11 U	12 U	11 U	9.1 U	9.8 U	9.2 U	9.8 U	9.8 U	9.5 U	9.5 UJ	9.4 UJ
Phenanthrene	11 U	8.1 J	8.2 J	9.1 U	7000	1.5 J	9.8 U	3.4 J	28	9.5 UJ	9.4 UJ
Pyrene	11 U	6.5 J	8.3 J	1 J	3000	1.6 J	1.2 J	2.9 J	66	9.5 UJ	9.4 UJ
LLPAH Totals (µg/kg)											
Low molecular weight PAHs	88	54.92	56.05	72.8	2672	49.87	69.42	56.14	145.6	76	59.3
High molecular weight PAHs	88.58	27.62	47.9	33.06	17451.8	44.7	26.58	37.71	448.5	85.5	42.68
Pesticides (µg/kg)											
4,4'-DDD	4.5 U	4.6 UJ	0.6 J	0.79 J	3.9 UJ	3.7 U	3.9 U	3.9 UJ	2.4 J	3.8 U	19 UJ
4,4'-DDE	4.5 U	4.6 UJ	0.48 J	4.5	3.9 UJ	0.46 J	0.67 J	3.9 UJ	53	3.8 U	19 UJ
4,4'-DDT	4.5 U	4.6 UJ	4.3 U	3.2 J	3.9 UJ	3.7 U	0.66 J	3.9 UJ	15	3.8 U	19 UJ
Aldrin	2.3 U	2.4 UJ	2.2 U	1.8 U	2 UJ	1.9 U	2 U	2 UJ	1.9 U	2 U	9.7 UJ
BHC, alpha-	2.3 U	2.4 UJ	2.2 U	1.8 U	2 UJ	1.9 U	2 U	2 UJ	1.9 U	2 U	9.7 UJ

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB01	59SB02	59SB03	59SB04	59SB06	59SB07	59SB08	59SB09	59SB11	59SB11
Sample ID	59SB01-00	59SB01-00D	59SB02-00	59SB03-00	59SB04-00	59SB06-00	59SB07-00	59SB08-00	59SB09-00	59SB11-00	59SB11-00D
Sample Date	4/19/2010	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	5/19/2010	5/19/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Pesticides (µg/kg) (cont.)											
BHC, beta-	2.3 U	2.4 UJ	2.2 U	0.47 J	2.4 R	1.9 U	0.57 J	2 UJ	1.9 U	0.98 U	4.8 UJ
BHC, delta-	2.3 U	2.4 UJ	2.2 U	1.8 U	2 UJ	1.9 U	2 U	2 UJ	1.9 U	2 U	9.7 UJ
BHC, gamma- (Lindane)	2.3 U	2.4 UJ	2.2 U	1.8 U	2 UJ	1.9 U	2 U	2 UJ	1.9 U	2 U	9.7 UJ
Chlordane, alpha-	2.3 U	2.4 UJ	2.2 U	1.2 J	1.1 J	1.9 U	1.2 J	2 UJ	1.9 U	2 U	1.3 NJ
Chlordane, gamma-	2.3 U	2.4 UJ	2.2 U	1.8 U	2 UJ	0.57 J	2 U	2 UJ	1.9 U	2 U	9.7 UJ
Chlorobenzilate	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Dieldrin	4.5 U	4.6 UJ	4.3 U	3.6 U	3.9 UJ	3.7 U	3.9 U	3.9 UJ	3.8 U	3.8 U	19 UJ
Endosulfan I	2.3 U	2.4 UJ	2.2 U	1.8 U	2 UJ	1.9 U	2 U	2 UJ	1.9 U	2 U	9.7 UJ
Endosulfan II	4.5 U	4.6 UJ	4.3 U	3.6 U	3.9 UJ	3.7 U	3.9 U	3.9 UJ	3.8 U	3.8 U	19 UJ
Endosulfan Sulfate	4.5 U	4.6 UJ	4.3 U	3.6 U	0.72 J	3.7 U	3.9 U	3.9 UJ	0.61 J	3.8 U	19 UJ
Endrin	4.5 U	4.6 UJ	4.3 U	3.6 U	3.9 UJ	3.7 U	3.9 U	3.9 UJ	3.8 U	3.8 U	19 UJ
Endrin Aldehyde	4.5 R	4.6 R	4.3 R	3.6 R	3.9 R	3.7 R	3.9 R	3.9 R	1.8 J	3.8 U	19 UJ
Heptachlor	2.3 U	2.4 UJ	2.2 U	1.8 U	2 UJ	1.9 U	2 U	2 UJ	1.9 U	2 U	9.7 UJ
Heptachlor Epoxide	2.3 U	2.4 UJ	2.2 U	1.8 U	2 UJ	1.9 U	2 U	2 UJ	1.9 U	2 U	9.7 UJ
Isodrin	230 U	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Kepone (Chlordecone)	230 UJ	240 UJ	220 UJ	190 UJ	200 UJ	190 UJ	200 UJ	200 UJ	200 UJ	200 R	190 R
Methoxychlor	23 U	24 UJ	22 U	18 U	20 UJ	19 U	20 U	20 UJ	19 U	20 U	26 NJ
Toxaphene	110 U	120 UJ	110 U	90 U	98 UJ	92 U	98 U	98 UJ	94 U	95 U	470 UJ
Metals (mg/kg)											
Antimony	6.5 UJ	1.4 UJ	1.3 UJ	1.1 UJ	1.1 UJ	1.1 UJ	1.1 UJ	1.2 UJ	1.2 J	5.7 UJ	5.7 UJ
Arsenic	3.3 U	1.2	0.81	0.78	0.57 U	0.53 U	1.4	0.58 U	0.89	2.8 U	2.8 U
Barium	184 J	75.6 J	40.2 J	90.2 J	155 J	87.3 J	42.9 J	267 J	154 J	36.6	35.5
Beryllium	3.3 U	0.34 J	0.41 J	0.14 J	0.26 J	0.21 J	0.21 J	0.36 J	0.2 J	2.8 U	2.8 U
Cadmium	3.3 U	0.071 J	0.93	0.5 J	0.087 J	0.35 J	0.31 J	1.3	2	0.25 J	0.25 J
Chromium	16.7 J	31 J	41.9 J	24.3 J	5.3 J	41.6 J	40.7 J	19 J	45.6 J	15.9 J	25.9 J
Cobalt	6.4 J	10.4 J	27.1 J	25.9 J	18.4 J	20.2 J	26.4 J	19.2 J	26.9 J	25.5	22.9
Copper	93.6 J	96.8 J	84.7 J	106 J	24.8 J	91.7 J	126 J	41.5 J	237 J	107	92.2
Lead	5.9 J	17 J	31 J	51.3 J	3.4 J	10.5 J	27.3 J	2.6 J	654 J	5.5 J	8.7 J
Mercury	0.043 J	0.05	0.017 J	0.02 J	0.014 J	0.015 J	0.009 J	0.014 J	0.081	0.017 J	0.037 U
Nickel	5.2	6.1	13.5	22.3	7.9	14.1	26.8	11	27.5	8.9	11.7
Selenium	16.3 U	1 J	1.1 J	0.21 J	0.22 J	0.36 J	0.46 J	0.57 J	0.47 J	14.2 U	14.2 U
Silver	3.3 U	0.68 U	0.65 U	0.53 U	0.57 U	0.53 U	0.57 U	0.58 U	2.6	2.8 U	2.8 U
Thallium	3.3 U	0.68 U	0.65 U	0.53 U	0.57 U	0.53 U	0.57 U	0.58 U	0.56 U	2.8 U	2.8 U
Tin	2.5 J	3 J	5.7 J	6.3	3.8 J	3.8 J	5.6 J	3.3 J	36.5	5.7 U	5.7 U
Vanadium	143 J	260 J	226 J	118 J	91.7 J	132 J	157 J	72.8 J	191 J	139	169
Zinc	33.8 J	34.1 J	57 J	101 J	62.3 J	77.9 J	82.4 J	80.5 J	468 J	53.5	64.5

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB12	59SB13	59SB14	59SB15	59SB17	59SB17	59SB18	59SB20	59SB21	59SB22	59SB23
Sample ID	59SB12-00	59SB13-00	59SB14-00	59SB15-00	59SB17-00	59SB17-00D	59SB18-00	59SB20-00	59SB21-00	59SB22-00	59SB23-00
Sample Date	5/18/2010	5/18/2010	5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Volatile Organics (µg/kg)											
1,1,1,2-Tetrachloroethane	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
1,1,1-Trichloroethane	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
1,1,2,2-Tetrachloroethane	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
1,1,2-Trichloroethane	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
1,1-Dichloroethane	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
1,1-Dichloroethene	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
1,2,3-Trichloropropane	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
1,2-Dibromo-3-chloropropane (DBCP)	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
1,2-Dibromoethane (EDB)	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
1,2-Dichloroethane	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
1,2-Dichloroethene (trans)	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
1,2-Dichloropropane	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
1,3-Dichloropropene (cis)	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
1,3-Dichloropropene (trans)	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
1,4-Dichloro-2-butene (trans)	18 U	19 U	18 U	18 U	18 U	17 U	17 U	16 U	18 U	16 U	18 U
1,4-Dioxane (p-)	220 R	240 R	230 R	230 R	220 R	210 R	210 R	200 R	220 R	200 R	220 R
2-Butanone (MEK)	16 U	12 U	11 U	11 U	11 U	11 U	11 U	10 U	11 U	10 U	11 U
2-Chloro-1,3-butadiene (Chloroprene)	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
2-Hexanone (MBK)	4.8 J	12 U	11 U	11 U	11 U	11 U	11 U	10 U	11 U	10 U	11 U
3-Chloropropene (Allyl Chloride)	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
4-Methyl-2-pentanone (MIBK)	11 U	12 U	11 U	11 U	11 U	11 U	11 U	10 U	11 U	10 U	11 U
Acetone	110 J	16 U	14 U	59 J	72	66	34	31	190	97	38
Acetonitrile	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Acrolein	45 R	47 R	45 R	46 R	45 R	43 R	42 R	41 R	45 R	40 R	44 R
Acrylonitrile	3.4 J	47 U	45 U	46 U	45 U	43 U	42 U	41 U	45 U	40 U	44 U
Benzene	0.37 J	4.7 U	4.5 U	0.73 J	4.5 U	4.3 U	0.53 J	4.1 U	4.5 U	4 U	4.4 U
Bromodichloromethane	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Bromoform	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Bromomethane	2.4 J	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	3.4 J
Carbon Disulfide	0.52 J	4.7 U	4.5 U	4.6 U	1 J	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Carbon Tetrachloride	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Chlorobenzene	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Chloroethane	4.5 UJ	4.7 U	4.5 UJ	4.6 UJ	4.5 UJ	4.3 UJ	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Chloroform	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Chloromethane	0.39 J	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	0.35 J	0.52 J	0.47 J
Dibromochloromethane	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB12	59SB13	59SB14	59SB15	59SB17	59SB17	59SB18	59SB20	59SB21	59SB22	59SB23
Sample ID	59SB12-00	59SB13-00	59SB14-00	59SB15-00	59SB17-00	59SB17-00D	59SB18-00	59SB20-00	59SB21-00	59SB22-00	59SB23-00
Sample Date	5/18/2010	5/18/2010	5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Volatile Organics (µg/kg) (cont.)											
Dibromomethane	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Ethyl Methacrylate	45 U	47 U	45 U	46 U	45 U	43 U	42 U	41 U	45 U	40 U	44 U
Ethylbenzene	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Freon 11 (Trichlorofluoromethane)	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Freon-12 (Dichlorodifluoromethane)	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Isobutyl Alcohol	220 R	240 R	230 R	230 R	220 R	210 R	210 R	200 R	220 R	200 R	220 R
Methyl Acrylonitrile	3.3 J	47 U	45 U	46 U	45 U	43 U	42 U	41 U	45 U	40 U	44 U
Methyl Iodide	1.9 J	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	2.6 J
Methyl Methacrylate	45 R	47 R	45 R	46 R	45 R	43 R	42 R	41 R	45 R	40 R	44 R
Methylene Chloride	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Pentachloroethane	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Propionitrile (Ethyl Cyanide)	220 R	240 R	230 R	230 R	220 R	210 R	210 R	200 R	220 R	200 R	220 R
Styrene (Ethenylbenzene)	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Tetrachloroethene (PCE)	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Toluene	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Trichloroethene (TCE)	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Vinyl Acetate	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 UJ	4.5 UJ	4 UJ	4.4 UJ
Vinyl Chloride	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Xylene, m/p-	8.9 U	9.5 U	9.1 U	9.2 U	8.9 U	8.6 U	8.4 U	8.1 U	8.9 U	8 U	8.8 U
Xylene, o-	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Xylenes, total	4.5 U	4.7 U	4.5 U	4.6 U	4.5 U	4.3 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Semivolatile Organics (µg/kg)											
1,2,4,5-Tetrachlorobenzene	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
1,2,4-Trichlorobenzene	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
1,2-Dichlorobenzene (o-)	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
1,3,5-Trinitrobenzene (TNB)	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
1,3-Dichlorobenzene (m-)	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
1,3-Dinitrobenzene (m-)	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
1,4-Dichlorobenzene (p-)	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
1,4-Naphthoquinone	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
1,4-Phenylenediamine	1900 R	2100 R	2100 R	1900 R	2000 R	2000 R	2000 R	1800 R	2000 R	2000 R	2100 R
1-Naphthylamine	190 UJ	210 UJ	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
2,2'-Oxybis[1-chloropropane]	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
2,3,4,6-Tetrachlorophenol	370 UJ	410 U	410 UJ	370 UJ	380 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U
2,4,5-Trichlorophenol	370 UJ	410 U	410 UJ	370 UJ	380 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U

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SUMMARY OF ANALYTICAL RESULTS - SURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB12	59SB13	59SB14	59SB15	59SB17	59SB17	59SB18	59SB20	59SB21	59SB22	59SB23
Sample ID	59SB12-00	59SB13-00	59SB14-00	59SB15-00	59SB17-00	59SB17-00D	59SB18-00	59SB20-00	59SB21-00	59SB22-00	59SB23-00
Sample Date	5/18/2010	5/18/2010	5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Semivolatile Organics (µg/kg) (cont.)											
2,4,6-Trichlorophenol	370 UJ	410 U	410 UJ	370 UJ	380 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U
2,4-Dichlorophenol	370 UJ	410 U	410 UJ	370 UJ	380 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U
2,4-Dimethylphenol	370 UJ	410 U	410 UJ	370 UJ	380 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U
2,4-Dinitrophenol	370 UJ	410 U	410 UJ	370 UJ	380 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U
2,4-Dinitrotoluene (DNT)	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
2,6-Dichlorophenol	370 UJ	410 U	410 UJ	370 UJ	380 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U
2,6-Dinitrotoluene (DNT)	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
2-Acetylaminofluorene	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 UJ	180 UJ	200 U	200 UJ	210 U
2-Chloronaphthalene	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
2-Chlorophenol	370 UJ	410 U	410 UJ	370 UJ	380 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U
2-Methyl-5-nitroaniline	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
2-Methylphenol (o-Cresol)	370 UJ	410 U	410 UJ	370 UJ	380 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U
2-Naphthylamine	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
2-Nitroaniline	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
2-Nitrophenol	370 UJ	410 U	410 UJ	370 UJ	380 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U
2-Picoline	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
3,3'-Dichlorobenzidine	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
3,3'-Dimethylbenzidine	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 UJ	180 UJ	200 U	200 UJ	210 U
3-Methylcholanthrene	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 UJ	180 UJ	200 U	200 UJ	210 U
3-Methylphenol (m-Cresol)	280 UJ	310 U	310 UJ	280 UJ	290 UJ	300 UJ	290 U	270 U	290 U	290 U	310 U
3-Nitroaniline	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
4,6-Dinitro-2-methylphenol	370 UJ	410 U	410 UJ	370 UJ	380 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U
4-Aminobiphenyl	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
4-Bromophenyl-phenylether	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
4-Chloro-3-methylphenol	370 UJ	410 U	410 UJ	370 UJ	380 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U
4-Chloroaniline	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
4-Chlorophenyl-phenylether	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
4-Dimethylaminoazobenzene (p-)	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
4-Methylphenol (p-Cresol)	280 UJ	310 U	310 UJ	280 UJ	290 UJ	300 UJ	290 U	270 U	290 U	290 U	310 U
4-Nitroaniline	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
4-Nitrophenol	370 UJ	410 U	410 UJ	370 UJ	380 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U
4-Nitroquinoline-1-oxide	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
7,12-Dimethylbenz(a)anthracene	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
a,a-Dimethylphenethylamine	520 UJ	590 U	580 UJ	520 UJ	540 UJ	560 UJ	540 UJ	510 UJ	540 U	550 UJ	590 U
Acetophenone	94 UJ	110 U	100 UJ	94 UJ	98 UJ	100 UJ	98 U	92 U	98 U	100 U	110 U
Aniline	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB12	59SB13	59SB14	59SB15	59SB17	59SB17	59SB18	59SB20	59SB21	59SB22	59SB23
Sample ID	59SB12-00	59SB13-00	59SB14-00	59SB15-00	59SB17-00	59SB17-00D	59SB18-00	59SB20-00	59SB21-00	59SB22-00	59SB23-00
Sample Date	5/18/2010	5/18/2010	5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Semivolatile Organics (µg/kg) (cont.)											
Aramite	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Benzyl Alcohol	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Bis(2-chloroethoxy)methane	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Bis(2-chloroethyl)ether	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Bis(2-ethylhexyl) Phthalate (BEHP)	190 UJ	210 U	210 UJ	470 J	200 UJ	200 UJ	200 U	180 U	200 U	200 U	53 J
Butyl Benzyl Phthalate	190 UJ	210 U	210 UJ	170 J	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Diallate (cis)	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Diallate (trans)	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Dibenzofuran	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Diethyl Phthalate (DEP)	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Dimethyl Phthalate	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Di-n-butyl Phthalate (DBP)	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Di-n-octyl Phthalate	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Dinoseb	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Ethyl Methane Sulfonate (EMS)	190 UJ	210 UJ	210 UJ	190 UJ	200 UJ	200 UJ	200 UJ	180 UJ	200 UJ	200 UJ	210 UJ
Hexachloro-1,3-butadiene	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Hexachlorobenzene	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Hexachlorocyclopentadiene	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Hexachloroethane	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Hexachloropropene	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Isophorone	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Isosafrole	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Methapyrilene	190 UJ	210 R	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Methyl Methane Sulfonate	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Nitrobenzene	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
n-Nitrosodiethylamine	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
n-Nitrosodimethylamine (NDMA)	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
n-Nitroso-di-n-butylamine	190 UJ	210 UJ	210 UJ	190 UJ	200 UJ	200 UJ	200 UJ	180 UJ	200 UJ	200 UJ	210 UJ
n-Nitrosodi-n-propylamine	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
n-Nitrosodiphenylamine	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
n-Nitrosomethylethylamine	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
n-Nitrosomorpholine	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
n-Nitrosopiperidine	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
n-Nitrosopyrrolidine	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 UJ	180 UJ	200 U	200 UJ	210 U
o-Toluidine	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Pentachlorobenzene	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U

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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB12	59SB13	59SB14	59SB15	59SB17	59SB17	59SB18	59SB20	59SB21	59SB22	59SB23
Sample ID	59SB12-00	59SB13-00	59SB14-00	59SB15-00	59SB17-00	59SB17-00D	59SB18-00	59SB20-00	59SB21-00	59SB22-00	59SB23-00
Sample Date	5/18/2010	5/18/2010	5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Semivolatile Organics (µg/kg) (cont.)											
Pentachloronitrobenzene	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Pentachlorophenol	370 UJ	410 U	410 UJ	370 UJ	380 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U
Phenacetin	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Phenol	370 UJ	410 U	410 UJ	370 UJ	380 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U
Pronamide	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Pyridine	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Safrole	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
LLPAHs (µg/kg)											
2-Methylnaphthalene	9.2 UJ	10 U	10 UJ	1.2 J	9.5 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Acenaphthene	9.2 UJ	10 U	10 UJ	9.2 UJ	9.5 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Acenaphthylene	9.2 UJ	10 U	10 UJ	1.7 J	9.5 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Anthracene	2.2 J	10 U	10 UJ	3.8 J	9.5 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Benzo(a)anthracene	9.6 J	10 U	10 UJ	22 J	0.87 J	0.7 J	9.5 U	9 U	9.5 U	9.8 U	10 U
Benzo(a)pyrene (BaP)	11 J	10 U	10 UJ	9.2 UJ	9.5 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Benzo(b)fluoranthene	9.9 J	10 U	10 UJ	9.2 UJ	9.5 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Benzo(g,h,i)perylene	9.2 UJ	10 U	10 UJ	9.2 UJ	9.5 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Benzo(k)fluoranthene	9.8 J	10 U	10 UJ	9.2 UJ	9.5 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Chrysene	9.9 J	10 U	10 UJ	32 J	1.2 J	0.9 J	1.5 J	9 U	9.5 U	9.8 U	2.3 J
Dibenz(a,h)anthracene	9.2 UJ	10 U	10 UJ	9.2 UJ	9.5 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Fluoranthene	16 J	10 U	10 UJ	15 J	9.5 UJ	9.9 UJ	1.8 J	9 U	9.5 U	9.8 U	4.6 J
Fluorene	0.63 J	10 U	10 UJ	9.2 UJ	9.5 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Indeno(1,2,3-cd)pyrene	9.2 UJ	10 U	10 UJ	9.2 UJ	9.5 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Naphthalene	0.92 J	10 U	1.4 J	2.2 J	1.2 J	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Phenanthrene	9.2 UJ	10 U	10 UJ	9.2 UJ	9.5 UJ	9.9 UJ	9.5 U	9 U	1.7 J	9.8 U	10 U
Pyrene	18 J	10 U	10 UJ	81 J	9.5 UJ	9.9 UJ	2.1 J	3.2 J	9.5 U	9.8 U	3.5 J
LLPAH Totals (µg/kg)											
Low molecular weight PAHs	56.55	80	71.4	51.5	67.7	79.2	68.3	72	68.2	78.4	74.6
High molecular weight PAHs	95.8	90	90	190.2	68.57	70.9	70.1	75.2	85.5	88.2	75.8
Pesticides (µg/kg)											
4,4'-DDD	3.7 U	4.1 UJ	4.1 U	8.1 J	3.8 U	3.9 U	3.8 U	3.6 U	3.8 U	3.9 U	4.1 U
4,4'-DDE	3.7 U	4.1 UJ	4.1 U	160	3.8 U	1.2 J	12	3.6 U	3.8 U	3.4 J	1.6 J
4,4'-DDT	0.85 J	4.1 UJ	4.1 U	160	3.8 U	1.7 J	2.7 J	3.6 U	3.8 U	1.2 J	2.3 J
Aldrin	1.9 U	2.1 UJ	2.1 U	19 U	2 U	2 U	2 U	1.8 U	2 U	2 U	2.1 U
BHC, alpha-	1.9 U	2.1 UJ	2.1 U	19 U	2 U	2 U	2 U	1.8 U	2 U	2 U	2.1 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB12	59SB13	59SB14	59SB15	59SB17	59SB17	59SB18	59SB20	59SB21	59SB22	59SB23
Sample ID	59SB12-00	59SB13-00	59SB14-00	59SB15-00	59SB17-00	59SB17-00D	59SB18-00	59SB20-00	59SB21-00	59SB22-00	59SB23-00
Sample Date	5/18/2010	5/18/2010	5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Pesticides (µg/kg) (cont.)											
BHC, beta-	0.95 U	0.63 NJ	1.1 U	8.6 NJ	0.98 U	9.2 NJ	2 U	1.8 U	2 U	2 U	2.1 U
BHC, delta-	1.9 U	2.1 UJ	2.1 U	19 U	2 U	2 U	2 U	1.8 U	2 U	2 U	2.1 U
BHC, gamma- (Lindane)	1.9 U	2.1 UJ	2.1 U	19 U	2 U	2 U	2 U	1.8 U	2 U	2 U	2.1 U
Chlordane, alpha-	0.25 J	2.1 UJ	2.1 U	19 U	2 U	2 U	2 U	1.8 U	2 U	1.9 J	1.1 J
Chlordane, gamma-	1.9 U	2.1 UJ	2.1 U	3.5 J	2 U	2 U	2 U	1.8 U	2 U	2 U	2.1 U
Chlorobenzilate	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Dieldrin	3.7 U	4.1 UJ	4.1 U	37 U	3.8 U	3.9 U	3.8 U	3.6 U	3.8 U	3.9 U	4.1 U
Endosulfan I	1.9 U	2.1 UJ	2.1 U	19 U	2 U	2 U	2 U	1.8 U	2 U	2 U	2.1 U
Endosulfan II	3.7 U	4.1 UJ	4.1 U	37 U	3.8 U	3.9 U	3.8 U	3.6 U	3.8 U	3.9 U	4.1 U
Endosulfan Sulfate	0.52 J	4.1 UJ	4.1 U	37 U	3.8 U	3.9 U	3.8 U	3.6 U	3.8 U	3.9 U	4.1 U
Endrin	3.7 U	4.1 UJ	4.1 U	37 U	3.8 U	3.9 U	3.8 U	3.6 U	3.8 U	3.9 U	4.1 U
Endrin Aldehyde	3.7 U	4.1 UJ	4.1 U	37 U	3.8 U	3.9 U	3.8 U	3.6 U	3.8 U	3.9 U	4.1 U
Heptachlor	1.9 U	2.1 UJ	2.1 U	19 U	2 U	2 U	2 U	1.8 U	2 U	2 U	2.1 U
Heptachlor Epoxide	1.9 U	2.1 UJ	2.1 U	19 U	2 U	2 U	2 U	1.8 U	2 U	2 U	2.1 U
Isodrin	190 UJ	210 U	210 UJ	190 UJ	200 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Kepone (Chlordecone)	190 R	210 U	210 R	1900 R	200 R	200 R	200 UJ	180 UJ	200 UJ	200 UJ	210 U
Methoxychlor	19 U	21 UJ	21 U	190 U	20 U	20 U	20 U	18 U	20 U	20 U	21 U
Toxaphene	92 U	100 UJ	100 U	920 U	95 U	99 U	95 U	90 U	95 U	98 U	100 U
Metals (mg/kg)											
Antimony	0.77 J	0.29 J	5.9 UJ	8.5 J	5.7 UJ	5.7 UJ	0.17 J	0.88 J	5.6 UJ	5.7 UJ	0.17 J
Arsenic	0.69	0.63 U	2.9 U	5.5	2.9 U	2.9 U	0.29 J	2.5 U	2.8 U	2.9 U	0.71
Barium	81.5	33.4	122	145	82.5	86.7	48	104	102	107	81.6
Beryllium	0.23 J	0.23 J	2.9 U	0.31 J	0.27 J	0.29 J	0.15 J	0.62 J	0.27 J	2.9 U	0.19 J
Cadmium	0.8	0.15 J	0.34 J	2.6	0.33 J	2.9 U	0.26 J	0.64 J	0.26 J	0.42 J	0.35 J
Chromium	15.7 J	7.4	45.7 J	32.5 J	30 J	28.5 J	19.6	54.4	29.4	29.5	51.2
Cobalt	14.1	20.2 J	45.2	15.6	23.3	8.1	15.2 J	30.2 J	18.3 J	21.2 J	29 J
Copper	81.3	94.9 J	291	120	76.3	68.8	59.5 J	94.2 J	102 J	76.6 J	73.9 J
Lead	47.4	5.2	3.5	638	22.4	9.8	7.1	3.6	15.1	16.7	11.8
Mercury	0.095	0.041 U	0.041 U	0.053	0.026 J	0.019 J	0.038 U	0.01 J	0.009 J	0.011 J	0.041 U
Nickel	12	6.6	20.7	13.1	12.5	7.3	10.3	22.2	13.9	16.1	22.2
Selenium	0.5 J	0.27 J	14.7 U	0.61 J	14.3 U	0.86 J	0.34 J	2.4 J	13.9 U	14.3 U	0.46 J
Silver	0.55 U	0.093 J	2.9 U	0.55 U	2.9 U	2.9 U	0.1 J	0.48 J	2.8 U	2.9 U	0.14 J
Thallium	0.032 J	0.05 J	2.9 U	0.065 J	2.9 U	2.9 U	0.032 J	0.37 J	2.8 U	2.9 U	0.027 J
Tin	8.5	6.3 UJ	5.9 U	10.5	6	5.7 U	5.6 UJ	5.1 UJ	5.6 UJ	5.7 UJ	6.2 UJ
Vanadium	84.3	129 J	249	94.9	155	184	102 J	109 J	107 J	126 J	115 J
Zinc	232	58.6	123	747	132	63.2	59.9	81.5	87.7	77.4	52

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Notes:

J - Estimated: The analyte was positively identified; the quantitation is an estimation.
U - Non detected at the Limit of Detection.
UJ - Reported quantitation limit is qualified as estimated.
NJ - Analyte has been tentatively identified; the quantitation is an estimation.
R - Rejected data; data is not usable.
ft bgs - feet below ground surface
LLPAHs - Low Level Polynuclear Aromatic Hydrocarbons
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram

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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB24	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB24-00	59SB24-00D	59SB25-00	59SB26-00	59SB27-00	59SB28-00	59SB29-00	59SB30-00	59SB31-00	59SB32-00	59SB33-00
Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Depth Range	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Volatile Organics (µg/kg)											
1,1,1,2-Tetrachloroethane	2.2 U	2.5 U	2.3 U	2.3 U	2.4 U	2.1 U	1.7 U	1.9 U	2.2 U	2.6 U	2.4 U
1,1,1-Trichloroethane	0.93 U	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
1,1,2,2-Tetrachloroethane	1.5 U	1.6 U	1.6 U	1.5 U	1.6 U	1.4 U	1.1 U	1.3 U	1.4 U	1.7 U	1.6 U
1,1,2-Trichloroethane	1.2 U	1.3 U	1.3 U	1.2 U	1.3 U	1.1 U	0.93 U	1 U	1.2 U	1.4 U	1.3 U
1,1-Dichloroethane	1 U	1.1 U	1.1 U	1 U	1.1 U	0.97 U	0.79 U	0.88 U	0.99 U	1.2 U	1.1 U
1,1-Dichloroethene	1.4 U	1.5 U	1.5 U	1.4 U	1.5 U	1.3 U	1.1 U	1.2 U	1.3 U	1.6 U	1.5 U
1,2,3-Trichloropropane	2.2 U	2.5 U	2.3 U	2.3 U	2.4 U	2.1 U	1.7 U	1.9 U	2.2 U	2.6 U	2.4 U
1,2,4-Trichlorobenzene	0.93 U	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
1,2-Dibromo-3-Chloropropane	4.1 U	4.5 U	4.3 U	4.2 U	4.4 U	3.9 U	3.1 U	3.5 U	4 U	4.7 U	4.4 U
1,2-Dibromoethane	1.4 U	1.5 U	1.5 U	1.4 U	1.5 U	1.3 U	1.1 U	1.2 U	1.3 U	1.6 U	1.5 U
1,2-Dichlorobenzene	1.2 U	1.3 U	1.3 U	1.2 U	1.3 U	1.1 U	0.93 U	1 U	1.2 U	1.4 U	1.3 U
1,2-Dichloroethane	1 U	1.1 U	1.1 U	1 U	1.1 U	0.97 U	0.79 U	0.88 U	0.99 U	1.2 U	1.1 U
1,2-Dichloropropane	0.93 U	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
1,3-Dichlorobenzene	1.5 U	1.6 U	1.6 U	1.5 U	1.6 U	1.4 U	1.1 U	1.3 U	1.4 U	1.7 U	1.6 U
1,4-Dichlorobenzene	0.93 U	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
1,4-Dioxane	46 R	51 R	48 R	48 R	49 R	44 R	36 R	40 R	45 R	53 R	50 R
2-Butanone	2.2 U	2.5 U	2.3 U	2.3 U	2.4 U	2.1 U	1.7 U	1.9 U	2.2 U	2.6 U	2.4 U
2-Hexanone	3.1 U	3.4 U	3.2 U	3.1 U	3.3 U	2.9 U	2.4 U	2.7 U	3 U	3.5 U	3.3 U
4-Methyl-2-pentanone	3.9 U	4.3 U	4.1 U	4 U	4.2 U	3.7 U	3 U	3.4 U	3.8 U	4.5 U	4.2 U
Acetone	10 U	11 UJ	27 J	10 U	11 U	9.7 U	7.9 U	15 J	30 J	45 J	11 U
Acetonitrile	38 U	42 U	40 UJ	39 UJ	41 UJ	36 UJ	29 UJ	33 U	37 UJ	44 UJ	41 U
Acrolein	22 UJ	25 U	23 UJ	23 UJ	24 UJ	21 UJ	17 UJ	19 U	22 UJ	26 UJ	24 U
Acrylonitrile	32 UJ	35 U	33 UJ	32 UJ	34 UJ	30 UJ	24 UJ	27 U	31 UJ	36 UJ	34 U
Allyl chloride	2 U	2.3 U	2.1 U	2.1 U	2.2 U	1.9 U	1.6 U	1.8 U	2 U	2.4 U	2.2 U
Benzene	0.93 U	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
Bromodichloromethane	0.93 U	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
Bromoform	1.4 U	1.5 U	1.5 U	1.4 U	1.5 U	1.3 U	1.1 U	1.2 U	1.3 U	1.6 U	1.5 U
Bromomethane	1.4 U	1.5 U	1.5 U	1.4 U	1.5 U	1.3 U	1.1 U	1.2 U	1.3 U	1.6 U	1.5 U
Carbon disulfide	1 U	1.1 U	1.1 U	1 U	1.1 U	0.97 U	0.79 U	0.88 U	0.99 U	1.2 U	1.1 U
Carbon tetrachloride	0.93 U	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
Chlorobenzene	0.93 U	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
Chloroethane	2.5 U	2.8 U	2.6 U	2.6 U	2.7 U	2.4 U	1.9 U	2.2 U	2.4 U	2.9 U	2.7 U
Chloroform	1 U	1.1 U	1.1 U	1 U	1.1 U	0.97 U	0.79 U	0.88 U	0.99 U	1.2 U	1.1 U
Chloromethane	1.9 U	2.1 U	1.9 U	1.9 U	2 U	1.8 U	1.4 U	1.6 U	1.8 U	2.1 U	2 U
Chloroprene	2 U	2.2 U	2 U	2 U	2.1 U	1.8 U	1.5 U	1.7 U	1.9 U	2.2 U	2.1 U
cis-1,3-Dichloropropene	0.93 U	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U

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Site ID	59SB24	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB24-00	59SB24-00D	59SB25-00	59SB26-00	59SB27-00	59SB28-00	59SB29-00	59SB30-00	59SB31-00	59SB32-00	59SB33-00
Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Depth Range	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Volatile Organics (µg/kg) (cont.)											
Dibromochloromethane	1.6 U	1.8 U	1.6 U	1.6 U	1.7 U	1.5 U	1.2 U	1.4 U	1.5 U	1.8 U	1.7 U
Dibromomethane	1.6 U	1.8 U	1.6 U	1.6 U	1.7 U	1.5 U	1.2 U	1.4 U	1.5 U	1.8 U	1.7 U
Dichlorodifluoromethane	0.93 U	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
Ethyl methacrylate	3.2 U	3.5 U	3.3 U	3.2 U	3.4 U	3 U	2.4 U	2.7 U	3.1 U	3.6 U	3.4 U
Ethylbenzene	1.2 U	1.3 U	1.3 U	1.2 U	1.3 U	1.1 U	0.93 U	1 U	1.2 U	1.4 U	1.3 U
Hexachlorobutadiene	2.9 U	3.2 U	3 U	3 U	3.1 U	2.7 U	2.2 U	2.5 U	2.8 U	3.3 U	3.1 U
Iodomethane	1.7 UJ	1.9 U	1.7 UJ	1.7 UJ	1.8 UJ	1.6 UJ	1.3 UJ	1.4 U	1.6 UJ	1.9 UJ	1.8 U
Isobutanol	48 R	54 R	50 R	50 R	51 R	46 R	37 R	42 R	47 R	56 R	52 R
Methacrylonitrile	21 U	24 U	22 UJ	22 UJ	23 UJ	20 UJ	16 UJ	18 U	21 UJ	25 UJ	23 U
Methyl methacrylate	4.2 U	4.6 U	4.4 U	4.3 U	4.5 U	4 U	3.2 U	3.6 U	4 U	4.8 U	4.5 U
Methylene Chloride	0.93 U	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
Naphthalene	1.9 R	1.2 R	1.2 R	1.1 R	1.2 R	1.1 R	0.86 R	0.96 R	1.1 R	1.3 R	1.2 R
Pentachloroethane	5.9 U	6.5 U	6.1 U	6 U	6.2 U	5.5 U	4.5 U	5.1 U	5.7 U	6.7 U	6.3 U
Propionitrile	24 U	27 U	25 UJ	25 UJ	26 UJ	23 UJ	19 UJ	21 U	23 UJ	28 UJ	26 U
Styrene	0.93 U	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
Tetrachloroethene	1.8 U	2 U	1.8 U	1.8 U	1.9 U	1.7 U	1.4 U	1.5 U	1.7 U	2 U	1.9 U
Toluene	0.93 U	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
trans-1,2-Dichloroethene	0.93 U	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
trans-1,3-Dichloropropene	0.93 U	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
trans-1,4-Dichloro-2-butene	2.7 U	3 U	2.8 U	2.8 U	2.9 U	2.5 U	2.1 U	2.3 U	2.6 U	3.1 U	2.9 U
Trichloroethene	1.2 U	1.3 U	1.3 U	1.2 U	1.3 U	1.1 U	0.93 U	1 U	1.2 U	1.4 U	1.3 U
Trichlorofluoromethane	1.1 U	1.2 U	1.2 U	1.1 U	1.2 U	1.1 U	0.86 U	0.96 U	1.1 U	1.3 U	1.2 U
Vinyl acetate	2.3 U	2.6 U	2.4 U	2.4 U	2.5 U	2.2 U	1.8 U	2 U	2.2 U	2.7 U	2.5 U
Vinyl chloride	1.4 U	1.5 U	1.5 U	1.4 U	1.5 U	1.3 U	1.1 U	1.2 U	1.3 U	1.6 U	1.5 U
Xylenes, Total	1 U	1.1 U	1.1 U	1 U	1.1 U	0.97 U	0.79 U	0.88 U	0.99 U	1.2 U	1.1 U
Semivolatile Organics (µg/kg)											
1,2,4,5-Tetrachlorobenzene	4.3 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
1,2,4-Trichlorobenzene	6.1 U	5.9 U	6.1 U	5.7 U	64 U	26 U	27 U	27 U	5.9 U	6.4 U	6.2 U
1,2-Dichlorobenzene	8.7 U	8.5 U	8.7 U	8.2 U	92 U	37 U	39 U	39 U	8.5 U	9.1 U	8.8 U
1,3,5-Trinitrobenzene	22 U	22 U	22 U	21 U	240 UJ	96 UJ	100 UJ	100 UJ	22 U	24 U	23 UJ
1,3-Dichlorobenzene	7.4 U	7.2 U	7.4 U	7 U	78 U	32 U	33 U	33 U	7.2 U	7.8 U	7.5 U
1,3-Dinitrobenzene	22 U	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
1,4-Dichlorobenzene	6.8 U	6.7 U	6.9 U	6.5 U	73 U	29 U	31 U	31 U	6.7 U	7.2 U	7 U
1,4-Naphthoquinone	4.3 UJ	4.3 UJ	4.4 UJ	4.1 UJ	46 UJ	19 UJ	20 UJ	19 UJ	4.3 UJ	4.6 UJ	4.4 UJ
1-Naphthylamine	22 UJ	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 UJ

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SURFACE SOIL, 2012 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB24	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB24-00	59SB24-00D	59SB25-00	59SB26-00	59SB27-00	59SB28-00	59SB29-00	59SB30-00	59SB31-00	59SB32-00	59SB33-00
Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Depth Range	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Semivolatile Organics (µg/kg) (cont.)											
2,2'-oxybis[1-chloropropane]	9.5 U	9.3 U	9.5 U	9 U	100 U	41 U	43 U	42 U	9.3 U	10 U	9.6 U
2,3,4,6-Tetrachlorophenol	4.3 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
2,4,5-Trichlorophenol	10 U	9.8 U	10 U	9.5 U	110 U	43 U	45 U	45 U	9.8 U	11 U	10 U
2,4,6-Trichlorophenol	10 U	10 U	10 U	9.8 U	110 U	44 U	47 U	47 U	10 U	11 U	11 U
2,4-Dichlorophenol	9.5 U	9.3 U	9.5 U	9 U	100 U	41 U	43 U	42 U	9.3 U	10 U	9.6 U
2,4-Dimethylphenol	10 U	9.8 U	10 U	9.5 U	110 U	43 U	45 U	45 U	9.8 U	11 U	10 U
2,4-Dinitrophenol	55 U	54 U	55 U	52 U	590 UJ	240 UJ	250 UJ	250 UJ	54 U	58 U	56 UJ
2,4-Dinitrotoluene	9.9 U	9.7 U	9.9 U	9.3 U	100 U	42 U	44 U	44 U	9.7 U	10 U	10 U
2,6-Dichlorophenol	4.3 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
2,6-Dinitrotoluene	10 U	10 U	10 U	9.8 U	110 U	44 U	47 U	47 U	10 U	11 U	11 U
2-Acetylaminofluorene	43 U	43 U	44 U	41 U	460 U	190 U	200 U	190 U	43 U	46 U	44 U
2-Chloronaphthalene	7.9 U	7.8 U	7.9 U	7.5 U	84 U	34 U	36 U	35 U	7.7 U	8.3 U	8 U
2-Chlorophenol	7 U	6.8 U	7 U	6.6 U	74 U	30 U	31 U	31 U	6.8 U	7.3 U	7.1 U
2-Methylphenol	8.3 U	8.1 U	8.3 U	7.8 U	88 U	35 U	37 U	37 U	8.1 U	8.7 U	8.4 U
2-Naphthylamine	22 U	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
2-Nitroaniline	9.2 U	9 U	9.2 U	8.7 U	98 U	39 U	41 U	41 U	9 U	9.7 U	9.4 U
2-Nitrophenol	7.6 U	7.5 U	7.7 U	7.2 U	81 U	33 U	34 U	34 U	7.5 U	8 U	7.8 U
2-Picoline	4.3 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
2-Toluidine	4.3 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
3 & 4 Methylphenol	9.6 U	9.4 U	9.6 U	9.1 U	100 U	41 U	43 U	43 U	9.4 U	10 U	9.8 U
3,3'-Dichlorobenzidine	22 U	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
3,3'-Dimethylbenzidine	87 U	85 U	87 U	82 U	920 UJ	370 UJ	390 UJ	390 UJ	85 U	91 U	88 UJ
3-Methylcholanthrene	43 U	43 U	44 U	41 U	460 U	190 U	200 U	190 U	43 U	46 U	44 U
3-Nitroaniline	8.8 U	8.7 U	8.8 U	8.3 U	93 U	38 U	40 U	39 U	8.6 U	9.3 U	9 U
4,6-Dinitro-2-methylphenol	22 U	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
4-Aminobiphenyl	22 UJ	22 UJ	22 UJ	21 UJ	240 U	96 U	100 U	100 U	22 UJ	24 UJ	23 U
4-Bromophenyl phenyl ether	9.1 U	8.9 U	9.1 U	8.6 U	96 U	39 U	41 U	41 U	8.9 U	9.6 U	9.2 U
4-Chloro-3-methylphenol	9.2 U	9 U	9.2 U	8.7 U	98 U	39 U	41 U	41 U	9 U	9.7 U	9.4 U
4-Chloroaniline	6.8 U	6.7 U	6.9 U	6.5 U	73 U	29 U	31 U	31 U	6.7 U	7.2 U	7 U
4-Chlorophenyl phenyl ether	8.4 U	8.3 U	8.5 U	8 U	89 U	36 U	38 U	38 U	8.3 U	8.9 U	8.6 U
4-Nitroaniline	22 U	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
4-Nitrophenol	96 U	94 U	96 U	91 U	1000 U	410 U	430 U	430 U	94 U	100 U	98 U
4-Nitroquinoline-1-oxide	55 U	54 U	55 U	52 U	590 U	240 U	250 U	250 U	54 U	58 U	56 U
7,12-Dimethylbenz(a)anthracene	22 U	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
Acetophenone	9 U	8.8 U	9 U	8.5 U	95 U	38 U	40 U	40 U	8.8 U	9.4 U	9.1 U
alpha,alpha-Dimethyl phenethylamine	430 UJ	430 UJ	440 UJ	410 UJ	4600 UJ	1900 UJ	2000 UJ	1900 UJ	430 UJ	460 UJ	440 UJ

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SURFACE SOIL, 2012 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB24	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB24-00	59SB24-00D	59SB25-00	59SB26-00	59SB27-00	59SB28-00	59SB29-00	59SB30-00	59SB31-00	59SB32-00	59SB33-00
Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Depth Range	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Semivolatile Organics (µg/kg) (cont.)											
Aniline	11 U	11 U	11 U	10 U	110 U	46 U	49 U	48 U	11 U	11 U	11 U
Aramite, Total	6.3 U	6.2 U	6.3 U	6 U	67 U	27 U	28 U	28 U	6.2 U	6.6 U	6.4 U
Benzyl alcohol	8 U	7.9 U	8.1 U	7.6 U	85 U	34 U	36 U	36 U	7.9 U	8.4 U	8.2 U
Bis(2-chloroethoxy)methane	8.6 U	8.4 U	8.6 U	8.1 U	91 U	37 U	38 U	38 U	8.4 U	9 U	8.7 U
Bis(2-chloroethyl)ether	8.6 U	8.4 U	8.6 U	8.1 U	91 U	37 U	38 U	38 U	8.4 U	9 U	8.7 U
Bis(2-ethylhexyl) phthalate	43 J	21 J	78 J	7.5 U	84 U	34 U	36 U	35 J	11 J	8.3 U	19 J
Butyl benzyl phthalate	8.8 U	8.7 U	8.8 U	8.3 U	93 U	38 U	40 U	39 U	8.6 U	9.3 U	9 U
Diallate	7.4 U	7.2 U	7.4 U	7 U	78 U	32 U	33 U	33 U	7.2 U	7.8 U	7.5 U
Dibenzofuran	8.8 U	8.7 U	8.8 U	8.3 U	93 U	38 U	40 U	39 U	8.6 U	9.3 U	9 U
Diethyl phthalate	9.7 U	9.6 U	9.8 U	9.2 U	100 U	42 U	44 U	44 U	9.5 U	10 U	9.9 U
Dimethyl phthalate	9.9 U	9.7 U	9.9 U	9.3 U	100 U	42 U	44 U	44 U	9.7 U	10 U	10 U
Di-n-butyl phthalate	22 U	22 U	22 U	21 U	240 U	96 U	100 U	100 UJ	22 U	24 U	23 U
Di-n-octyl phthalate	8.8 U	8.7 U	8.8 U	8.3 U	93 U	38 U	40 U	39 U	8.6 U	9.3 U	9 U
Dinoseb	8.8 U	8.7 U	8.8 U	8.3 U	93 UJ	38 UJ	40 UJ	39 UJ	8.6 U	9.3 U	9 UJ
Ethyl methanesulfonate	10 U	10 U	10 U	9.7 U	110 U	44 U	46 U	46 U	10 U	11 U	10 U
Hexachlorobenzene	10 U	9.8 U	10 U	9.5 U	110 U	43 U	45 U	45 U	9.8 U	11 U	10 U
Hexachlorobutadiene	9 U	8.8 U	9 U	8.5 U	95 U	38 U	40 U	40 U	8.8 U	9.4 U	9.1 U
Hexachlorocyclopentadiene	4.9 U	4.8 U	4.9 U	4.6 U	52 U	21 U	22 U	22 U	4.8 U	5.1 U	5 U
Hexachloroethane	7.6 U	7.5 U	7.7 U	7.2 U	81 U	33 U	34 U	34 U	7.5 U	8 U	7.8 U
Hexachlorophene	3200 UJ	3100 U	3200 U	3000 U	33000 UJ	14000 UJ	14000 UJ	14000 UJ	3100 U	3300 U	3200 UJ
Hexachloropropene	7 U	6.8 U	7 U	6.6 U	74 U	30 U	31 U	31 U	6.8 U	7.3 U	7.1 U
Isophorone	9.2 U	9 U	9.2 U	8.7 U	98 U	39 U	41 U	41 U	9 U	9.7 U	9.4 U
Isosafrole	4.3 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
Methapyrilene	88 UJ	87 UJ	88 UJ	83 UJ	930 UJ	380 UJ	400 UJ	390 UJ	86 UJ	93 UJ	90 UJ
Methyl methanesulfonate	5 UJ	4.9 UJ	5 UJ	4.7 UJ	53 UJ	21 UJ	22 UJ	22 UJ	4.9 UJ	5.3 UJ	5.1 UJ
Nitrobenzene	8.7 U	8.5 U	8.7 U	8.2 U	92 U	37 U	39 U	39 U	8.5 U	9.1 U	8.8 U
N-Nitro-o-toluidine	22 U	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
N-Nitrosodiethylamine	4.3 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
N-Nitrosodimethylamine	25 U	25 U	25 U	24 U	270 U	110 U	110 U	110 U	25 U	26 U	25 U
N-Nitrosodi-n-butylamine	22 U	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
N-Nitrosodi-n-propylamine	9.9 U	9.7 U	9.9 U	9.3 U	100 U	42 U	44 U	44 U	9.7 U	10 U	10 U
N-Nitrosodiphenylamine	8 U	7.9 U	8.1 U	7.6 U	85 U	34 U	36 U	36 U	7.9 U	8.4 U	8.2 U
N-Nitrosomethylethylamine	4.3 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
N-Nitrosomorpholine	5.9 U	5.8 U	5.9 U	5.6 U	63 U	25 U	27 U	27 U	5.8 U	6.2 U	6 U
N-Nitrosopiperidine	4.5 U	4.4 U	4.5 U	4.2 U	47 U	19 U	20 U	20 U	4.4 U	4.7 U	4.6 U
N-Nitrosopyrrolidine	4.7 U	4.7 U	4.8 U	4.5 U	50 U	20 U	21 U	21 U	4.6 U	5 U	4.8 U

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SUMMARY OF ANALYTICAL RESULTS - SURFACE SOIL, 2012 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB24	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB24-00	59SB24-00D	59SB25-00	59SB26-00	59SB27-00	59SB28-00	59SB29-00	59SB30-00	59SB31-00	59SB32-00	59SB33-00
Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Depth Range	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Semivolatile Organics (µg/kg) (cont.)											
p-Dimethylamino azobenzene	22 U	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
Pentachlorobenzene	4.3 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
Pentachloronitrobenzene	22 U	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
Pentachlorophenol	22 U	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
Phenacetin	22 U	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
Phenol	8.6 U	8.4 U	8.6 U	8.1 U	91 U	37 U	38 U	38 U	8.4 U	9 U	8.7 U
p-Phenylene diamine	1100 UJ	1100 U	1100 U	1000 U	12000 UJ	4700 UJ	4900 UJ	4900 UJ	1100 U	1100 U	1100 UJ
Pronamide	5.5 U	5.4 U	5.5 U	5.2 U	59 U	24 U	25 U	25 U	5.4 U	5.8 U	5.6 U
Pyridine	26 U	26 U	26 U	25 U	280 U	110 U	120 U	120 U	26 U	28 U	27 U
Safrole, Total	4.3 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
LLPAHs (µg/kg)											
2-Methylnaphthalene	4.3 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	6.4 J	4.6 U	4.4 U
Acenaphthene	4.3 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
Acenaphthylene	4.3 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
Anthracene	4.3 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 UJ	4.3 U	4.6 U	4.4 U
Benzo[a]anthracene	4.3 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
Benzo[a]pyrene	4.3 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 UJ	4.3 U	4.6 U	4.4 U
Benzo[b]fluoranthene	4.3 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 UJ	4.3 U	4.6 U	4.4 U
Benzo[g,h,i]perylene	4.3 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 UJ	4.3 U	4.6 U	4.4 U
Benzo[k]fluoranthene	4.3 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 UJ	4.3 U	4.6 U	4.4 U
Chrysene	4.3 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
Dibenz(a,h)anthracene	8.8 U	8.7 U	8.8 U	8.3 U	93 U	38 U	40 U	39 UJ	8.6 U	9.3 U	9 U
Fluoranthene	4.3 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 UJ	4.3 U	4.6 U	4.4 U
Fluorene	4.3 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
Indeno[1,2,3-cd]pyrene	4.3 U	4.3 U	4.4 U	4.1 U	46 UJ	19 UJ	20 UJ	19 UJ	4.3 U	4.6 U	4.4 UJ
Naphthalene	4.3 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
Phenanthrene	8.8 U	8.7 U	8.8 U	8.3 U	93 U	38 U	40 U	39 UJ	6 J	9.3 U	9 U
Pyrene	4.3 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
LLPAH Totals (µg/kg)											
Low Molecular Weight PAHs	38.9	38.8	39.6	37	415	171	180	172	38.2	41.5	39.8
High Molecular Weight PAHs	43.2	43.1	44	41.1	461	190	200	191	43	46.1	44.2

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SURFACE SOIL, 2012 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB24	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB24-00	59SB24-00D	59SB25-00	59SB26-00	59SB27-00	59SB28-00	59SB29-00	59SB30-00	59SB31-00	59SB32-00	59SB33-00
Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Depth Range	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Metals (mg/kg)											
Antimony	0.65 U	0.64 U	0.64 U	0.62 U	0.69 U	0.57 U	0.6 U	0.59 U	0.64 U	0.69 U	0.66 U
Arsenic	1.8	1.6	1.3	0.69	0.84	0.46	0.9	1	0.82	1.7	1.4
Barium	210 J	140 J	160	110	100	24	160	130	99	91	130
Beryllium	0.63 J	0.42 J	0.28	0.38	0.097	0.11	0.22	0.26	0.37	0.33	0.18
Cadmium	0.1	0.16	0.47	0.075	0.1	0.062	0.11	0.071	0.11	0.047 J	0.12
Chromium	71	91	61	47	71	33	36	32	51	73	150
Cobalt	27 J	19 J	25 J	36 J	22 J	14 J	15 J	17 J	19 J	6 J	20 J
Copper	260 J	170 J	71	100	50	66	130	83	99	120	110
Lead	9.6 R	12 R	12 R	3 R	1.4 R	1.8 R	2.7 R	4.4 R	3.2 R	6.9 R	4.7 R
Mercury	0.011 U	0.01 U	0.069	0.0098 U	0.011 U	0.0093 U	0.014 J	0.017 J	0.01 U	0.038	0.012 U
Nickel	33 J	32	30	30	33	17	17	16	23	15	47
Selenium	0.32 U	0.32 U	0.74	0.31 U	0.35 U	0.29 U	0.3 U	0.47 J	0.32 U	1.2	0.33 U
Silver	0.088 J	0.064 U	0.15	0.062 U	0.069 U	0.057 U	0.06 U	0.059 U	0.064 U	0.35	0.066 U
Thallium	0.039 J	0.038 J	0.043 J	0.031 U	0.035 U	0.029 U	0.03 U	0.073 J	0.032 U	0.035 U	0.033 U
Tin	3.3 U	8.3 J	3.3 U	3.1 U	3.5 U	2.9 U	3 U	3 U	3.3 U	3.5 U	3.4 U
Vanadium	280 J	180 J	180	140	230	110	140	170	240	240	330
Zinc	100 J	67 J	73	76	42	44	68	50	78	46	57

Notes:

J - Estimated: The analyte was positively identified; the quantitation is an estimation.
U - Non detected at the Limit of Detection.
UJ - Reported quantitation limit is qualified as estimated.
R - Rejected data; data is not usable.
ft bgs - feet below ground surface
LLPAHs - Low Level Polynuclear Aromatic Hydrocarbons
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SURFACE SOIL, 2012 PRE-EXCAVATION DELINIATION SAMPLING
SWMU 59 - FORMER VEHICLE MAINTENACE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SS01	59SS02	59SS03	59SS04	59SS04D	59SS05	59SS06	59SS07	59SS08	59SS09
Sample ID	59SS01	59SS02	59SS03	59SS04	59SS04D	59SS05	59SS06	59SS07	59SS08	59SS09
Date	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012
Depth Range (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Metals (mg/kg)										
Copper	NA	NA	NA	415	244	46	89	100	NA	NA
Lead	45.2	23	5.49	230	214	0.92	4	75.2	242	580
Zinc	132	61	66.7	284	289	37	70	250	302	74

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SURFACE SOIL, 2012 PRE-EXCAVATION DELINIATION SAMPLING
SWMU 59 - FORMER VEHICLE MAINTENACE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SS10	59SS11	59SS12	59SS13	59SS14	59SS14D	59SS15	59SS16	59SS17	59SS18
Sample ID	59SS10	59SS11	59SS12	59SS13	59SS14	59SS14D	59SS15	59SS16	59SS17	59SS18
Date	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012
Depth Range (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Metals (mg/kg)										
Copper	NA	67.8	113	136	NA	NA	NA	NA	NA	NA
Lead	1.4	NA	NA	NA	19.9	26.5	66.7	3.96	NA	NA
Zinc	59	63.3	140	66.8	72.7	99.2	656	119	97.9	60

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SURFACE SOIL, 2012 PRE-EXCAVATION DELINIATION SAMPLING
SWMU 59 - FORMER VEHICLE MAINTENACE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SS19	59SS20	59SS21	59SS21D	59SS22	59SS23	59SS24	59SS25	59SS26
Sample ID	59SS19	59SS20	59SS21	59SS21D	59SS22	59SS23	59SS24	59SS25	59SS26
Date	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	9/14/2012	11/10/2012	11/10/2012
Depth Range (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Metals (mg/kg)									
Copper	NA	NA	NA	NA	NA	NA	NA	NA	140 J
Lead	NA	NA	NA	NA	NA	NA	NA	NA	59 J
Zinc	111	150	240	237	215	86	110	120	120 J

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SURFACE SOIL, 2012 PRE-EXCAVATION DELINIATION SAMPLING
SWMU 59 - FORMER VEHICLE MAINTENACE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SS26D	59SS27	59SS28	59SS29	59SS30	59SS31	59SS32	59SS33	59SS34
Sample ID	59SS26D	59SS27	59SS28	59SS29	59SS30	59SS31	59SS32	59SS33	59SS34
Date	11/10/2012	11/10/2012	11/10/2012	11/10/2012	11/10/2012	11/10/2012	11/10/2012	11/10/2012	11/10/2012
Depth Range (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Metals (mg/kg)									
Copper	150	NA	NA	NA	NA	NA	NA	NA	NA
Lead	68	49	100	110	270	NA	NA	NA	NA
Zinc	130	200	240	NA	NA	230	2100 D	390	86

Notes:

D - The reported value is from a dilution
ft bgs - feet below ground surface
mg/kg - milligram per kilogram
NA - Not Analyzed

SUBSURFACE SOIL DATA

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB01	59SB02	59SB02	59SB02	59SB03	59SB03	59SB04	59SB04	59SB05	59SB05
Sample ID	59SB01-01	59SB01-03	59SB02-01	59SB02-01D	59SB02-04	59SB03-01	59SB03-04	59SB04-01	59SB04-05	59SB05-01	59SB05-05
Sample Date	4/19/2010	4/19/2010	4/20/2010	4/20/2010	4/20/2010	4/19/2010	4/19/2010	4/22/2010	4/22/2010	4/20/2010	4/20/2010
Sample Depth (ft bgs)	1.0 - 3.0	5.0 - 7.0	1.0 - 3.0	1.0 - 3.0	7.0 - 9.0	1.0 - 3.0	7.0 - 9.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Volatile Organics (µg/kg)											
1,1,1,2-Tetrachloroethane	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
1,1,1-Trichloroethane	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
1,1,2,2-Tetrachloroethane	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
1,1,2-Trichloroethane	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
1,1-Dichloroethane	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
1,1-Dichloroethene	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
1,2,3-Trichloropropane	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
1,2-Dibromo-3-chloropropane (DBCP)	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
1,2-Dibromoethane (EDB)	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
1,2-Dichloroethane	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
1,2-Dichloroethene (trans)	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
1,2-Dichloropropane	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
1,3-Dichloropropene (cis)	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
1,3-Dichloropropene (trans)	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
1,4-Dichloro-2-butene (trans)	21 U	24 U	19 U	21 UJ	24 U	20 U	18 U	22 U	17 U	15 UJ	18 UJ
1,4-Dioxane (p-)	270 R	300 R	240 R	260 R	300 R	250 R	230 R	280 R	210 R	190 R	220 R
2-Butanone (MEK)	13 U	15 U	12 U	13 U	15 U	12 U	11 U	14 UJ	11 UJ	9.6 U	11 U
2-Chloro-1,3-butadiene (Chloroprene)	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
2-Hexanone (MBK)	13 U	15 U	12 U	13 UJ	15 U	12 U	11 U	14 UJ	11 UJ	9.6 UJ	11 UJ
3-Chloropropene (Allyl Chloride)	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
4-Methyl-2-pentanone (MIBK)	13 U	15 U	12 U	13 U	15 U	12 U	11 U	14 UJ	11 UJ	9.6 U	11 U
Acetone	13 U	15 U	140	150	15 U	12 U	11 U	25 UJ	11 UJ	9.6 U	11 U
Acetonitrile	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
Acrolein	54 R	60 R	48 R	52 R	59 R	50 R	46 R	55 R	42 R	38 R	44 R
Acrylonitrile	54 U	60 U	48 U	52 U	59 U	50 U	46 U	55 U	42 U	38 U	44 U
Benzene	5.4 U	6 U	0.35 J	0.4 J	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
Bromodichloromethane	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
Bromoform	5.4 U	6 U	4.8 U	5.2 U	35	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
Bromomethane	5.4 U	6 U	1.4 J	5.2 U	5.9 U	5 U	4.6 U	5.5 UJ	4.2 UJ	3.8 U	4.4 U
Carbon Disulfide	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
Carbon Tetrachloride	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
Chlorobenzene	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
Chloroethane	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
Chloroform	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
Chloromethane	5.4 U	6 U	1.1 J	1.1 J	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 UJ	4.4 UJ
Dibromochloromethane	5.4 U	6 U	4.8 U	5.2 U	0.9 J	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB01	59SB02	59SB02	59SB02	59SB03	59SB03	59SB04	59SB04	59SB05	59SB05
Sample ID	59SB01-01	59SB01-03	59SB02-01	59SB02-01D	59SB02-04	59SB03-01	59SB03-04	59SB04-01	59SB04-05	59SB05-01	59SB05-05
Sample Date	4/19/2010	4/19/2010	4/20/2010	4/20/2010	4/20/2010	4/19/2010	4/19/2010	4/22/2010	4/22/2010	4/20/2010	4/20/2010
Sample Depth (ft bgs)	1.0 - 3.0	5.0 - 7.0	1.0 - 3.0	1.0 - 3.0	7.0 - 9.0	1.0 - 3.0	7.0 - 9.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Volatile Organics (µg/kg) (cont.)											
Dibromomethane	5.4 U	6 U	4.8 U	5.2 UJ	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 UJ	4.4 UJ
Ethyl Methacrylate	54 U	60 U	48 U	52 U	59 U	50 U	46 U	55 U	42 U	38 U	44 U
Ethylbenzene	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
Freon 11 (Trichlorofluoromethane)	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
Freon-12 (Dichlorodifluoromethane)	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
Isobutyl Alcohol	270 R	300 R	240 R	260 R	300 R	250 R	230 R	280 R	210 R	190 R	220 R
Methyl Acrylonitrile	54 U	60 U	48 U	52 U	59 U	50 U	46 U	55 U	42 U	38 U	44 U
Methyl Iodide	5.4 U	6 U	21	30 J	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 UJ	4.4 UJ
Methyl Methacrylate	54 R	60 R	48 R	52 R	59 R	50 R	46 R	55 R	42 R	38 R	44 R
Methylene Chloride	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
Pentachloroethane	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
Propionitrile (Ethyl Cyanide)	270 R	300 R	240 R	260 R	300 R	250 R	230 R	280 R	210 R	190 R	220 R
Styrene (Ethenylbenzene)	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
Tetrachloroethene (PCE)	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
Toluene	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
Trichloroethene (TCE)	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
Vinyl Acetate	5.4 U	6 U	4.8 U	5.2 UJ	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 UJ	4.4 UJ
Vinyl Chloride	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
Xylene, m/p-	0.19 J	12 U	9.7 U	0.19 J	12 U	9.9 U	0.2 J	11 U	0.15 J	0.15 J	0.24 J
Xylene, o-	5.4 U	6 U	4.8 U	5.2 U	5.9 U	5 U	4.6 U	5.5 U	4.2 U	3.8 U	4.4 U
Xylenes, total	0.19 J	6 U	4.8 U	0.19 J	5.9 U	5 U	0.2 J	5.5 U	0.15 J	0.15 J	0.24 J
Semivolatile Organics (µg/kg)											
1,2,4,5-Tetrachlorobenzene	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
1,2,4-Trichlorobenzene	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
1,2-Dichlorobenzene (o-)	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
1,3,5-Trinitrobenzene (TNB)	250 UJ	250 UJ	220 UJ	220 UJ	240 UJ	200 UJ	200 UJ	230 UJ	200 UJ	190 UJ	220 UJ
1,3-Dichlorobenzene (m-)	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
1,3-Dinitrobenzene (m-)	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
1,4-Dichlorobenzene (p-)	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
1,4-Naphthoquinone	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
1,4-Phenylenediamine	2500 R	2500 R	2200 R	2200 R	2400 R	2000 R	2000 R	2300 R	2000 R	1900 R	2200 R
1-Naphthylamine	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 UJ	200 UJ	190 U	220 U
2,2'-Oxybis[1-chloropropane]	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
2,3,4,6-Tetrachlorophenol	480 U	480 U	430 U	430 U	470 U	400 U	390 U	440 U	400 U	370 U	420 U
2,4,5-Trichlorophenol	480 U	480 U	430 U	430 U	470 U	400 U	390 U	440 U	400 U	370 U	420 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB01	59SB02	59SB02	59SB02	59SB03	59SB03	59SB04	59SB04	59SB05	59SB05
Sample ID	59SB01-01	59SB01-03	59SB02-01	59SB02-01D	59SB02-04	59SB03-01	59SB03-04	59SB04-01	59SB04-05	59SB05-01	59SB05-05
Sample Date	4/19/2010	4/19/2010	4/20/2010	4/20/2010	4/20/2010	4/19/2010	4/19/2010	4/22/2010	4/22/2010	4/20/2010	4/20/2010
Sample Depth (ft bgs)	1.0 - 3.0	5.0 - 7.0	1.0 - 3.0	1.0 - 3.0	7.0 - 9.0	1.0 - 3.0	7.0 - 9.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Semivolatile Organics (µg/kg) (cont.)											
2,4,6-Trichlorophenol	480 U	480 U	430 U	430 U	470 U	400 U	390 U	440 U	400 U	370 U	420 U
2,4-Dichlorophenol	480 U	480 U	430 U	430 U	470 U	400 U	390 U	440 U	400 U	370 U	420 U
2,4-Dimethylphenol	480 U	480 U	430 U	430 U	470 U	400 U	390 U	440 U	400 U	370 U	420 U
2,4-Dinitrophenol	480 UJ	480 UJ	430 UJ	430 UJ	470 UJ	400 UJ	390 UJ	440 UJ	400 UJ	370 UJ	420 UJ
2,4-Dinitrotoluene (DNT)	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
2,6-Dichlorophenol	480 U	480 U	430 U	430 U	470 U	400 U	390 U	440 U	400 U	370 U	420 U
2,6-Dinitrotoluene (DNT)	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
2-Acetylaminofluorene	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
2-Chloronaphthalene	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
2-Chlorophenol	480 U	480 U	430 U	430 U	470 U	400 U	390 U	440 U	400 U	370 U	420 U
2-Methyl-5-nitroaniline	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
2-Methylphenol (o-Cresol)	480 U	480 U	430 U	430 U	470 U	400 U	390 U	440 U	400 U	370 U	420 U
2-Naphthylamine	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
2-Nitroaniline	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
2-Nitrophenol	480 U	480 U	430 U	430 U	470 U	400 U	390 U	440 U	400 U	370 U	420 U
2-Picoline	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 UJ	220 UJ
3,3'-Dichlorobenzidine	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
3,3'-Dimethylbenzidine	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
3-Methylcholanthrene	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
3-Methylphenol (m-Cresol)	370 U	370 U	320 U	320 U	360 U	300 U	290 U	330 U	300 U	280 U	320 U
3-Nitroaniline	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
4,6-Dinitro-2-methylphenol	480 U	480 U	430 U	430 U	470 U	400 U	390 U	440 U	400 U	370 U	420 U
4-Aminobiphenyl	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
4-Bromophenyl-phenylether	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
4-Chloro-3-methylphenol	480 U	480 U	430 U	430 U	470 U	400 U	390 U	440 U	400 U	370 U	420 U
4-Chloroaniline	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
4-Chlorophenyl-phenylether	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
4-Dimethylaminoazobenzene (p-)	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
4-Methylphenol (p-Cresol)	370 U	370 U	320 U	320 U	360 U	300 U	290 U	330 U	300 U	280 U	320 U
4-Nitroaniline	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
4-Nitrophenol	480 U	480 U	430 U	430 U	470 U	400 U	390 U	440 U	400 U	370 U	420 U
4-Nitroquinoline-1-oxide	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
7,12-Dimethylbenz(a)anthracene	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
a,a-Dimethylphenethylamine	480 UJ	480 UJ	430 UJ	430 UJ	470 UJ	400 UJ	390 UJ	440 UJ	400 UJ	370 UJ	420 UJ
Acetophenone	120 U	120 U	110 U	110 U	120 U	100 U	100 U	110 U	100 U	94 U	110 U
Aniline	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 UJ	220 UJ

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB01	59SB02	59SB02	59SB02	59SB03	59SB03	59SB04	59SB04	59SB05	59SB05
Sample ID	59SB01-01	59SB01-03	59SB02-01	59SB02-01D	59SB02-04	59SB03-01	59SB03-04	59SB04-01	59SB04-05	59SB05-01	59SB05-05
Sample Date	4/19/2010	4/19/2010	4/20/2010	4/20/2010	4/20/2010	4/19/2010	4/19/2010	4/22/2010	4/22/2010	4/20/2010	4/20/2010
Sample Depth (ft bgs)	1.0 - 3.0	5.0 - 7.0	1.0 - 3.0	1.0 - 3.0	7.0 - 9.0	1.0 - 3.0	7.0 - 9.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Semivolatile Organics (µg/kg) (cont.)											
Aramite	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
Benzyl Alcohol	250 UJ	250 UJ	220 UJ	220 UJ	240 UJ	200 UJ	200 UJ	230 UJ	200 UJ	190 UJ	220 UJ
Bis(2-chloroethoxy)methane	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
Bis(2-chloroethyl)ether	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
Bis(2-ethylhexyl) Phthalate (BEHP)	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	230	190 U	98 J
Butyl Benzyl Phthalate	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
Diallate (cis)	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
Diallate (trans)	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
Dibenzofuran	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
Diethyl Phthalate (DEP)	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
Dimethyl Phthalate	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
Di-n-butyl Phthalate (DBP)	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
Di-n-octyl Phthalate	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
Dinoseb	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethyl Methane Sulfonate (EMS)	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 UJ	200 UJ	190 U	220 U
Hexachloro-1,3-butadiene	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
Hexachlorobenzene	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
Hexachlorocyclopentadiene	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
Hexachloroethane	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
Hexachloropropene	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
Isophorone	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
Isosafrole	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
Methapyrilene	250 U	250 U	220 R	220 U	240 U	200 U	200 U	230 U	200 U	190 UJ	220 UJ
Methyl Methane Sulfonate	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
Nitrobenzene	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
n-Nitrosodiethylamine	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 UJ	220 UJ
n-Nitrosodimethylamine (NDMA)	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
n-Nitroso-di-n-butylamine	250 UJ	250 UJ	220 UJ	220 UJ	240 UJ	200 UJ	200 UJ	230 U	200 U	190 UJ	220 UJ
n-Nitrosodi-n-propylamine	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 UJ	220 UJ
n-Nitrosodiphenylamine	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
n-Nitrosomethylethylamine	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
n-Nitrosomorpholine	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 UJ	220 UJ
n-Nitrosopiperidine	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
n-Nitrosopyrrolidine	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 UJ	220 UJ
o-Toluidine	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
Pentachlorobenzene	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB01	59SB02	59SB02	59SB02	59SB03	59SB03	59SB04	59SB04	59SB05	59SB05
Sample ID	59SB01-01	59SB01-03	59SB02-01	59SB02-01D	59SB02-04	59SB03-01	59SB03-04	59SB04-01	59SB04-05	59SB05-01	59SB05-05
Sample Date	4/19/2010	4/19/2010	4/20/2010	4/20/2010	4/20/2010	4/19/2010	4/19/2010	4/22/2010	4/22/2010	4/20/2010	4/20/2010
Sample Depth (ft bgs)	1.0 - 3.0	5.0 - 7.0	1.0 - 3.0	1.0 - 3.0	7.0 - 9.0	1.0 - 3.0	7.0 - 9.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Semivolatile Organics (µg/kg) (cont.)											
Pentachloronitrobenzene	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
Pentachlorophenol	480 U	480 U	430 U	430 U	470 U	400 U	390 U	440 U	400 U	370 U	420 U
Phenacetin	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
Phenol	480 U	480 U	430 U	430 U	470 U	400 U	390 U	440 U	400 U	370 U	420 U
Pronamide	480 U	480 U	430 U	430 U	470 U	400 U	390 U	230 U	200 U	370 U	420 U
Pyridine	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
Safrole	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
LLPAHs (µg/kg)											
2-Methylnaphthalene	12 UJ	12 UJ	7.9 J	11 UJ	12 UJ	10 UJ	9.8 UJ	11 U	10 U	0.96 J	11 UJ
Acenaphthene	12 U	12 U	7.7 J	11 U	12 U	10 U	9.8 U	11 U	10 U	9.2 U	11 U
Acenaphthylene	12 U	12 U	11 U	11 U	12 U	10 U	9.8 U	11 U	10 U	9.2 U	11 U
Anthracene	12 U	12 U	3.1 J	11 U	12 U	10 U	9.8 U	11 U	10 U	9.2 U	11 U
Benzo(a)anthracene	12 U	12 U	8.6 J	11 U	12 U	10 U	9.8 U	11 U	10 U	9.2 U	11 U
Benzo(a)pyrene (BaP)	12 UJ	12 UJ	6 J	11 UJ	12 UJ	10 UJ	9.8 UJ	11 U	10 U	9.2 UJ	11 UJ
Benzo(b)fluoranthene	12 U	12 U	11 U	11 U	12 U	10 U	9.8 U	11 U	10 U	9.2 U	11 U
Benzo(g,h,i)perylene	12 U	12 U	20 J	11 UJ	12 U	10 U	9.8 U	11 U	10 U	1.8 J	11 U
Benzo(k)fluoranthene	12 U	12 U	2.3 J	11 U	12 U	10 U	9.8 U	11 U	10 U	0.8 J	11 U
Chrysene	12 U	12 U	1 J	11 U	12 U	10 U	9.8 U	11 U	10 U	0.94 J	11 U
Dibenz(a,h)anthracene	12 U	12 U	1 J	11 UJ	12 U	10 UJ	9.8 UJ	11 U	10 U	1.2 J	11 UJ
Fluoranthene	12 U	12 U	1.2 J	11 UJ	12 U	10 UJ	9.8 UJ	11 UJ	10 UJ	9.2 UJ	11 UJ
Fluorene	12 UJ	12 UJ	1.5 J	11 U	12 UJ	10 U	9.8 U	11 UJ	10 UJ	0.49 J	11 U
Indeno(1,2,3-cd)pyrene	12 UJ	12 UJ	2 J	11 UJ	12 UJ	10 UJ	9.8 UJ	11 U	10 U	2 J	11 UJ
Naphthalene	12 U	12 U	11 U	11 U	12 U	10 U	9.8 U	11 UJ	10 UJ	9.2 U	11 U
Phenanthrene	12 UJ	12 UJ	0.77 J	11 UJ	12 UJ	10 UJ	9.8 UJ	11 UJ	10 UJ	9.2 UJ	11 UJ
Pyrene	12 U	12 U	5.7 J	11 U	12 U	10 U	9.8 U	11 U	10 U	1.1 J	0.92 J
LLPAH Totals (µg/kg)											
Low molecular weight PAHs	96	96	75.3	88	96	80	78.4	88	80	57.96	88
High molecular weight PAHs	108	108	26.47	99	108	90	88.2	99	90	34.13	88.92
Pesticides (µg/kg)											
4,4'-DDD	4.9 U	4.9 U	4.2 U	4.3 U	4.7 U	4 U	3.9 U	4.4 U	4 U	3.7 U	4.2 U
4,4'-DDE	4.9 U	4.9 U	4.2 U	4.3 U	4.7 U	4 U	3.9 U	4.4 U	4 U	3.5 J	4.2 U
4,4'-DDT	4.9 U	4.9 U	4.2 U	4.3 U	4.7 U	4 U	3.9 U	4.4 U	4 U	0.77 J	4.2 U
Aldrin	2.5 U	2.5 U	2.2 U	2.2 U	2.4 U	2 U	2 U	2.3 U	2 U	1.9 U	2.2 U
BHC, alpha-	2.5 U	2.5 U	2.2 U	2.2 U	2.4 U	2 U	2 U	2.3 U	2 U	1.9 U	2.2 U

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SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB01	59SB02	59SB02	59SB02	59SB03	59SB03	59SB04	59SB04	59SB05	59SB05
Sample ID	59SB01-01	59SB01-03	59SB02-01	59SB02-01D	59SB02-04	59SB03-01	59SB03-04	59SB04-01	59SB04-05	59SB05-01	59SB05-05
Sample Date	4/19/2010	4/19/2010	4/20/2010	4/20/2010	4/20/2010	4/19/2010	4/19/2010	4/22/2010	4/22/2010	4/20/2010	4/20/2010
Sample Depth (ft bgs)	1.0 - 3.0	5.0 - 7.0	1.0 - 3.0	1.0 - 3.0	7.0 - 9.0	1.0 - 3.0	7.0 - 9.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Pesticides (µg/kg) (cont.)											
BHC, beta-	2.5 U	0.91 J	2.2 U	0.87 J	2.4 U	2 U	2 U	2.3 U	0.57 J	0.84 J	2.2 U
BHC, delta-	2.5 U	2.5 U	2.2 U	2.2 U	2.4 U	2 U	0.27 J	2.3 U	2 U	1.9 U	2.2 U
BHC, gamma- (Lindane)	2.5 U	2.5 U	2.2 U	2.2 U	2.4 U	2 U	2 U	2.3 U	2 U	1.9 U	2.2 U
Chlordane, alpha-	2.5 U	2.5 U	2.2 U	2.2 U	2.4 U	2 U	8.4	2.3 U	2 U	1.9 U	2.2 U
Chlordane, gamma-	2.5 U	2.5 U	2.2 U	2.2 U	2.4 U	2 U	2 U	2.3 U	2 U	1.9 U	2.2 U
Chlorobenzilate	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
Dieldrin	4.9 U	4.9 U	4.2 U	4.3 U	4.7 U	4 U	3.9 U	4.4 U	4 U	3.7 U	4.2 U
Endosulfan I	2.5 U	2.5 U	2.2 U	2.2 U	2.4 U	2 U	2 U	2.3 U	2 U	1.9 U	2.2 U
Endosulfan II	4.9 U	4.9 U	4.2 U	4.3 U	4.7 U	4 U	3.9 U	4.4 U	4 U	3.7 U	4.2 U
Endosulfan Sulfate	4.9 U	4.9 U	4.2 U	4.3 U	4.7 U	4 U	3.9 U	4.4 U	4 U	3.7 U	4.2 U
Endrin	4.9 U	4.9 U	4.2 U	4.3 U	4.7 U	4 U	3.9 U	0.56 J	4 U	3.7 U	4.2 U
Endrin Aldehyde	4.9 U	4.9 U	4.2 U	4.3 U	4.7 U	4 U	3.9 U	4.4 R	4 R	0.46 J	4.2 U
Heptachlor	2.5 U	2.5 U	2.2 U	2.2 U	2.4 U	2 U	2 U	2.3 U	2 U	1.9 U	2.2 U
Heptachlor Epoxide	2.5 U	2.5 U	2.2 U	2.2 U	2.4 U	2 U	2 U	2.3 U	2 U	1.9 U	2.2 U
Isodrin	250 U	250 U	220 U	220 U	240 U	200 U	200 U	230 U	200 U	190 U	220 U
Kepone (Chlordecone)	250 R	250 R	220 R	220 R	240 R	200 R	200 R	230 UJ	200 UJ	190 R	220 R
Methoxychlor	25 U	25 U	22 U	22 U	24 U	20 U	20 U	23 U	20 U	19 U	22 U
Toxaphene	120 U	120 U	110 U	110 U	120 U	100 U	98 U	110 U	100 U	92 U	110 U
Metals (mg/kg)											
Antimony	7.1 UJ	7.3 UJ	6.5 UJ	1.3 UJ	6.9 UJ	1.2 UJ	1.2 UJ	6.5 UJ	1.2 UJ	1.1 UJ	1.2 UJ
Arsenic	3.5 UJ	3.6 UJ	1.3 J	0.74 J	3.5 UJ	0.6 UJ	0.26 J	3.2 U	0.41 J	1.2 J	0.61 UJ
Barium	33.3 R	16.4 R	186 R	80.7 R	79.2 R	62.1 R	23.7 R	229 J	25.3 J	69.9 R	21 R
Beryllium	3.5 U	3.6 U	0.47 J	0.47 J	0.79 J	0.24 J	0.19 J	3.2 U	0.28 J	0.3 J	0.21 J
Cadmium	3.5 U	3.6 U	0.76 J	0.53 J	0.26 J	0.22 J	0.22 J	0.75 J	0.5 J	0.34 J	0.4 J
Chromium	13 J	10.3 J	50.9 J	36.2 J	35.4 J	50.3 J	25.5 J	63.5 J	9.6 J	17.2 J	86.2 J
Cobalt	9.6 J	28.5 J	51.6 J	72.1 J	83.9 J	32.6 J	30.3 J	53.4 J	16.7 J	15.9 J	25.1 J
Copper	126 J	41 J	91.9 J	65 J	90.4 J	71.1 J	98.4 J	217 J	88.1 J	82.6 J	164 J
Lead	3.5 UJ	3.6 UJ	33 J	29.6 J	3.5 UJ	1 J	0.72 J	3.2 UJ	1.3 J	14.1 J	3.6 J
Mercury	0.048 U	0.005 J	0.098	0.1	0.047 U	0.04 U	0.039 U	0.009 J	0.04 U	0.014 J	0.042 U
Nickel	9.1 J	8.8 J	17.8 J	12 J	22 J	18.5 J	16.4 J	20.7	7.1	10.8 J	28.8 J
Selenium	17.7 UJ	18.2 UJ	2.6 J	1.7 J	17.3 UJ	0.41 J	0.3 J	16.2 U	0.3 J	0.48 J	0.46 J
Silver	3.5 U	3.6 U	0.41 J	0.65 U	3.5 U	0.6 U	0.58 U	3.2 U	0.6 U	0.56 U	0.61 U
Thallium	3.5 U	3.6 U	3.2 U	0.041 J	3.5 U	0.6 U	0.58 U	3.2 U	0.6 U	0.036 J	0.61 U
Tin	2.8 J	2.8 J	2 J	1.8 J	2.2 J	2.5 J	3.1 J	2.7 J	2.6 J	2.8 J	2.3 J
Vanadium	73.1 J	67.2 J	282 J	175 J	344 J	161 J	136 J	138 J	123 J	85.1 J	188 J
Zinc	66.8 J	87.3 J	77.3 J	53.3 J	105 J	63.2 J	55.6 J	242 J	87.8 J	49.5 J	140 J

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB06	59SB06	59SB07	59SB07	59SB07	59SB08	59SB08	59SB09	59SB09	59SB10	59SB10
Sample ID	59SB06-01	59SB06-03	59SB07-01	59SB07-01D	59SB07-05	59SB08-01	59SB08-05	59SB09-01	59SB09-05	59SB10-01	59SB10-05
Sample Date	4/20/2010	4/20/2010	4/21/2010	4/21/2010	4/21/2010	4/21/2010	4/21/2010	4/22/2010	4/22/2010	4/21/2010	4/21/2010
Sample Depth (ft bgs)	1.0 - 3.0	5.0 - 7.0	1.0 - 3.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Volatile Organics (µg/kg)											
1,1,1,2-Tetrachloroethane	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
1,1,1-Trichloroethane	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
1,1,2,2-Tetrachloroethane	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
1,1,2-Trichloroethane	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
1,1-Dichloroethane	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
1,1-Dichloroethene	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
1,2,3-Trichloropropane	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
1,2-Dibromo-3-chloropropane (DBCP)	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
1,2-Dibromoethane (EDB)	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
1,2-Dichloroethane	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
1,2-Dichloroethene (trans)	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
1,2-Dichloropropane	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
1,3-Dichloropropene (cis)	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
1,3-Dichloropropene (trans)	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
1,4-Dichloro-2-butene (trans)	18 UJ	18 UJ	18 UJ	17 UJ	17 UJ	15 UJ	19 UJ	16 UJ	19 UJ	19 UJ	20 UJ
1,4-Dioxane (p-)	220 R	230 R	230 R	210 R	210 R	190 R	230 R	200 R	240 R	240 R	250 R
2-Butanone (MEK)	11 U	12 U	11 U	10 U	10 U	9.4 U	12 U	10 U	12 U	12 U	13 U
2-Chloro-1,3-butadiene (Chloroprene)	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
2-Hexanone (MBK)	11 UJ	12 UJ	11 UJ	10 UJ	10 UJ	9.4 UJ	12 UJ	10 UJ	12 UJ	12 UJ	13 UJ
3-Chloropropene (Allyl Chloride)	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
4-Methyl-2-pentanone (MIBK)	11 U	12 U	11 U	10 U	10 U	9.4 U	12 U	10 U	12 U	12 U	13 U
Acetone	11 U	12 U	11 U	10 U	10 U	9.4 U	12 U	26	12 U	12 U	13 U
Acetonitrile	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
Acrolein	44 R	46 R	46 R	42 R	42 R	38 R	47 R	41 R	48 R	47 R	50 R
Acrylonitrile	44 U	46 U	46 U	42 U	42 U	38 U	47 U	41 U	48 U	47 U	50 U
Benzene	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
Bromodichloromethane	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
Bromoform	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
Bromomethane	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
Carbon Disulfide	4.4 U	10	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
Carbon Tetrachloride	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
Chlorobenzene	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
Chloroethane	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
Chloroform	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
Chloromethane	4.4 UJ	4.6 UJ	4.6 UJ	4.2 UJ	4.2 UJ	3.8 UJ	4.7 UJ	4.1 UJ	4.8 UJ	4.7 UJ	5 UJ
Dibromochloromethane	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB06	59SB06	59SB07	59SB07	59SB07	59SB08	59SB08	59SB09	59SB09	59SB10	59SB10
Sample ID	59SB06-01	59SB06-03	59SB07-01	59SB07-01D	59SB07-05	59SB08-01	59SB08-05	59SB09-01	59SB09-05	59SB10-01	59SB10-05
Sample Date	4/20/2010	4/20/2010	4/21/2010	4/21/2010	4/21/2010	4/21/2010	4/21/2010	4/22/2010	4/22/2010	4/21/2010	4/21/2010
Sample Depth (ft bgs)	1.0 - 3.0	5.0 - 7.0	1.0 - 3.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Volatile Organics (µg/kg) (cont.)											
Dibromomethane	4.4 UJ	4.6 UJ	4.6 UJ	4.2 UJ	4.2 UJ	3.8 UJ	4.7 UJ	4.1 UJ	4.8 UJ	4.7 UJ	5 UJ
Ethyl Methacrylate	44 U	46 U	46 U	42 U	42 U	38 U	47 U	41 U	48 U	47 U	50 U
Ethylbenzene	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
Freon 11 (Trichlorofluoromethane)	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
Freon-12 (Dichlorodifluoromethane)	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
Isobutyl Alcohol	220 R	230 R	230 R	210 R	210 R	190 R	230 R	200 R	240 R	240 R	250 R
Methyl Acrylonitrile	44 U	46 U	46 U	42 U	42 U	38 U	47 U	41 U	48 U	47 U	50 U
Methyl Iodide	1.9 J	4.6 UJ	4.6 UJ	4.2 UJ	4.2 UJ	3.8 UJ	4.7 UJ	1.3 J	4.8 UJ	4.7 UJ	5 UJ
Methyl Methacrylate	44 R	46 R	46 R	42 R	42 R	38 R	47 R	41 R	48 R	47 R	50 R
Methylene Chloride	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
Pentachloroethane	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
Propionitrile (Ethyl Cyanide)	220 R	230 R	230 R	210 R	210 R	190 R	230 R	200 R	240 R	240 R	250 R
Styrene (Ethenylbenzene)	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
Tetrachloroethene (PCE)	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
Toluene	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
Trichloroethene (TCE)	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
Vinyl Acetate	4.4 UJ	4.6 UJ	4.6 UJ	4.2 UJ	4.2 UJ	3.8 UJ	4.7 UJ	4.1 UJ	4.8 UJ	4.7 UJ	5 UJ
Vinyl Chloride	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
Xylene, m/p-	0.16 J	0.13 J	0.19 J	8.4 U	8.4 U	0.12 J	9.4 U	0.15 J	9.7 U	0.14 J	10 U
Xylene, o-	4.4 U	4.6 U	4.6 U	4.2 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U	4.7 U	5 U
Xylenes, total	0.16 J	0.13 J	0.18 J	4.2 U	4.2 U	0.12 J	4.7 U	0.15 J	4.8 U	0.14 J	5 U
Semivolatile Organics (µg/kg)											
1,2,4,5-Tetrachlorobenzene	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
1,2,4-Trichlorobenzene	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
1,2-Dichlorobenzene (o-)	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
1,3,5-Trinitrobenzene (TNB)	200 UJ	210 UJ	210 UJ	200 UJ	200 UJ	190 UJ	200 UJ	190 UJ	200 UJ	220 UJ	230 UJ
1,3-Dichlorobenzene (m-)	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
1,3-Dinitrobenzene (m-)	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
1,4-Dichlorobenzene (p-)	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
1,4-Naphthoquinone	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
1,4-Phenylenediamine	2000 R	2100 R	2100 R	2000 R	2000 R	1900 R	2000 R	1900 R	2000 R	2200 R	2300 R
1-Naphthylamine	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
2,2'-Oxybis[1-chloropropane]	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
2,3,4,6-Tetrachlorophenol	380 U	410 U	410 U	390 U	390 U	370 U	390 U	360 U	390 U	430 U	440 U
2,4,5-Trichlorophenol	380 U	410 U	410 U	390 U	390 U	370 U	390 U	360 U	390 U	430 U	440 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB06	59SB06	59SB07	59SB07	59SB07	59SB08	59SB08	59SB09	59SB09	59SB10	59SB10
Sample ID	59SB06-01	59SB06-03	59SB07-01	59SB07-01D	59SB07-05	59SB08-01	59SB08-05	59SB09-01	59SB09-05	59SB10-01	59SB10-05
Sample Date	4/20/2010	4/20/2010	4/21/2010	4/21/2010	4/21/2010	4/21/2010	4/21/2010	4/22/2010	4/22/2010	4/21/2010	4/21/2010
Sample Depth (ft bgs)	1.0 - 3.0	5.0 - 7.0	1.0 - 3.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Semivolatile Organics (µg/kg) (cont.)											
2,4,6-Trichlorophenol	380 U	410 U	410 U	390 U	390 U	370 U	390 U	360 U	390 U	430 U	440 U
2,4-Dichlorophenol	380 U	410 U	410 U	390 U	390 U	370 U	390 U	360 U	390 U	430 U	440 U
2,4-Dimethylphenol	380 U	410 U	410 U	390 U	390 U	370 U	390 U	360 U	390 U	430 U	440 U
2,4-Dinitrophenol	380 UJ	410 UJ	410 UJ	390 UJ	390 UJ	370 UJ	390 UJ	360 UJ	390 UJ	430 UJ	440 UJ
2,4-Dinitrotoluene (DNT)	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
2,6-Dichlorophenol	380 U	410 U	410 U	390 U	390 U	370 U	390 U	360 U	390 U	430 U	440 U
2,6-Dinitrotoluene (DNT)	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
2-Acetylaminofluorene	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
2-Chloronaphthalene	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
2-Chlorophenol	380 U	410 U	410 U	390 U	390 U	370 U	390 U	360 U	390 U	430 U	440 U
2-Methyl-5-nitroaniline	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
2-Methylphenol (o-Cresol)	380 U	410 U	410 U	390 U	390 U	370 U	390 U	360 U	390 U	430 U	440 U
2-Naphthylamine	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
2-Nitroaniline	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
2-Nitrophenol	380 U	410 U	410 U	390 U	390 U	370 U	390 U	360 U	390 U	430 U	440 U
2-Picoline	200 U	210 U	210 U	200 U	200 UJ	190 UJ	200 UJ	190 UJ	200 UJ	220 UJ	230 UJ
3,3'-Dichlorobenzidine	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
3,3'-Dimethylbenzidine	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
3-Methylcholanthrene	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
3-Methylphenol (m-Cresol)	290 U	310 U	310 U	290 U	290 U	280 U	300 U	270 U	300 U	330 U	340 U
3-Nitroaniline	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
4,6-Dinitro-2-methylphenol	380 U	410 U	410 U	390 U	390 U	370 U	390 U	360 U	390 U	430 U	440 U
4-Aminobiphenyl	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
4-Bromophenyl-phenylether	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
4-Chloro-3-methylphenol	380 U	410 U	410 U	390 U	390 U	370 U	390 U	360 U	390 U	430 U	440 U
4-Chloroaniline	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
4-Chlorophenyl-phenylether	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
4-Dimethylaminoazobenzene (p-)	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
4-Methylphenol (p-Cresol)	290 U	310 U	310 U	290 U	290 U	280 U	300 U	270 U	300 U	330 U	340 U
4-Nitroaniline	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
4-Nitrophenol	380 U	410 U	410 U	390 U	390 U	370 U	390 U	360 U	390 U	430 U	440 U
4-Nitroquinoline-1-oxide	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
7,12-Dimethylbenz(a)anthracene	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
a,a-Dimethylphenethylamine	380 UJ	410 UJ	410 UJ	390 UJ	390 UJ	370 UJ	390 UJ	360 UJ	390 UJ	430 UJ	440 UJ
Acetophenone	99 U	110 U	100 U	100 U	100 U	96 U	100 U	93 U	100 U	110 U	110 U
Aniline	200 U	210 U	210 U	200 U	200 UJ	190 UJ	200 UJ	190 UJ	200 UJ	220 UJ	230 UJ

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB06	59SB06	59SB07	59SB07	59SB07	59SB08	59SB08	59SB09	59SB09	59SB10	59SB10
Sample ID	59SB06-01	59SB06-03	59SB07-01	59SB07-01D	59SB07-05	59SB08-01	59SB08-05	59SB09-01	59SB09-05	59SB10-01	59SB10-05
Sample Date	4/20/2010	4/20/2010	4/21/2010	4/21/2010	4/21/2010	4/21/2010	4/21/2010	4/22/2010	4/22/2010	4/21/2010	4/21/2010
Sample Depth (ft bgs)	1.0 - 3.0	5.0 - 7.0	1.0 - 3.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Semivolatile Organics (µg/kg) (cont.)											
Aramite	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
Benzyl Alcohol	200 UJ	210 UJ	210 UJ	200 UJ	200 UJ	190 UJ	200 UJ	190 UJ	200 UJ	220 UJ	230 UJ
Bis(2-chloroethoxy)methane	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
Bis(2-chloroethyl)ether	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
Bis(2-ethylhexyl) Phthalate (BEHP)	200 U	210 U	58 J	200 U	200 U	83 J	200 U	190 U	200 U	220 U	230 U
Butyl Benzyl Phthalate	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
Diallate (cis)	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
Diallate (trans)	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
Dibenzofuran	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
Diethyl Phthalate (DEP)	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
Dimethyl Phthalate	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
Di-n-butyl Phthalate (DBP)	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
Di-n-octyl Phthalate	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
Dinoseb	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethyl Methane Sulfonate (EMS)	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
Hexachloro-1,3-butadiene	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
Hexachlorobenzene	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
Hexachlorocyclopentadiene	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
Hexachloroethane	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
Hexachloropropene	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
Isophorone	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
Isosafrole	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
Methapyrilene	200 U	210 U	210 U	200 U	200 UJ	190 UJ	200 UJ	190 UJ	200 UJ	220 UJ	230 UJ
Methyl Methane Sulfonate	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
Nitrobenzene	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
n-Nitrosodiethylamine	200 U	210 U	210 U	200 U	200 UJ	190 UJ	200 UJ	190 UJ	200 UJ	220 UJ	230 UJ
n-Nitrosodimethylamine (NDMA)	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
n-Nitroso-di-n-butylamine	200 UJ	210 UJ	210 UJ	200 UJ	200 UJ	190 UJ	200 UJ	190 UJ	200 UJ	220 UJ	230 UJ
n-Nitrosodi-n-propylamine	200 U	210 U	210 U	200 U	200 UJ	190 UJ	200 UJ	190 UJ	200 UJ	220 UJ	230 UJ
n-Nitrosodiphenylamine	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
n-Nitrosomethylethylamine	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
n-Nitrosomorpholine	200 U	210 U	210 U	200 U	200 UJ	190 UJ	200 UJ	190 UJ	200 UJ	220 UJ	230 UJ
n-Nitrosopiperidine	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
n-Nitrosopyrrolidine	200 U	210 U	210 U	200 U	200 UJ	190 UJ	200 UJ	190 UJ	200 UJ	220 UJ	230 UJ
o-Toluidine	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
Pentachlorobenzene	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB06	59SB06	59SB07	59SB07	59SB07	59SB08	59SB08	59SB09	59SB09	59SB10	59SB10
Sample ID	59SB06-01	59SB06-03	59SB07-01	59SB07-01D	59SB07-05	59SB08-01	59SB08-05	59SB09-01	59SB09-05	59SB10-01	59SB10-05
Sample Date	4/20/2010	4/20/2010	4/21/2010	4/21/2010	4/21/2010	4/21/2010	4/21/2010	4/22/2010	4/22/2010	4/21/2010	4/21/2010
Sample Depth (ft bgs)	1.0 - 3.0	5.0 - 7.0	1.0 - 3.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Semivolatile Organics (µg/kg) (cont.)											
Pentachloronitrobenzene	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
Pentachlorophenol	380 U	410 U	410 U	390 U	390 U	370 U	390 U	360 U	390 U	430 U	440 U
Phenacetin	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
Phenol	380 U	410 U	410 U	390 U	390 U	370 U	390 U	360 U	390 U	430 U	440 U
Pronamide	380 U	410 U	410 U	390 U	390 U	370 U	390 U	360 U	390 U	430 U	440 U
Pyridine	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
Safrole	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
LLPAHs (µg/kg)											
2-Methylnaphthalene	9.7 UJ	10 UJ	10 UJ	9.8 UJ	9.8 UJ	9.3 UJ	9.9 UJ	9.1 UJ	9.9 UJ	11 UJ	11 UJ
Acenaphthene	9.7 U	10 U	10 U	9.8 U	9.8 U	9.3 U	9.9 U	9.1 U	9.9 U	11 U	11 U
Acenaphthylene	9.7 U	10 U	10 U	9.8 U	9.8 U	0.65 J	9.9 U	9.1 U	9.9 U	11 U	11 U
Anthracene	9.7 U	10 U	10 U	9.8 U	9.8 U	9.3 U	9.9 U	9.1 U	9.9 U	11 U	11 U
Benzo(a)anthracene	9.7 U	10 U	10 U	9.8 U	9.8 U	7.3 J	9.9 U	9.1 U	9.9 U	11 U	11 U
Benzo(a)pyrene (BaP)	9.7 UJ	10 UJ	10 UJ	9.8 UJ	9.8 UJ	9.3 UJ	9.9 UJ	9.1 UJ	9.9 UJ	11 U	11 UJ
Benzo(b)fluoranthene	9.7 U	10 U	10 U	9.8 U	9.8 U	9.3 U	9.9 U	9.1 U	9.9 U	11 U	11 U
Benzo(g,h,i)perylene	9.7 U	10 U	10 U	9.8 U	9.8 U	5.6 J	9.9 U	9.1 U	9.9 U	11 U	11 U
Benzo(k)fluoranthene	9.7 U	10 U	10 U	9.8 U	9.8 U	1.2 J	9.9 U	0.63 J	9.9 U	11 U	11 U
Chrysene	9.7 U	10 U	10 U	9.8 U	9.8 U	3 J	9.9 U	0.85 J	9.9 U	11 U	11 U
Dibenz(a,h)anthracene	9.7 UJ	10 UJ	10 UJ	9.8 UJ	9.8 UJ	2.8 J	9.9 UJ	0.64 J	9.9 UJ	11 U	11 UJ
Fluoranthene	9.7 UJ	10 UJ	10 UJ	9.8 UJ	9.8 UJ	1.9 J	9.9 UJ	0.58 J	9.9 UJ	11 UJ	11 UJ
Fluorene	9.7 U	10 U	10 U	9.8 U	9.8 U	4.1 J	9.9 U	0.92 J	9.9 U	11 U	11 U
Indeno(1,2,3-cd)pyrene	9.7 UJ	10 UJ	10 UJ	9.8 UJ	9.8 UJ	3 J	9.9 UJ	9.1 UJ	9.9 UJ	11 UJ	11 UJ
Naphthalene	9.7 U	10 U	10 U	9.8 U	9.8 U	0.39 J	9.9 U	9.1 U	9.9 U	11 U	11 U
Phenanthrene	9.7 UJ	10 UJ	10 UJ	9.8 UJ	9.8 UJ	2.8 J	9.9 UJ	0.84 J	9.9 UJ	11 UJ	11 UJ
Pyrene	9.7 U	10 U	10 U	9.8 U	9.8 U	6.1 J	9.9 U	9.1 U	9.9 U	11 U	11 U
LLPAH Totals (µg/kg)											
Low molecular weight PAHs	77.6	80	80	78.4	78.4	60.05	79.2	72.8	79.2	88	88
High molecular weight PAHs	87.3	90	90	88.2	88.2	25.29	89.1	31.76	89.1	99	99
Pesticides (µg/kg)											
4,4'-DDD	3.8 U	4.1 U	4.1 U	3.9 U	3.9 U	3.7 U	3.9 U	3.6 U	3.9 U	4.3 U	4.5 U
4,4'-DDE	3.8 U	4.1 U	4.1 U	3.9 U	3.9 U	3.7 U	1.6 J	3.6 U	3.9 U	4.3 U	4.5 U
4,4'-DDT	3.8 U	4.1 U	4.1 U	3.9 U	3.9 U	3.7 U	1.5 J	3.6 U	3.9 U	4.3 U	4.5 U
Aldrin	2 U	2.1 U	2.1 U	2 U	2 U	1.9 U	2 U	1.9 U	2 U	2.2 U	2.3 U
BHC, alpha-	2 U	2.1 U	2.1 U	2 U	2 U	1.9 U	2 U	1.9 U	2 U	2.2 U	2.3 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB06	59SB06	59SB07	59SB07	59SB07	59SB08	59SB08	59SB09	59SB09	59SB10	59SB10
Sample ID	59SB06-01	59SB06-03	59SB07-01	59SB07-01D	59SB07-05	59SB08-01	59SB08-05	59SB09-01	59SB09-05	59SB10-01	59SB10-05
Sample Date	4/20/2010	4/20/2010	4/21/2010	4/21/2010	4/21/2010	4/21/2010	4/21/2010	4/22/2010	4/22/2010	4/21/2010	4/21/2010
Sample Depth (ft bgs)	1.0 - 3.0	5.0 - 7.0	1.0 - 3.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Pesticides (µg/kg) (cont.)											
BHC, beta-	0.88 J	2.1 U	2.1 U	2 U	2 U	1.9 U	2 U	1.9 U	2 U	2.2 U	2.3 U
BHC, delta-	2 U	2.1 U	2.1 U	2 U	2 U	1.9 U	2 U	1.9 U	2 U	2.2 U	2.3 U
BHC, gamma- (Lindane)	2 U	2.1 U	2.1 U	2 U	2 U	1.9 U	2 U	1.9 U	2 U	2.2 U	2.3 U
Chlordane, alpha-	2 U	2.1 U	2.1 U	2 U	2 U	1.9 U	2 U	1.9 U	2 U	2.2 U	2.3 U
Chlordane, gamma-	2 U	2.1 U	2.1 U	2 U	2 U	1.9 U	2 U	1.9 U	2 U	2.2 U	2.3 U
Chlorobenzilate	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
Dieldrin	3.8 U	4.1 U	4.1 U	3.9 U	3.9 U	3.7 U	3.9 U	3.6 U	3.9 U	4.3 U	4.5 U
Endosulfan I	2 U	2.1 U	2.1 U	2 U	2 U	1.9 U	2 U	1.9 U	2 U	2.2 U	2.3 U
Endosulfan II	3.8 U	4.1 U	4.1 U	3.9 U	3.9 U	3.7 U	3.9 U	3.6 U	3.9 U	4.3 U	4.5 U
Endosulfan Sulfate	3.8 U	4.1 U	4.1 U	3.9 U	3.9 U	3.7 U	3.9 U	3.6 U	3.9 U	4.3 U	4.5 U
Endrin	3.8 U	4.1 U	4.1 U	3.9 U	3.9 U	3.7 U	3.9 U	3.6 U	3.9 U	4.3 U	4.5 U
Endrin Aldehyde	3.8 U	4.1 U	4.1 U	3.9 U	3.9 U	3.7 U	3.9 U	3.6 U	3.9 U	0.54 J	4.5 U
Heptachlor	2 U	2.1 U	2.1 U	2 U	2 U	1.9 U	2 U	1.9 U	2 U	2.2 U	2.3 U
Heptachlor Epoxide	2 U	2.1 U	2.1 U	2 U	2 U	1.9 U	2 U	1.9 U	2 U	2.2 U	2.3 U
Isodrin	200 U	210 U	210 U	200 U	200 U	190 U	200 U	190 U	200 U	220 U	230 U
Kepone (Chlordecone)	200 R	210 R	210 R	200 R	200 R	190 R	200 R	190 R	200 R	220 R	230 R
Methoxychlor	20 U	21 U	21 U	20 U	20 U	19 U	20 U	19 U	20 U	22 U	23 U
Toxaphene	97 U	100 U	100 U	98 U	98 U	93 U	99 U	91 U	99 U	110 U	110 U
Metals (mg/kg)											
Antimony	5.8 UJ	6 UJ	6 UJ	1.2 UJ	5.9 UJ	1.1 UJ	1.2 UJ	5.3 UJ	1.2 UJ	1.3 UJ	1.4 UJ
Arsenic	2.9 UJ	1.6 J	3 UJ	0.59 UJ	2.9 UJ	0.19 J	0.58 UJ	2.7 UJ	0.6 UJ	0.65 UJ	0.68 UJ
Barium	151 R	23.6 R	173 R	143 R	54 R	149 R	171 R	127 R	184 R	163 R	198 R
Beryllium	2.9 U	3 U	3 U	0.27 J	0.26 J	0.38 J	0.36 J	2.7 U	0.13 J	0.44 J	0.075 J
Cadmium	0.22 J	3 U	0.35 J	0.31 J	2.9 U	0.62	5	0.31 J	0.39 J	0.28 J	0.45 J
Chromium	46.4 J	37.4 J	57.3 J	73.5 J	41.4 J	16.2 J	14.6 J	59.5 J	40.6 J	22.5 J	29 J
Cobalt	17.5 J	4.3 J	26.7 J	28.8 J	24 J	13 J	21.7 J	32.6 J	32.8 J	28 J	14.3 J
Copper	77.7 J	64.7 J	74.3 J	70.4 J	194 J	5.1 J	49.3 J	77.6 J	66.9 J	49.3 J	65.2 J
Lead	5.3 J	21.3 J	3 UJ	4.7 J	2.9 UJ	1.8 J	2.4 J	3 J	2.5 J	1.3 J	1.8 J
Mercury	0.038 U	0.15	0.04 U	0.039 U	0.039 U	0.037 U	0.039 U	0.016 J	0.017 J	0.009 J	0.005 J
Nickel	16.3 J	4.7 J	25.1 J	27.9 J	18 J	8.7 J	8.8 J	27.9 J	24 J	29.6 J	25.3 J
Selenium	14.5 UJ	2.1 J	15 UJ	0.48 J	14.7 UJ	0.56 J	0.3 J	13.3 UJ	0.34 J	0.64 J	0.38 J
Silver	2.9 U	3 U	3 U	0.59 U	2.9 U	0.55 U	0.58 U	2.7 U	0.6 U	0.65 U	0.68 U
Thallium	2.9 U	3 U	3 U	0.59 U	2.9 U	0.029 J	0.58 U	2.7 U	0.027 J	0.65 U	0.68 U
Tin	2.3 J	2.3 J	2.6 J	2.5 J	3 J	1.9 J	2.8 J	2.7 J	3.3 J	2.3 J	2.5 J
Vanadium	146 J	245 J	111 J	151 J	56.8 J	73.6 J	81 J	190 J	153 J	46.9 J	154 J
Zinc	61.9 J	35.2 J	69.6 J	78.6 J	88.4 J	90.6 J	114 J	75.4 J	61.3 J	68.7 J	53.5 J

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB11	59SB11	59SB11	59SB12	59SB12	59SB13	59SB13	59SB13	59SB14	59SB14	59SB15
Sample ID	59SB11-01	59SB11-01D	59SB11-02	59SB12-01	59SB12-05	59SB13-01	59SB13-01D	59SB13-05	59SB14-01	59SB14-05	59SB15-01
Sample Date	5/19/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010
Sample Depth (ft bgs)	1.0 - 3.0	1.0 - 3.0	3.0 - 5.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0
Volatile Organics (µg/kg)											
1,1,1,2-Tetrachloroethane	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
1,1,1-Trichloroethane	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
1,1,2,2-Tetrachloroethane	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
1,1,2-Trichloroethane	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
1,1-Dichloroethane	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
1,1-Dichloroethene	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
1,2,3-Trichloropropane	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
1,2-Dibromo-3-chloropropane (DBCP)	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
1,2-Dibromoethane (EDB)	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
1,2-Dichloroethane	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
1,2-Dichloroethene (trans)	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
1,2-Dichloropropane	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
1,3-Dichloropropene (cis)	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
1,3-Dichloropropene (trans)	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
1,4-Dichloro-2-butene (trans)	16 U	15 U	19 U	22 U	20 U	19 U	19 U	18 U	18 U	22 U	20 U
1,4-Dioxane (p-)	200 R	190 R	230 R	270 R	250 R	240 R	240 R	230 R	230 R	280 R	250 R
2-Butanone (MEK)	10 U	9.3 U	12 U	14 U	12 U	12 U	12 U	11 U	11 U	14 U	12 U
2-Chloro-1,3-butadiene (Chloroprene)	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
2-Hexanone (MBK)	10 U	9.3 U	12 U	14 U	12 U	12 U	12 U	11 U	11 U	14 U	12 U
3-Chloropropene (Allyl Chloride)	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
4-Methyl-2-pentanone (MIBK)	10 U	9.3 U	12 U	14 U	12 U	12 U	12 U	11 U	11 U	14 U	12 U
Acetone	10 U	11 U	15 U	27 U	12 U	13 U	19 U	11 U	19 U	14 U	13 U
Acetonitrile	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
Acrolein	40 R	37 R	47 R	54 R	50 R	47 R	48 R	46 R	46 R	55 R	50 R
Acrylonitrile	40 U	37 U	47 U	54 U	50 U	47 U	48 U	46 U	46 U	55 U	50 U
Benzene	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
Bromodichloromethane	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
Bromoform	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
Bromomethane	0.98 J	1.2 J	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
Carbon Disulfide	4 U	3.7 U	4.7 U	5.4 U	5 U	0.76 J	4.8 U	4.6 U	4.6 U	5.5 U	5 U
Carbon Tetrachloride	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
Chlorobenzene	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
Chloroethane	4 UJ	3.7 UJ	4.7 U	5.4 UJ	5 UJ	4.7 U	4.8 U	4.6 U	4.6 UJ	5.5 UJ	5 UJ
Chloroform	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
Chloromethane	4 U	3.7 U	4.7 U	0.37 J	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
Dibromochloromethane	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB11	59SB11	59SB11	59SB12	59SB12	59SB13	59SB13	59SB13	59SB14	59SB14	59SB15
Sample ID	59SB11-01	59SB11-01D	59SB11-02	59SB12-01	59SB12-05	59SB13-01	59SB13-01D	59SB13-05	59SB14-01	59SB14-05	59SB15-01
Sample Date	5/19/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010
Sample Depth (ft bgs)	1.0 - 3.0	1.0 - 3.0	3.0 - 5.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0
Volatile Organics (µg/kg) (cont.)											
Dibromomethane	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
Ethyl Methacrylate	40 U	37 U	47 U	54 U	50 U	47 U	48 U	46 U	46 U	55 U	50 U
Ethylbenzene	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
Freon 11 (Trichlorofluoromethane)	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
Freon-12 (Dichlorodifluoromethane)	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
Isobutyl Alcohol	200 R	190 R	230 R	270 R	250 R	240 R	240 R	230 R	230 R	280 R	250 R
Methyl Acrylonitrile	40 U	37 U	47 U	54 U	50 U	47 U	48 U	46 U	46 U	55 U	50 U
Methyl Iodide	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
Methyl Methacrylate	40 R	37 R	47 R	54 R	50 R	47 R	48 R	46 R	46 R	55 R	50 R
Methylene Chloride	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
Pentachloroethane	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
Propionitrile (Ethyl Cyanide)	200 R	190 R	230 R	270 R	250 R	240 R	240 R	230 R	230 R	280 R	250 R
Styrene (Ethenylbenzene)	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
Tetrachloroethene (PCE)	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
Toluene	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
Trichloroethene (TCE)	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
Vinyl Acetate	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
Vinyl Chloride	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
Xylene, m/p-	8 U	7.4 U	9.4 U	11 U	9.9 U	9.5 U	9.7 U	9.1 U	9.2 U	11 U	9.9 U
Xylene, o-	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
Xylenes, total	4 U	3.7 U	4.7 U	5.4 U	5 U	4.7 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U
Semivolatile Organics (µg/kg)											
1,2,4,5-Tetrachlorobenzene	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
1,2,4-Trichlorobenzene	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
1,2-Dichlorobenzene (o-)	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
1,3,5-Trinitrobenzene (TNB)	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
1,3-Dichlorobenzene (m-)	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
1,3-Dinitrobenzene (m-)	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
1,4-Dichlorobenzene (p-)	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
1,4-Naphthoquinone	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
1,4-Phenylenediamine	2000 R	1900 R	2000 R	2100 R	2300 R	2200 R	2200 R	2300 R	2200 R	2400 R	1900 R
1-Naphthylamine	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 UJ	220 UJ	230 U	220 UJ	240 UJ	190 UJ
2,2'-Oxybis[1-chloropropane]	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
2,3,4,6-Tetrachlorophenol	390 UJ	380 UJ	400 UJ	400 UJ	440 UJ	420 U	420 U	450 U	420 UJ	470 UJ	370 UJ
2,4,5-Trichlorophenol	390 UJ	380 UJ	400 UJ	400 UJ	440 UJ	420 U	420 U	450 U	420 UJ	470 UJ	370 UJ

APPENDIX B

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB11	59SB11	59SB11	59SB12	59SB12	59SB13	59SB13	59SB13	59SB14	59SB14	59SB15
Sample ID	59SB11-01	59SB11-01D	59SB11-02	59SB12-01	59SB12-05	59SB13-01	59SB13-01D	59SB13-05	59SB14-01	59SB14-05	59SB15-01
Sample Date	5/19/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010
Sample Depth (ft bgs)	1.0 - 3.0	1.0 - 3.0	3.0 - 5.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0
Semivolatile Organics (µg/kg) (cont.)											
2,4,6-Trichlorophenol	390 UJ	380 UJ	400 UJ	400 UJ	440 UJ	420 U	420 U	450 U	420 UJ	470 UJ	370 UJ
2,4-Dichlorophenol	390 UJ	380 UJ	400 UJ	400 UJ	440 UJ	420 U	420 U	450 U	420 UJ	470 UJ	370 UJ
2,4-Dimethylphenol	390 UJ	380 UJ	400 UJ	400 UJ	440 UJ	420 U	420 U	450 U	420 UJ	470 UJ	370 UJ
2,4-Dinitrophenol	390 UJ	380 UJ	400 UJ	400 UJ	440 UJ	420 U	420 U	450 U	420 UJ	470 UJ	370 UJ
2,4-Dinitrotoluene (DNT)	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
2,6-Dichlorophenol	390 UJ	380 UJ	400 UJ	400 UJ	440 UJ	420 U	420 U	450 U	420 UJ	470 UJ	370 UJ
2,6-Dinitrotoluene (DNT)	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
2-Acetylaminofluorene	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
2-Chloronaphthalene	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
2-Chlorophenol	390 UJ	380 UJ	400 UJ	400 UJ	440 UJ	420 U	420 U	450 U	420 UJ	470 UJ	370 UJ
2-Methyl-5-nitroaniline	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
2-Methylphenol (o-Cresol)	390 UJ	380 UJ	400 UJ	400 UJ	440 UJ	420 UJ	420 UJ	450 UJ	420 UJ	470 UJ	370 UJ
2-Naphthylamine	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
2-Nitroaniline	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
2-Nitrophenol	390 UJ	380 UJ	400 UJ	400 UJ	440 UJ	420 U	420 U	450 U	420 UJ	470 UJ	370 UJ
2-Picoline	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
3,3'-Dichlorobenzidine	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
3,3'-Dimethylbenzidine	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
3-Methylcholanthrene	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
3-Methylphenol (m-Cresol)	290 UJ	280 UJ	300 UJ	300 UJ	330 UJ	320 U	320 U	340 U	320 UJ	360 UJ	280 UJ
3-Nitroaniline	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
4,6-Dinitro-2-methylphenol	390 UJ	380 UJ	400 UJ	400 UJ	440 UJ	420 U	420 U	450 U	420 UJ	470 UJ	370 UJ
4-Aminobiphenyl	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
4-Bromophenyl-phenylether	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
4-Chloro-3-methylphenol	390 UJ	380 UJ	400 UJ	400 UJ	440 UJ	420 U	420 U	450 U	420 UJ	470 UJ	370 UJ
4-Chloroaniline	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
4-Chlorophenyl-phenylether	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
4-Dimethylaminoazobenzene (p-)	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
4-Methylphenol (p-Cresol)	290 UJ	280 UJ	300 UJ	300 UJ	330 UJ	320 U	320 U	340 U	320 UJ	360 UJ	280 UJ
4-Nitroaniline	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
4-Nitrophenol	390 UJ	380 UJ	400 UJ	400 UJ	440 UJ	420 U	420 U	450 U	420 UJ	470 UJ	370 UJ
4-Nitroquinoline-1-oxide	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
7,12-Dimethylbenz(a)anthracene	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 UJ	220 UJ	240 UJ	190 UJ
a,a-Dimethylphenethylamine	550 UJ	530 UJ	570 UJ	570 UJ	630 UJ	590 UJ	590 UJ	640 U	600 UJ	670 UJ	530 UJ
Acetophenone	100 UJ	96 UJ	100 UJ	100 UJ	110 UJ	110 U	110 U	120 U	110 UJ	120 UJ	96 UJ
Aniline	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ

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SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB11	59SB11	59SB11	59SB12	59SB12	59SB13	59SB13	59SB13	59SB14	59SB14	59SB15
Sample ID	59SB11-01	59SB11-01D	59SB11-02	59SB12-01	59SB12-05	59SB13-01	59SB13-01D	59SB13-05	59SB14-01	59SB14-05	59SB15-01
Sample Date	5/19/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010
Sample Depth (ft bgs)	1.0 - 3.0	1.0 - 3.0	3.0 - 5.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0
Semivolatile Organics (µg/kg) (cont.)											
Aramite	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
Benzyl Alcohol	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
Bis(2-chloroethoxy)methane	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
Bis(2-chloroethyl)ether	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
Bis(2-ethylhexyl) Phthalate (BEHP)	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
Butyl Benzyl Phthalate	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
Diallate (cis)	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
Diallate (trans)	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 UJ	220 UJ	230 UJ	220 UJ	240 UJ	190 UJ
Dibenzofuran	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
Diethyl Phthalate (DEP)	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
Dimethyl Phthalate	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
Di-n-butyl Phthalate (DBP)	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
Di-n-octyl Phthalate	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
Dinoseb	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
Ethyl Methane Sulfonate (EMS)	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
Hexachloro-1,3-butadiene	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
Hexachlorobenzene	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
Hexachlorocyclopentadiene	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
Hexachloroethane	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
Hexachloropropene	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
Isophorone	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
Isosafrole	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
Methapyrilene	200 R	190 R	200 UJ	210 UJ	230 UJ	220 R	220 R	230 U	220 UJ	240 UJ	190 UJ
Methyl Methane Sulfonate	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
Nitrobenzene	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
n-Nitrosodiethylamine	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
n-Nitrosodimethylamine (NDMA)	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
n-Nitroso-di-n-butylamine	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 UJ	220 UJ	230 UJ	220 UJ	240 UJ	190 UJ
n-Nitrosodi-n-propylamine	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
n-Nitrosodiphenylamine	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
n-Nitrosomethylethylamine	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
n-Nitrosomorpholine	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
n-Nitrosopiperidine	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
n-Nitrosopyrrolidine	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
o-Toluidine	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
Pentachlorobenzene	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB11	59SB11	59SB11	59SB12	59SB12	59SB13	59SB13	59SB13	59SB14	59SB14	59SB15
Sample ID	59SB11-01	59SB11-01D	59SB11-02	59SB12-01	59SB12-05	59SB13-01	59SB13-01D	59SB13-05	59SB14-01	59SB14-05	59SB15-01
Sample Date	5/19/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010
Sample Depth (ft bgs)	1.0 - 3.0	1.0 - 3.0	3.0 - 5.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0
Semivolatile Organics (µg/kg) (cont.)											
Pentachloronitrobenzene	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
Pentachlorophenol	390 UJ	380 UJ	400 UJ	400 UJ	440 UJ	420 U	420 U	450 U	420 UJ	470 UJ	370 UJ
Phenacetin	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
Phenol	390 UJ	380 UJ	400 UJ	400 UJ	440 UJ	420 U	420 U	450 U	420 UJ	470 UJ	370 UJ
Pronamide	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
Pyridine	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
Safrole	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
LLPAHs (µg/kg)											
2-Methylnaphthalene	9.8 UJ	9.4 UJ	10 UJ	10 UJ	11 UJ	11 U	11 U	11 U	11 UJ	12 UJ	9.3 UJ
Acenaphthene	9.8 UJ	9.4 UJ	10 UJ	10 UJ	11 UJ	11 U	11 U	11 U	11 UJ	12 UJ	9.3 UJ
Acenaphthylene	9.8 UJ	9.4 UJ	10 UJ	10 UJ	11 UJ	11 U	11 U	11 U	11 UJ	12 UJ	9.3 UJ
Anthracene	9.8 UJ	9.4 UJ	10 UJ	10 UJ	11 UJ	11 UJ	11 UJ	11 UJ	11 UJ	12 UJ	9.3 UJ
Benzo(a)anthracene	9.8 UJ	9.4 UJ	1.7 J	10 UJ	11 UJ	11 U	11 U	11 U	11 UJ	12 UJ	9.3 UJ
Benzo(a)pyrene (BaP)	9.8 UJ	9.4 UJ	10 UJ	10 UJ	11 UJ	11 U	11 U	11 U	11 UJ	12 UJ	9.3 UJ
Benzo(b)fluoranthene	9.8 UJ	9.4 UJ	10 UJ	10 UJ	1.2 J	11 U	11 U	11 U	11 UJ	12 UJ	9.3 UJ
Benzo(g,h,i)perylene	9.8 UJ	9.4 UJ	10 UJ	10 UJ	11 UJ	11 U	11 U	11 U	11 UJ	12 UJ	9.3 UJ
Benzo(k)fluoranthene	9.8 UJ	9.4 UJ	4.7 J	10 UJ	11 UJ	11 U	11 U	11 U	11 UJ	12 UJ	9.3 UJ
Chrysene	9.8 UJ	9.4 UJ	10 UJ	10 UJ	11 UJ	11 U	11 U	11 U	11 UJ	12 UJ	9.3 UJ
Dibenz(a,h)anthracene	9.8 UJ	9.4 UJ	10 UJ	10 UJ	11 UJ	11 U	11 UJ	11 UJ	11 UJ	12 UJ	9.3 UJ
Fluoranthene	9.8 UJ	9.4 UJ	10 UJ	10 UJ	11 UJ	11 U	11 UJ	11 UJ	11 UJ	12 UJ	9.3 UJ
Fluorene	9.8 UJ	9.4 UJ	10 UJ	10 UJ	11 UJ	11 U	11 UJ	11 UJ	11 UJ	12 UJ	9.3 UJ
Indeno(1,2,3-cd)pyrene	9.8 UJ	9.4 UJ	16 J	10 UJ	11 UJ	11 U	11 U	11 U	11 UJ	12 UJ	9.3 UJ
Naphthalene	9.8 UJ	9.4 UJ	10 UJ	10 UJ	11 UJ	11 U	11 U	11 U	11 UJ	12 UJ	9.3 UJ
Phenanthrene	9.8 UJ	9.4 UJ	10 UJ	10 UJ	11 UJ	11 U	11 U	11 U	11 UJ	12 UJ	9.3 UJ
Pyrene	9.8 UJ	9.4 UJ	21 J	10 UJ	11 UJ	11 U	11 UJ	11 UJ	11 UJ	12 UJ	9.3 UJ
LLPAH Totals (µg/kg)											
Low molecular weight PAHs	78.4	75.2	71.7	80	78.2	88	88	88	88	96	74.4
High molecular weight PAHs	88.2	84.6	101.7	90	99	99	99	99	99	108	83.7
Pesticides (µg/kg)											
4,4'-DDD	3.9 U	3.8 U	4 UJ	4 U	4.4 U	4.2 U	4.1 U	4.5 U	4.2 U	4.7 U	3.7 U
4,4'-DDE	3.9 U	3.8 U	4 UJ	4 U	4.4 U	4.2 U	4.1 U	4.5 U	4.2 U	4.7 U	0.66 J
4,4'-DDT	3.9 U	3.8 U	4 UJ	4 U	4.4 U	4.2 U	4.1 U	4.5 U	4.2 U	4.7 U	3.7 U
Aldrin	2 U	1.9 U	2 UJ	2.1 U	2.3 U	2.2 U	2.1 U	2.3 U	2.2 U	2.4 U	1.9 U
BHC, alpha-	2 U	1.9 U	2 UJ	2.1 U	2.3 U	2.2 U	2.1 U	2.3 U	2.2 U	2.4 U	1.9 U

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CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB11	59SB11	59SB11	59SB12	59SB12	59SB13	59SB13	59SB13	59SB14	59SB14	59SB15
Sample ID	59SB11-01	59SB11-01D	59SB11-02	59SB12-01	59SB12-05	59SB13-01	59SB13-01D	59SB13-05	59SB14-01	59SB14-05	59SB15-01
Sample Date	5/19/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010
Sample Depth (ft bgs)	1.0 - 3.0	1.0 - 3.0	3.0 - 5.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0
Pesticides (µg/kg) (cont.)											
BHC, beta-	1 U	0.97 U	1 UJ	1 U	12 NJ	1.1 U	1.1 U	1.2 U	1.1 U	1.2 U	8.9 NJ
BHC, delta-	2 U	1.9 U	2 UJ	2.1 U	2.3 U	2.2 U	2.1 U	2.3 U	2.2 U	2.4 U	1.9 U
BHC, gamma- (Lindane)	2 U	1.9 U	2 UJ	2.1 U	2.3 U	2.2 U	2.1 U	2.3 U	2.2 U	2.4 U	1.9 U
Chlordane, alpha-	2 U	1.9 U	2 UJ	2.1 U	2.3 U	2.2 U	2.1 U	2.3 U	2.2 U	2.4 U	1.9 U
Chlordane, gamma-	2 U	1.9 U	2 UJ	2.1 U	2.3 U	2.2 U	2.1 U	2.3 U	2.2 U	2.4 U	1.9 U
Chlorobenzilate	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
Dieldrin	3.9 U	3.8 U	4 UJ	4 U	4.4 U	4.2 U	4.1 U	4.5 U	4.2 U	4.7 U	3.7 U
Endosulfan I	2 U	1.9 U	2 UJ	2.1 U	2.3 U	2.2 U	2.1 U	2.3 U	2.2 U	2.4 U	1.9 U
Endosulfan II	3.9 U	3.8 U	4 UJ	4 U	4.4 U	4.2 U	4.1 U	4.5 U	4.2 U	4.7 U	3.7 U
Endosulfan Sulfate	3.9 U	3.8 U	4 UJ	4 U	4.4 U	4.2 U	4.1 U	4.5 U	4.2 U	4.7 U	3.7 U
Endrin	3.9 U	3.8 U	4 UJ	4 U	4.4 U	4.2 U	4.1 U	4.5 U	4.2 U	4.7 U	3.7 U
Endrin Aldehyde	3.9 U	3.8 U	4 UJ	4 U	4.4 U	4.2 U	4.1 U	4.5 U	4.2 U	4.7 U	3.7 U
Heptachlor	2 U	1.9 U	2 UJ	2.1 U	2.3 U	2.2 U	0.22 J	2.3 U	2.2 U	2.4 U	1.9 U
Heptachlor Epoxide	2 U	1.9 U	2 UJ	2.1 U	2.3 U	2.2 U	2.1 U	2.3 U	2.2 U	2.4 U	1.9 U
Isodrin	200 UJ	190 UJ	200 UJ	210 UJ	230 UJ	220 U	220 U	230 U	220 UJ	240 UJ	190 UJ
Kepone (Chlordecone)	200 R	190 R	200 R	210 R	230 R	220 UJ	220 UJ	230 U	220 R	240 R	190 R
Methoxychlor	20 U	19 U	20 UJ	21 U	23 U	22 U	21 U	23 U	22 U	24 U	19 U
Toxaphene	98 U	94 U	100 UJ	100 U	110 U	110 U	100 U	110 U	110 U	120 U	92 U
Metals (mg/kg)											
Antimony	5.9 UJ	5.7 UJ	5.8 UJ	6.1 UJ	6.5 UJ	0.39 J	0.34 J	0.38 J	6.4 UJ	7 UJ	1 J
Arsenic	2.9 U	2.9 U	2.9 U	3.1 U	1.9 J	0.54 J	0.63 U	0.67 U	3.2 U	3.5 U	0.63
Barium	70.5	86.8	69	82.8	4.1 J	267 J	144 J	45.3 J	76	61.8	58
Beryllium	2.9 U	2.9 U	0.25 J	0.3 J	0.32 J	0.88	0.96	0.11 J	3.2 U	3.5 U	0.18 J
Cadmium	2.9 U	0.2 J	0.45 J	3.1 U	3.3 U	0.28 J	0.25 J	0.7 J	0.36 J	0.52 J	0.23 J
Chromium	17.7 J	25.3 J	52.9 J	79.3 J	19.9 J	8	6.9	18.5	39.8 J	7 UJ	32.1 J
Cobalt	24.8	26.9	21.4	28.8	15.6	67.6 J	43.6 J	21.2 J	41.6	30.9	27.7
Copper	89.6	65.1	86.9	76.2	123	83.1 J	75 J	58.5 J	270	9.8	56.2
Lead	2.9 U	2.9 U	2.9 U	3.1 U	37.4	28.4 R	11.2 R	2.3 R	4.1	3.5 U	3.2
Mercury	0.039 U	0.038 U	0.012 J	0.04 U	0.044 U	0.042 U	0.042 U	0.045 U	0.01 J	0.016 J	0.037 U
Nickel	12.4	14.9	26.8	22.6	11	5.9	6.3	16.9	21.6	9	13.3
Selenium	14.7 U	14.3 U	14.6 U	15.3 U	16.3 U	0.48 J	0.43 J	0.32 J	16 U	17.4 U	0.21 J
Silver	2.9 U	2.9 U	2.9 U	3.1 U	3.3 U	0.1 J	0.1 J	0.11 J	3.2 U	3.5 U	0.56 U
Thallium	2.9 U	0.1 J	2.9 U	3.1 U	3.3 U	0.055 J	0.04 J	0.67 U	3.2 U	3.5 U	0.072 J
Tin	5.9 U	5.7 U	5.8 U	6.1 U	6.5 U	6.3 U	6.3 U	6.7 U	6.4 U	7 U	5.6 U
Vanadium	145	143	158	136	407	107 J	103 J	294 J	236	152	125
Zinc	59.4	71	61.8	75.3	117	152	160	59.7	92.8	79.4	78.4

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB15	59SB16	59SB16	59SB17	59SB17	59SB18	59SB18	59SB19	59SB19	59SB20	59SB20
Sample ID	59SB15-05	59SB16-01	59SB16-05	59SB17-01	59SB17-05	59SB18-01	59SB18-02	59SB19-01	59SB19-05	59SB20-01	59SB20-05
Sample Date	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010
Sample Depth (ft bgs)	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	3.0 - 5.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Volatile Organics (µg/kg)											
1,1,1,2-Tetrachloroethane	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
1,1,1-Trichloroethane	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
1,1,2,2-Tetrachloroethane	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
1,1,2-Trichloroethane	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
1,1-Dichloroethane	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
1,1-Dichloroethene	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
1,2,3-Trichloropropane	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
1,2-Dibromo-3-chloropropane (DBCP)	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
1,2-Dibromoethane (EDB)	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
1,2-Dichloroethane	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
1,2-Dichloroethene (trans)	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
1,2-Dichloropropane	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
1,3-Dichloropropene (cis)	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
1,3-Dichloropropene (trans)	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
1,4-Dichloro-2-butene (trans)	19 U	18 U	19 U	17 U	21 U	17 U	17 U	21 U	22 U	16 U	21 U
1,4-Dioxane (p-)	240 R	220 R	240 R	210 R	270 R	220 R	210 R	260 R	270 R	200 R	260 R
2-Butanone (MEK)	12 U	11 U	12 U	11 U	13 U	11 U	10 U	13 U	14 U	10 U	13 U
2-Chloro-1,3-butadiene (Chloroprene)	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
2-Hexanone (MBK)	12 U	11 U	12 U	11 U	13 U	11 U	10 U	13 U	14 U	10 U	13 U
3-Chloropropene (Allyl Chloride)	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
4-Methyl-2-pentanone (MIBK)	12 U	11 U	12 U	11 U	13 U	11 U	10 U	13 U	14 U	10 U	13 U
Acetone	12 U	13 U	12 U	37	13 U	18 U	10 U	13 U	14 U	10 U	13 U
Acetonitrile	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
Acrolein	48 R	45 R	48 R	43 R	53 R	43 R	42 R	52 R	55 R	41 R	53 R
Acrylonitrile	48 U	45 U	48 U	43 U	53 U	43 U	42 U	52 U	55 U	41 U	53 U
Benzene	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	0.71 J	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
Bromodichloromethane	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
Bromoform	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
Bromomethane	4.8 U	4.5 U	4.8 U	1.6 J	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
Carbon Disulfide	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
Carbon Tetrachloride	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
Chlorobenzene	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
Chloroethane	4.8 UJ	4.5 UJ	4.8 UJ	4.3 UJ	5.3 UJ	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
Chloroform	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
Chloromethane	4.8 U	4.5 U	4.8 U	0.74 J	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
Dibromochloromethane	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB15	59SB16	59SB16	59SB17	59SB17	59SB18	59SB18	59SB19	59SB19	59SB20	59SB20
Sample ID	59SB15-05	59SB16-01	59SB16-05	59SB17-01	59SB17-05	59SB18-01	59SB18-02	59SB19-01	59SB19-05	59SB20-01	59SB20-05
Sample Date	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010
Sample Depth (ft bgs)	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	3.0 - 5.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Volatile Organics (µg/kg) (cont.)											
Dibromomethane	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
Ethyl Methacrylate	48 U	45 U	48 U	43 U	53 U	43 U	42 U	52 U	55 U	41 U	53 U
Ethylbenzene	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
Freon 11 (Trichlorofluoromethane)	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
Freon-12 (Dichlorodifluoromethane)	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
Isobutyl Alcohol	240 R	220 R	240 R	210 R	270 R	220 R	210 R	260 R	270 R	200 R	260 R
Methyl Acrylonitrile	48 U	45 U	48 U	43 U	53 U	43 U	42 U	52 U	55 U	41 U	53 U
Methyl Iodide	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
Methyl Methacrylate	48 R	45 R	48 R	43 R	53 R	43 R	42 R	52 R	55 R	41 R	53 R
Methylene Chloride	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
Pentachloroethane	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
Propionitrile (Ethyl Cyanide)	240 R	220 R	240 R	210 R	270 R	220 R	210 R	260 R	270 R	200 R	260 R
Styrene (Ethenylbenzene)	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
Tetrachloroethene (PCE)	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
Toluene	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
Trichloroethene (TCE)	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
Vinyl Acetate	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 UJ	4.2 UJ	5.2 UJ	5.5 UJ	4.1 UJ	5.3 UJ
Vinyl Chloride	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
Xylene, m/p-	9.7 U	8.9 U	9.5 U	8.6 U	11 U	8.6 U	8.3 U	10 U	11 U	8.1 U	11 U
Xylene, o-	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
Xylenes, total	4.8 U	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U
Semivolatile Organics (µg/kg)											
1,2,4,5-Tetrachlorobenzene	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
1,2,4-Trichlorobenzene	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
1,2-Dichlorobenzene (o-)	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
1,3,5-Trinitrobenzene (TNB)	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
1,3-Dichlorobenzene (m-)	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
1,3-Dinitrobenzene (m-)	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
1,4-Dichlorobenzene (p-)	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
1,4-Naphthoquinone	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
1,4-Phenylenediamine	2000 R	2100 R	2200 R	2000 R	2400 R	1800 R	2100 R	2200 R	2300 R	1800 R	1900 R
1-Naphthylamine	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
2,2'-Oxybis[1-chloropropane]	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
2,3,4,6-Tetrachlorophenol	400 UJ	410 UJ	430 UJ	390 UJ	460 UJ	350 U	410 U	430 U	440 U	360 U	380 U
2,4,5-Trichlorophenol	400 UJ	410 UJ	430 UJ	390 UJ	460 UJ	350 U	410 U	430 U	440 U	360 U	380 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB15	59SB16	59SB16	59SB17	59SB17	59SB18	59SB18	59SB19	59SB19	59SB20	59SB20
Sample ID	59SB15-05	59SB16-01	59SB16-05	59SB17-01	59SB17-05	59SB18-01	59SB18-02	59SB19-01	59SB19-05	59SB20-01	59SB20-05
Sample Date	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010
Sample Depth (ft bgs)	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	3.0 - 5.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Semivolatile Organics (µg/kg) (cont.)											
2,4,6-Trichlorophenol	400 UJ	410 UJ	430 UJ	390 UJ	460 UJ	350 U	410 U	430 U	440 U	360 U	380 U
2,4-Dichlorophenol	400 UJ	410 UJ	430 UJ	390 UJ	460 UJ	350 U	410 U	430 U	440 U	360 U	380 U
2,4-Dimethylphenol	400 UJ	410 UJ	430 UJ	390 UJ	460 UJ	350 U	410 U	430 U	440 U	360 U	380 U
2,4-Dinitrophenol	400 UJ	410 UJ	430 UJ	390 UJ	460 UJ	350 U	410 U	430 U	440 U	360 U	380 U
2,4-Dinitrotoluene (DNT)	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
2,6-Dichlorophenol	400 UJ	410 UJ	430 UJ	390 UJ	460 UJ	350 U	410 U	430 U	440 U	360 U	380 U
2,6-Dinitrotoluene (DNT)	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
2-Acetylaminofluorene	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
2-Chloronaphthalene	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
2-Chlorophenol	400 UJ	410 UJ	430 UJ	390 UJ	460 UJ	350 U	410 U	430 U	440 U	360 U	380 U
2-Methyl-5-nitroaniline	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
2-Methylphenol (o-Cresol)	400 UJ	410 UJ	430 UJ	390 UJ	460 UJ	350 U	410 U	430 U	440 U	360 U	380 U
2-Naphthylamine	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
2-Nitroaniline	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
2-Nitrophenol	400 UJ	410 UJ	430 UJ	390 UJ	460 UJ	350 U	410 U	430 U	440 U	360 U	380 U
2-Picoline	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
3,3'-Dichlorobenzidine	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
3,3'-Dimethylbenzidine	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
3-Methylcholanthrene	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
3-Methylphenol (m-Cresol)	300 UJ	310 UJ	320 UJ	300 UJ	350 UJ	260 U	310 U	320 U	330 U	270 U	280 U
3-Nitroaniline	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
4,6-Dinitro-2-methylphenol	400 UJ	410 UJ	430 UJ	390 UJ	460 UJ	350 U	410 U	430 U	440 U	360 U	380 U
4-Aminobiphenyl	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
4-Bromophenyl-phenylether	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
4-Chloro-3-methylphenol	400 UJ	410 UJ	430 UJ	390 UJ	460 UJ	350 U	410 U	430 U	440 U	360 U	380 U
4-Chloroaniline	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
4-Chlorophenyl-phenylether	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
4-Dimethylaminoazobenzene (p-)	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
4-Methylphenol (p-Cresol)	300 UJ	310 UJ	320 UJ	300 UJ	350 UJ	260 U	310 U	320 U	330 U	270 U	280 U
4-Nitroaniline	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
4-Nitrophenol	400 UJ	410 UJ	430 UJ	390 UJ	460 UJ	350 U	410 U	430 U	440 U	360 U	380 U
4-Nitroquinoline-1-oxide	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
7,12-Dimethylbenz(a)anthracene	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
a,a-Dimethylphenethylamine	570 UJ	590 UJ	610 UJ	560 UJ	650 UJ	500 U	580 U	610 U	630 UJ	510 U	530 U
Acetophenone	100 UJ	110 UJ	110 UJ	100 UJ	120 UJ	90 U	100 U	110 U	110 U	92 U	96 U
Aniline	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U

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SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB15	59SB16	59SB16	59SB17	59SB17	59SB18	59SB18	59SB19	59SB19	59SB20	59SB20
Sample ID	59SB15-05	59SB16-01	59SB16-05	59SB17-01	59SB17-05	59SB18-01	59SB18-02	59SB19-01	59SB19-05	59SB20-01	59SB20-05
Sample Date	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010
Sample Depth (ft bgs)	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	3.0 - 5.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Semivolatile Organics (µg/kg) (cont.)											
Aramite	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
Benzyl Alcohol	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 UJ	180 U	190 U
Bis(2-chloroethoxy)methane	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
Bis(2-chloroethyl)ether	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
Bis(2-ethylhexyl) Phthalate (BEHP)	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
Butyl Benzyl Phthalate	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
Diallate (cis)	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
Diallate (trans)	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
Dibenzofuran	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
Diethyl Phthalate (DEP)	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
Dimethyl Phthalate	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
Di-n-butyl Phthalate (DBP)	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
Di-n-octyl Phthalate	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
Dinoseb	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
Ethyl Methane Sulfonate (EMS)	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 UJ	210 UJ	220 UJ	230 UJ	180 UJ	190 UJ
Hexachloro-1,3-butadiene	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
Hexachlorobenzene	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
Hexachlorocyclopentadiene	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
Hexachloroethane	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
Hexachloropropene	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
Isophorone	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
Isosafrole	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
Methapyrilene	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
Methyl Methane Sulfonate	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
Nitrobenzene	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
n-Nitrosodiethylamine	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
n-Nitrosodimethylamine (NDMA)	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
n-Nitroso-di-n-butylamine	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 UJ	210 UJ	220 UJ	230 UJ	180 UJ	190 UJ
n-Nitrosodi-n-propylamine	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
n-Nitrosodiphenylamine	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
n-Nitrosomethylethylamine	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
n-Nitrosomorpholine	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
n-Nitrosopiperidine	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
n-Nitrosopyrrolidine	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
o-Toluidine	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
Pentachlorobenzene	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB15	59SB16	59SB16	59SB17	59SB17	59SB18	59SB18	59SB19	59SB19	59SB20	59SB20
Sample ID	59SB15-05	59SB16-01	59SB16-05	59SB17-01	59SB17-05	59SB18-01	59SB18-02	59SB19-01	59SB19-05	59SB20-01	59SB20-05
Sample Date	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010
Sample Depth (ft bgs)	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	3.0 - 5.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Semivolatile Organics (µg/kg) (cont.)											
Pentachloronitrobenzene	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
Pentachlorophenol	400 UJ	410 UJ	430 UJ	390 UJ	460 UJ	350 U	410 U	430 U	440 U	360 U	380 U
Phenacetin	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
Phenol	400 UJ	410 UJ	430 UJ	390 UJ	460 UJ	350 U	410 U	430 U	440 U	360 U	380 U
Pronamide	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
Pyridine	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
Safrole	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
LLPAHs (µg/kg)											
2-Methylnaphthalene	10 UJ	10 UJ	11 UJ	9.9 UJ	12 UJ	8.8 U	10 U	11 U	11 U	9 U	9.4 U
Acenaphthene	10 UJ	10 UJ	11 UJ	9.9 UJ	12 UJ	2 J	10 U	11 U	11 U	9 U	9.4 U
Acenaphthylene	10 UJ	10 UJ	11 UJ	9.9 UJ	12 UJ	0.61 J	10 U	11 U	11 U	9 U	9.4 U
Anthracene	10 UJ	10 UJ	11 UJ	9.9 UJ	12 UJ	8.8 U	10 U	11 U	11 U	9 U	9.4 U
Benzo(a)anthracene	10 UJ	10 UJ	11 UJ	9.9 UJ	12 UJ	21	10 U	11 U	11 U	9 U	9.4 U
Benzo(a)pyrene (BaP)	10 UJ	10 UJ	11 UJ	9.9 UJ	12 UJ	8.8 U	10 U	11 U	11 U	9 U	9.4 U
Benzo(b)fluoranthene	10 UJ	1.1 J	1.4 J	9.9 UJ	12 UJ	8.8 U	10 U	11 U	11 U	9 U	9.4 U
Benzo(g,h,i)perylene	10 UJ	10 UJ	11 UJ	9.9 UJ	12 UJ	6.5 J	10 U	11 U	11 U	9 U	9.4 U
Benzo(k)fluoranthene	0.75 J	10 UJ	11 UJ	0.7 J	12 UJ	12	10 U	11 U	11 U	9 U	9.4 U
Chrysene	10 UJ	10 UJ	11 UJ	0.88 J	12 UJ	8.8 U	10 U	11 U	11 U	9 U	9.4 U
Dibenz(a,h)anthracene	10 UJ	10 UJ	11 UJ	1.4 J	12 UJ	8.8 U	10 U	11 U	11 U	9 U	9.4 U
Fluoranthene	10 UJ	10 UJ	11 UJ	9.9 UJ	12 UJ	8.8 U	10 U	11 U	11 U	9 U	9.4 U
Fluorene	10 UJ	10 UJ	11 UJ	0.99 J	12 UJ	8.8 U	10 U	11 U	11 U	9 U	9.4 U
Indeno(1,2,3-cd)pyrene	1 J	10 UJ	11 UJ	0.85 J	12 UJ	15	10 U	11 U	11 U	9 U	9.4 U
Naphthalene	10 UJ	10 UJ	11 UJ	9.9 UJ	12 UJ	8.8 U	10 U	11 U	11 U	9 U	9.4 U
Phenanthrene	10 UJ	10 UJ	11 UJ	9.9 UJ	12 UJ	8.8 U	10 U	11 U	11 U	9 U	9.4 U
Pyrene	10 UJ	10 UJ	11 UJ	9.9 UJ	12 UJ	24	2.1 J	11 U	11 U	9 U	9.4 U
LLPAH Totals (µg/kg)											
Low molecular weight PAHs	80	71.1	78.4	79.2	96	65.31	80	88	88	72	75.2
High molecular weight PAHs	71.75	90	99	44.42	108	103.8	82.1	99	99	81	84.6
Pesticides (µg/kg)											
4,4'-DDD	4 U	4.1 U	4.3 U	3.9 U	4.6 U	0.39 J	4.1 U	4.3 U	4.4 UJ	3.6 U	3.8 U
4,4'-DDE	4 U	4.1 U	4.3 U	3.9 U	4.6 U	1.2 J	4.1 U	4.3 U	4.4 UJ	3.6 U	3.8 U
4,4'-DDT	4 U	4.1 U	4.3 U	3.9 U	4.6 U	1.3 J	4.1 U	4.3 U	4.4 UJ	3.6 U	3.8 U
Aldrin	2 U	2.1 U	2.2 U	2 U	2.4 U	1.8 U	2.1 U	2.2 U	2.3 UJ	1.8 U	1.9 U
BHC, alpha-	2 U	2.1 U	2.2 U	2 U	2.4 U	1.8 U	2.1 U	2.2 U	2.3 UJ	1.8 U	1.9 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB15	59SB16	59SB16	59SB17	59SB17	59SB18	59SB18	59SB19	59SB19	59SB20	59SB20
Sample ID	59SB15-05	59SB16-01	59SB16-05	59SB17-01	59SB17-05	59SB18-01	59SB18-02	59SB19-01	59SB19-05	59SB20-01	59SB20-05
Sample Date	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010
Sample Depth (ft bgs)	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	3.0 - 5.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Pesticides (µg/kg) (cont.)											
BHC, beta-	1 U	1.1 U	1.1 U	1 U	1.2 U	1.8 U	2.1 U	2.2 U	2.3 UJ	1.8 U	1.9 U
BHC, delta-	2 U	2.1 U	2.2 U	2 U	2.4 U	1.8 U	2.1 U	2.2 U	2.3 UJ	1.8 U	1.9 U
BHC, gamma- (Lindane)	2 U	2.1 U	2.2 U	2 U	2.4 U	1.8 U	2.1 U	2.2 U	2.3 UJ	1.8 U	1.9 U
Chlordane, alpha-	2 U	2.1 U	2.2 U	2 U	2.4 U	1.8 U	2.1 U	2.2 U	2.3 UJ	1.8 U	1.9 U
Chlordane, gamma-	2 U	2.1 U	2.2 U	2 U	2.4 U	1.8 U	2.1 U	2.2 U	2.3 UJ	1.8 U	1.9 U
Chlorobenzilate	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
Dieldrin	4 U	4.1 U	4.3 U	3.9 U	4.6 U	3.5 U	4.1 U	4.3 U	4.4 UJ	3.6 U	3.8 U
Endosulfan I	2 U	2.1 U	2.2 U	2 U	2.4 U	1.8 U	2.1 U	2.2 U	2.3 UJ	1.8 U	1.9 U
Endosulfan II	4 U	4.1 U	4.3 U	3.9 U	4.6 U	3.5 U	4.1 U	4.3 U	4.4 UJ	3.6 U	3.8 U
Endosulfan Sulfate	4 U	4.1 U	4.3 U	3.9 U	4.6 U	3.5 U	4.1 U	4.3 U	4.4 UJ	3.6 U	3.8 U
Endrin	4 U	4.1 U	4.3 U	3.9 U	4.6 U	3.5 U	4.1 U	4.3 U	4.4 UJ	3.6 U	3.8 U
Endrin Aldehyde	4 U	4.1 U	4.3 U	3.9 U	4.6 U	0.53 J	4.1 U	4.3 U	4.4 UJ	3.6 U	3.8 U
Heptachlor	2 U	2.1 U	2.2 U	2 U	2.4 U	1.8 U	2.1 U	2.2 U	2.3 UJ	1.8 U	1.9 U
Heptachlor Epoxide	2 U	2.1 U	2.2 U	2 U	2.4 U	1.8 U	2.1 U	2.2 U	2.3 UJ	1.8 U	1.9 U
Isodrin	200 UJ	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U
Kepone (Chlordecone)	200 R	210 R	220 R	200 R	240 R	180 U	210 U	220 U	230 UJ	180 UJ	190 UJ
Methoxychlor	20 U	21 U	22 U	20 U	24 U	18 U	21 U	22 U	23 UJ	18 U	19 U
Toxaphene	100 U	100 U	110 U	99 U	120 U	88 U	100 U	110 U	110 UJ	90 U	94 U
Metals (mg/kg)											
Antimony	5.9 UJ	6.2 UJ	6.3 UJ	5.7 UJ	6.7 UJ	1.1 J	0.97 J	1.2 J	1.1 J	0.15 J	5.6 UJ
Arsenic	3 U	3.1 U	3.2 U	1 J	3.4 U	1.8	0.23 J	0.51 J	3 U	0.54 U	2.8 U
Barium	139	76.8	31.4 J	89.1	49.1	51.2	62.6	161	312	29.5	54.4
Beryllium	3 U	0.34 J	3.2 U	0.37 J	0.86 J	0.4 J	0.65	0.71	0.63 J	0.091 J	2.8 U
Cadmium	0.38 J	3.1 U	0.38 J	0.43 J	3.4 U	0.68	0.75	0.77	0.77 J	0.12 J	0.31 J
Chromium	22.5 J	29.5 J	232 J	57.2 J	21 J	14.3	8.1	23.1	33.5	24.4	63.9
Cobalt	16.4	31.6	25.7	28.6	44.7	14.4 J	21.5 J	20.2 J	12.9 J	9.8 J	19 J
Copper	66.2	115	50.5	109	57.1	51.1 J	83.3 J	64.6 J	37.4 J	34.9 J	73.1 J
Lead	3	3.1 U	12.5	24.6	3.4 U	31.3	2	1.9	3 U	2	2.8 U
Mercury	0.04 U	0.041 U	0.13	0.032 J	0.012 J	0.009 J	0.008 J	0.043 U	0.044 U	0.036 U	0.038 U
Nickel	11.4	14.1	44.4	47.3	27.9	8.4	9.8	14.2	10.2	9.8	25.6
Selenium	14.8 U	15.5 U	15.8 U	0.95 J	16.8 U	2 J	2.1 J	2.4 J	2.9 J	0.2 J	14 U
Silver	3 U	3.1 U	3.2 U	2.8 U	3.4 U	0.43 J	0.54 J	0.57 J	0.56 J	0.12 J	2.8 U
Thallium	3 U	3.1 U	3.2 U	2.8 U	3.4 U	0.4 J	0.53 J	0.5 J	0.45 J	0.54 U	2.8 U
Tin	5.9 U	6.2 U	6.3 U	26	6.7 U	5.1 UJ	6.1 UJ	6.5 UJ	6.1 UJ	5.4 UJ	5.6 UJ
Vanadium	189	214	71.3	188	89	65.3 J	118 J	87.2 J	59.7 J	43.5 J	135 J
Zinc	85.1	40.2	113	148	94.6	50.7	63.5	67.3	57.9	39.3	54.1

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB21	59SB21	59SB21	59SB22	59SB22	59SB23	59SB23
Sample ID	59SB21-01	59SB21-01D	59SB21-05	59SB22-01	59SB22-05	59SB23-01	59SB23-05
Sample Date	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010
Sample Depth (ft bgs)	1.0 - 3.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Volatile Organics (µg/kg)							
1,1,1,2-Tetrachloroethane	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
1,1,1-Trichloroethane	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
1,1,2,2-Tetrachloroethane	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
1,1,2-Trichloroethane	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
1,1-Dichloroethane	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
1,1-Dichloroethene	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
1,2,3-Trichloropropane	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
1,2-Dibromo-3-chloropropane (DBCP)	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
1,2-Dibromoethane (EDB)	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
1,2-Dichloroethane	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
1,2-Dichloroethene (trans)	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
1,2-Dichloropropane	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
1,3-Dichloropropene (cis)	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
1,3-Dichloropropene (trans)	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
1,4-Dichloro-2-butene (trans)	17 U	16 U	16 U	16 U	17 U	17 U	21 U
1,4-Dioxane (p-)	210 R	200 R	200 R	190 R	210 R	210 R	260 R
2-Butanone (MEK)	10 U	10 U	9.9 U	9.7 U	11 U	10 U	13 U
2-Chloro-1,3-butadiene (Chloroprene)	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
2-Hexanone (MBK)	10 U	10 U	9.9 U	9.7 U	11 U	10 U	13 U
3-Chloropropene (Allyl Chloride)	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
4-Methyl-2-pentanone (MIBK)	10 U	10 U	9.9 U	9.7 U	11 U	10 U	13 U
Acetone	10 U	10 U	9.9 U	40	11 U	10 U	16 U
Acetonitrile	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
Acrolein	42 R	40 R	40 R	39 R	42 R	42 R	52 R
Acrylonitrile	42 U	40 U	40 U	39 U	42 U	42 U	52 U
Benzene	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
Bromodichloromethane	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
Bromoform	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
Bromomethane	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
Carbon Disulfide	4.2 U	4 U	4 U	0.54 J	0.99 J	4.2 U	1.6 J
Carbon Tetrachloride	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
Chlorobenzene	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
Chloroethane	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
Chloroform	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
Chloromethane	4.2 U	4 U	4 U	0.43 J	4.2 U	4.2 U	5.2 U
Dibromochloromethane	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB21	59SB21	59SB21	59SB22	59SB22	59SB23	59SB23
Sample ID	59SB21-01	59SB21-01D	59SB21-05	59SB22-01	59SB22-05	59SB23-01	59SB23-05
Sample Date	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010
Sample Depth (ft bgs)	1.0 - 3.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Volatile Organics (µg/kg) (cont.)							
Dibromomethane	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
Ethyl Methacrylate	42 U	40 U	40 U	39 U	42 U	42 U	52 U
Ethylbenzene	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
Freon 11 (Trichlorofluoromethane)	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
Freon-12 (Dichlorodifluoromethane)	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
Isobutyl Alcohol	210 R	200 R	200 R	190 R	210 R	210 R	260 R
Methyl Acrylonitrile	42 U	40 U	40 U	39 U	42 U	42 U	52 U
Methyl Iodide	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
Methyl Methacrylate	42 R	40 R	40 R	39 R	42 R	42 R	52 R
Methylene Chloride	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
Pentachloroethane	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
Propionitrile (Ethyl Cyanide)	210 R	200 R	200 R	190 R	210 R	210 R	260 R
Styrene (Ethenylbenzene)	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
Tetrachloroethene (PCE)	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
Toluene	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
Trichloroethene (TCE)	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
Vinyl Acetate	4.2 UJ	4 UJ	4 UJ	3.9 UJ	4.2 UJ	4.2 UJ	5.2 UJ
Vinyl Chloride	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
Xylene, m/p-	8.3 U	8.1 U	7.9 U	7.8 U	8.5 U	8.4 U	10 U
Xylene, o-	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
Xylenes, total	4.2 U	4 U	4 U	3.9 U	4.2 U	4.2 U	5.2 U
Semivolatile Organics (µg/kg)							
1,2,4,5-Tetrachlorobenzene	180 U	180 U	180 U	200 U	210 U	190 U	230 U
1,2,4-Trichlorobenzene	180 U	180 U	180 U	200 U	210 U	190 U	230 U
1,2-Dichlorobenzene (o-)	180 U	180 U	180 U	200 U	210 U	190 U	230 U
1,3,5-Trinitrobenzene (TNB)	180 U	180 U	180 U	200 U	210 U	190 U	230 U
1,3-Dichlorobenzene (m-)	180 U	180 U	180 U	200 U	210 U	190 U	230 U
1,3-Dinitrobenzene (m-)	180 U	180 U	180 U	200 U	210 U	190 U	230 U
1,4-Dichlorobenzene (p-)	180 U	180 U	180 U	200 U	210 U	190 U	230 U
1,4-Naphthoquinone	180 U	180 U	180 U	200 U	210 U	190 U	230 U
1,4-Phenylenediamine	1800 R	1800 R	1800 R	2000 R	2100 R	1900 R	2300 R
1-Naphthylamine	180 U	180 U	180 U	200 U	210 U	190 U	230 U
2,2'-Oxybis[1-chloropropane]	180 U	180 U	180 U	200 U	210 U	190 U	230 U
2,3,4,6-Tetrachlorophenol	360 U	350 U	350 U	380 UJ	410 U	380 U	440 U
2,4,5-Trichlorophenol	360 U	350 U	350 U	380 UJ	410 U	380 U	440 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB21	59SB21	59SB21	59SB22	59SB22	59SB23	59SB23
Sample ID	59SB21-01	59SB21-01D	59SB21-05	59SB22-01	59SB22-05	59SB23-01	59SB23-05
Sample Date	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010
Sample Depth (ft bgs)	1.0 - 3.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Semivolatile Organics (µg/kg) (cont.)							
2,4,6-Trichlorophenol	360 U	350 U	350 U	380 UJ	410 U	380 U	440 U
2,4-Dichlorophenol	360 U	350 U	350 U	380 UJ	410 U	380 U	440 U
2,4-Dimethylphenol	360 U	350 U	350 U	380 UJ	410 U	380 U	440 U
2,4-Dinitrophenol	360 U	350 U	350 U	380 UJ	410 U	380 U	440 U
2,4-Dinitrotoluene (DNT)	180 U	180 U	180 U	200 U	210 U	190 U	230 U
2,6-Dichlorophenol	360 U	350 U	350 U	380 UJ	410 U	380 U	440 U
2,6-Dinitrotoluene (DNT)	180 U	180 U	180 U	200 U	210 U	190 U	230 U
2-Acetylaminofluorene	180 U	180 UJ	180 UJ	200 UJ	210 UJ	190 U	230 U
2-Chloronaphthalene	180 U	180 U	180 U	200 U	210 U	190 U	230 U
2-Chlorophenol	360 U	350 U	350 U	380 UJ	410 U	380 U	440 U
2-Methyl-5-nitroaniline	180 U	180 U	180 U	200 U	210 U	190 U	230 U
2-Methylphenol (o-Cresol)	360 U	350 U	350 U	380 UJ	410 U	380 U	440 U
2-Naphthylamine	180 U	180 U	180 U	200 U	210 U	190 U	230 U
2-Nitroaniline	180 U	180 U	180 U	200 U	210 U	190 U	230 U
2-Nitrophenol	360 U	350 U	350 U	380 UJ	410 U	380 U	440 U
2-Picoline	180 U	180 U	180 U	200 U	210 U	190 U	230 U
3,3'-Dichlorobenzidine	180 U	180 U	180 U	200 U	210 U	190 U	230 U
3,3'-Dimethylbenzidine	180 U	180 UJ	180 UJ	200 UJ	210 UJ	190 U	230 U
3-Methylcholanthrene	180 U	180 UJ	180 UJ	200 UJ	210 UJ	190 U	230 U
3-Methylphenol (m-Cresol)	270 U	270 U	270 U	290 UJ	310 U	280 U	330 U
3-Nitroaniline	180 U	180 U	180 U	200 U	210 U	190 U	230 U
4,6-Dinitro-2-methylphenol	360 U	350 U	350 U	380 UJ	410 U	380 U	440 U
4-Aminobiphenyl	180 U	180 U	180 U	200 U	210 U	190 U	230 U
4-Bromophenyl-phenylether	180 U	180 U	180 U	200 U	210 U	190 U	230 U
4-Chloro-3-methylphenol	360 U	350 U	350 U	380 UJ	410 U	380 U	440 U
4-Chloroaniline	180 U	180 U	180 U	200 U	210 U	190 U	230 U
4-Chlorophenyl-phenylether	180 U	180 U	180 U	200 U	210 U	190 U	230 U
4-Dimethylaminoazobenzene (p-)	180 U	180 U	180 U	200 U	210 U	190 U	230 U
4-Methylphenol (p-Cresol)	270 U	270 U	270 U	290 UJ	310 U	280 U	330 U
4-Nitroaniline	180 U	180 U	180 U	200 U	210 U	190 U	230 U
4-Nitrophenol	360 U	350 U	350 U	380 UJ	410 U	380 U	440 U
4-Nitroquinoline-1-oxide	180 U	180 U	180 U	200 U	210 U	190 U	230 U
7,12-Dimethylbenz(a)anthracene	180 U	180 U	180 U	200 U	210 U	190 U	230 U
a,a-Dimethylphenethylamine	510 UJ	500 UJ	500 UJ	540 UJ	590 UJ	530 U	630 U
Acetophenone	92 U	91 U	91 U	98 U	110 U	96 U	110 U
Aniline	180 U	180 U	180 U	200 U	210 U	190 U	230 U

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SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB21	59SB21	59SB21	59SB22	59SB22	59SB23	59SB23
Sample ID	59SB21-01	59SB21-01D	59SB21-05	59SB22-01	59SB22-05	59SB23-01	59SB23-05
Sample Date	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010
Sample Depth (ft bgs)	1.0 - 3.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Semivolatile Organics (µg/kg) (cont.)							
Aramite	180 U	180 U	180 U	200 U	210 U	190 U	230 U
Benzyl Alcohol	180 UJ	180 U	180 U	200 UJ	210 U	190 U	230 U
Bis(2-chloroethoxy)methane	180 U	180 U	180 U	200 U	210 U	190 U	230 U
Bis(2-chloroethyl)ether	180 U	180 U	180 U	200 U	210 U	190 U	230 U
Bis(2-ethylhexyl) Phthalate (BEHP)	180 U	180 U	180 U	200 U	210 U	190 U	230 U
Butyl Benzyl Phthalate	180 U	180 U	180 U	200 U	210 U	190 U	230 U
Diallate (cis)	180 U	180 U	180 U	200 U	210 U	190 U	230 U
Diallate (trans)	180 U	180 U	180 U	200 U	210 U	190 U	230 U
Dibenzofuran	180 U	180 U	180 U	200 U	210 U	190 U	230 U
Diethyl Phthalate (DEP)	180 U	180 U	180 U	200 U	210 U	190 U	230 U
Dimethyl Phthalate	180 U	180 U	180 U	200 U	210 U	190 U	230 U
Di-n-butyl Phthalate (DBP)	180 U	180 U	180 U	200 U	210 U	190 U	230 U
Di-n-octyl Phthalate	180 U	180 U	180 U	55 J	210 U	190 U	230 U
Dinoseb	180 U	180 U	180 U	200 U	210 U	190 U	230 U
Ethyl Methane Sulfonate (EMS)	180 UJ	180 UJ	180 UJ	200 UJ	210 UJ	190 UJ	230 UJ
Hexachloro-1,3-butadiene	180 U	180 U	180 U	200 U	210 U	190 U	230 U
Hexachlorobenzene	180 U	180 U	180 U	200 U	210 U	190 U	230 U
Hexachlorocyclopentadiene	180 U	180 U	180 U	200 U	210 U	190 U	230 U
Hexachloroethane	180 U	180 U	180 U	200 U	210 U	190 U	230 U
Hexachloropropene	180 U	180 U	180 U	200 U	210 U	190 U	230 U
Isophorone	180 U	180 U	180 U	200 U	210 U	190 U	230 U
Isosafrole	180 U	180 U	180 U	200 U	210 U	190 U	230 U
Methapyrilene	180 U	180 U	180 U	200 U	210 U	190 U	230 U
Methyl Methane Sulfonate	180 U	180 U	180 U	200 U	210 U	190 U	230 U
Nitrobenzene	180 U	180 U	180 U	200 U	210 U	190 U	230 U
n-Nitrosodiethylamine	180 U	180 U	180 U	200 U	210 U	190 U	230 U
n-Nitrosodimethylamine (NDMA)	180 U	180 U	180 U	200 U	210 U	190 U	230 U
n-Nitroso-di-n-butylamine	180 UJ	180 UJ	180 UJ	200 UJ	210 UJ	190 UJ	230 UJ
n-Nitrosodi-n-propylamine	180 U	180 U	180 U	200 U	210 U	190 U	230 U
n-Nitrosodiphenylamine	180 U	180 U	180 U	200 U	210 U	190 U	230 U
n-Nitrosomethylethylamine	180 U	180 U	180 U	200 U	210 U	190 U	230 U
n-Nitrosomorpholine	180 U	180 U	180 U	200 U	210 U	190 U	230 U
n-Nitrosopiperidine	180 U	180 U	180 U	200 U	210 U	190 U	230 U
n-Nitrosopyrrolidine	180 U	180 UJ	180 UJ	200 UJ	210 UJ	190 U	230 U
o-Toluidine	180 U	180 U	180 U	200 U	210 U	190 U	230 U
Pentachlorobenzene	180 U	180 U	180 U	200 U	210 U	190 U	230 U

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SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB21	59SB21	59SB21	59SB22	59SB22	59SB23	59SB23
Sample ID	59SB21-01	59SB21-01D	59SB21-05	59SB22-01	59SB22-05	59SB23-01	59SB23-05
Sample Date	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010
Sample Depth (ft bgs)	1.0 - 3.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Semivolatile Organics (µg/kg) (cont.)							
Pentachloronitrobenzene	180 U	180 U	180 U	200 U	210 U	190 U	230 U
Pentachlorophenol	360 U	350 U	350 U	380 UJ	410 U	380 U	440 U
Phenacetin	180 U	180 U	180 U	200 U	210 U	190 U	230 U
Phenol	360 U	350 U	350 U	380 UJ	410 U	380 U	440 U
Pronamide	180 U	180 U	180 U	200 U	210 U	190 U	230 U
Pyridine	180 U	180 U	180 U	200 U	210 U	190 U	230 U
Safrole	180 U	180 U	180 U	200 U	210 U	190 U	230 U
LLPAHs (µg/kg)							
2-Methylnaphthalene	9 U	8.9 U	8.9 U	9.5 U	10 U	9.4 U	11 U
Acenaphthene	9 U	8.9 U	8.9 U	9.5 U	10 U	9.4 U	11 U
Acenaphthylene	9 U	8.9 U	8.9 U	9.5 U	10 U	9.4 U	11 U
Anthracene	9 U	8.9 U	8.9 U	9.5 U	10 U	9.4 U	11 U
Benzo(a)anthracene	9 U	8.9 U	8.9 U	9.5 U	10 U	9.4 U	11 U
Benzo(a)pyrene (BaP)	9 U	8.9 U	8.9 U	9.5 U	10 U	9.4 U	11 U
Benzo(b)fluoranthene	9 U	8.9 U	8.9 U	9.5 U	10 U	9.4 U	11 U
Benzo(g,h,i)perylene	9 U	8.9 U	8.9 U	9.5 U	10 U	9.4 U	11 U
Benzo(k)fluoranthene	9 U	8.9 U	8.9 U	9.5 U	10 U	9.4 U	11 U
Chrysene	9 U	8.9 U	8.9 U	9.5 U	10 U	9.4 U	11 U
Dibenz(a,h)anthracene	9 U	8.9 U	8.9 U	9.5 U	10 U	9.4 U	11 U
Fluoranthene	9 U	8.9 U	8.9 U	9.5 U	10 U	9.4 U	11 U
Fluorene	9 U	8.9 U	8.9 U	9.5 U	10 U	9.4 U	11 U
Indeno(1,2,3-cd)pyrene	9 U	8.9 U	8.9 U	0.88 J	10 U	9.4 U	11 U
Naphthalene	9 U	8.9 U	8.9 U	9.5 U	10 U	9.4 U	11 U
Phenanthrene	9 U	8.9 U	8.9 U	9.5 U	10 U	9.4 U	11 U
Pyrene	9 U	8.9 U	8.9 U	1.5 J	10 U	9.4 U	11 U
LLPAH Totals (µg/kg)							
Low molecular weight PAHs	72	71.2	71.2	76	80	75.2	88
High molecular weight PAHs	81	80.1	80.1	68.88	90	84.6	99
Pesticides (µg/kg)							
4,4'-DDD	3.6 U	3.5 U	3.5 U	3.8 U	4.1 UJ	3.8 U	4.4 U
4,4'-DDE	3.6 U	3.5 U	3.5 U	3.8 U	4.1 UJ	2.9 J	0.69 J
4,4'-DDT	3.6 U	3.5 U	3.5 U	3.8 U	4.1 UJ	0.63 J	4.4 U
Aldrin	1.8 U	1.8 U	1.8 U	2 U	2.1 UJ	1.9 U	2.3 U
BHC, alpha-	1.8 U	1.8 U	1.8 U	2 U	2.1 UJ	1.9 U	2.3 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB21	59SB21	59SB21	59SB22	59SB22	59SB23	59SB23
Sample ID	59SB21-01	59SB21-01D	59SB21-05	59SB22-01	59SB22-05	59SB23-01	59SB23-05
Sample Date	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010
Sample Depth (ft bgs)	1.0 - 3.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Pesticides (µg/kg) (cont.)							
BHC, beta-	1.8 U	1.8 U	1.8 U	2 U	2.1 UJ	1.9 U	2.3 U
BHC, delta-	1.8 U	1.8 U	1.8 U	2 U	2.1 UJ	1.9 U	2.3 U
BHC, gamma- (Lindane)	1.8 U	1.8 U	1.8 U	2 U	2.1 UJ	1.9 U	2.3 U
Chlordane, alpha-	1.8 U	1.8 U	1.8 U	2 U	2.1 UJ	1.9 U	2.3 U
Chlordane, gamma-	1.8 U	1.8 U	1.8 U	2 U	2.1 UJ	1.9 U	2.3 U
Chlorobenzilate	180 U	180 U	180 U	200 U	210 U	190 U	230 U
Dieldrin	3.6 U	3.5 U	3.5 U	3.8 U	4.1 UJ	3.8 U	4.4 U
Endosulfan I	1.8 U	1.8 U	1.8 U	2 U	2.1 UJ	1.9 U	2.3 U
Endosulfan II	3.6 U	3.5 U	3.5 U	3.8 U	4.1 UJ	3.8 U	4.4 U
Endosulfan Sulfate	3.6 U	3.5 U	3.5 U	3.8 U	4.1 UJ	3.8 U	4.4 U
Endrin	3.6 U	3.5 U	3.5 U	3.8 U	4.1 UJ	3.8 U	4.4 U
Endrin Aldehyde	3.6 U	3.5 U	3.5 U	3.8 U	4.1 UJ	3.8 U	4.4 U
Heptachlor	1.8 U	1.8 U	1.8 U	2 U	2.1 UJ	1.9 U	2.3 U
Heptachlor Epoxide	1.8 U	1.8 U	1.8 U	2 U	2.1 UJ	1.9 U	2.3 U
Isodrin	180 U	180 U	180 U	200 U	210 U	190 U	230 U
Kepone (Chlordecone)	180 UJ	180 U	180 UJ	200 UJ	210 UJ	190 U	230 U
Methoxychlor	18 U	18 U	18 U	20 U	21 UJ	19 U	23 U
Toxaphene	90 U	89 U	89 U	95 U	100 UJ	94 U	110 U
Metals (mg/kg)							
Antimony	5.3 UJ	5.2 UJ	5.3 UJ	5.3 UJ	5.9 UJ	5.6 UJ	6.4 UJ
Arsenic	2.6 U	2.6 U	2.7 U	2.6 U	2.9 U	2.8 U	3.2 U
Barium	111	98.3	52.3	118	158	88.3	113
Beryllium	2.6 U	2.6 U	0.27 J	2.6 U	0.32 J	0.34 J	0.35 J
Cadmium	0.44 J	0.41 J	0.43 J	0.52 J	2.9 U	0.37 J	3.2 U
Chromium	16.3	9.7	17.3	32.7	54.7	34.5	67.2
Cobalt	21 J	19 J	15.2 J	22.1 J	16.8 J	22.6 J	20.1 J
Copper	54 J	44.3 J	104 J	74.8 J	119 J	79.4 J	74.8 J
Lead	2.6 U	3	2.7 U	15.7	13.7	18.7	6.8
Mercury	0.01 J	0.036 U	0.01 J	0.038 U	0.024 J	0.022 J	0.034 J
Nickel	7.9	6.3	5.3	16.9	12.6	14.4	20.3
Selenium	13.2 U	13.1 U	13.3 U	13.2 U	1.1 J	0.97 J	16 U
Silver	2.6 U	2.6 U	2.7 U	2.6 U	2.9 U	2.8 U	3.2 U
Thallium	2.6 U	2.6 U	2.7 U	2.6 U	2.9 U	2.8 U	3.2 U
Tin	5.3 UJ	5.2 UJ	5.3 UJ	5.3 UJ	5.9 UJ	5.6 UJ	6.4 UJ
Vanadium	93.1 J	78.7 J	72.3 J	126 J	182 J	171 J	214 J
Zinc	132	126	88.1	71.8 J	49.9	119	58.6

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Notes:

J - Estimated: The analyte was positively identified; the quantitation is an estimation.
U - Non detected at the Limit of Detection.
UJ - Reported quantitation limit is qualified as estimated.
R - Rejected data; data is not usable.
NJ - Analyte has been tentatively identified; the quantitation is an estimation.
ft bgs - feet below ground surface
LLPAHs - Low Level Polynuclear Aromatic Hydrocarbons
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL, 2012 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB24	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB24-01	59SB24-01D	59SB25-01	59SB26-01	59SB27-01	59SB28-01	59SB29-01	59SB30-01	59SB31-01	59SB32-01	59SB33-01
Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Depth Range (ft bgs)	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0
Volatile Organics (µg/kg)											
1,1,1,2-Tetrachloroethane	2.4 U	2.4 U	2.3 U	2.3 U	2.7 U	2 U	2.3 U	2.3 U	3.4 U	2.1 U	2.5 U
1,1,1-Trichloroethane	0.99 U	0.98 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
1,1,2,2-Tetrachloroethane	1.6 U	1.6 U	1.5 U	1.6 U	1.8 U	1.3 U	1.5 U	1.5 U	2.3 U	1.4 U	1.7 U
1,1,2-Trichloroethane	1.3 U	1.3 U	1.2 U	1.3 U	1.5 U	1.1 U	1.2 U	1.3 U	1.8 U	1.1 U	1.4 U
1,1-Dichloroethane	1.1 U	1.1 U	1 U	1.1 U	1.2 U	0.91 U	1 U	1.1 U	1.5 U	0.95 U	1.2 U
1,1-Dichloroethene	1.5 U	1.5 U	1.4 U	1.5 U	1.7 U	1.2 U	1.4 U	1.4 U	2.1 U	1.3 U	1.6 U
1,2,3-Trichloropropane	2.4 U	2.4 U	2.3 U	2.3 U	2.7 U	2 U	2.3 U	2.3 U	3.4 U	2.1 U	2.5 U
1,2,4-Trichlorobenzene	0.99 U	0.98 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
1,2-Dibromo-3-Chloropropane	4.4 U	4.3 U	4.2 U	4.3 U	4.9 U	3.6 U	4.2 U	4.2 U	6.2 U	3.8 U	4.7 U
1,2-Dibromoethane	1.5 U	1.5 U	1.4 U	1.5 U	1.7 U	1.2 U	1.4 U	1.4 U	2.1 U	1.3 U	1.6 U
1,2-Dichlorobenzene	1.3 U	1.3 U	1.2 U	1.3 U	1.5 U	1.1 U	1.2 U	1.3 U	1.8 U	1.1 U	1.4 U
1,2-Dichloroethane	1.1 U	1.1 U	1 U	1.1 U	1.2 U	0.91 U	1 U	1.1 U	1.5 U	0.95 U	1.2 U
1,2-Dichloropropane	0.99 U	0.98 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
1,3-Dichlorobenzene	1.6 U	1.6 U	1.5 U	1.6 U	1.8 U	1.3 U	1.5 U	1.5 U	2.3 U	1.4 U	1.7 U
1,4-Dichlorobenzene	0.99 U	0.98 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
1,4-Dioxane	49 R	49 R	47 R	49 R	56 R	41 R	48 R	48 R	70 R	43 R	53 R
2-Butanone	2.4 U	2.4 U	2.3 U	2.3 U	2.7 U	2 U	2.3 U	2.3 U	3.4 U	2.1 U	2.5 U
2-Hexanone	3.3 U	3.2 U	3.1 U	3.2 U	3.7 U	2.7 U	3.1 U	3.2 U	4.6 U	2.8 U	3.5 U
4-Methyl-2-pentanone	4.2 U	4.1 U	4 U	4.1 U	4.7 U	3.5 U	4 U	4 U	5.9 U	3.6 U	4.5 U
Acetone	11 UJ	11 U	16 J	11 U	12 U	9.1 U	40 J	14 J	15 U	9.5 U	12 U
Acetonitrile	41 U	40 U	39 U	40 UJ	46 UJ	34 UJ	39 UJ	40 U	58 U	35 UJ	44 U
Acrolein	24 U	24 UJ	23 U	23 UJ	27 UJ	20 UJ	23 UJ	23 U	34 UJ	21 UJ	25 U
Acrylonitrile	34 U	33 UJ	32 U	33 UJ	38 UJ	28 UJ	32 UJ	33 U	48 UJ	29 UJ	36 U
Allyl chloride	2.2 U	2.2 U	2.1 U	2.1 U	2.5 U	1.8 U	2.1 U	2.1 U	3.1 U	1.9 U	2.3 U
Benzene	0.99 U	0.98 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
Bromodichloromethane	0.99 U	0.98 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
Bromoform	1.5 U	1.5 U	1.4 U	1.5 U	1.7 U	1.2 U	1.4 U	1.4 U	2.1 U	1.3 U	1.6 U
Bromomethane	1.5 U	1.5 U	1.4 U	1.5 U	1.7 U	1.2 U	1.4 U	1.4 U	2.1 U	1.3 U	1.6 U
Carbon disulfide	1.1 U	1.1 U	1 U	1.1 U	1.2 U	0.91 U	1 U	1.1 U	1.5 U	0.95 U	1.2 U
Carbon tetrachloride	0.99 U	0.98 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
Chlorobenzene	0.99 U	0.98 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
Chloroethane	2.7 U	2.6 U	2.5 U	2.6 U	3 U	2.2 U	2.6 U	2.6 U	3.8 U	2.3 U	2.9 U
Chloroform	1.1 U	1.1 U	1 U	1.1 U	1.2 U	0.91 U	1 U	1.1 U	1.5 U	0.95 U	1.2 U
Chloromethane	2 U	2 U	1.9 U	1.9 U	2.2 U	1.7 U	1.9 U	1.9 U	2.8 U	1.7 U	2.1 U
Chloroprene	2.1 U	2.1 U	2 U	2 U	2.4 U	1.7 U	2 U	2 U	3 U	1.8 U	2.2 U
cis-1,3-Dichloropropene	0.99 U	0.98 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL, 2012 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB24	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB24-01	59SB24-01D	59SB25-01	59SB26-01	59SB27-01	59SB28-01	59SB29-01	59SB30-01	59SB31-01	59SB32-01	59SB33-01
Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Depth Range (ft bgs)	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0
Volatile Organics (µg/kg) (cont.)											
Dibromochloromethane	1.7 U	1.7 U	1.6 U	1.7 U	1.9 U	1.4 U	1.6 U	1.6 U	2.4 U	1.5 U	1.8 U
Dibromomethane	1.7 U	1.7 U	1.6 U	1.7 U	1.9 U	1.4 U	1.6 U	1.6 U	2.4 U	1.5 U	1.8 U
Dichlorodifluoromethane	0.99 U	0.98 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
Ethyl methacrylate	3.4 U	3.3 U	3.2 U	3.3 U	3.8 U	2.8 U	3.2 U	3.3 U	4.8 U	2.9 U	3.6 U
Ethylbenzene	1.3 U	1.3 U	1.2 U	1.3 U	1.5 U	1.1 U	1.2 U	1.3 U	1.8 U	1.1 U	1.4 U
Hexachlorobutadiene	3.1 U	3 U	2.9 U	3 U	3.5 U	2.6 U	2.9 U	3 U	4.4 U	2.7 U	3.3 U
Iodomethane	1.8 U	1.8 UJ	1.7 U	1.8 UJ	2 UJ	1.5 UJ	1.7 UJ	1.7 U	2.5 UJ	1.5 UJ	1.9 U
Isobutanol	51 R	51 R	49 R	51 R	58 R	43 R	49 R	50 R	73 R	45 R	55 R
Methacrylonitrile	23 U	23 U	22 U	22 UJ	26 UJ	19 UJ	22 UJ	22 U	32 U	20 UJ	24 U
Methyl methacrylate	4.5 U	4.4 U	4.2 U	4.4 U	5.1 U	3.7 U	4.3 U	4.3 U	6.3 U	3.9 U	4.8 U
Methylene Chloride	0.99 U	0.98 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	7.2	0.86 U	1.1 U
Naphthalene	1.2 R	1.2 R	1.1 R	1.2 R	1.3 R	0.99 R	1.1 R	1.2 R	1.7 R	1 R	1.3 R
Pentachloroethane	6.2 U	6.2 U	5.9 U	6.1 U	7.1 U	5.2 U	6 U	6.1 U	8.9 U	5.4 U	6.7 U
Propionitrile	26 U	26 U	25 U	25 UJ	29 UJ	22 UJ	25 UJ	25 U	37 U	22 UJ	28 U
Styrene	0.99 U	0.98 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
Tetrachloroethene	1.9 U	1.9 U	1.8 U	1.8 U	2.1 U	1.6 U	1.8 U	1.8 U	2.7 U	1.6 U	2 U
Toluene	0.99 U	0.98 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
trans-1,2-Dichloroethene	0.99 U	0.98 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
trans-1,3-Dichloropropene	0.99 U	0.98 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
trans-1,4-Dichloro-2-butene	2.9 U	2.8 U	2.7 U	2.8 U	3.3 U	2.4 U	2.8 U	2.8 U	4.1 U	2.5 U	3.1 U
Trichloroethene	1.3 U	1.3 U	1.2 U	1.3 U	1.5 U	1.1 U	1.2 U	1.3 U	1.8 U	1.1 U	1.4 U
Trichlorofluoromethane	1.2 U	1.2 U	1.1 U	1.2 U	1.3 U	0.99 U	1.1 U	1.2 U	1.7 U	1 U	1.3 U
Vinyl acetate	2.5 U	2.5 U	2.4 U	2.4 U	2.8 U	2.1 U	2.4 U	2.4 U	3.5 U	2.2 U	2.7 U
Vinyl chloride	1.5 U	1.5 U	1.4 U	1.5 U	1.7 U	1.2 U	1.4 U	1.4 U	2.1 U	1.3 U	1.6 U
Xylenes, Total	1.1 U	1.1 U	1 U	1.1 U	1.2 U	0.91 U	1 U	1.1 U	1.5 U	0.95 U	1.2 U
Semivolatile Organics (µg/kg)											
1,2,4,5-Tetrachlorobenzene	4.2 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
1,2,4-Trichlorobenzene	5.9 U	5.8 U	6 U	6.3 U	6.5 U	5.2 U	6.1 U	6.2 U	6.5 U	5.8 U	6.3 U
1,2-Dichlorobenzene	8.5 U	8.4 U	8.7 U	9.1 U	9.4 U	7.4 U	8.7 U	9 U	9.4 U	8.3 U	9.1 U
1,3,5-Trinitrobenzene	22 U	22 U	22 U	23 U	24 U	19 U	22 UJ	23 UJ	24 U	21 U	23 UJ
1,3-Dichlorobenzene	7.2 U	7.1 U	7.4 U	7.7 U	7.9 U	6.3 U	7.4 U	7.6 U	8 U	7.1 U	7.7 U
1,3-Dinitrobenzene	22 U	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
1,4-Dichlorobenzene	6.7 U	6.6 U	6.8 U	7.2 U	7.4 U	5.9 U	6.9 U	7.1 U	7.4 U	6.6 U	7.2 U
1,4-Naphthoquinone	4.2 UJ	4.2 UJ	4.3 UJ	4.5 UJ	4.7 UJ	3.7 UJ	4.4 UJ	4.5 UJ	4.7 UJ	4.2 UJ	4.5 UJ
1-Naphthylamine	22 U	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB24	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB24-01	59SB24-01D	59SB25-01	59SB26-01	59SB27-01	59SB28-01	59SB29-01	59SB30-01	59SB31-01	59SB32-01	59SB33-01
Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Depth Range (ft bgs)	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0
Semivolatile Organics (µg/kg) (cont.)											
2,2'-oxybis[1-chloropropane]	9.2 U	9.1 U	9.5 U	9.9 U	10 U	8.1 U	9.5 U	9.8 U	10 U	9.1 U	9.9 U
2,3,4,6-Tetrachlorophenol	4.2 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
2,4,5-Trichlorophenol	9.7 U	9.7 U	10 U	10 U	11 U	8.6 U	10 U	10 U	11 U	9.6 U	10 U
2,4,6-Trichlorophenol	10 U	10 U	10 U	11 U	11 U	8.9 U	10 U	11 U	11 U	10 U	11 U
2,4-Dichlorophenol	9.2 U	9.1 U	9.5 U	9.9 U	10 U	8.1 U	9.5 U	9.8 U	10 U	9.1 U	9.9 U
2,4-Dimethylphenol	9.7 U	9.7 U	17 J	10 U	11 U	8.6 U	10 U	10 U	11 U	9.6 U	10 U
2,4-Dinitrophenol	54 U	53 U	55 U	58 U	60 U	47 U	55 UJ	57 UJ	60 U	53 U	58 UJ
2,4-Dinitrotoluene	9.6 U	9.5 U	9.9 U	10 U	11 U	8.5 U	9.9 U	10 U	11 U	9.5 U	10 U
2,6-Dichlorophenol	4.2 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
2,6-Dinitrotoluene	10 U	10 U	10 U	11 U	11 U	8.9 U	10 U	11 U	11 U	10 U	11 U
2-Acetylaminofluorene	42 U	42 U	43 U	45 U	47 U	37 U	44 U	45 U	47 U	42 U	45 U
2-Chloronaphthalene	7.7 U	7.6 U	7.9 U	8.3 U	8.5 U	6.8 U	7.9 U	8.1 U	8.5 U	7.6 U	8.3 U
2-Chlorophenol	6.8 U	6.7 U	7 U	7.3 U	7.5 U	6 U	7 U	7.2 U	7.5 U	6.7 U	7.3 U
2-Methylphenol	8.1 U	8 U	8.3 U	8.7 U	8.9 U	7.1 U	8.3 U	8.6 U	9 U	7.9 U	8.7 U
2-Naphthylamine	22 U	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
2-Nitroaniline	9 U	8.9 U	9.2 U	9.6 U	9.9 U	7.9 U	9.2 U	9.5 U	10 U	8.8 U	9.6 U
2-Nitrophenol	7.4 U	7.4 U	7.6 U	8 U	8.2 U	6.5 U	7.7 U	7.9 U	8.3 U	7.3 U	8 U
2-Picoline	4.2 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
2-Toluidine	4.2 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
3 & 4 Methylphenol	9.4 U	9.3 U	9.6 U	10 U	10 U	8.2 U	9.6 U	9.9 U	10 U	9.2 U	10 U
3,3'-Dichlorobenzidine	22 U	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
3,3'-Dimethylbenzidine	85 U	84 U	87 U	91 U	94 U	74 U	87 UJ	90 UJ	94 U	83 U	91 UJ
3-Methylcholanthrene	42 U	42 U	43 U	45 U	47 U	37 U	44 U	45 U	47 U	42 U	45 U
3-Nitroaniline	8.6 U	8.5 U	8.8 U	9.2 U	9.5 U	7.6 U	8.8 U	9.1 U	9.5 U	8.4 U	9.2 U
4,6-Dinitro-2-methylphenol	22 U	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
4-Aminobiphenyl	22 UJ	22 UJ	22 UJ	23 UJ	24 UJ	19 UJ	22 U	23 U	24 UJ	21 UJ	23 U
4-Bromophenyl phenyl ether	8.8 U	8.8 U	9.1 U	9.5 U	9.8 U	7.8 U	9.1 U	9.4 U	9.8 U	8.7 U	9.5 U
4-Chloro-3-methylphenol	9 U	8.9 U	9.2 U	9.6 U	9.9 U	7.9 U	9.2 U	9.5 U	10 U	8.8 U	9.6 U
4-Chloroaniline	6.7 U	6.6 U	6.8 U	7.2 U	7.4 U	5.9 U	6.9 U	7.1 U	7.4 U	6.6 U	7.2 U
4-Chlorophenyl phenyl ether	8.2 U	8.1 U	8.4 U	8.8 U	9.1 U	7.2 U	8.4 U	8.7 U	9.1 U	8.1 U	8.8 U
4-Nitroaniline	22 U	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
4-Nitrophenol	94 U	93 U	96 U	100 U	100 U	82 U	96 U	99 U	100 U	92 U	100 U
4-Nitroquinoline-1-oxide	54 U	53 U	55 U	58 U	60 U	47 U	55 U	57 U	60 U	53 U	58 U
7,12-Dimethylbenz(a)anthracene	22 U	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
Acetophenone	8.7 U	8.6 U	8.9 U	9.4 U	9.6 U	7.7 U	9 U	9.2 U	9.7 U	8.6 U	9.4 U
alpha,alpha-Dimethyl phenethylamine	420 UJ	420 UJ	430 UJ	450 UJ	470 UJ	370 UJ	440 UJ	450 UJ	470 UJ	420 UJ	450 UJ

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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB24	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB24-01	59SB24-01D	59SB25-01	59SB26-01	59SB27-01	59SB28-01	59SB29-01	59SB30-01	59SB31-01	59SB32-01	59SB33-01
Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Depth Range (ft bgs)	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0
Semivolatile Organics (µg/kg) (cont.)											
Aniline	11 U	10 U	11 U	11 U	12 U	9.3 U	11 U	11 U	12 U	10 U	11 U
Aramite, Total	6.2 U	6.1 U	6.3 U	6.6 U	6.8 U	5.4 U	6.3 U	6.5 U	6.8 U	6.1 U	6.6 U
Benzyl alcohol	7.8 U	7.7 U	8 U	8.4 U	8.7 U	6.9 U	8 U	8.3 U	8.7 U	7.7 U	8.4 U
Bis(2-chloroethoxy)methane	8.3 U	8.3 U	8.5 U	8.9 U	9.2 U	7.3 U	8.6 U	8.8 U	9.3 U	8.2 U	9 U
Bis(2-chloroethyl)ether	8.3 U	8.3 U	8.5 U	8.9 U	9.2 U	7.3 U	8.6 U	8.8 U	9.3 U	8.2 U	9 U
Bis(2-ethylhexyl) phthalate	12 J	8.3 J	59 J	43 J	14 J	15 J	7.9 U	18 J	8.6 J	8.5 J	8.3 U
Butyl benzyl phthalate	8.6 U	8.5 U	8.8 U	9.2 U	9.5 U	7.6 U	8.8 U	9.1 U	9.5 U	8.4 U	9.2 U
Diallate	7.2 U	7.1 U	7.4 U	7.7 U	7.9 U	6.3 U	7.4 U	7.6 U	8 U	7.1 U	7.7 U
Dibenzofuran	8.6 U	8.5 U	8.8 U	9.2 U	9.5 U	7.6 U	8.8 U	9.1 U	9.5 U	8.4 U	9.2 U
Diethyl phthalate	9.5 U	9.4 U	9.7 U	10 U	10 U	8.4 U	9.8 U	10 U	11 U	9.3 U	10 U
Dimethyl phthalate	9.6 U	9.5 U	9.9 U	10 U	11 U	8.5 U	9.9 U	10 U	11 U	9.5 U	10 U
Di-n-butyl phthalate	22 U	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
Di-n-octyl phthalate	8.6 U	8.5 U	8.8 U	9.2 U	9.5 U	7.6 U	8.8 U	9.1 U	9.5 U	8.4 U	9.2 U
Dinoseb	8.6 U	8.5 U	8.8 U	9.2 U	9.5 U	7.6 U	8.8 UJ	9.1 UJ	9.5 U	8.4 U	9.2 UJ
Ethyl methanesulfonate	10 U	9.9 U	10 U	11 U	11 U	8.8 U	10 U	11 U	11 U	9.8 U	11 U
Hexachlorobenzene	9.7 U	9.7 U	10 U	10 U	11 U	8.6 U	10 U	10 U	11 U	9.6 U	10 U
Hexachlorobutadiene	8.7 U	8.6 U	8.9 U	9.4 U	9.6 U	7.7 U	9 U	9.2 U	9.7 U	8.6 U	9.4 U
Hexachlorocyclopentadiene	4.7 U	4.7 U	4.9 U	5.1 U	5.2 U	4.2 U	4.9 U	5 U	5.3 U	4.7 U	5.1 U
Hexachloroethane	7.4 U	7.4 U	7.6 U	8 U	8.2 U	6.5 U	7.7 U	7.9 U	8.3 U	7.3 U	8 U
Hexachlorophene	3100 U	3000 U	3200 U	3300 U	3400 U	2700 U	3200 UJ	3300 UJ	3400 U	3000 U	3300 UJ
Hexachloropropene	6.8 U	6.7 U	7 U	7.3 U	7.5 U	6 U	7 U	7.2 U	7.5 U	6.7 U	7.3 U
Isophorone	9 U	8.9 U	9.2 U	9.6 U	9.9 U	7.9 U	9.2 U	9.5 U	10 U	8.8 U	9.6 U
Isosafrole	4.2 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Methapyrilene	86 UJ	85 UJ	88 UJ	92 UJ	95 UJ	76 UJ	88 UJ	91 UJ	95 UJ	84 UJ	92 UJ
Methyl methanesulfonate	4.9 UJ	4.8 UJ	5 UJ	5.2 UJ	5.4 UJ	4.3 UJ	5 UJ	5.2 UJ	5.4 UJ	4.8 UJ	5.2 UJ
Nitrobenzene	8.5 U	8.4 U	8.7 U	9.1 U	9.4 U	7.4 U	8.7 U	9 U	9.4 U	8.3 U	9.1 U
N-Nitro-o-toluidine	22 U	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
N-Nitrosodiethylamine	4.2 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
N-Nitrosodimethylamine	24 U	24 U	25 U	26 U	27 U	21 U	25 U	26 U	27 U	24 U	26 U
N-Nitrosodi-n-butylamine	22 U	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
N-Nitrosodi-n-propylamine	9.6 U	9.5 U	9.9 U	10 U	11 U	8.5 U	9.9 U	10 U	11 U	9.5 U	10 U
N-Nitrosodiphenylamine	7.8 U	7.7 U	8 U	8.4 U	8.7 U	6.9 U	8 U	8.3 U	8.7 U	7.7 U	8.4 U
N-Nitrosomethylethylamine	4.2 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
N-Nitrosomorpholine	5.8 U	5.7 U	5.9 U	6.2 U	6.4 U	5.1 U	5.9 U	6.1 U	6.4 U	5.7 U	6.2 U
N-Nitrosopiperidine	4.4 U	4.3 U	4.5 U	4.7 U	4.8 U	3.8 U	4.5 U	4.6 U	4.8 U	4.3 U	4.7 U
N-Nitrosopyrrolidine	4.6 U	4.6 U	4.7 U	5 U	5.1 U	4.1 U	4.7 U	4.9 U	5.1 U	4.5 U	5 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL, 2012 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB24	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB24-01	59SB24-01D	59SB25-01	59SB26-01	59SB27-01	59SB28-01	59SB29-01	59SB30-01	59SB31-01	59SB32-01	59SB33-01
Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Depth Range (ft bgs)	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0
Semivolatile Organics (µg/kg) (cont.)											
p-Dimethylamino azobenzene	22 U	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
Pentachlorobenzene	4.2 U	5.6 J	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Pentachloronitrobenzene	22 U	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
Pentachlorophenol	22 U	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
Phenacetin	22 U	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
Phenol	8.3 U	8.3 U	8.5 U	8.9 U	9.2 U	7.3 U	8.6 U	8.8 U	9.3 U	8.2 U	9 U
p-Phenylene diamine	1100 U	1100 U	1100 U	1100 U	1200 U	940 U	1100 UJ	1100 UJ	1200 U	1000 U	1100 UJ
Pronamide	5.4 U	5.3 U	5.5 U	5.8 U	6 U	4.7 U	5.5 U	5.7 U	6 U	5.3 U	5.8 U
Pyridine	26 U	25 U	26 U	28 U	28 U	23 U	26 U	27 U	28 U	25 U	28 U
Safrole, Total	4.2 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
LLPAHs (µg/kg)											
2-Methylnaphthalene	4.2 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Acenaphthene	4.2 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Acenaphthylene	4.2 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Anthracene	4.2 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Benzo[a]anthracene	4.2 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Benzo[a]pyrene	4.2 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Benzo[b]fluoranthene	4.2 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Benzo[g,h,i]perylene	4.2 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Benzo[k]fluoranthene	4.2 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Chrysene	4.2 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Dibenz(a,h)anthracene	8.6 U	8.5 U	8.8 U	9.2 U	9.5 U	7.6 U	8.8 U	9.1 U	9.5 U	8.4 U	9.2 U
Fluoranthene	4.2 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Fluorene	4.2 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Indeno[1,2,3-cd]pyrene	4.2 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 UJ	4.5 UJ	4.7 U	4.2 U	4.5 UJ
Naphthalene	4.2 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Phenanthrene	8.6 U	8.5 U	8.8 U	9.2 U	9.5 U	7.6 U	4.6 J	9.1 U	9.5 U	8.4 U	9.2 U
Pyrene	4.2 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
LLPAH Totals (µg/kg)											
Low Molecular Weight PAHs	38	37.9	38.9	40.7	42.4	33.5	35.4	40.6	42.4	37.8	40.7
High Molecular Weight PAHs	42.2	42.1	43.2	45.2	47.1	37.2	44	45.1	47.1	42	45.2

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SUBSURFACE SOIL, 2012 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB24	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB24-01	59SB24-01D	59SB25-01	59SB26-01	59SB27-01	59SB28-01	59SB29-01	59SB30-01	59SB31-01	59SB32-01	59SB33-01
Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Depth Range (ft bgs)	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0
Metals (mg/kg)											
Antimony	0.63 U	0.63 U	0.64 U	0.68 U	0.7 U	0.55 U	0.65 U	0.67 U	0.7 U	0.64 U	0.7 U
Arsenic	1.2	1.1	1.1	1	0.7	1.1	0.95	1	0.74	1.1	0.86
Barium	120	120	120	77	120	30	110	120	81	51	43 J
Beryllium	0.5	0.44	0.24	0.42	0.12	0.13	0.27	0.22	0.24	0.31	0.14
Cadmium	0.048 J	0.04 J	0.45	0.22	0.11	0.043 J	0.049 J	0.034 U	0.041 J	0.016 J	0.066 J
Chromium	45	36	63	60	25	23	64	70	110	16	120
Cobalt	16 J	18 J	24 J	15 J	16 J	15 J	15 J	4.7 J	14 J	3.5 J	15 J
Copper	210	200	60	110	73	150	89	110	48	67	110
Lead	4.5 R	6.3 R	12 R	2.8 R	1.2 R	0.64 R	3.5 R	3.8 R	0.85 R	4.6 R	2.1 R
Mercury	0.01 U	0.011 U	0.067	0.011 U	0.013 J	0.0091 U	0.083	0.011 U	0.011 U	0.011 U	0.011 J
Nickel	18	16	29	43	26	14	25	17	32	5.7	44
Selenium	0.31 U	0.32 U	0.69	0.34 U	0.35 U	0.28 U	0.56 J	0.49 J	0.35 U	0.57 J	0.35 U
Silver	0.063 U	0.063 U	0.064 U	0.068 U	0.07 U	0.055 U	0.065 U	0.067 U	0.07 U	0.064 U	0.26
Thallium	0.031 U	0.032 U	0.032 U	0.034 U	0.035 U	0.028 U	0.033 U	0.034 U	0.035 U	0.037 J	0.035 U
Tin	3.2 U	3.2 U	3.3 U	3.5 U	3.6 U	2.8 U	3.3 U	3.4 U	3.6 U	3.3 U	3.5 U
Vanadium	180	150	170	180	170	110	280	280	320	140	400
Zinc	62	51	61	77	41	47	56	35	39	68	47

Notes:

J - Estimated: The analyte was positively identified; the quantitation is an estimation.
U - Non detected at the Limit of Detection.
UJ - Reported quantitation limit is qualified as estimated.
R - Rejected data; data is not usable.
ft bgs - feet below ground surface
LLPAHs - Low Level Polynuclear Aromatic Hydrocarbons
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram

GROUNDWATER DATA

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - GROUNDWATER, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB02	59SB03	59SB04	59SB05	59SB06	59SB07	59SB08	59SB09	59SB10
Sample ID	59GW01	59GW02	59GW02D	59GW03	59GW04	59GW05	59GW06	59GW07	59GW08	59GW09	59GW10
Sample Date	5/22/2010	5/23/2010	5/23/2010	5/22/2010	5/23/2010	5/22/2010	5/21/2010	5/21/2010	5/22/2010	5/21/2010	5/22/2010
Volatile Organics (µg/L)											
1,1,1,2-Tetrachloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,1-Trichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2,2-Tetrachloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2-Trichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-Dichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-Dichloroethene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,3-Trichloropropane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dibromo-3-chloropropane (DBCP)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dibromoethane (EDB)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloroethene (trans)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloropropane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,3-Dichloropropene (cis)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,3-Dichloropropene (trans)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,4-Dichloro-2-butene (trans)	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
1,4-Dioxane (p-)	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R
2-Butanone (MEK)	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R
2-Chloro-1,3-butadiene (Chloroprene)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
2-Hexanone (MBK)	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
3-Chloropropene (Allyl Chloride)	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ
4-Methyl-2-pentanone (MIBK)	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Acetone	3.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R
Acetonitrile	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Acrolein	5 R	5 R	5 R	5 R	5 R	5 R	5 R	5 R	5 R	5 R	5 R
Acrylonitrile	5 R	5 R	5 R	5 R	5 R	5 R	5 R	5 R	5 R	5 R	5 R
Benzene	0.5 U	0.5 U	0.5 U	0.5 U	0.055 J	0.5 U	0.5 U	0.036 J	0.067 J	0.1 J	0.5 U
Bromodichloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromoform	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromomethane	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ
Carbon Disulfide	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.059 J	0.05 J	0.5 U	0.15 J	0.5 U
Carbon Tetrachloride	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloroform	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - GROUNDWATER, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB02	59SB03	59SB04	59SB05	59SB06	59SB07	59SB08	59SB09	59SB10
Sample ID	59GW01	59GW02	59GW02D	59GW03	59GW04	59GW05	59GW06	59GW07	59GW08	59GW09	59GW10
Sample Date	5/22/2010	5/23/2010	5/23/2010	5/22/2010	5/23/2010	5/22/2010	5/21/2010	5/21/2010	5/22/2010	5/21/2010	5/22/2010
Volatile Organics (µg/L) (cont.)											
Dibromochloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Dibromomethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Ethyl Methacrylate	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Ethylbenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Freon 11 (Trichlorofluoromethane)	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ
Freon-12 (Dichlorodifluoromethane)	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ
Isobutyl Alcohol	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R
Methyl Acrylonitrile	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Methyl Iodide	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ
Methyl Methacrylate	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Methylene Chloride	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Pentachloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Propionitrile (Ethyl Cyanide)	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R
Styrene (Ethenylbenzene)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Tetrachloroethene (PCE)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Toluene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Trichloroethene (TCE)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Vinyl Acetate	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Vinyl Chloride	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Xylene, m/p-	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Xylene, o-	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Xylenes, total	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Semivolatile Organics (µg/L)											
1,2,4,5-Tetrachlorobenzene	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
1,2,4-Trichlorobenzene	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
1,2-Dichlorobenzene (o-)	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
1,3,5-Trinitrobenzene (TNB)	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
1,3-Dichlorobenzene (m-)	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
1,3-Dinitrobenzene (m-)	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
1,4-Dichlorobenzene (p-)	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
1,4-Naphthoquinone	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
1,4-Phenylenediamine	51 R	54 R	52 R	51 R	51 R	51 R	51 R	51 R	51 R	52 R	51 R
1-Naphthylamine	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
2,2'-Oxybis[1-chloropropane]	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ

APPENDIX B

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB02	59SB03	59SB04	59SB05	59SB06	59SB07	59SB08	59SB09	59SB10
Sample ID	59GW01	59GW02	59GW02D	59GW03	59GW04	59GW05	59GW06	59GW07	59GW08	59GW09	59GW10
Sample Date	5/22/2010	5/23/2010	5/23/2010	5/22/2010	5/23/2010	5/22/2010	5/21/2010	5/21/2010	5/22/2010	5/21/2010	5/22/2010
Semivolatile Organics (µg/L) (cont.)											
2,3,4,6-Tetrachlorophenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
2,4,5-Trichlorophenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
2,4,6-Trichlorophenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
2,4-Dichlorophenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
2,4-Dimethylphenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
2,4-Dinitrophenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
2,4-Dinitrotoluene (DNT)	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
2,6-Dichlorophenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
2,6-Dinitrotoluene (DNT)	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
2-Acetylaminofluorene	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
2-Chloronaphthalene	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
2-Chlorophenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
2-Methyl-5-nitroaniline	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
2-Methylphenol (o-Cresol)	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
2-Naphthylamine	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
2-Nitroaniline	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
2-Nitrophenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
2-Picoline	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
3,3'-Dichlorobenzidine	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
3,3'-Dimethylbenzidine	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
3-Methylcholanthrene	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
3-Methylphenol (m-Cresol)	8 UJ	8.4 UJ	8.2 UJ	8 UJ	8 UJ	8 UJ	8 UJ	8 UJ	8 UJ	8.2 UJ	8 UJ
3-Nitroaniline	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
4,6-Dinitro-2-methylphenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
4-Aminobiphenyl	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
4-Bromophenyl-phenylether	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
4-Chloro-3-methylphenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
4-Chloroaniline	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
4-Chlorophenyl-phenylether	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
4-Dimethylaminoazobenzene (p-)	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
4-Methylphenol (p-Cresol)	8 UJ	8.4 UJ	8.2 UJ	8 UJ	8 UJ	8 UJ	8 UJ	8 UJ	8 UJ	8.2 UJ	8 UJ
4-Nitroaniline	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
4-Nitrophenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
4-Nitroquinoline-1-oxide	5 R	5.3 R	5.1 R	5 R	5 R	5 UJ	5 R	5 R	5 R	5.1 R	5 R
7,12-Dimethylbenz(a)anthracene	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ

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Sample ID	59GW01	59GW02	59GW02D	59GW03	59GW04	59GW05	59GW06	59GW07	59GW08	59GW09	59GW10
Sample Date	5/22/2010	5/23/2010	5/23/2010	5/22/2010	5/23/2010	5/22/2010	5/21/2010	5/21/2010	5/22/2010	5/21/2010	5/22/2010
Semivolatile Organics (µg/L) (cont.)											
a,a-Dimethylphenethylamine	50 UJ	53 UJ	51 UJ	50 UJ	50 UJ	50 UJ	50 UJ	50 UJ	50 UJ	51 UJ	50 UJ
Acetophenone	2.5 UJ	2.6 UJ	2.6 UJ	2.5 UJ	2.5 UJ	2.5 UJ	2.5 UJ	2.5 UJ	2.5 UJ	2.6 UJ	2.5 UJ
Aniline	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Aramite	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Benzyl Alcohol	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Bis(2-chloroethoxy)methane	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Bis(2-chloroethyl)ether	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Bis(2-ethylhexyl) Phthalate (BEHP)	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	2.4 J	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Butyl Benzyl Phthalate	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Diallate (cis)	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Diallate (trans)	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Dibenzofuran	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Diethyl Phthalate (DEP)	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Dimethyl Phthalate	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Di-n-butyl Phthalate (DBP)	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Di-n-octyl Phthalate	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Dinoseb	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Ethyl Methane Sulfonate (EMS)	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Hexachloro-1,3-butadiene	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Hexachlorobenzene	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Hexachlorocyclopentadiene	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Hexachloroethane	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Hexachloropropene	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Isophorone	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Isosafrole	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Methapyrilene	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Methyl Methane Sulfonate	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Nitrobenzene	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
n-Nitrosodiethylamine	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
n-Nitrosodimethylamine (NDMA)	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
n-Nitroso-di-n-butylamine	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
n-Nitrosodi-n-propylamine	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
n-Nitrosodiphenylamine	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
n-Nitrosomethylethylamine	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
n-Nitrosomorpholine	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ

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Sample Date	5/22/2010	5/23/2010	5/23/2010	5/22/2010	5/23/2010	5/22/2010	5/21/2010	5/21/2010	5/22/2010	5/21/2010	5/22/2010
Semivolatile Organics (µg/L) (cont.)											
n-Nitrosopiperidine	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
n-Nitrosopyrrolidine	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
o-Toluidine	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Pentachlorobenzene	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Pentachloronitrobenzene	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Pentachlorophenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
Phenacetin	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Phenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
Pronamide	5 UJ	5.3 R	5.1 R	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Pyridine	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Safrole	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
LLPAHs (µg/L)											
2-Methylnaphthalene	0.2 UJ	0.21 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Acenaphthene	0.2 UJ	0.21 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Acenaphthylene	0.2 UJ	0.21 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Anthracene	0.2 UJ	0.21 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Benzo(a)anthracene	0.2 UJ	0.21 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Benzo(a)pyrene (BaP)	0.2 UJ	0.21 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Benzo(b)fluoranthene	0.2 UJ	0.21 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Benzo(g,h,i)perylene	0.2 UJ	0.21 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Benzo(k)fluoranthene	0.2 UJ	0.21 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Chrysene	0.2 UJ	0.21 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Dibenz(a,h)anthracene	0.2 UJ	0.21 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Fluoranthene	0.2 UJ	0.21 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Fluorene	0.2 UJ	0.21 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Indeno(1,2,3-cd)pyrene	0.2 UJ	0.21 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Naphthalene	0.2 UJ	0.21 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	1.3 J	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Phenanthrene	0.2 UJ	0.21 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.054 J
Pyrene	0.01 J	0.21 UJ	0.012 J	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Pesticides (µg/L)											
4,4'-DDD	0.11 U	0.11 U	0.1 U	0.11 U	0.1 U	0.1 U	0.1 U	0.1 U	0.11 U	0.1 U	0.11 U
4,4'-DDE	0.11 U	0.11 U	0.1 U	0.11 U	0.1 U	0.1 U	0.1 U	0.1 U	0.11 U	0.1 U	0.11 U
4,4'-DDT	0.11 U	0.11 U	0.1 U	0.11 U	0.1 U	0.1 U	0.1 U	0.1 U	0.11 U	0.1 U	0.11 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - GROUNDWATER, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB02	59SB03	59SB04	59SB05	59SB06	59SB07	59SB08	59SB09	59SB10
Sample ID	59GW01	59GW02	59GW02D	59GW03	59GW04	59GW05	59GW06	59GW07	59GW08	59GW09	59GW10
Sample Date	5/22/2010	5/23/2010	5/23/2010	5/22/2010	5/23/2010	5/22/2010	5/21/2010	5/21/2010	5/22/2010	5/21/2010	5/22/2010
Pesticides (µg/L) (cont.)											
Aldrin	0.056 U	0.056 U	0.051 U	0.056 U	0.05 U	0.05 U	0.051 U	0.05 U	0.054 U	0.051 U	0.054 U
BHC, alpha-	0.056 U	0.056 U	0.051 U	0.056 U	0.05 U	0.05 U	0.051 U	0.05 U	0.054 U	0.051 U	0.054 U
BHC, beta-	0.056 U	0.056 U	0.051 U	0.056 U	0.05 U	0.05 U	0.051 U	0.05 U	0.054 U	0.051 U	0.054 U
BHC, delta-	0.056 U	0.056 U	0.051 U	0.056 U	0.05 U	0.05 U	0.051 U	0.05 U	0.054 U	0.051 U	0.054 U
BHC, gamma- (Lindane)	0.056 U	0.056 U	0.051 U	0.056 U	0.05 U	0.05 U	0.051 U	0.05 U	0.054 U	0.051 U	0.054 U
Chlordane, alpha-	0.056 U	0.056 U	0.051 U	0.056 U	0.016 NJ	0.05 U	0.051 U	0.05 U	0.054 U	0.051 U	0.054 U
Chlordane, gamma-	0.056 U	0.056 U	0.051 U	0.056 U	0.05 U	0.05 U	0.051 U	0.05 U	0.054 U	0.051 U	0.054 U
Chlorobenzilate	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Dieldrin	0.11 U	0.11 U	0.1 U	0.11 U	0.1 U	0.1 U	0.1 U	0.1 U	0.11 U	0.1 U	0.11 U
Endosulfan I	0.056 U	0.056 U	0.051 U	0.056 U	0.05 U	0.05 U	0.051 U	0.05 U	0.054 U	0.051 U	0.054 U
Endosulfan II	0.11 U	0.11 U	0.1 U	0.11 U	0.1 U	0.1 U	0.1 U	0.1 U	0.11 U	0.1 U	0.11 U
Endosulfan Sulfate	0.11 U	0.11 U	0.1 U	0.11 U	0.1 U	0.1 U	0.1 U	0.1 U	0.11 U	0.1 U	0.11 U
Endrin	0.11 U	0.11 U	0.1 U	0.11 U	0.1 U	0.1 U	0.1 U	0.1 U	0.11 U	0.1 U	0.11 U
Endrin Aldehyde	0.11 U	0.11 UJ	0.1 UJ	0.11 U	0.1 U	0.1 U	0.1 U	0.1 U	0.11 U	0.1 U	0.11 U
Heptachlor	0.056 U	0.056 U	0.051 U	0.056 U	0.05 U	0.05 U	0.051 U	0.05 U	0.054 U	0.051 U	0.054 U
Heptachlor Epoxide	0.056 U	0.056 U	0.051 U	0.056 U	0.05 U	0.05 U	0.051 U	0.05 U	0.054 U	0.051 U	0.054 U
Isodrin	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Kepone (Chlordecone)	5 UJ	5.3 UJ	5.1 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Methoxychlor	0.56 U	0.56 U	0.51 U	0.56 U	0.5 U	0.5 U	0.51 U	0.5 U	0.54 U	0.51 U	0.54 U
Toxaphene	2.8 U	2.8 U	2.6 U	2.8 U	2.5 U	2.5 U	2.6 U	2.5 U	2.7 U	2.6 U	2.7 U
Total Metals (µg/L)											
Antimony	0.5 J	2 U	2 U	0.52 J	0.36 J	0.26 J	2 U	0.26 J	2 U	0.54 J	2 U
Arsenic	6.2	4.5	4.4	1.1	2.9	3.1	4.1	4.3	0.94 J	2.9	2.1
Barium	22.2	46	46.5	20.4	16.2	6.5 J	49.1	15.1	27.9	7.5 J	34.4
Beryllium	1 U	1 U	1 U	0.055 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Cadmium	0.71 J	1 U	1 U	0.19 J	0.26 J	0.093 J	0.67 J	1 U	0.11 J	0.069 J	1 U
Chromium	1.4 J	0.48 J	0.48 J	5.5	0.6 J	1.3 J	2.2	0.67 J	0.46 J	0.58 J	0.6 J
Cobalt	2.6	2.1	2	5.8	1.9	1.5	5.5	0.81 J	0.77 J	0.3 J	1.8
Copper	21.3	4.7 J	4.5	20.1	8.7	8	10.9	8.2	3.9	5	4.3
Lead	1 U	1 U	1 U	5	1 U	1 U	1.7	1 U	1 U	1 U	1 U
Mercury	0.2 R	0.2 R	0.2 R	0.2 R	0.2 R	0.2 R	0.2 R	0.2 R	0.2 R	0.1 R	0.2 R
Nickel	8	1.2	1.2	4.6	2.8	2.1	3.9	2.4	1 U	1.6	1.8
Selenium	24.2	13.9	13.2	0.48 J	11.7	15.3	18.1	10.1	4.1 J	2.1 J	2.5 J
Silver	0.65 J	1 UJ	1 UJ	0.061 J	0.19 J	0.054 J	0.41 J	0.082 J	1 UJ	1 UJ	1 UJ

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB02	59SB03	59SB04	59SB05	59SB06	59SB07	59SB08	59SB09	59SB10
Sample ID	59GW01	59GW02	59GW02D	59GW03	59GW04	59GW05	59GW06	59GW07	59GW08	59GW09	59GW10
Sample Date	5/22/2010	5/23/2010	5/23/2010	5/22/2010	5/23/2010	5/22/2010	5/21/2010	5/21/2010	5/22/2010	5/21/2010	5/22/2010
Total Metals (µg/L) (cont.)											
Thallium	0.43 J	1 U	1 U	1 U	0.2 J	0.096 J	1 U	0.2 J	1 U	0.1 J	1 U
Tin	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Vanadium	24.9	9.1	9.2	66.2	20.2	107	22.2	97	30.1	85.1 J	171
Zinc	15 R	24.4 R	3 R	32.9 R	8.9 R	3.8 R	11.3 R	3.4 R	3 R	11.3 R	3.2 R
Dissolved Metals (µg/L)											
Antimony	0.45 J	0.23 J	2 U	0.3 J	0.47 J	0.23 J	2 U	0.25 J	2 U	0.44 J	2 U
Arsenic	5.3	4.4	4	0.92 J	2.7	3	3.7	4.2	1	2.4	2.3
Barium	21.3	44.2	44.7	4.6 J	13.7	6.1 J	45.7	15.7	27.3	6.6 J	31.5
Beryllium	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Cadmium	0.55 J	1 U	1 U	1 U	0.19 J	0.1 J	0.55 J	1 U	1 U	1 U	1 U
Chromium	1.4 J	0.42 J	0.54 J	2 U	0.6 J	1.2 J	1.3 J	0.69 J	0.27 J	0.47 J	0.33 J
Cobalt	2.6	2	1.9	0.4 J	1.3	1.3	3.5	0.84 J	0.69 J	0.19 J	1.5
Copper	19	5.8 J	4.5	2.3	9.7	8.2	8.3	8.4	3.4	4.3	3.9
Lead	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Mercury	0.2 R	0.2 R	0.2 R	0.2 R	0.2 R	0.2 R	0.2 R	0.2 R	0.2 R	0.2 R	0.2 R
Nickel	8.3	1 U	1.1	1 U	2.7	2.3	3.3	2.6	1 U	1.4	1.7
Selenium	23.8	14.1	12.6	0.6 J	12	16	19.3	10.4	4.7 J	2.2 J	2.8 J
Silver	0.045 J	1 U	1 U	1 U	0.055 J	1 U	1 U	1 U	1 U	1 U	1 U
Thallium	0.39 J	1 U	1 U	1 U	0.29 J	0.084 J	1 U	0.19 J	1 U	0.098 J	1 U
Tin	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Vanadium	22.8	9.5	9.4	57.6	19.8	106	16.8	102	29.6	113 J	179
Zinc	13.4 J	12.1 R	3.7 R	2.6 J	8.2 J	3.8 J	4.8 J	2.8 J	2 UJ	4.4 J	2 UJ

Notes:

J - Estimated: The analyte was positively identified; the quantitation is an estimation.
U - Non detected at the Limit of Detection.
UJ - Reported quantitation limit is qualified as estimated.
R - Rejected data; data is not usable.
LLPAHs - Low Level Polynuclear Aromatic Hydrocarbons
µg/L - microgram per liter

SURFACE WATER DATA

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SW01	59SW02	59SW03
Sample ID	59SW01	59SW02	59SW03
Sample Date	4/20/2010	5/20/2010	5/20/2010
Volatile Organics (µg/L)			
1,1,1,2-Tetrachloroethane	0.5 U	0.5 U	0.5 U
1,1,1-Trichloroethane	0.5 U	0.5 U	0.5 U
1,1,2,2-Tetrachloroethane	0.5 UJ	0.5 U	0.5 U
1,1,2-Trichloroethane	0.5 UJ	0.5 U	0.5 U
1,1-Dichloroethane	0.5 U	0.5 U	0.5 U
1,1-Dichloroethene	0.5 U	0.5 U	0.5 U
1,2,3-Trichloropropane	0.5 UJ	0.5 U	0.5 U
1,2-Dibromo-3-chloropropane (DBCP)	0.5 UJ	0.5 U	0.5 U
1,2-Dibromoethane (EDB)	0.5 UJ	0.5 U	0.5 U
1,2-Dichloroethane	0.5 U	0.5 U	0.5 U
1,2-Dichloroethene (trans)	0.5 U	0.5 U	0.5 U
1,2-Dichloropropane	0.5 U	0.5 U	0.5 U
1,3-Dichloropropene (cis)	0.5 U	0.5 U	0.5 U
1,3-Dichloropropene (trans)	0.5 U	0.5 U	0.5 U
1,4-Dichloro-2-butene (trans)	2 UJ	2 U	2 U
1,4-Dioxane (p-)	25 R	25 R	25 R
2-Butanone (MEK)	2.5 R	2.5 R	2.5 R
2-Chloro-1,3-butadiene (Chloroprene)	0.5 U	0.5 U	0.5 U
2-Hexanone (MBK)	2.5 UJ	2.5 U	2.5 U
3-Chloropropene (Allyl Chloride)	0.5 U	0.5 U	0.5 U
4-Methyl-2-pentanone (MIBK)	2.5 UJ	2.5 U	2.5 U
Acetone	2.5 R	2.5 R	2.8 R
Acetonitrile	0.5 UJ	0.5 U	0.5 U
Acrolein	5 R	5 R	5 R
Acrylonitrile	5 R	5 R	5 R
Benzene	0.5 U	0.5 U	0.5 U
Bromodichloromethane	0.34 J	0.5 U	0.5 U
Bromoform	0.5 U	0.5 U	0.5 U
Bromomethane	0.5 U	0.5 U	0.5 U
Carbon Disulfide	0.5 U	0.5 U	0.021 J
Carbon Tetrachloride	0.5 U	0.5 U	0.5 U
Chlorobenzene	0.5 U	0.5 U	0.5 U
Chloroethane	0.5 U	0.5 U	0.5 U
Chloroform	1.2	0.5 U	0.5 U
Chloromethane	0.5 U	0.5 U	0.5 U
Dibromochloromethane	0.16 J	0.5 U	0.5 U
Dibromomethane	0.5 U	0.5 U	0.5 U
Ethyl Methacrylate	5 UJ	5 U	5 U
Ethylbenzene	0.5 U	0.5 U	0.5 U
Freon 11 (Trichlorofluoromethane)	0.5 U	0.5 UJ	0.5 UJ
Freon-12 (Dichlorodifluoromethane)	0.5 U	0.5 U	0.5 U
Isobutyl Alcohol	25 R	25 R	25 R
Methyl Acrylonitrile	5 UJ	5 U	5 U
Methyl Iodide	0.5 U	0.5 U	0.5 U
Methyl Methacrylate	5 U	5 U	5 U
Methylene Chloride	0.5 U	0.5 U	0.5 U
Pentachloroethane	0.5 U	0.5 U	0.5 U
Propionitrile (Ethyl Cyanide)	25 R	25 R	25 R
Styrene (Ethenylbenzene)	0.5 U	0.5 U	0.5 U
Tetrachloroethene (PCE)	0.5 U	0.5 U	0.5 U
Toluene	0.5 U	0.5 U	0.5 U

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SW01	59SW02	59SW03
Sample ID	59SW01	59SW02	59SW03
Sample Date	4/20/2010	5/20/2010	5/20/2010
Volatile Organics (µg/L) (cont.)			
Trichloroethene (TCE)	0.5 UJ	0.5 U	0.5 U
Vinyl Acetate	1 UJ	1 U	1 U
Vinyl Chloride	0.5 U	0.5 U	0.5 U
Xylene, m/p-	1 U	1 U	1 U
Xylene, o-	0.5 U	0.5 U	0.5 U
Xylenes, total	0.5 U	0.5 U	0.5 U
Semivolatile Organics (µg/L)			
1,2,4,5-Tetrachlorobenzene	5 U	5.1 UJ	5 UJ
1,2,4-Trichlorobenzene	5 U	5.1 UJ	5 UJ
1,2-Dichlorobenzene (o-)	5 U	5.1 UJ	5 UJ
1,3,5-Trinitrobenzene (TNB)	5 UJ	5.1 UJ	5 UJ
1,3-Dichlorobenzene (m-)	5 U	5.1 UJ	5 UJ
1,3-Dinitrobenzene (m-)	5 U	5.1 UJ	5 UJ
1,4-Dichlorobenzene (p-)	5 U	5.1 UJ	5 UJ
1,4-Naphthoquinone	5 U	5.1 UJ	5 UJ
1,4-Phenylenediamine	51 R	52 R	51 R
1-Naphthylamine	5 U	5.1 UJ	5 UJ
2,2'-Oxybis[1-chloropropane]	5 U	5.1 UJ	5 UJ
2,3,4,6-Tetrachlorophenol	10 U	10 UJ	10 UJ
2,4,5-Trichlorophenol	10 U	10 UJ	10 UJ
2,4,6-Trichlorophenol	10 U	10 UJ	10 UJ
2,4-Dichlorophenol	10 U	10 UJ	10 UJ
2,4-Dimethylphenol	10 U	10 UJ	10 UJ
2,4-Dinitrophenol	10 UJ	10 UJ	10 UJ
2,4-Dinitrotoluene (DNT)	5 U	5.1 UJ	5 UJ
2,6-Dichlorophenol	10 U	10 UJ	10 UJ
2,6-Dinitrotoluene (DNT)	5 U	5.1 UJ	5 UJ
2-Acetylaminofluorene	5 U	5.1 UJ	5 UJ
2-Chloronaphthalene	5 U	5.1 UJ	5 UJ
2-Chlorophenol	10 U	10 UJ	10 UJ
2-Methyl-5-nitroaniline	5 U	5.1 UJ	5 UJ
2-Methylphenol (o-Cresol)	10 U	10 UJ	10 UJ
2-Naphthylamine	5 U	5.1 UJ	5 UJ
2-Nitroaniline	5 U	5.1 UJ	5 UJ
2-Nitrophenol	10 U	10 UJ	10 UJ
2-Picoline	5 U	5.1 UJ	5 UJ
3,3'-Dichlorobenzidine	5 U	5.1 UJ	5 UJ
3,3'-Dimethylbenzidine	5 U	5.1 UJ	5 UJ
3-Methylcholanthrene	5 U	5.1 UJ	5 UJ
3-Methylphenol (m-Cresol)	8 U	8.2 UJ	8 UJ
3-Nitroaniline	5 U	5.1 UJ	5 UJ
4,6-Dinitro-2-methylphenol	10 U	10 UJ	10 UJ
4-Aminobiphenyl	5 U	5.1 UJ	5 UJ
4-Bromophenyl-phenylether	5 U	5.1 UJ	5 UJ
4-Chloro-3-methylphenol	10 U	10 UJ	10 UJ
4-Chloroaniline	5 U	5.1 UJ	5 UJ
4-Chlorophenyl-phenylether	5 U	5.1 UJ	5 UJ
4-Dimethylaminoazobenzene (p-)	5 U	5.1 UJ	5 UJ
4-Methylphenol (p-Cresol)	8 U	8.2 UJ	8 UJ
4-Nitroaniline	5 U	5.1 UJ	5 UJ

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SW01	59SW02	59SW03
Sample ID	59SW01	59SW02	59SW03
Sample Date	4/20/2010	5/20/2010	5/20/2010
Semivolatile Organics (µg/L)			
4-Nitrophenol	10 U	10 UJ	10 UJ
4-Nitroquinoline-1-oxide	5 U	5.1 R	5 R
7,12-Dimethylbenz(a)anthracene	5 U	5.1 UJ	5 UJ
a,a-Dimethylphenethylamine	50 UJ	51 UJ	50 UJ
Acetophenone	2.5 U	2.6 UJ	2.5 UJ
Aniline	5 U	5.1 UJ	5 UJ
Aramite	5 U	5.1 UJ	5 UJ
Benzyl Alcohol	5 UJ	5.1 UJ	5 UJ
Bis(2-chloroethoxy)methane	5 U	5.1 UJ	5 UJ
Bis(2-chloroethyl)ether	5 U	5.1 UJ	5 UJ
Bis(2-ethylhexyl) Phthalate (BEHP)	5 U	5.1 UJ	5 UJ
Butyl Benzyl Phthalate	5 U	5.1 UJ	5 UJ
Diallate (cis)	5 U	5.1 UJ	5 UJ
Diallate (trans)	5 U	5.1 UJ	5 UJ
Dibenzofuran	5 U	5.1 UJ	5 UJ
Diethyl Phthalate (DEP)	5 U	5.1 UJ	5 UJ
Dimethyl Phthalate	5 U	5.1 UJ	5 UJ
Di-n-butyl Phthalate (DBP)	5 U	5.1 UJ	5 UJ
Di-n-octyl Phthalate	5 U	5.1 UJ	5 UJ
Dinoseb	NA	5.1 UJ	5 UJ
Ethyl Methane Sulfonate (EMS)	5 U	5.1 UJ	5 UJ
Hexachloro-1,3-butadiene	5 U	5.1 UJ	5 UJ
Hexachlorobenzene	5 U	5.1 UJ	5 UJ
Hexachlorocyclopentadiene	5 U	5.1 UJ	5 UJ
Hexachloroethane	5 U	5.1 UJ	5 UJ
Hexachloropropene	5 U	5.1 UJ	5 UJ
Isophorone	5 U	5.1 UJ	5 UJ
Isosafrole	5 U	5.1 UJ	5 UJ
Methapyrilene	5 U	5.1 UJ	5 UJ
Methyl Methane Sulfonate	5 U	5.1 UJ	5 UJ
Nitrobenzene	5 U	5.1 UJ	5 UJ
n-Nitrosodiethylamine	5 U	5.1 UJ	5 UJ
n-Nitrosodimethylamine (NDMA)	5 U	5.1 UJ	5 UJ
n-Nitroso-di-n-butylamine	5 U	5.1 UJ	5 UJ
n-Nitrosodi-n-propylamine	5 U	5.1 UJ	5 UJ
n-Nitrosodiphenylamine	5 U	5.1 UJ	5 UJ
n-Nitrosomethylethylamine	5 U	5.1 UJ	5 UJ
n-Nitrosomorpholine	5 U	5.1 UJ	5 UJ
n-Nitrosopiperidine	5 U	5.1 UJ	5 UJ
n-Nitrosopyrrolidine	5 U	5.1 UJ	5 UJ
o-Toluidine	5 U	5.1 UJ	5 UJ
Pentachlorobenzene	5 U	5.1 UJ	5 UJ
Pentachloronitrobenzene	5 U	5.1 UJ	5 UJ
Pentachlorophenol	10 U	10 UJ	10 UJ
Phenacetin	5 U	5.1 UJ	5 UJ
Phenol	10 U	10 UJ	10 UJ
Pronamide	10 U	5.1 UJ	5 UJ
Pyridine	5 U	5.1 UJ	5 UJ
Safrole	5 U	5.1 UJ	5 UJ

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SW01	59SW02	59SW03
Sample ID	59SW01	59SW02	59SW03
Sample Date	4/20/2010	5/20/2010	5/20/2010
LLPAHs (µg/L)			
2-Methylnaphthalene	0.2 UJ	0.21 UJ	0.2 UJ
Acenaphthene	0.2 U	0.21 UJ	0.2 UJ
Acenaphthylene	0.2 U	0.21 UJ	0.2 UJ
Anthracene	0.2 U	0.21 UJ	0.2 UJ
Benzo(a)anthracene	0.2 U	0.21 UJ	0.2 UJ
Benzo(a)pyrene (BaP)	0.2 U	0.21 UJ	0.2 UJ
Benzo(b)fluoranthene	0.2 U	0.21 UJ	0.2 UJ
Benzo(g,h,i)perylene	0.2 U	0.21 UJ	0.2 UJ
Benzo(k)fluoranthene	0.2 UJ	0.21 UJ	0.2 UJ
Chrysene	0.2 U	0.21 UJ	0.2 UJ
Dibenz(a,h)anthracene	0.2 U	0.21 UJ	0.2 UJ
Fluoranthene	0.2 U	0.019 J	0.017 J
Fluorene	0.2 U	0.21 UJ	0.2 UJ
Indeno(1,2,3-cd)pyrene	0.2 U	0.21 UJ	0.2 UJ
Naphthalene	0.2 U	0.21 UJ	0.2 UJ
Phenanthrene	0.2 U	0.21 UJ	0.2 UJ
Pyrene	0.2 U	0.02 J	0.018 J
Pesticides (µg/L)			
4,4'-DDD	0.1 U	0.1 U	0.1 U
4,4'-DDE	0.006 J	0.1 U	0.1 U
4,4'-DDT	0.0065 J	0.1 U	0.1 U
Aldrin	0.05 U	0.05 U	0.051 U
BHC, alpha-	0.05 U	0.05 U	0.051 U
BHC, beta-	0.05 U	0.05 U	0.051 U
BHC, delta-	0.05 U	0.05 U	0.051 U
BHC, gamma- (Lindane)	0.05 U	0.05 U	0.051 U
Chlordane, alpha-	0.05 U	0.05 U	0.051 U
Chlordane, gamma-	0.05 U	0.05 U	0.051 U
Chlorobenzilate	5 U	5.1 UJ	5 UJ
Dieldrin	0.1 U	0.1 U	0.1 U
Endosulfan I	0.05 U	0.05 U	0.051 U
Endosulfan II	0.1 U	0.1 U	0.1 U
Endosulfan Sulfate	0.1 U	0.1 U	0.1 U
Endrin	0.1 U	0.1 U	0.1 U
Endrin Aldehyde	0.1 R	0.1 U	0.1 U
Heptachlor	0.05 U	0.05 U	0.051 U
Heptachlor Epoxide	0.05 U	0.05 U	0.051 U
Isodrin	5 U	5.1 UJ	5 UJ
Kepone (Chlordecone)	5 U	5.1 UJ	5 UJ
Methoxychlor	0.5 U	0.5 U	0.51 U
Toxaphene	2.5 U	2.5 U	2.6 U
Total Metals (µg/L)			
Antimony	2 U	0.26 J	0.23 J
Arsenic	0.49 J	0.44 J	0.42 J
Barium	21.4	19.9	19.4
Beryllium	1 U	1 U	1 U
Cadmium	1 U	1 U	1 U
Calcium	18900	NA	NA
Chromium	0.68 J	0.76 J	0.75 J

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SURFACE WATER, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SW01	59SW02	59SW03
Sample ID	59SW01	59SW02	59SW03
Sample Date	4/20/2010	5/20/2010	5/20/2010
Total Metals (µg/L) (cont.)			
Cobalt	0.32 J	0.34 J	0.34 J
Copper	3.8	4	4
Lead	1 U	1 U	1 U
Magnesium	5000 U	NA	NA
Mercury	0.2 U	0.2 R	0.2 R
Nickel	1 U	1 U	1 U
Selenium	0.75 J	0.52 J	0.47 J
Silver	1 U	1 UJ	1 UJ
Thallium	1 U	1 U	1 U
Tin	20 U	20 U	20 U
Vanadium	7	7.6	7.3
Zinc	7.9 J	7 R	7.1 R
Dissolved Metals (µg/L)			
Antimony	2 U	0.23 J	0.23 J
Arsenic	0.52 J	0.41 J	0.4 J
Barium	20.5	17.8	17.7
Beryllium	1 U	1 U	1 U
Cadmium	1 U	1 U	1 U
Chromium	0.39 J	0.4 J	0.39 J
Cobalt	0.084 J	0.062 J	0.061 J
Copper	3.1	3	2.9
Lead	1 U	1 U	1 U
Mercury	0.2 U	0.2 R	0.2 R
Nickel	1 U	1 U	1 U
Selenium	0.82 J	0.51 J	0.48 J
Silver	1 U	1 U	1 U
Thallium	1 U	1 U	1 U
Tin	20 U	20 U	20 U
Vanadium	6.3	6.1	6.1
Zinc	5.5 J	2.2 J	2.4 J

Notes:

J - Estimated: The analyte was positively identified; the quantitation is an estimation.
U - Non detected at the Limit of Detection.
UJ - Reported quantitation limit is qualified as estimated.
R - Rejected data; data is not usable.
LLPAHs - Low Level Polynuclear Aromatic Hydrocarbons
µg/L - microgram per liter

SEDIMENT DATA

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SEDIMENT, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SD01		59SD02		59SD03	
Sample ID	59SD01		59SD02		59SD03	
Sample Date	4/22/2010		5/20/2010		5/20/2010	
Sample Depth (ft bgs)	0.0 - 0.5		0.0 - 0.5		0.0 - 0.5	
Volatile Organics (µg/kg)						
1,1,1,2-Tetrachloroethane	11	UJ	12	UJ	6.7	U
1,1,1-Trichloroethane	11	UJ	12	UJ	6.7	U
1,1,2,2-Tetrachloroethane	11	UJ	12	UJ	6.7	U
1,1,2-Trichloroethane	11	UJ	12	UJ	6.7	U
1,1-Dichloroethane	11	UJ	12	UJ	6.7	U
1,1-Dichloroethene	11	UJ	12	UJ	6.7	U
1,2,3-Trichloropropane	11	UJ	12	UJ	6.7	U
1,2-Dibromo-3-chloropropane (DBCP)	11	UJ	12	UJ	6.7	U
1,2-Dibromoethane (EDB)	11	UJ	12	UJ	6.7	U
1,2-Dichloroethane	11	UJ	12	UJ	6.7	U
1,2-Dichloroethene (trans)	11	UJ	12	UJ	6.7	U
1,2-Dichloropropane	11	UJ	12	UJ	6.7	U
1,3-Dichloropropene (cis)	11	UJ	12	UJ	6.7	U
1,3-Dichloropropene (trans)	11	UJ	12	UJ	6.7	U
1,4-Dichloro-2-butene (trans)	42	UJ	47	UJ	27	U
1,4-Dioxane (p-)	530	R	590	R	340	R
2-Butanone (MEK)	26	UJ	29	UJ	17	U
2-Chloro-1,3-butadiene (Chloroprene)	11	UJ	12	UJ	6.7	U
2-Hexanone (MBK)	26	UJ	29	UJ	17	U
3-Chloropropene (Allyl Chloride)	11	UJ	12	UJ	6.7	U
4-Methyl-2-pentanone (MIBK)	26	UJ	29	UJ	17	U
Acetone	28	R	150	J	78	
Acetonitrile	11	UJ	12	UJ	6.7	U
Acrolein	110	R	120	R	67	R
Acrylonitrile	110	R	120	UJ	67	U
Benzene	11	UJ	12	UJ	6.7	U
Bromodichloromethane	11	UJ	12	UJ	6.7	U
Bromoform	11	UJ	12	UJ	6.7	U
Bromomethane	11	UJ	12	UJ	6.7	U
Carbon Disulfide	2.3	J	12	UJ	6.7	U
Carbon Tetrachloride	11	UJ	12	UJ	6.7	U
Chlorobenzene	11	UJ	12	UJ	6.7	U
Chloroethane	11	UJ	12	UJ	6.7	U
Chloroform	11	UJ	12	UJ	6.7	U
Chloromethane	11	UJ	12	UJ	6.7	U
Dibromochloromethane	11	UJ	12	UJ	6.7	U
Dibromomethane	11	UJ	12	UJ	6.7	U
Ethyl Methacrylate	110	UJ	120	UJ	67	U
Ethylbenzene	11	UJ	12	UJ	6.7	U
Freon 11 (Trichlorofluoromethane)	11	UJ	12	UJ	6.7	U
Freon-12 (Dichlorodifluoromethane)	11	UJ	12	UJ	6.7	U
Isobutyl Alcohol	530	R	590	R	340	R
Methyl Acrylonitrile	110	UJ	120	UJ	67	U
Methyl Iodide	11	UJ	12	UJ	6.7	U
Methyl Methacrylate	110	UJ	120	R	67	R
Methylene Chloride	11	UJ	12	UJ	6.7	U
Pentachloroethane	11	UJ	12	UJ	6.7	U
Propionitrile (Ethyl Cyanide)	530	R	590	R	340	R
Styrene (Ethenylbenzene)	11	UJ	12	UJ	6.7	U
Tetrachloroethene (PCE)	11	UJ	12	UJ	6.7	U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SEDIMENT, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SD01	59SD02	59SD03
Sample ID	59SD01	59SD02	59SD03
Sample Date	4/22/2010	5/20/2010	5/20/2010
Sample Depth (ft bgs)	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5
Volatile Organics (µg/kg) (cont.)			
Toluene	11 UJ	12 UJ	6.7 U
Trichloroethene (TCE)	11 UJ	12 UJ	6.7 U
Vinyl Acetate	11 UJ	12 UJ	6.7 U
Vinyl Chloride	11 UJ	12 UJ	6.7 U
Xylene, m/p-	0.79 J	24 UJ	13 U
Xylene, o-	11 UJ	12 UJ	6.7 U
Xylenes, total	0.79 J	12 UJ	6.7 U
Semivolatile Organics (µg/kg)			
1,2,4,5-Tetrachlorobenzene	350 UJ	360 UJ	310 U
1,2,4-Trichlorobenzene	350 UJ	360 UJ	310 U
1,2-Dichlorobenzene (o-)	350 UJ	360 UJ	310 U
1,3,5-Trinitrobenzene (TNB)	350 UJ	360 UJ	310 U
1,3-Dichlorobenzene (m-)	350 UJ	360 UJ	310 U
1,3-Dinitrobenzene (m-)	350 UJ	360 UJ	310 U
1,4-Dichlorobenzene (p-)	350 UJ	360 UJ	310 U
1,4-Naphthoquinone	350 UJ	360 UJ	310 U
1,4-Phenylenediamine	3500 R	3600 R	3100 R
1-Naphthylamine	350 UJ	360 UJ	310 U
2,2'-Oxybis[1-chloropropane]	350 UJ	360 UJ	310 U
2,3,4,6-Tetrachlorophenol	690 UJ	700 UJ	600 U
2,4,5-Trichlorophenol	690 UJ	700 UJ	600 U
2,4,6-Trichlorophenol	690 UJ	700 UJ	600 U
2,4-Dichlorophenol	690 UJ	700 UJ	600 U
2,4-Dimethylphenol	690 UJ	700 UJ	600 U
2,4-Dinitrophenol	690 UJ	700 UJ	600 U
2,4-Dinitrotoluene (DNT)	350 UJ	360 UJ	310 U
2,6-Dichlorophenol	690 UJ	700 UJ	600 U
2,6-Dinitrotoluene (DNT)	350 UJ	360 UJ	310 U
2-Acetylaminofluorene	350 UJ	360 UJ	310 U
2-Chloronaphthalene	350 UJ	360 UJ	310 U
2-Chlorophenol	690 UJ	700 UJ	600 U
2-Methyl-5-nitroaniline	350 UJ	360 UJ	310 U
2-Methylphenol (o-Cresol)	690 UJ	700 UJ	600 UJ
2-Naphthylamine	350 UJ	360 UJ	310 U
2-Nitroaniline	350 UJ	360 UJ	310 U
2-Nitrophenol	690 UJ	700 UJ	600 U
2-Picoline	350 UJ	360 UJ	310 U
3,3'-Dichlorobenzidine	350 UJ	360 UJ	310 U
3,3'-Dimethylbenzidine	350 UJ	360 UJ	310 U
3-Methylcholanthrene	350 UJ	360 UJ	310 U
3-Methylphenol (m-Cresol)	520 UJ	530 UJ	450 U
3-Nitroaniline	350 UJ	360 UJ	310 U
4,6-Dinitro-2-methylphenol	690 UJ	700 UJ	600 U
4-Aminobiphenyl	350 UJ	360 UJ	310 U
4-Bromophenyl-phenylether	350 UJ	360 UJ	310 U
4-Chloro-3-methylphenol	690 UJ	700 UJ	600 U
4-Chloroaniline	350 UJ	360 UJ	310 U
4-Chlorophenyl-phenylether	350 UJ	360 UJ	310 U
4-Dimethylaminoazobenzene (p-)	350 UJ	360 UJ	310 U

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SUMMARY OF ANALYTICAL RESULTS - SEDIMENT, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SD01	59SD02	59SD03
Sample ID	59SD01	59SD02	59SD03
Sample Date	4/22/2010	5/20/2010	5/20/2010
Sample Depth (ft bgs)	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5
Semivolatile Organics (µg/kg) (cont.)			
4-Methylphenol (p-Cresol)	520 UJ	530 UJ	450 U
4-Nitroaniline	350 UJ	360 UJ	310 U
4-Nitrophenol	690 UJ	700 UJ	600 U
4-Nitroquinoline-1-oxide	350 UJ	360 UJ	310 U
7,12-Dimethylbenz(a)anthracene	350 UJ	360 UJ	310 UJ
a,a-Dimethylphenethylamine	690 UJ	1000 UJ	850 U
Acetophenone	180 UJ	180 UJ	150 U
Aniline	350 UJ	360 UJ	310 U
Aramite	350 UJ	360 UJ	310 U
Benzyl Alcohol	350 UJ	360 UJ	310 U
Bis(2-chloroethoxy)methane	350 UJ	360 UJ	310 U
Bis(2-chloroethyl)ether	350 UJ	360 UJ	310 U
Bis(2-ethylhexyl) Phthalate (BEHP)	140 J	110 J	730
Butyl Benzyl Phthalate	63 J	360 UJ	310 U
Diallate (cis)	350 UJ	360 UJ	310 U
Diallate (trans)	350 UJ	360 UJ	310 UJ
Dibenzofuran	350 UJ	360 UJ	310 U
Diethyl Phthalate (DEP)	350 UJ	360 UJ	310 U
Dimethyl Phthalate	350 UJ	360 UJ	310 U
Di-n-butyl Phthalate (DBP)	350 UJ	360 UJ	310 U
Di-n-octyl Phthalate	350 UJ	360 UJ	310 U
Dinoseb	NA	360 UJ	310 U
Ethyl Methane Sulfonate (EMS)	350 UJ	360 UJ	310 U
Hexachloro-1,3-butadiene	350 UJ	360 UJ	310 U
Hexachlorobenzene	350 UJ	360 UJ	310 U
Hexachlorocyclopentadiene	350 UJ	360 UJ	310 U
Hexachloroethane	350 UJ	360 UJ	310 U
Hexachloropropene	350 UJ	360 UJ	310 U
Isophorone	350 UJ	360 UJ	310 U
Isosafrole	350 UJ	360 UJ	310 U
Methapyrilene	350 UJ	360 UJ	310 U
Methyl Methane Sulfonate	350 UJ	360 UJ	310 U
Nitrobenzene	350 UJ	360 UJ	310 U
n-Nitrosodiethylamine	350 UJ	360 UJ	310 U
n-Nitrosodimethylamine (NDMA)	350 UJ	360 UJ	310 U
n-Nitroso-di-n-butylamine	350 UJ	360 UJ	310 UJ
n-Nitrosodi-n-propylamine	350 UJ	360 UJ	310 U
n-Nitrosodiphenylamine	350 UJ	360 UJ	310 U
n-Nitrosomethylethylamine	350 UJ	360 UJ	310 U
n-Nitrosomorpholine	350 UJ	360 UJ	310 U
n-Nitrosopiperidine	350 UJ	360 UJ	310 U
n-Nitrosopyrrolidine	350 UJ	360 UJ	310 U
o-Toluidine	350 UJ	360 UJ	310 U
Pentachlorobenzene	350 UJ	360 UJ	310 U
Pentachloronitrobenzene	350 UJ	360 UJ	310 U
Pentachlorophenol	690 UJ	700 UJ	600 U
Phenacetin	350 UJ	360 UJ	310 U
Phenol	690 UJ	700 UJ	600 U
Pronamide	690 UJ	360 UJ	310 U
Pyridine	350 UJ	360 UJ	310 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SEDIMENT, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SD01	59SD02	59SD03
Sample ID	59SD01	59SD02	59SD03
Sample Date	4/22/2010	5/20/2010	5/20/2010
Sample Depth (ft bgs)	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5
Semivolatile Organics (µg/kg) (cont.)			
Safrole	350 UJ	360 UJ	310 U
LLPAHs (µg/kg)			
2-Methylnaphthalene	4.4 J	360 UJ	310 U
Acenaphthene	17 UJ	360 UJ	310 U
Acenaphthylene	1.6 J	360 UJ	310 U
Anthracene	4.6 J	360 UJ	310 U
Benzo(a)anthracene	5 J	360 UJ	310 U
Benzo(a)pyrene (BaP)	17 UJ	360 UJ	310 U
Benzo(b)fluoranthene	17 UJ	360 UJ	310 U
Benzo(g,h,i)perylene	17 UJ	360 UJ	310 U
Benzo(k)fluoranthene	17 UJ	360 UJ	310 U
Chrysene	6.9 J	360 UJ	310 U
Dibenz(a,h)anthracene	17 UJ	360 UJ	310 U
Fluoranthene	7.2 J	360 UJ	36 J
Fluorene	2.3 J	360 UJ	310 U
Indeno(1,2,3-cd)pyrene	8.3 J	360 UJ	310 U
Naphthalene	17 UJ	360 UJ	310 U
Phenanthrene	6.3 J	360 UJ	310 U
Pyrene	8.8 J	360 UJ	41 J
Pesticides (µg/kg)			
4,4'-DDD	1.6 J	2.6 J	5.9 J
4,4'-DDE	35 J	32 J	160
4,4'-DDT	1.3 J	7 UJ	6 U
Aldrin	3.5 UJ	3.6 UJ	0.66 J
BHC, alpha-	3.5 UJ	3.6 UJ	3.1 U
BHC, beta-	1.8 UJ	1.8 UJ	1.5 U
BHC, delta-	3.5 UJ	3.6 UJ	3.1 U
BHC, gamma- (Lindane)	3.5 UJ	3.6 UJ	3.1 U
Chlordane, alpha-	2.1 NJ	25 NJ	3.1 U
Chlordane, gamma-	18 J	31 J	3.1 U
Chlorobenzilate	350 UJ	360 UJ	310 U
Dieldrin	0.9 J	7 UJ	6 U
Endosulfan I	3.5 UJ	3.6 UJ	3.1 U
Endosulfan II	6.9 UJ	7 UJ	6 U
Endosulfan Sulfate	6.9 UJ	7 UJ	6 U
Endrin	6.9 UJ	7 UJ	6 U
Endrin Aldehyde	1.1 J	0.87 J	6 U
Heptachlor	3.5 UJ	1.2 J	3.1 U
Heptachlor Epoxide	3.5 UJ	3.6 UJ	3.1 U
Isodrin	350 UJ	360 UJ	310 U
Kepone (Chlordecone)	350 UJ	360 U	310 U
Methoxychlor	35 UJ	36 UJ	31 U
Toxaphene	170 UJ	180 UJ	150 U
Metals (mg/kg)			
Antimony	2.1 UJ	0.8 J	0.58 J
Arsenic	0.98 J	0.65 J	1.5
Barium	81.6 J	164 J	109 J

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - SEDIMENT, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SD01		59SD02		59SD03	
Sample ID	59SD01		59SD02		59SD03	
Sample Date	4/22/2010		5/20/2010		5/20/2010	
Sample Depth (ft bgs)	0.0 - 0.5		0.0 - 0.5		0.0 - 0.5	
Metals (mg/kg) (cont.)						
Beryllium	0.38	J	0.45	J	0.35	J
Cadmium	0.9	J	0.69	J	0.99	J
Chromium	39.1	J	42.1	J	37.3	
Cobalt	20.9	J	31.9	J	22.4	J
Copper	125	J	144	J	90.7	J
Lead	71.2	J	37.6	R	36.9	R
Mercury	0.087		0.033	J	0.19	
Nickel	18.7	J	22.6	J	28.1	
Selenium	0.8	J	1	J	0.69	J
Silver	0.17	J	0.23	J	0.17	J
Thallium	1	UJ	0.14	J	0.053	J
Tin	10.4	UJ	10.5	UJ	8.1	U
Vanadium	156	J	232	J	144	J
Zinc	122	J	139	J	176	
TOC (mg/kg)						
Total Organic Carbon	21290		21000		68100	
AVS/SEM Metals (uMole/g)						
Cadmium	NA		0.00305		0.00269	
Copper	NA		0.588		0.339	
Lead	NA		0.071	J	0.0485	J
Nickel	NA		0.075		0.066	
Silver	NA		0.0018	U	0.0014	U
Zinc	NA		0.92		1.12	
Sulfide (uMole/g)						
Sulfide	NA		0.17	U	0.15	
Total Solids (%)						
Solids, Total	NA		50.3		62.5	

Notes:

J - Estimated: The analyte was positively identified; the quantitation is an estimation.
U - Non detected at the Limit of Detection.
UJ - Reported quantitation limit is qualified as estimated.
R - Rejected data; data is not usable.
NJ - Analyte has been tentatively identified; the quantitation is an estimation.
% - percent
AVS - Acid Volatile Sulfide
ft bgs - feet below ground surface
LLPAH - Low Level Polynuclear Aromatic Hydrocarbons
µg/kg - microgram per kilogram
µMole/g - micromole per gram
mg/kg - milligram per kilogram
NA - Not Analyzed
SEM - Simultaneously Extracted Metals
TOC - Total Organic Carbon

APPENDIX B

SUMMARY OF ANALTYICAL RESULTS - SEDIMENT, 2012 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SD04	59SD04	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Sample ID	59SD04	59SD04D	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Date	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012
Depth Range (ft bgs)	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5
Metals (mg/kg)										
Copper	107	83.8	187 J	160 J	87.6 J	134 J	36.2 J	78.3 J	161 J	52.4 J
Lead	45.3 J	30.1 J	55 J	70 J	20.4 J	23.1 J	4.92 J	10.9 J	22.6 J	4.93 J
Zinc	193 J	130 J	357 J	319 J	191 J	154 J	71.7 J	108 J	232 J	262 J

Notes:

J - Estimated: The analyte was positively identified; the quantitation is and estimation.
ft bgs - feet below ground surface
mg/kg - milligram per kilogram

QA/QC DATA

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - QA/QC SAMPLES, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

	Equipment Rinsates										
Sample ID	59ER01	59ER02	59ER03	59ER04	59ER05	59ER06	59ER07	59ER08	59ER09	59ER10	59ER11
Sample Date	4/19/2010	4/20/2010	4/21/2010	4/22/2010	5/18/2010	5/19/2010	5/20/2010	5/21/2010	5/22/2010	5/23/2010	5/24/2010
Volatile Organics (µg/L)											
1,1,1,2-Tetrachloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,1-Trichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2,2-Tetrachloroethane	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2-Trichloroethane	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-Dichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-Dichloroethene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,3-Trichloropropane	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dibromo-3-chloropropane (DBCP)	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dibromoethane (EDB)	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloroethene (trans)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloropropane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,3-Dichloropropene (cis)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,3-Dichloropropene (trans)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,4-Dichloro-2-butene (trans)	2 UJ	2 UJ	2 UJ	2 UJ	2 U	2 U	2 U	2 U	2 U	2 U	2 U
1,4-Dioxane (p-)	25 R	25 R	25 R	25 U	25 R	25 R	25 R	25 R	25 R	25 R	25 R
2-Butanone (MEK)	1.1 J	1.2 J	1.3 J	2.5 R	1.1 J	1 J	1.1 J	1.4 J	1.2 J	2.5 R	2.1 J
2-Chloro-1,3-butadiene (Chloroprene)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
2-Hexanone (MBK)	2.5 UJ	2.5 UJ	2.5 UJ	2.5 UJ	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
3-Chloropropene (Allyl Chloride)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 U
4-Methyl-2-pentanone (MIBK)	2.5 UJ	2.5 UJ	2.5 UJ	2.5 UJ	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Acetone	3.4 J	2.8 J	3.6 J	0.71 J	3.4 J	3.9 J	82 J	88 J	100 J	90 J	5.7 J
Acetonitrile	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Acrolein	5 R	5 R	5 R	5 R	5 R	5 R	5 R	5 R	5 R	5 R	5 R
Acrylonitrile	5 R	5 R	5 R	5 R	5 R	5 R	5 R	5 R	5 R	5 R	5 R
Benzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromodichloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromoform	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromomethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ
Carbon Disulfide	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.055 J	0.029 J	0.5 U
Carbon Tetrachloride	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chlorobenzene	0.27 J	0.13 J	0.061 J	0.5 U	0.5 U	0.5 U	0.33 J	0.27 J	0.13 J	0.029 J	0.17 J
Chloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloroform	0.086 J	0.077 J	0.053 J	0.5 U	0.043 J	0.041 J	0.28 J	0.3 J	0.22 J	0.12 J	0.086 J
Chloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Dibromochloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Dibromomethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U

APPENDIX B

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Volatile Organics (µg/L) (cont.)											
Ethyl Methacrylate	5 UJ	5 UJ	5 UJ	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Ethylbenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Freon 11 (Trichlorofluoromethane)	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ
Freon-12 (Dichlorodifluoromethane)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ
Isobutyl Alcohol	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R
Methyl Acrylonitrile	5 UJ	5 UJ	5 UJ	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Methyl Iodide	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ
Methyl Methacrylate	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Methylene Chloride	4.6	4	3.4	0.34 J	1.2	1.2	4.7	4.6	4.6	2.7	4.5
Pentachloroethane	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Propionitrile (Ethyl Cyanide)	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R
Styrene (Ethenylbenzene)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Tetrachloroethene (PCE)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Toluene	1.8	0.97	0.51	0.085 J	0.22 J	0.16 J	1.7	1.4	0.8	0.3 J	1.1 J
Trichloroethene (TCE)	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Vinyl Acetate	1 UJ	1 UJ	1 UJ	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Vinyl Chloride	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Xylene, m/p-	1 U	1 U	1 U	1 U	1 U	1 U	0.095 J	1 U	1 U	1 U	1 U
Xylene, o-	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.057 J	0.048 J	0.033 J	0.5 U	0.5 U
Xylenes, total	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.1 J	0.5 U	0.5 U	0.5 U	0.5 U
Semivolatile Organics (µg/L)											
1,2,4,5-Tetrachlorobenzene	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
1,2,4-Trichlorobenzene	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
1,2-Dichlorobenzene (o-)	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
1,3,5-Trinitrobenzene (TNB)	5.1 UJ	5 UJ	5.1 UJ	5.3 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
1,3-Dichlorobenzene (m-)	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
1,3-Dinitrobenzene (m-)	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
1,4-Dichlorobenzene (p-)	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
1,4-Naphthoquinone	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
1,4-Phenylenediamine	52 R	51 R	52 R	54 R	54 R	51 R	51 R	51 R	52 R	54 R	NA
1-Naphthylamine	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
2,2'-Oxybis[1-chloropropane]	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
2,3,4,6-Tetrachlorophenol	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	NA
2,4,5-Trichlorophenol	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	NA
2,4,6-Trichlorophenol	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	NA
2,4-Dichlorophenol	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	NA

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	Equipment Rinsates										
Sample ID	59ER01	59ER02	59ER03	59ER04	59ER05	59ER06	59ER07	59ER08	59ER09	59ER10	59ER11
Sample Date	4/19/2010	4/20/2010	4/21/2010	4/22/2010	5/18/2010	5/19/2010	5/20/2010	5/21/2010	5/22/2010	5/23/2010	5/24/2010
Semivolatile Organics (µg/L) (cont.)											
2,4-Dimethylphenol	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	NA
2,4-Dinitrophenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	NA
2,4-Dinitrotoluene (DNT)	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
2,6-Dichlorophenol	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	NA
2,6-Dinitrotoluene (DNT)	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
2-Acetylaminofluorene	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
2-Chloronaphthalene	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
2-Chlorophenol	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	NA
2-Methyl-5-nitroaniline	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
2-Methylphenol (o-Cresol)	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	NA
2-Naphthylamine	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
2-Nitroaniline	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
2-Nitrophenol	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	NA
2-Picoline	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
3,3'-Dichlorobenzidine	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
3,3'-Dimethylbenzidine	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
3-Methylcholanthrene	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
3-Methylphenol (m-Cresol)	8.2 U	8 U	8.2 U	8.4 U	8.4 UJ	8 UJ	8 UJ	8 UJ	8.2 UJ	8.4 UJ	NA
3-Nitroaniline	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
4,6-Dinitro-2-methylphenol	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	NA
4-Aminobiphenyl	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
4-Bromophenyl-phenylether	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
4-Chloro-3-methylphenol	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	NA
4-Chloroaniline	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
4-Chlorophenyl-phenylether	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
4-Dimethylaminoazobenzene (p-)	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
4-Methylphenol (p-Cresol)	8.2 U	8 U	8.2 U	8.4 U	8.4 UJ	8 UJ	8 UJ	8 UJ	8.2 UJ	8.4 UJ	NA
4-Nitroaniline	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
4-Nitrophenol	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	NA
4-Nitroquinoline-1-oxide	5.1 U	5 U	5.1 U	5.3 U	5.3 R	5 R	5 R	5 UJ	5.1 UJ	5.3 UJ	NA
7,12-Dimethylbenz(a)anthracene	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
a,a-Dimethylphenethylamine	51 UJ	50 UJ	51 UJ	53 UJ	53 UJ	50 UJ	50 UJ	50 UJ	51 UJ	53 UJ	NA
Acetophenone	2.6 U	2.5 U	2.6 U	2.6 U	2.6 UJ	2.5 UJ	2.5 UJ	2.5 UJ	2.6 UJ	2.6 UJ	NA
Aniline	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
Aramite	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
Benzyl Alcohol	5.1 UJ	5 UJ	5.1 UJ	5.3 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
Bis(2-chloroethoxy)methane	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA

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Semivolatile Organics (µg/L) (cont.)											
Bis(2-chloroethyl)ether	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
Bis(2-ethylhexyl) Phthalate (BEHP)	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
Butyl Benzyl Phthalate	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
Diallate (cis)	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
Diallate (trans)	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
Dibenzofuran	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
Diethyl Phthalate (DEP)	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
Dimethyl Phthalate	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
Di-n-butyl Phthalate (DBP)	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
Di-n-octyl Phthalate	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
Dinoseb	NA	NA	NA	NA	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
Ethyl Methane Sulfonate (EMS)	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
Hexachloro-1,3-butadiene	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
Hexachlorobenzene	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
Hexachlorocyclopentadiene	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
Hexachloroethane	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
Hexachloropropene	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
Isophorone	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
Isosafrole	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
Methapyrilene	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
Methyl Methane Sulfonate	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
Nitrobenzene	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
n-Nitrosodiethylamine	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
n-Nitrosodimethylamine (NDMA)	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
n-Nitroso-di-n-butylamine	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
n-Nitrosodi-n-propylamine	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
n-Nitrosodiphenylamine	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
n-Nitrosomethylethylamine	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
n-Nitrosomorpholine	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
n-Nitrosopiperidine	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
n-Nitrosopyrrolidine	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
o-Toluidine	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
Pentachlorobenzene	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
Pentachloronitrobenzene	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
Pentachlorophenol	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	NA
Phenacetin	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
Phenol	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	NA

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SUMMARY OF ANALYTICAL RESULTS - QA/QC SAMPLES, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

	Equipment Rinsates										
Sample ID	59ER01	59ER02	59ER03	59ER04	59ER05	59ER06	59ER07	59ER08	59ER09	59ER10	59ER11
Sample Date	4/19/2010	4/20/2010	4/21/2010	4/22/2010	5/18/2010	5/19/2010	5/20/2010	5/21/2010	5/22/2010	5/23/2010	5/24/2010
Semivolatile Organics (µg/L) (cont.)											
Pronamide	10 U	10 U	10 U	10 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
Pyridine	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
Safrole	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
LLPAHs (µg/L)											
2-Methylnaphthalene	0.21 UJ	0.021 J	0.032 J	0.21 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.21 UJ	NA
Acenaphthene	0.21 U	0.2 U	0.21 U	0.21 U	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.21 UJ	NA
Acenaphthylene	0.21 U	0.2 U	0.21 U	0.21 U	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.21 UJ	NA
Anthracene	0.21 U	0.2 U	0.21 U	0.21 U	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.21 UJ	NA
Benzo(a)anthracene	0.21 U	0.2 U	0.21 U	0.21 U	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.21 UJ	NA
Benzo(a)pyrene (BaP)	0.21 U	0.2 U	0.21 U	0.21 U	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.21 UJ	NA
Benzo(b)fluoranthene	0.21 U	0.2 U	0.21 U	0.21 U	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.21 UJ	NA
Benzo(g,h,i)perylene	0.21 U	0.2 U	0.21 UJ	0.21 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.21 UJ	NA
Benzo(k)fluoranthene	0.21 UJ	0.2 UJ	0.21 U	0.21 U	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.21 UJ	NA
Chrysene	0.21 U	0.2 U	0.21 UJ	0.21 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.21 UJ	NA
Dibenz(a,h)anthracene	0.21 U	0.2 U	0.21 U	0.21 U	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.21 UJ	NA
Fluoranthene	0.21 U	0.2 U	0.21 U	0.21 U	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.21 UJ	NA
Fluorene	0.21 U	0.2 U	0.21 UJ	0.21 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.21 UJ	NA
Indeno(1,2,3-cd)pyrene	0.21 U	0.2 U	0.21 U	0.21 U	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.21 UJ	NA
Naphthalene	0.045 J	0.075 J	0.089 J	0.21 UJ	0.21 UJ	0.2 UJ	0.048 J	0.042 J	0.041 J	0.04 J	NA
Phenanthrene	0.21 U	0.2 U	0.21 U	0.21 U	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.21 UJ	NA
Pyrene	0.21 U	0.2 U	0.21 U	0.21 U	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.21 UJ	NA
Pesticides (µg/L)											
4,4'-DDD	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	NA
4,4'-DDE	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	NA
4,4'-DDT	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	NA
Aldrin	0.05 U	0.05 U	0.05 U	0.05 U	0.051 U	0.05 U	0.051 U	0.05 U	0.05 U	0.05 U	NA
BHC, alpha-	0.05 U	0.05 U	0.05 U	0.05 U	0.051 U	0.05 U	0.051 U	0.05 U	0.05 U	0.05 U	NA
BHC, beta-	0.05 U	0.05 U	0.05 U	0.05 U	0.051 U	0.05 U	0.051 U	0.05 U	0.05 U	0.05 U	NA
BHC, delta-	0.05 U	0.05 U	0.05 U	0.05 U	0.051 U	0.05 U	0.051 U	0.05 U	0.05 U	0.05 U	NA
BHC, gamma- (Lindane)	0.05 U	0.05 U	0.05 U	0.05 U	0.051 U	0.05 U	0.051 U	0.05 U	0.05 U	0.05 U	NA
Chlordane, alpha-	0.05 U	0.05 U	0.05 U	0.05 U	0.051 U	0.05 U	0.051 U	0.05 U	0.05 U	0.05 U	NA
Chlordane, gamma-	0.05 U	0.05 U	0.05 U	0.05 U	0.051 U	0.05 U	0.051 U	0.05 U	0.05 U	0.05 U	NA
Chlorobenzilate	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
Dieldrin	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	NA
Endosulfan I	0.05 U	0.05 U	0.05 U	0.05 U	0.051 U	0.05 U	0.051 U	0.05 U	0.05 U	0.05 U	NA

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SUMMARY OF ANALYTICAL RESULTS - QA/QC SAMPLES, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

	Equipment Rinsates										
Sample ID	59ER01	59ER02	59ER03	59ER04	59ER05	59ER06	59ER07	59ER08	59ER09	59ER10	59ER11
Sample Date	4/19/2010	4/20/2010	4/21/2010	4/22/2010	5/18/2010	5/19/2010	5/20/2010	5/21/2010	5/22/2010	5/23/2010	5/24/2010
Pesticides (µg/L) (cont.)											
Endosulfan II	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	NA
Endosulfan Sulfate	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	NA
Endrin	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	NA
Endrin Aldehyde	0.1 R	0.1 R	0.1 R	0.1 R	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	NA
Heptachlor	0.05 U	0.05 U	0.05 U	0.05 U	0.051 U	0.05 U	0.051 U	0.05 U	0.05 U	0.05 U	NA
Heptachlor Epoxide	0.05 U	0.05 U	0.05 U	0.05 U	0.051 U	0.05 U	0.051 U	0.05 U	0.05 U	0.05 U	NA
Isodrin	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
Kepone (Chlordecone)	5.1 U	5 U	5.1 U	5.3 U	5.3 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5.3 UJ	NA
Methoxychlor	0.5 U	0.5 U	0.5 U	0.5 U	0.51 U	0.5 U	0.51 U	0.5 U	0.5 U	0.5 U	NA
Toxaphene	2.5 U	2.5 U	2.5 U	2.5 U	2.6 U	2.5 U	2.6 U	2.5 U	2.5 U	2.5 U	NA
Total Metals (µg/L)											
Antimony	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	NA
Arsenic	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA
Barium	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	NA
Beryllium	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA
Cadmium	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA
Chromium	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	NA
Cobalt	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA
Copper	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	NA
Lead	0.11 J	0.068 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA
Mercury	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NA
Nickel	0.12 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA
Selenium	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	NA
Silver	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA
Thallium	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA
Tin	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	NA
Vanadium	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	NA
Zinc	2.2	3.3	1.8 J	2	2.7	0.7 J	0.82 J	0.7 J	1.2 J	1.3 J	NA

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SUMMARY OF ANALYTICAL RESULTS - QA/QC SAMPLES, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

	Field Blanks		Trip Blanks					
Sample ID	59FB01	59FB02	59TB01	59TB02	59TB03	59TB04	59TB05	59TB06
Sample Date	4/19/2010	5/18/2010	4/19/2010	4/20/2010	4/22/2010	5/18/2010	5/20/2010	5/22/2010
Volatile Organics (µg/L)								
1,1,1,2-Tetrachloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,1-Trichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2,2-Tetrachloroethane	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U
1,1,2-Trichloroethane	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U
1,1-Dichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-Dichloroethene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,3-Trichloropropane	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U
1,2-Dibromo-3-chloropropane (DBCP)	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U
1,2-Dibromoethane (EDB)	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U
1,2-Dichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloroethene (trans)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloropropane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,3-Dichloropropene (cis)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,3-Dichloropropene (trans)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,4-Dichloro-2-butene (trans)	2 UJ	2 U	2 UJ	2 UJ	2 UJ	2 U	2 U	2 U
1,4-Dioxane (p-)	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R
2-Butanone (MEK)	1.2 J	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R
2-Chloro-1,3-butadiene (Chloroprene)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
2-Hexanone (MBK)	2.5 UJ	2.5 U	2.5 UJ	2.5 UJ	2.5 UJ	2.5 U	2.5 U	2.5 U
3-Chloropropene (Allyl Chloride)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
4-Methyl-2-pentanone (MIBK)	2.5 UJ	2.5 U	2.5 UJ	2.5 UJ	2.5 UJ	2.5 U	2.5 U	2.5 U
Acetone	3 J	5 J	2.5 R	2.5 R	2.5 R	2.5 R	1.3 J	2.5 R
Acetonitrile	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U
Acrolein	5 R	5 R	5 R	5 R	5 R	5 R	5 R	5 R
Acrylonitrile	5 R	5 R	5 R	5 R	5 R	5 R	5 R	5 R
Benzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromodichloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromoform	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromomethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ
Carbon Disulfide	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ
Carbon Tetrachloride	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chlorobenzene	0.34 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloroform	0.12 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Dibromochloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Dibromomethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U

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SUMMARY OF ANALYTICAL RESULTS - QA/QC SAMPLES, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

	Field Blanks		Trip Blanks					
Sample ID	59FB01	59FB02	59TB01	59TB02	59TB03	59TB04	59TB05	59TB06
Sample Date	4/19/2010	5/18/2010	4/19/2010	4/20/2010	4/22/2010	5/18/2010	5/20/2010	5/22/2010
Volatile Organics (µg/L) (cont.)								
Ethyl Methacrylate	5 UJ	5 U	5 UJ	5 UJ	5 UJ	5 U	5 U	5 U
Ethylbenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Freon 11 (Trichlorofluoromethane)	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 U
Freon-12 (Dichlorodifluoromethane)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Isobutyl Alcohol	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R
Methyl Acrylonitrile	5 UJ	5 U	5 UJ	5 UJ	5 UJ	5 U	5 U	5 U
Methyl Iodide	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methyl Methacrylate	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Methylene Chloride	5.5	0.16 J	0.19 J	0.18 J	0.19 J	0.22 J	0.2 J	0.5 U
Pentachloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Propionitrile (Ethyl Cyanide)	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R
Styrene (Ethenylbenzene)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Tetrachloroethene (PCE)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Toluene	2.4	0.19 J	0.041 J	0.045 J	0.041 J	0.13 J	0.13 J	0.5 U
Trichloroethene (TCE)	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U
Vinyl Acetate	1 UJ	1 U	1 UJ	1 UJ	1 UJ	1 U	1 U	1 UJ
Vinyl Chloride	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Xylene, m/p-	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Xylene, o-	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Xylenes, total	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Semivolatile Organics (µg/L)								
1,2,4,5-Tetrachlorobenzene	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene (o-)	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
1,3,5-Trinitrobenzene (TNB)	5.1 UJ	5 UJ	NA	NA	NA	NA	NA	NA
1,3-Dichlorobenzene (m-)	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
1,3-Dinitrobenzene (m-)	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene (p-)	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
1,4-Naphthoquinone	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
1,4-Phenylenediamine	52 R	51 R	NA	NA	NA	NA	NA	NA
1-Naphthylamine	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
2,2'-Oxybis[1-chloropropane]	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
2,3,4,6-Tetrachlorophenol	10 U	10 UJ	NA	NA	NA	NA	NA	NA
2,4,5-Trichlorophenol	10 U	10 UJ	NA	NA	NA	NA	NA	NA
2,4,6-Trichlorophenol	10 U	10 UJ	NA	NA	NA	NA	NA	NA
2,4-Dichlorophenol	10 U	10 UJ	NA	NA	NA	NA	NA	NA

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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

	Field Blanks		Trip Blanks					
Sample ID	59FB01	59FB02	59TB01	59TB02	59TB03	59TB04	59TB05	59TB06
Sample Date	4/19/2010	5/18/2010	4/19/2010	4/20/2010	4/22/2010	5/18/2010	5/20/2010	5/22/2010
Semivolatile Organics (µg/L) (cont.)								
2,4-Dimethylphenol	10 U	10 UJ	NA	NA	NA	NA	NA	NA
2,4-Dinitrophenol	10 UJ	10 UJ	NA	NA	NA	NA	NA	NA
2,4-Dinitrotoluene (DNT)	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
2,6-Dichlorophenol	10 U	10 UJ	NA	NA	NA	NA	NA	NA
2,6-Dinitrotoluene (DNT)	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
2-Acetylaminofluorene	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
2-Chloronaphthalene	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
2-Chlorophenol	10 U	10 UJ	NA	NA	NA	NA	NA	NA
2-Methyl-5-nitroaniline	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
2-Methylphenol (o-Cresol)	10 U	10 UJ	NA	NA	NA	NA	NA	NA
2-Naphthylamine	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
2-Nitroaniline	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
2-Nitrophenol	10 U	10 UJ	NA	NA	NA	NA	NA	NA
2-Picoline	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
3,3'-Dichlorobenzidine	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
3,3'-Dimethylbenzidine	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
3-Methylcholanthrene	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
3-Methylphenol (m-Cresol)	8.2 U	8 UJ	NA	NA	NA	NA	NA	NA
3-Nitroaniline	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
4,6-Dinitro-2-methylphenol	10 U	10 UJ	NA	NA	NA	NA	NA	NA
4-Aminobiphenyl	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
4-Bromophenyl-phenylether	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
4-Chloro-3-methylphenol	10 U	10 UJ	NA	NA	NA	NA	NA	NA
4-Chloroaniline	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
4-Chlorophenyl-phenylether	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
4-Dimethylaminoazobenzene (p-)	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
4-Methylphenol (p-Cresol)	8.2 U	8 UJ	NA	NA	NA	NA	NA	NA
4-Nitroaniline	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
4-Nitrophenol	10 U	10 UJ	NA	NA	NA	NA	NA	NA
4-Nitroquinoline-1-oxide	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
7,12-Dimethylbenz(a)anthracene	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
a,a-Dimethylphenethylamine	51 UJ	50 UJ	NA	NA	NA	NA	NA	NA
Acetophenone	2.6 U	2.5 UJ	NA	NA	NA	NA	NA	NA
Aniline	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
Aramite	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
Benzyl Alcohol	5.1 UJ	5 UJ	NA	NA	NA	NA	NA	NA
Bis(2-chloroethoxy)methane	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA

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	Field Blanks		Trip Blanks					
Sample ID	59FB01	59FB02	59TB01	59TB02	59TB03	59TB04	59TB05	59TB06
Sample Date	4/19/2010	5/18/2010	4/19/2010	4/20/2010	4/22/2010	5/18/2010	5/20/2010	5/22/2010
Semivolatile Organics (µg/L) (cont.)								
Bis(2-chloroethyl)ether	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
Bis(2-ethylhexyl) Phthalate (BEHP)	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
Butyl Benzyl Phthalate	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
Diallate (cis)	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
Diallate (trans)	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
Dibenzofuran	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
Diethyl Phthalate (DEP)	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
Dimethyl Phthalate	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
Di-n-butyl Phthalate (DBP)	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
Di-n-octyl Phthalate	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
Dinoseb	NA	5 UJ	NA	NA	NA	NA	NA	NA
Ethyl Methane Sulfonate (EMS)	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
Hexachloro-1,3-butadiene	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
Hexachlorocyclopentadiene	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
Hexachloroethane	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
Hexachloropropene	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
Isophorone	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
Isosafrole	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
Methapyrilene	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
Methyl Methane Sulfonate	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
Nitrobenzene	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
n-Nitrosodiethylamine	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
n-Nitrosodimethylamine (NDMA)	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
n-Nitroso-di-n-butylamine	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
n-Nitrosodi-n-propylamine	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
n-Nitrosodiphenylamine	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
n-Nitrosomethylethylamine	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
n-Nitrosomorpholine	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
n-Nitrosopiperidine	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
n-Nitrosopyrrolidine	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
o-Toluidine	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
Pentachlorobenzene	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
Pentachloronitrobenzene	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
Pentachlorophenol	10 U	10 UJ	NA	NA	NA	NA	NA	NA
Phenacetin	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
Phenol	10 U	10 UJ	NA	NA	NA	NA	NA	NA

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	Field Blanks		Trip Blanks					
Sample ID	59FB01	59FB02	59TB01	59TB02	59TB03	59TB04	59TB05	59TB06
Sample Date	4/19/2010	5/18/2010	4/19/2010	4/20/2010	4/22/2010	5/18/2010	5/20/2010	5/22/2010
Semivolatile Organics (µg/L) (cont.)								
Pronamide	10 U	5 UJ	NA	NA	NA	NA	NA	NA
Pyridine	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
Safrole	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
LLPAHs (µg/L)								
2-Methylnaphthalene	0.21 UJ	0.2 UJ	NA	NA	NA	NA	NA	NA
Acenaphthene	0.21 U	0.2 UJ	NA	NA	NA	NA	NA	NA
Acenaphthylene	0.21 U	0.2 UJ	NA	NA	NA	NA	NA	NA
Anthracene	0.21 U	0.2 UJ	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	0.21 U	0.2 UJ	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene (BaP)	0.21 U	0.2 UJ	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	0.21 U	0.2 UJ	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	0.21 U	0.2 UJ	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	0.21 UJ	0.2 UJ	NA	NA	NA	NA	NA	NA
Chrysene	0.21 U	0.2 UJ	NA	NA	NA	NA	NA	NA
Dibenz(a,h)anthracene	0.21 U	0.2 UJ	NA	NA	NA	NA	NA	NA
Fluoranthene	0.21 U	0.2 UJ	NA	NA	NA	NA	NA	NA
Fluorene	0.21 U	0.2 UJ	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	0.21 U	0.2 UJ	NA	NA	NA	NA	NA	NA
Naphthalene	0.048 J	0.2 UJ	NA	NA	NA	NA	NA	NA
Phenanthrene	0.21 U	0.2 UJ	NA	NA	NA	NA	NA	NA
Pyrene	0.21 U	0.2 UJ	NA	NA	NA	NA	NA	NA
Pesticides (µg/L)								
4,4'-DDD	0.1 U	0.1 U	NA	NA	NA	NA	NA	NA
4,4'-DDE	0.1 U	0.1 U	NA	NA	NA	NA	NA	NA
4,4'-DDT	0.1 U	0.1 U	NA	NA	NA	NA	NA	NA
Aldrin	0.05 U	0.05 U	NA	NA	NA	NA	NA	NA
BHC, alpha-	0.05 U	0.05 U	NA	NA	NA	NA	NA	NA
BHC, beta-	0.05 U	0.012 J	NA	NA	NA	NA	NA	NA
BHC, delta-	0.05 U	0.05 U	NA	NA	NA	NA	NA	NA
BHC, gamma- (Lindane)	0.05 U	0.05 U	NA	NA	NA	NA	NA	NA
Chlordane, alpha-	0.05 U	0.05 U	NA	NA	NA	NA	NA	NA
Chlordane, gamma-	0.05 U	0.05 U	NA	NA	NA	NA	NA	NA
Chlorobenzilate	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
Dieldrin	0.1 U	0.1 U	NA	NA	NA	NA	NA	NA
Endosulfan I	0.05 U	0.05 U	NA	NA	NA	NA	NA	NA

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	Field Blanks		Trip Blanks					
Sample ID	59FB01	59FB02	59TB01	59TB02	59TB03	59TB04	59TB05	59TB06
Sample Date	4/19/2010	5/18/2010	4/19/2010	4/20/2010	4/22/2010	5/18/2010	5/20/2010	5/22/2010
Pesticides (µg/L) (cont.)								
Endosulfan II	0.1 U	0.1 U	NA	NA	NA	NA	NA	NA
Endosulfan Sulfate	0.1 U	0.1 U	NA	NA	NA	NA	NA	NA
Endrin	0.1 U	0.1 U	NA	NA	NA	NA	NA	NA
Endrin Aldehyde	0.1 R	0.1 U	NA	NA	NA	NA	NA	NA
Heptachlor	0.05 U	0.05 U	NA	NA	NA	NA	NA	NA
Heptachlor Epoxide	0.05 U	0.05 U	NA	NA	NA	NA	NA	NA
Isodrin	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
Kepone (Chlordecone)	5.1 U	5 UJ	NA	NA	NA	NA	NA	NA
Methoxychlor	0.5 U	0.5 U	NA	NA	NA	NA	NA	NA
Toxaphene	2.5 U	2.5 U	NA	NA	NA	NA	NA	NA
Total Metals (µg/L)								
Antimony	2 U	2 U	NA	NA	NA	NA	NA	NA
Arsenic	1 U	1 U	NA	NA	NA	NA	NA	NA
Barium	10 U	10 U	NA	NA	NA	NA	NA	NA
Beryllium	1 U	1 U	NA	NA	NA	NA	NA	NA
Cadmium	1 U	1 U	NA	NA	NA	NA	NA	NA
Chromium	2 U	2 U	NA	NA	NA	NA	NA	NA
Cobalt	1 U	1 U	NA	NA	NA	NA	NA	NA
Copper	2 U	0.8 J	NA	NA	NA	NA	NA	NA
Lead	0.07 J	0.089 J	NA	NA	NA	NA	NA	NA
Mercury	0.2 U	0.2 U	NA	NA	NA	NA	NA	NA
Nickel	1 U	0.14 J	NA	NA	NA	NA	NA	NA
Selenium	5 U	5 U	NA	NA	NA	NA	NA	NA
Silver	1 U	1 U	NA	NA	NA	NA	NA	NA
Thallium	1 U	1 U	NA	NA	NA	NA	NA	NA
Tin	20 U	20 U	NA	NA	NA	NA	NA	NA
Vanadium	5 U	5 U	NA	NA	NA	NA	NA	NA
Zinc	2.2	1.3 J	NA	NA	NA	NA	NA	NA

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Notes:

J - Estimated: The analyte was positively identified; the quantitation is an estimation.
U - Non detected at the Limit of Detection.
UJ - Reported quantitation limit is qualified as estimated.
R - Rejected data; data is not usable.
LLPAHs - Low Level Polynuclear Aromatic Hydrocarbons
µg/L - microgram per liter
NA - Not Analyzed
QA/QC - Quality Assurance/Quality Control

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	Equipment Rinsates		Field Blank	Trip Blank
Sample ID	59ER12	59ER14	59FB03	59TB07
Date	9/13/2012	9/15/2012	9/13/2012	9/13/2012
Volatile Organics (µg/L)				
1,1,1,2-Tetrachloroethane	0.33 U	NA	0.33 U	0.33 U
1,1,1-Trichloroethane	0.5 U	NA	0.5 U	0.5 U
1,1,2,2-Tetrachloroethane	0.25 U	NA	0.25 U	0.25 U
1,1,2-Trichloroethane	0.25 U	NA	0.25 U	0.25 U
1,1-Dichloroethane	0.25 U	NA	0.25 U	0.25 U
1,1-Dichloroethene	0.25 U	NA	0.25 U	0.25 U
1,2,3-Trichloropropane	0.5 U	NA	0.5 U	0.5 U
1,2,4-Trichlorobenzene	0.25 U	NA	0.25 U	0.25 U
1,2-Dibromo-3-Chloropropane	1 U	NA	1 U	1 U
1,2-Dibromoethane	0.25 U	NA	0.25 U	0.25 U
1,2-Dichlorobenzene	0.25 U	NA	0.25 U	0.25 U
1,2-Dichloroethane	0.25 U	NA	0.25 U	0.25 U
1,2-Dichloropropane	0.25 U	NA	0.25 U	0.25 U
1,3-Dichlorobenzene	0.25 U	NA	0.25 U	0.25 U
1,4-Dichlorobenzene	0.28 U	NA	0.28 U	0.28 U
1,4-Dioxane	50 R	NA	50 R	50 R
2-Butanone	1 U	NA	1 U	1 U
2-Hexanone	1 U	NA	1 U	1 U
4-Methyl-2-pentanone	1 U	NA	1 U	1 U
Acetone	5 U	NA	5 U	5 U
Acetonitrile	10 U	NA	10 U	10 U
Acrolein	7.4 U	NA	7.4 U	7.4 U
Acrylonitrile	7.2 U	NA	7.2 U	7.2 U
Allyl chloride	0.5 UJ	NA	0.5 UJ	0.5 UJ
Benzene	0.25 U	NA	0.25 U	0.25 U
Bromodichloromethane	0.25 U	NA	0.25 U	0.25 U
Bromoform	0.5 U	NA	0.5 U	0.5 U
Bromomethane	0.8 UJ	NA	0.8 UJ	0.8 UJ
Carbon disulfide	0.6 U	NA	0.6 U	0.6 U
Carbon tetrachloride	0.5 U	NA	0.5 U	0.5 U
Chlorobenzene	0.25 U	NA	0.25 U	0.25 U
Chloroethane	1 U	NA	1 U	1 U
Chloroform	0.25 U	NA	0.25 U	0.25 U
Chloromethane	0.33 UJ	NA	0.33 UJ	0.33 UJ
Chloroprene	0.3 U	NA	0.3 U	0.3 U
cis-1,3-Dichloropropene	0.25 U	NA	0.25 U	0.25 U
Dibromochloromethane	0.25 U	NA	0.25 U	0.25 U
Dibromomethane	0.25 U	NA	0.25 U	0.25 U
Dichlorodifluoromethane	0.25 U	NA	0.25 U	0.25 U
Ethyl methacrylate	0.25 U	NA	0.25 U	0.25 U
Ethylbenzene	0.25 U	NA	0.25 U	0.25 U
Hexachlorobutadiene	0.5 U	NA	0.5 U	0.5 U
Iodomethane	1 UJ	NA	1 UJ	1 UJ
Isobutanol	20 R	NA	20 R	20 R
Methacrylonitrile	5 U	NA	5 U	5 U
Methyl methacrylate	0.5 U	NA	0.5 U	0.5 U
Methylene Chloride	1 U	NA	1 U	1 U
Naphthalene	1 R	NA	1 R	1 R
Pentachloroethane	1.2 UJ	NA	1.2 UJ	1.2 UJ
Propionitrile	5 U	NA	5 U	5 U
Styrene	0.25 U	NA	0.25 U	0.25 U

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	Equipment Rinsates		Field Blank	Trip Blank
Sample ID	59ER12	59ER14	59FB03	59TB07
Date	9/13/2012	9/15/2012	9/13/2012	9/13/2012
Volatile Organics (µg/L) (cont.)				
Tetrachloroethene	0.25 U	NA	0.25 U	0.25 U
Toluene	0.33 U	NA	0.33 U	0.33 U
trans-1,2-Dichloroethene	0.25 U	NA	0.25 U	0.25 U
trans-1,3-Dichloropropene	0.25 U	NA	0.25 U	0.25 U
trans-1,4-Dichloro-2-butene	1 UJ	NA	1 UJ	1 UJ
Trichloroethene	0.25 U	NA	0.25 U	0.25 U
Trichlorofluoromethane	0.25 U	NA	0.25 U	0.25 U
Vinyl acetate	0.5 U	NA	0.5 U	0.5 U
Vinyl chloride	0.5 U	NA	0.5 U	0.5 U
Xylenes, Total	0.75 U	NA	0.75 U	0.75 U
Semivolatile Organics (µg/L)				
1,2,4,5-Tetrachlorobenzene	0.092 UJ	NA	0.093 UJ	NA
1,2,4-Trichlorobenzene	0.092 UJ	NA	0.093 UJ	NA
1,2-Dichlorobenzene	0.092 UJ	NA	0.093 UJ	NA
1,3,5-Trinitrobenzene	0.46 UJ	NA	0.46 UJ	NA
1,3-Dichlorobenzene	0.092 UJ	NA	0.093 UJ	NA
1,3-Dinitrobenzene	0.092 UJ	NA	0.093 UJ	NA
1,4-Dichlorobenzene	0.092 UJ	NA	0.093 UJ	NA
1,4-Dioxane	0.29 UJ	NA	0.29 UJ	NA
1,4-Naphthoquinone	0.46 UJ	NA	0.46 UJ	NA
1-Naphthylamine	1.2 UJ	NA	1.2 UJ	NA
2,2'-oxybis[1-chloropropane]	0.092 UJ	NA	0.093 UJ	NA
2,3,4,6-Tetrachlorophenol	0.092 UJ	NA	0.093 UJ	NA
2,4,5-Trichlorophenol	0.11 UJ	NA	0.11 UJ	NA
2,4,6-Trichlorophenol	0.16 UJ	NA	0.16 UJ	NA
2,4-Dichlorophenol	0.092 UJ	NA	0.093 UJ	NA
2,4-Dimethylphenol	0.64 UJ	NA	0.64 UJ	NA
2,4-Dinitrophenol	1.2 UJ	NA	1.2 UJ	NA
2,4-Dinitrotoluene	0.11 UJ	NA	0.11 UJ	NA
2,6-Dichlorophenol	0.092 UJ	NA	0.093 UJ	NA
2,6-Dinitrotoluene	0.12 UJ	NA	0.12 UJ	NA
2-Acetylaminofluorene	0.18 UJ	NA	0.19 UJ	NA
2-Chloronaphthalene	0.092 UJ	NA	0.093 UJ	NA
2-Chlorophenol	0.11 UJ	NA	0.11 UJ	NA
2-Methylphenol	0.68 UJ	NA	0.69 UJ	NA
2-Naphthylamine	1.2 UJ	NA	1.2 UJ	NA
2-Nitroaniline	0.18 UJ	NA	0.19 UJ	NA
2-Nitrophenol	0.092 UJ	NA	0.093 UJ	NA
2-Picoline	0.18 UJ	NA	0.19 UJ	NA
2-Toluidine	0.12 UJ	NA	0.12 UJ	NA
3 & 4 Methylphenol	0.61 UJ	NA	0.61 UJ	NA
3,3'-Dichlorobenzidine	1.8 UJ	NA	1.9 UJ	NA
3,3'-Dimethylbenzidine	4.6 UJ	NA	4.6 UJ	NA
3-Methylcholanthrene	0.46 UJ	NA	0.46 UJ	NA
3-Nitroaniline	0.18 UJ	NA	0.19 UJ	NA
4,6-Dinitro-2-methylphenol	0.12 UJ	NA	0.12 UJ	NA
4-Aminobiphenyl	0.29 UJ	NA	0.29 UJ	NA
4-Bromophenyl phenyl ether	0.11 UJ	NA	0.11 UJ	NA
4-Chloro-3-methylphenol	0.11 UJ	NA	0.11 UJ	NA
4-Chloroaniline	0.33 UJ	NA	0.33 UJ	NA

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - QA/QC SAMPLES, 2012 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

	Equipment Rinsates		Field Blank	Trip Blank
Sample ID	59ER12	59ER14	59FB03	59TB07
Date	9/13/2012	9/15/2012	9/13/2012	9/13/2012
Semivolatile Organics (µg/L) (cont.)				
4-Chlorophenyl phenyl ether	0.092 UJ	NA	0.093 UJ	NA
4-Nitroaniline	0.46 UJ	NA	0.46 UJ	NA
4-Nitrophenol	0.46 UJ	NA	0.46 UJ	NA
4-Nitroquinoline-1-oxide	1.2 UJ	NA	1.2 UJ	NA
7,12-Dimethylbenz(a)anthracene	0.18 UJ	NA	0.19 UJ	NA
Acetophenone	0.25 J	NA	0.15 J	NA
alpha,alpha-Dimethyl phenethylamine	3.1 UJ	NA	3.2 UJ	NA
Aniline	0.89 UJ	NA	0.9 UJ	NA
Aramite, Total	0.1 UJ	NA	0.1 UJ	NA
Benzyl alcohol	0.18 UJ	NA	0.19 UJ	NA
Bis(2-chloroethoxy)methane	0.092 UJ	NA	0.093 UJ	NA
Bis(2-chloroethyl)ether	0.092 UJ	NA	0.093 UJ	NA
Bis(2-ethylhexyl) phthalate	0.59 UJ	NA	0.59 UJ	NA
Butyl benzyl phthalate	0.11 UJ	NA	0.11 UJ	NA
Diallate	0.092 UJ	NA	0.093 UJ	NA
Dibenzofuran	0.092 UJ	NA	0.093 UJ	NA
Diethyl phthalate	0.12 J	NA	0.1 UJ	NA
Dimethyl phthalate	0.092 UJ	NA	0.093 UJ	NA
Di-n-butyl phthalate	0.36 UJ	NA	0.36 UJ	NA
Di-n-octyl phthalate	0.16 UJ	NA	0.16 UJ	NA
Dinoseb	0.18 UJ	NA	0.19 UJ	NA
Ethyl methanesulfonate	0.092 UJ	NA	0.093 UJ	NA
Hexachlorobenzene	0.092 UJ	NA	0.093 UJ	NA
Hexachlorobutadiene	0.092 UJ	NA	0.093 UJ	NA
Hexachlorocyclopentadiene	0.46 UJ	NA	0.46 UJ	NA
Hexachloroethane	0.46 UJ	NA	0.46 UJ	NA
Hexachlorophene	23 UJ	NA	23 UJ	NA
Hexachloropropene	0.092 UJ	NA	0.093 UJ	NA
Isophorone	0.092 UJ	NA	0.093 UJ	NA
Isosafrole	0.092 UJ	NA	0.093 UJ	NA
Methapyrilene	2.3 UJ	NA	2.3 UJ	NA
Methyl methanesulfonate	0.092 UJ	NA	0.093 UJ	NA
Nitrobenzene	0.092 UJ	NA	0.093 UJ	NA
N-Nitro-o-toluidine	0.092 UJ	NA	0.093 UJ	NA
N-Nitrosodiethylamine	0.092 UJ	NA	0.093 UJ	NA
N-Nitrosodimethylamine	0.23 UJ	NA	0.23 UJ	NA
N-Nitrosodi-n-butylamine	0.092 UJ	NA	0.093 UJ	NA
N-Nitrosodi-n-propylamine	0.12 UJ	NA	0.12 UJ	NA
N-Nitrosodiphenylamine	0.34 UJ	NA	0.34 UJ	NA
N-Nitrosomethylethylamine	0.18 UJ	NA	0.19 UJ	NA
N-Nitrosomorpholine	0.092 UJ	NA	0.093 UJ	NA
N-Nitrosopiperidine	0.092 UJ	NA	0.093 UJ	NA
N-Nitrosopyrrolidine	0.092 UJ	NA	0.093 UJ	NA
p-Dimethylamino azobenzene	0.18 UJ	NA	0.19 UJ	NA
Pentachlorobenzene	0.092 UJ	NA	0.093 UJ	NA
Pentachloronitrobenzene	0.46 UJ	NA	0.46 UJ	NA
Pentachlorophenol	0.37 UJ	NA	0.37 UJ	NA
Phenacetin	0.092 UJ	NA	0.093 UJ	NA
Phenol	0.12 UJ	NA	0.12 UJ	NA
p-Phenylene diamine	15 UJ	NA	15 UJ	NA
Pronamide	0.11 UJ	NA	0.11 UJ	NA

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - QA/QC SAMPLES, 2012 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

	Equipment Rinsates		Field Blank	Trip Blank
Sample ID	59ER12	59ER14	59FB03	59TB07
Date	9/13/2012	9/15/2012	9/13/2012	9/13/2012
Semivolatile Organics (µg/L) (cont.)				
Pyridine	0.67 UJ	NA	0.68 UJ	NA
Safrole, Total	0.092 UJ	NA	0.093 UJ	NA
LLPAHs (µg/L)				
2-Methylnaphthalene	0.092 UJ	NA	0.093 UJ	NA
Acenaphthene	0.092 UJ	NA	0.093 UJ	NA
Acenaphthylene	0.092 UJ	NA	0.093 UJ	NA
Anthracene	0.092 UJ	NA	0.093 UJ	NA
Benzo[a]anthracene	0.092 UJ	NA	0.093 UJ	NA
Benzo[a]pyrene	0.092 UJ	NA	0.093 UJ	NA
Benzo[b]fluoranthene	0.092 UJ	NA	0.093 UJ	NA
Benzo[g,h,i]perylene	0.092 UJ	NA	0.093 UJ	NA
Benzo[k]fluoranthene	0.092 UJ	NA	0.093 UJ	NA
Chrysene	0.092 UJ	NA	0.093 UJ	NA
Dibenz(a,h)anthracene	0.092 UJ	NA	0.093 UJ	NA
Fluoranthene	0.092 UJ	NA	0.093 UJ	NA
Fluorene	0.092 UJ	NA	0.093 UJ	NA
Indeno[1,2,3-cd]pyrene	0.092 UJ	NA	0.093 UJ	NA
Naphthalene	0.092 UJ	NA	0.093 UJ	NA
Phenanthrene	0.092 UJ	NA	0.093 UJ	NA
Pyrene	0.12 UJ	NA	0.12 UJ	NA
Metals (µg/L)				
Antimony	2 U	2 U	2 U	NA
Arsenic	1.3 U	1.3 U	1.3 U	NA
Barium	7.3	7.2	7	NA
Beryllium	0.25 U	0.25 U	0.25 U	NA
Cadmium	0.2 U	0.2 U	0.2 U	NA
Chromium	2.5 U	2.5 U	2.5 U	NA
Cobalt	0.3 U	0.3 U	0.3 U	NA
Copper	1.1 U	1.1 U	1.1 U	NA
Lead	0.5 U	0.5 U	0.5 U	NA
Mercury	0.1 U	0.1 U	0.1 U	NA
Nickel	2 U	2 U	2 U	NA
Selenium	1.1 U	1.1 U	1.1 U	NA
Silver	0.25 U	0.25 U	0.25 U	NA
Thallium	0.25 U	0.25 J	0.26 J	NA
Tin	1.5 J	1.4 U	1.4 U	NA
Vanadium	3.2 U	3.2 U	3.2 U	NA
Zinc	8.4 U	8.4 U	8.4 U	NA

Notes:

J - Estimated: The analyte was positively identified; the quantitation is an estimation.
U - Non detected at the Limit of Detection.
UJ - Reported quantitation limit is qualified as estimated.
R - Rejected data; data is not usable.
LLPAHs - Low Level Polynuclear Aromatic Hydrocarbons
µg/L - microgram per liter
NA - Not Analyzed
QA/QC - Quality Assurance/Quality Control

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS - QA/QC SAMPLES, 2012 PRE-EXCAVATION DELINEATION SAMPLING
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

	Equipment Rinsates		Field Blank
Sample ID	59ER13	59ER15	59FB05
Date	9/14/2012	11/10/2012	11/10/2012
Metals (µg/L)			
Antimony	2 U	NA	NA
Arsenic	1.3 U	NA	NA
Barium	7.2	NA	NA
Beryllium	0.25 U	NA	NA
Cadmium	0.2 U	NA	NA
Chromium	2.5 U	NA	NA
Cobalt	0.3 U	NA	NA
Copper	1.1 U	1.1 U	1.1 U
Lead	0.5 U	0.5 U	0.5 U
Mercury	0.1 U	NA	NA
Nickel	2 U	NA	NA
Selenium	1.1 U	NA	NA
Silver	0.25 U	NA	NA
Thallium	0.25 U	NA	NA
Tin	1.4 U	NA	NA
Vanadium	3.2 U	NA	NA
Zinc	8.4 U	8.4 U	8.4 U

Notes:

U - Non detected at the Limit of Detection.
µg/L - microgram per liter
NA - Not Analyzed
QA/QC - Quality Assurance/Quality Control

ECP PHASE II DATA

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS, SURFACE SOIL - ORGANICS
ECP SITE 5 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	5E-01	5E-02	5E-03	5E-04
Sample ID	5E-SS01	5E-SS02	5E-SS03	5E-SS04
Sample Date	05/03/04	05/03/04	05/03/04	05/03/04
Sample Depth (ft bgs)	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00
Volatile Organic Compounds (ug/kg)				
Chloroform	5.2 U	6.5 U	6.3 U	7.9 U
Dichlorodifluoromethane	5.2 U	6.5 U	6.3 U	7.9 U
1,1-Dichloroethane	5.2 U	6.5 U	6.3 U	7.9 U
1,2-Dichloroethane	5.2 U	6.5 U	6.3 U	7.9 U
1,1-Dichloroethene	5.2 U	6.5 U	6.3 U	7.9 U
1,2-Dichloropropane	5.2 U	6.5 U	6.3 U	7.9 U
Ethyl benzene	5.2 U	6.5 U	6.3 U	7.9 U
Acrolein	100 U	130 U	130 U	160 U
Methylene chloride	5.2 U	6.5 U	6.3 U	7.9 U
1,1,2,2-Tetrachloroethane	5.2 U	6.5 U	6.3 U	7.9 U
Tetrachloroethene	5.2 U	6.5 U	6.3 U	7.9 U
Toluene	5.2 U	6.5 U	6.3 U	7.9 U
trans-1,2-Dichloroethene	5.2 U	6.5 U	6.3 U	7.9 U
1,1,1-Trichloroethane	5.2 U	6.5 U	6.3 U	7.9 U
1,1,2-Trichloroethane	5.2 U	6.5 U	6.3 U	7.9 U
2-Butanone	26 U	32 U	32 U	39 U
Chloroprene	5.2 U	6.5 U	6.3 U	7.9 U
2-Hexanone	26 U	32 U	32 U	39 U
Acrylonitrile	100 U	130 U	130 U	160 U
3-Chloro-1-propene	5.2 U	6.5 U	6.3 U	7.9 U
Benzene	5.2 U	6.5 U	6.3 U	7.9 U
Bromoform	5.2 U	6.5 U	6.3 U	7.9 U
Carbon tetrachloride	5.2 U	2.1 J	4.4 J	7.9 U
Chlorobenzene	5.2 U	6.5 U	6.3 U	7.9 U
Acetonitrile	210 U	260 U	250 U	310 U
1,2-Dibromo-3-chloropropane	10 U	13 U	13 U	16 U
Dibromomethane	5.2 U	6.5 U	6.3 U	7.9 U
trans-1,4-Dichloro-2-butene	10 U	13 U	13 U	16 U
cis-1,3-Dichloropropene	5.2 U	6.5 U	6.3 U	7.9 U
trans-1,3-Dichloropropene	5.2 U	6.5 U	6.3 U	7.9 U
Ethyl methacrylate	5.2 U	6.5 U	6.3 U	7.9 U
Iodomethane	5.2 U	6.5 U	6.3 U	7.9 U
Methacrylonitrile	100 U	130 U	130 U	160 U
Methyl methacrylate	5.2 U	6.5 U	6.3 U	7.9 U
Pentachloroethane	26 U	32 U	32 U	39 U
1,1,1,2-Tetrachloroethane	5.2 U	6.5 U	6.3 U	7.9 U
Trichlorofluoromethane	5.2 U	6.5 U	6.3 U	7.9 U
1,2,3-Trichloropropane	5.2 U	6.5 U	6.3 U	7.9 U
Vinyl chloride	5.2 U	6.5 U	6.3 U	7.9 U
Dibromochloromethane	5.2 U	6.5 U	6.3 U	7.9 U
Chloroethane	5.2 U	6.5 U	6.3 U	7.9 U
Acetone	52 U	65 U	63 U	79 U
Bromodichloromethane	5.2 U	6.5 U	6.3 U	7.9 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS, SURFACE SOIL - ORGANICS
ECP SITE 5 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	5E-01	5E-02	5E-03	5E-04
Sample ID	5E-SS01	5E-SS02	5E-SS03	5E-SS04
Sample Date	05/03/04	05/03/04	05/03/04	05/03/04
Sample Depth (ft bgs)	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00
Volatile Organic Compounds (ug/kg) (Cont.)				
Bromomethane	5.2 U	6.5 U	6.3 U	7.9 U
Chloromethane	5.2 U	6.5 U	6.3 U	7.9 U
Carbon disulfide	5.2 U	6.5 U	6.3 U	7.9 U
1,2-Dibromoethane	5.2 U	6.5 U	6.3 U	7.9 U
Propionitrile	100 U	130 U	130 U	160 U
Isobutanol	210 U	260 U	250 U	310 U
4-Methyl-2-pentanone	26 U	32 U	32 U	39 U
Styrene	5.2 U	6.5 U	6.3 U	7.9 U
Trichloroethene	5.2 U	6.5 U	6.3 U	7.9 U
Vinyl acetate	10 U	13 U	13 U	16 U
Xylene	10 U	13 U	13 U	16 U
Semivolatile Organic Compounds (ug/kg)				
Phenol	390 U	440 U	450 U	550 U
bis(2-Chloroethoxy)methane	390 U	440 U	450 U	550 U
2,4,6-Trichlorophenol	390 U	440 U	450 U	550 U
bis(2-Chloroethyl)ether	390 U	440 U	450 U	550 U
bis(2-Chloroisopropyl)ether	390 U	440 U	450 U	550 U
bis(2-Ethylhexyl)phthalate	390 U	440 U	450 U	550 U
4-Bromophenylphenyl ether	390 U	440 U	450 U	550 U
Butylbenzylphthalate	390 U	120 J	450 U	550 U
2-Chloronaphthalene	390 U	440 U	450 U	550 U
4-Chlorophenyl phenyl ether	390 U	440 U	450 U	550 U
Chrysene	390 U	440 U	450 U	60 J
Dibenzo(a,h)anthracene	390 U	440 U	450 U	550 U
2-Chlorophenol	390 U	440 U	450 U	550 U
Acenaphthene	390 U	440 U	450 U	550 U
3,3'-Dichlorobenzidine	780 U	890 U	900 U	1,100 U
Diethylphthalate	390 U	440 U	450 U	550 U
Dimethyl phthalate	390 U	440 U	450 U	550 U
2,4-Dinitrotoluene	390 U	440 U	450 U	550 U
2,6-Dinitrotoluene	390 U	440 U	450 U	550 U
Di-n-octylphthalate	390 U	440 U	450 U	550 U
2,4-Dichlorophenol	390 U	440 U	450 U	550 U
Acenaphthylene	390 U	440 U	450 U	550 U
2-Methylnaphthalene	390 U	440 U	450 U	550 U
Fluoranthene	390 U	440 U	450 U	97 J
Fluorene	390 U	440 U	450 U	550 U
Hexachlorobenzene	390 U	440 U	450 U	550 U
Hexachlorobutadiene	390 U	440 U	450 U	550 U
Hexachlorocyclopentadiene	390 U	440 U	450 U	550 U
Hexachloroethane	390 U	440 U	450 U	550 U
Indeno(1,2,3-cd)pyrene	390 U	440 U	450 U	44 JB

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS, SURFACE SOIL - ORGANICS
ECP SITE 5 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	5E-01	5E-02	5E-03	5E-04
Sample ID	5E-SS01	5E-SS02	5E-SS03	5E-SS04
Sample Date	05/03/04	05/03/04	05/03/04	05/03/04
Sample Depth (ft bgs)	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00
Semivolatile Organic Compounds (ug/kg) (Cont.)				
Isophorone	390 U	440 U	450 U	550 U
Naphthalene	390 U	440 U	450 U	550 U
2,4-Dimethylphenol	390 U	440 U	450 U	550 U
Anthracene	390 U	440 U	450 U	550 U
4,6-Dinitro-2-methylphenol	2,000 U	2,300 U	2,300 U	2,800 U
Nitrobenzene	390 U	440 U	450 U	550 U
N-Nitrosodimethylamine	390 U	440 U	450 U	550 U
N-Nitrosodiphenylamine	390 U	440 U	450 U	550 U
Phenanthrene	390 U	440 U	450 U	550 U
Pyrene	390 U	27 J	32 J	87 J
1,2,4-Trichlorobenzene	390 U	440 U	450 U	550 U
4-Nitroquinoline-1-oxide	3,900 U	4,400 U	4,500 U	5,500 U
2,4-Dinitrophenol	2,000 U	2,300 U	2,300 U	2,800 U
Benzo(a)anthracene	390 U	440 U	450 U	550 U
Benzo(a)pyrene	390 U	440 U	450 U	69 J
2,6-Dichlorophenol	390 U	440 U	450 U	550 U
Benzo(b)fluoranthene	390 U	440 U	450 U	67 J
4-Aminobiphenyl	390 U	440 U	450 U	550 U
p-(Dimethylamino)azobenzene	390 U	440 U	450 U	550 U
7,12-Dimethylbenz(a)anthracene	390 U	440 U	450 U	550 U
3,3'-Dimethyl benzidine	2,000 U	2,300 U	2,300 U	2,800 U
alpha,alpha-Dimethylphenethylamine	79,000 U	90,000 U	92,000 U	110,000 U
1,4-Dioxane	390 U	440 U	450 U	550 U
n-Nitrosodi-n-propylamine	390 U	440 U	450 U	550 U
Aniline	390 U	440 U	450 U	550 U
Ethylmethanesulfonate	390 U	440 U	450 U	550 U
Acetophenone	390 U	440 U	450 U	550 U
Aramite	390 U	440 U	450 U	550 U
Hexachlorophene	200,000 U	230,000 U	230,000 U	280,000 U
Hexachloropropene	390 U	440 U	450 U	550 U
Isosafrole	390 U	440 U	450 U	550 U
Methapyrilene	79,000 U	90,000 U	92,000 U	110,000 U
3-Methylcholanthrene	390 U	440 U	450 U	63 J
Methyl methanesulfonate	390 U	440 U	450 U	550 U
1,4-Naphthoquinone	390 U	440 U	450 U	550 U
1-Naphthylamine	390 U	440 U	450 U	550 U
2-Naphthylamine	390 U	440 U	450 U	550 U
N-Nitrosodi-n-butylamine	390 U	440 U	450 U	550 U
N-Nitrosodiethylamine	390 U	440 U	450 U	550 U
N-Nitrosomethylethylamine	390 U	440 U	450 U	550 U
N-Nitrosomorpholine	390 U	440 U	450 U	550 U
N-Nitrosopiperidine	390 U	440 U	450 U	550 U
N-Nitrosopyrrolidine	390 U	440 U	450 U	550 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS, SURFACE SOIL - ORGANICS
ECP SITE 5 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	5E-01	5E-02	5E-03	5E-04
Sample ID	5E-SS01	5E-SS02	5E-SS03	5E-SS04
Sample Date	05/03/04	05/03/04	05/03/04	05/03/04
Sample Depth (ft bgs)	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00
Semivolatile Organic Compounds (ug/kg) (Cont.)				
5-Nitro-o-toluidine	390 U	440 U	450 U	550 U
Pentachlorobenzene	390 U	440 U	450 U	550 U
Pentachloronitrobenzene	390 U	440 U	450 U	550 U
Phenacetin	390 U	440 U	450 U	550 U
2-Picoline	390 U	440 U	450 U	550 U
Pronamide	390 U	440 U	450 U	550 U
Pyridine	390 U	440 U	450 U	550 U
Safrole	390 U	440 U	450 U	550 U
1,2,4,5-Tetrachlorobenzene	390 U	440 U	450 U	550 U
2,3,4,6-Tetrachlorophenol	390 U	440 U	450 U	550 U
2,4,5-Trichlorophenol	390 U	440 U	450 U	550 U
1,3,5-Trinitrobenzene	390 U	440 U	450 U	550 U
2-Acetylaminofluorene	390 U	440 U	450 U	550 U
Dinoseb	390 U	440 U	450 U	550 U
4-Chloroaniline	780 U	890 U	900 U	1,100 U
4-Chloro-3-methylphenol	390 U	440 U	450 U	550 U
Benzo(g,h,i)perylene	390 U	440 U	36 J	66 J
Pentachlorophenol	2,000 U	2,300 U	2,300 U	2,800 U
Benzo(k)fluoranthene	390 U	20 J	27 J	76 J
Benzyl alcohol	390 U	440 U	450 U	550 U
Diallate	390 U	440 U	450 U	550 U
Dibenzofuran	390 U	440 U	450 U	550 U
Di-n-butylphthalate	390 U	440 U	450 U	550 U
Cresol, m & p	390 U	440 U	450 U	550 U
m-Dichlorobenzene	390 U	440 U	450 U	550 U
m-Dinitrobenzene	390 U	440 U	450 U	550 U
3-Nitroaniline	2,000 U	2,300 U	2,300 U	2,800 U
Cresol (ortho)	390 U	440 U	450 U	550 U
o-Dichlorobenzene	390 U	440 U	450 U	550 U
2-Nitroaniline	2,000 U	2,300 U	2,300 U	2,800 U
2-Nitrophenol	390 U	440 U	450 U	550 U
o-Toluidine	390 U	440 U	450 U	550 U
p-Dichlorobenzene	390 U	440 U	450 U	550 U
4-Nitroaniline	2,000 U	2,300 U	2,300 U	2,800 U
4-Nitrophenol	2,000 U	2,300 U	2,300 U	2,800 U
1,4-Phenylenediamine	2,000 U	2,300 U	2,300 U	2,800 U
Pesticides/PCBs (ug/kg)				
Dieldrin	3.9 U	4.4 U	90 U	280 U
Endosulfan sulfate	3.9 U	4.4 U	90 U	280 U
Endrin	3.9 U	4.4 U	90 U	280 U
Endrin aldehyde	3.9 U	4.4 U	90 U	280 U
Heptachlor	2 U	2.3 U	46 U	140 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS, SURFACE SOIL - ORGANICS
ECP SITE 5 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	5E-01	5E-02	5E-03	5E-04
Sample ID	5E-SS01	5E-SS02	5E-SS03	5E-SS04
Sample Date	05/03/04	05/03/04	05/03/04	05/03/04
Sample Depth (ft bgs)	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00
Pesticides/PCBs (ug/kg) (Cont.)				
Heptachlor epoxide	2 U	2.3 U	46 U	140 U
Aldrin	2 U	2.3 U	46 U	140 U
Toxaphene	200 U	230 U	4,600 U	14,000 U
alpha-BHC	2 U	2.3 U	46 U	140 U
beta-BHC	2 U	2.3 U	46 U	140 U
gamma-BHC	2 U	2.3 U	46 U	140 U
delta-BHC	2 U	2.3 U	46 U	140 U
Chlordane	20 U	23 U	460 U	1400 U
4,4'-DDT	1.5 J	6.1	340	460
Endosulfan I	2 U	2.3 U	46 U	140 U
Endosulfan II	3.9 U	4.4 U	90 U	280 U
Kepone	200 U	230 U	4,600 U	14,000 U
Chlorobenzilate	20 U	23 U	460 U	1,400 U
4,4'-DDE	1.9 J	6.5	610	1,400
4,4'-DDD	3.9 U	4.4 U	60 J	280 U
Isodrin	3.9 U	4.4 U	90 U	280 U
Methoxychlor	20 U	23 U	460 U	1,400 U
Aroclor-1242	39 U	44 U	900 U	2,800 U
Aroclor-1254	39 U	44 U	900 U	2,800 U
Aroclor-1221	79 U	90 U	1,800 U	5,600 U
Aroclor-1232	39 U	44 U	900 U	2,800 U
Aroclor-1248	39 U	44 U	900 U	2,800 U
Aroclor-1260	39 U	44 U	900 U	2,800 U
Aroclor-1016	39 U	44 U	900 U	2,800 U
OP-Pesticides (ug/kg)				
Thionazin	390 U	440 U	450 U	550 U
Famphur	390 U	440 U	450 U	550 U
Dimethoate	390 U	440 U	450 U	550 U
Disulfoton	390 U	440 U	450 U	550 U
Parathion (Ethyl parathion)	390 U	440 U	450 U	550 U
Methyl parathion	390 U	440 U	450 U	550 U
O,O,O-Triethyl phosphorothioate	390 U	440 U	450 U	550 U
Phorate	390 U	440 U	450 U	550 U
Sulfotepp	390 U	440 U	450 U	550 U
Chlorinated Herbicides (ug/kg)				
2,4,5-TP	9.8 U	11 U	11 U	14 U
2,4-D	9.8 U	11 U	11 U	14 U
2,4,5-T	9.8 U	11 U	11 U	14 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS, SURFACE SOIL - ORGANICS
ECP SITE 5 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	5E-04	5E-05	5E-06
Sample ID	5E-SS04D	5E-SS05	5E-SS06
Sample Date	05/03/04	05/04/04	05/04/04
Sample Depth (ft bgs)	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00
Volatile Organic Compounds (ug/kg)			
Chloroform	7.3 U	4.2 J	4.6 J
Dichlorodifluoromethane	7.3 U	6.2 U	7.5 U
1,1-Dichloroethane	7.3 U	6.2 U	7.5 U
1,2-Dichloroethane	7.3 U	6.2 U	7.5 U
1,1-Dichloroethene	7.3 U	6.2 U	7.5 U
1,2-Dichloropropane	7.3 U	6.2 U	7.5 U
Ethyl benzene	7.3 U	6.2 U	7.5 U
Acrolein	150 U	120 U	150 U
Methylene chloride	7.3 U	6.2 U	7.5 U
1,1,2,2-Tetrachloroethane	7.3 U	6.2 U	7.5 U
Tetrachloroethene	7.3 U	6.2 U	2.7 J
Toluene	7.3 U	6.2 U	7.5 U
trans-1,2-Dichloroethene	7.3 U	6.2 U	7.5 U
1,1,1-Trichloroethane	7.3 U	6.2 U	7.5 U
1,1,2-Trichloroethane	7.3 U	6.2 U	7.5 U
2-Butanone	36 U	31 U	38 U
Chloroprene	7.3 U	6.2 U	7.5 U
2-Hexanone	36 U	31 U	38 U
Acrylonitrile	150 U	120 U	150 U
3-Chloro-1-propene	7.3 U	6.2 U	7.5 U
Benzene	7.3 U	6.2 U	7.5 U
Bromoform	7.3 U	6.2 U	7.5 U
Carbon tetrachloride	7.3 U	4.8 J	14
Chlorobenzene	7.3 U	6.2 U	2.1 J
Acetonitrile	290 U	250 U	300 U
1,2-Dibromo-3-chloropropane	15 U	12 U	15 U
Dibromomethane	7.3 U	6.2 U	7.5 U
trans-1,4-Dichloro-2-butene	15 U	12 U	15 U
cis-1,3-Dichloropropene	7.3 U	6.2 U	7.5 U
trans-1,3-Dichloropropene	7.3 U	6.2 U	7.5 U
Ethyl methacrylate	7.3 U	6.2 U	7.5 U
Iodomethane	7.3 U	6.2 U	7.5 U
Methacrylonitrile	150 U	120 U	150 U
Methyl methacrylate	7.3 U	6.2 U	7.5 U
Pentachloroethane	36 U	31 U	38 U
1,1,1,2-Tetrachloroethane	7.3 U	6.2 U	7.5 U
Trichlorofluoromethane	7.3 U	6.2 U	7.5 U
1,2,3-Trichloropropane	7.3 U	6.2 U	7.5 U
Vinyl chloride	7.3 U	6.2 U	7.5 U
Dibromochloromethane	7.3 U	6.2 U	7.5 U
Chloroethane	7.3 U	6.2 U	7.5 U
Acetone	73 U	62 U	75 U
Bromodichloromethane	7.3 U	6.2 U	7.5 U

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ECP SITE 5 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	5E-04	5E-05	5E-06
Sample ID	5E-SS04D	5E-SS05	5E-SS06
Sample Date	05/03/04	05/04/04	05/04/04
Sample Depth (ft bgs)	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00
Volatile Organic Compounds (ug/kg) (Cont.			
Bromomethane	7.3 U	6.2 U	7.5 U
Chloromethane	7.3 U	6.2 U	7.5 U
Carbon disulfide	7.3 U	6.2 U	7.5 U
1,2-Dibromoethane	7.3 U	6.2 U	7.5 U
Propionitrile	150 U	120 U	150 U
Isobutanol	290 U	250 U	300 U
4-Methyl-2-pentanone	36 U	31 U	38 U
Styrene	7.3 U	6.2 U	7.5 U
Trichloroethene	7.3 U	6.2 U	7.5 U
Vinyl acetate	15 U	12 U	15 U
Xylene	15 U	12 U	15 U
Semivolatile Organic Compounds (ug/kg)			
Phenol	550 U	460 U	510 U
bis(2-Chloroethoxy)methane	550 U	460 U	510 U
2,4,6-Trichlorophenol	550 U	460 U	510 U
bis(2-Chloroethyl)ether	550 U	460 U	510 U
bis(2-Chloroisopropyl)ether	550 U	460 U	510 U
bis(2-Ethylhexyl)phthalate	550 U	460 U	110 J
4-Bromophenylphenyl ether	550 U	460 U	510 U
Butylbenzylphthalate	550 U	460 U	510 U
2-Chloronaphthalene	550 U	460 U	510 U
4-Chlorophenyl phenyl ether	550 U	460 U	510 U
Chrysene	56 J	460 U	510 U
Dibenzo(a,h)anthracene	550 U	460 U	510 U
2-Chlorophenol	550 U	460 U	510 U
Acenaphthene	550 U	460 U	510 U
3,3'-Dichlorobenzidine	1,100 U	930 U	1,000 U
Diethylphthalate	550 U	460 U	510 U
Dimethyl phthalate	550 U	460 U	510 U
2,4-Dinitrotoluene	550 U	460 U	510 U
2,6-Dinitrotoluene	550 U	460 U	510 U
Di-n-octylphthalate	550 U	460 U	510 U
2,4-Dichlorophenol	550 U	460 U	510 U
Acenaphthylene	550 U	460 U	510 U
2-Methylnaphthalene	550 U	460 U	510 U
Fluoranthene	99 J	460 U	510 U
Fluorene	550 U	460 U	510 U
Hexachlorobenzene	550 U	460 U	510 U
Hexachlorobutadiene	550 U	460 U	510 U
Hexachlorocyclopentadiene	550 U	460 U	510 U
Hexachloroethane	550 U	460 U	510 U
Indeno(1,2,3-cd)pyrene	37 JB	460 U	510 U

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SUMMARY OF ANALYTICAL RESULTS, SURFACE SOIL - ORGANICS
ECP SITE 5 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	5E-04	5E-05	5E-06
Sample ID	5E-SS04D	5E-SS05	5E-SS06
Sample Date	05/03/04	05/04/04	05/04/04
Sample Depth (ft bgs)	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00
Semivolatile Organic Compounds (ug/kg) (C			
Isophorone	550 U	460 U	510 U
Naphthalene	550 U	460 U	510 U
2,4-Dimethylphenol	550 U	460 U	510 U
Anthracene	550 U	460 U	510 U
4,6-Dinitro-2-methylphenol	2,800 U	2,400 U	2,600 U
Nitrobenzene	550 U	460 U	510 U
N-Nitrosodimethylamine	550 U	460 U	510 U
N-Nitrosodiphenylamine	550 U	460 U	510 U
Phenanthrene	550 U	460 U	510 U
Pyrene	83 J	21 J	510 U
1,2,4-Trichlorobenzene	550 U	460 U	510 U
4-Nitroquinoline-1-oxide	5,500 U	4,600 U	5,100 U
2,4-Dinitrophenol	2,800 U	2,400 U	2,600 U
Benzo(a)anthracene	550 U	460 U	510 U
Benzo(a)pyrene	550 U	460 U	510 U
2,6-Dichlorophenol	550 U	460 U	510 U
Benzo(b)fluoranthene	550 U	460 U	510 U
4-Aminobiphenyl	550 U	460 U	510 U
p-(Dimethylamino)azobenzene	550 U	460 U	510 U
7,12-Dimethylbenz(a)anthracene	550 U	460 U	510 U
3,3'-Dimethyl benzidine	2,800 U	2,400 U	2,600 U
alpha,alpha-Dimethylphenethylamine	110,000 U	94,000 U	100,000 U
1,4-Dioxane	550 U	460 U	510 U
n-Nitrosodi-n-propylamine	550 U	460 U	510 U
Aniline	550 U	460 U	510 U
Ethylmethanesulfonate	550 U	460 U	510 U
Acetophenone	550 U	460 U	510 U
Aramite	550 U	460 U	510 U
Hexachlorophene	280,000 U	240,000 U	260,000 U
Hexachloropropene	550 U	460 U	510 U
Isosafrole	550 U	460 U	510 U
Methapyrilene	110,000 U	94,000 U	100,000 U
3-Methylcholanthrene	550 U	460 U	510 U
Methyl methanesulfonate	550 U	460 U	510 U
1,4-Naphthoquinone	550 U	460 U	510 U
1-Naphthylamine	550 U	460 U	510 U
2-Naphthylamine	550 U	460 U	510 U
N-Nitrosodi-n-butylamine	550 U	460 U	510 U
N-Nitrosodiethylamine	550 U	460 U	510 U
N-Nitrosomethylethylamine	550 U	460 U	510 U
N-Nitrosomorpholine	550 U	460 U	510 U
N-Nitrosopiperidine	550 U	460 U	510 U
N-Nitrosopyrrolidine	550 U	460 U	510 U

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SUMMARY OF ANALYTICAL RESULTS, SURFACE SOIL - ORGANICS
ECP SITE 5 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	5E-04	5E-05	5E-06
Sample ID	5E-SS04D	5E-SS05	5E-SS06
Sample Date	05/03/04	05/04/04	05/04/04
Sample Depth (ft bgs)	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00
Semivolatile Organic Compounds (ug/kg) (C			
5-Nitro-o-toluidine	550 U	460 U	510 U
Pentachlorobenzene	550 U	460 U	510 U
Pentachloronitrobenzene	550 U	460 U	510 U
Phenacetin	550 U	460 U	510 U
2-Picoline	550 U	460 U	510 U
Pronamide	550 U	460 U	510 U
Pyridine	550 U	460 U	510 U
Safrole	550 U	460 U	510 U
1,2,4,5-Tetrachlorobenzene	550 U	460 U	510 U
2,3,4,6-Tetrachlorophenol	550 U	460 U	510 U
2,4,5-Trichlorophenol	550 U	460 U	510 U
1,3,5-Trinitrobenzene	550 U	460 U	510 U
2-Acetylaminofluorene	550 U	460 U	510 U
Dinoseb	550 U	460 U	510 U
4-Chloroaniline	1,100 U	930 U	1,000 U
4-Chloro-3-methylphenol	550 U	460 U	510 U
Benzo(g,h,i)perylene	55 J	460 U	52 J
Pentachlorophenol	2,800 U	2,400 U	2,600 U
Benzo(k)fluoranthene	60 J	19 J	28 J
Benzyl alcohol	550 U	460 U	510 U
Diallate	550 U	460 U	510 U
Dibenzofuran	550 U	460 U	510 U
Di-n-butylphthalate	550 U	460 U	510 U
Cresol, m & p	550 U	460 U	510 U
m-Dichlorobenzene	550 U	460 U	510 U
m-Dinitrobenzene	550 U	460 U	510 U
3-Nitroaniline	2,800 U	2,400 U	2,600 U
Cresol (ortho)	550 U	460 U	510 U
o-Dichlorobenzene	550 U	460 U	510 U
2-Nitroaniline	2,800 U	2,400 U	2,600 U
2-Nitrophenol	550 U	460 U	510 U
o-Toluidine	550 U	460 U	510 U
p-Dichlorobenzene	550 U	460 U	510 U
4-Nitroaniline	2,800 U	2,400 U	2,600 U
4-Nitrophenol	2,800 U	2,400 U	2,600 U
1,4-Phenylenediamine	2,800 U	2,400 U	2,600 U
Pesticides/PCBs (ug/kg)			
Dieldrin	280 U	4.6 U	5.1 U
Endosulfan sulfate	280 U	4.6 U	5.1 U
Endrin	280 U	4.6 U	5.1 U
Endrin aldehyde	280 U	4.6 U	5.1 U
Heptachlor	140 U	3 P	2.6 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS, SURFACE SOIL - ORGANICS
ECP SITE 5 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	5E-04	5E-05	5E-06
Sample ID	5E-SS04D	5E-SS05	5E-SS06
Sample Date	05/03/04	05/04/04	05/04/04
Sample Depth (ft bgs)	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00
Pesticides/PCBs (ug/kg) (Cont.)			
Heptachlor epoxide	140 U	2.4 U	2.6 U
Aldrin	140 U	2.4 U	2.6 U
Toxaphene	14,000 U	240 U	260 U
alpha-BHC	140 U	2.4 U	2.6 U
beta-BHC	140 U	2.4 U	2.6 U
gamma-BHC	140 U	2.4 U	2.6 U
delta-BHC	140 U	2.4 U	2.6 U
Chlordane	1400 U	24 U	26 U
4,4'-DDT	680	4.6 U	5.1 U
Endosulfan I	140 U	2.4 U	2.6 U
Endosulfan II	280 U	4.6 U	5.1 U
Kepone	14,000 U	240 U	260 U
Chlorobenzilate	1,400 U	24 U	26 U
4,4'-DDE	1,600	4.6 U	1.3 J
4,4'-DDD	120 J	4.6 U	5.1 U
Isodrin	280 U	4.6 U	5.1 U
Methoxychlor	1,400 U	24 U	26 U
Aroclor-1242	2,800 U	46 U	51 U
Aroclor-1254	2,800 U	46 U	51 U
Aroclor-1221	5,600 U	94 U	100 U
Aroclor-1232	2,800 U	46 U	51 U
Aroclor-1248	2,800 U	46 U	51 U
Aroclor-1260	2,800 U	46 U	51 U
Aroclor-1016	2,800 U	46 U	51 U
OP-Pesticides (ug/kg)			
Thionazin	550 U	460 U	510 U
Famphur	550 U	460 U	510 U
Dimethoate	550 U	460 U	510 U
Disulfoton	550 U	460 U	510 U
Parathion (Ethyl parathion)	550 U	460 U	510 U
Methyl parathion	550 U	460 U	510 U
O,O,O-Triethyl phosphorothioate	550 U	460 U	510 U
Phorate	550 U	460 U	510 U
Sulfotepp	550 U	460 U	510 U
Chlorinated Herbicides (ug/kg)			
2,4,5-TP	14 U	12 U	13 U
2,4-D	14 U	12 U	13 U
2,4,5-T	14 U	12 U	13 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS, SURFACE SOIL - INORGANICS
ECP SITE 5 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	5E-01	5E-02	5E-03	5E-04	5E-04	5E-05	5E-06
Sample ID	5E-SS01	5E-SS02	5E-SS03	5E-SS04	5E-SS04D	5E-SS05	5E-SS06
Sample Date	05/03/04	05/03/04	05/03/04	05/03/04	05/03/04	05/04/04	05/04/04
Sample Depth (ft bgs)	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00
Appendix IX Inorganics (mg/kg)							
Silver	1.1 U	1.2 U	0.68 B	0.26 B	0.23 B	1.2 U	1.5 U
Arsenic	2	21	2.3	1.5 U	1.6	1.2 U	2.6
Barium	67 N	110 N	210 N	240 N	160 N	110 N	120 N
Beryllium	0.26 B	0.19 B	0.19 B	0.25 B	0.24 B	0.37 B	0.22 B
Cadmium	0.18 B	1.5	2.3	1.2	1.1	0.62 U	0.4 B
Cobalt	21	17	26	31	31	16	28
Chromium	78	52	65	35	40	24	36
Copper	100 N	150 N	250 N	110 N	130 N	64 N	110 N
Nickel	49	19	31	26	26	8.7	26
Lead	10	120	280	98	94	3.4	1100
Antimony	2.3 UN	1.1 BN	1.9 BN	2.4 BN	2.2 BN	2.5 UN	3 UN
Selenium	1.1 U	1.2 U	1.3 U	1.5 U	1.5 U	1.2 U	1.5 U
Tin	95	5.2 B	28	6.9 B	5.9 B	1.3 B	92
Thallium	1.1 U	1.2 U	1.3 U	1.5 U	1.5 U	1.2 U	1.5 U
Vanadium	130 N	110 N	150 N	250 N	220 N	140 N	150 N
Zinc	78	210	930	280	290	49	160
Cyanide	0.58 U	0.65 U	0.67 U	0.83 U	0.8 U	0.68 U	0.52 B
Sulfide	29 U	34 U	34 U	42 U	42 U	35 U	38 U
Mercury	0.0075 BN	0.047 N	0.24 N	0.054 N	0.044 N	0.015 BN	0.037 N

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS, SUBSURFACE SOIL - ORGANICS
ECP SITE 5 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	5E-01	5E-02	5E-03	5E-04	5E-05
Sample ID	5E-SB01-03	5E-SB02-02	5E-SB03-02	5E-SB04-02	5E-SB05-01
Sample Date	05/03/04	05/03/04	05/03/04	05/03/04	05/04/04
Sample Depth (ft bgs)	5.00 - 7.00	3.00 - 5.00	3.00 - 5.00	3.00 - 5.00	1.00 - 3.00
Volatile Organic Compounds (ug/kg)					
Chloroform	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
Dichlorodifluoromethane	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
1,1-Dichloroethane	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
1,2-Dichloroethane	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
1,1-Dichloroethene	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
1,2-Dichloropropane	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
Ethyl benzene	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
Acrolein	110 U	120 U	110 U	120 U	110 U
Methylene chloride	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
1,1,2,2-Tetrachloroethane	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
Tetrachloroethene	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
Toluene	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
trans-1,2-Dichloroethene	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
1,1,1-Trichloroethane	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
1,1,2-Trichloroethane	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
2-Butanone	29 U	29 U	28 U	31 U	29 U
Chloroprene	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
2-Hexanone	29 U	29 U	28 U	31 U	29 U
Acrylonitrile	110 U	120 U	110 U	120 U	110 U
3-Chloro-1-propene	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
Benzene	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
Bromoform	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
Carbon tetrachloride	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
Chlorobenzene	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
Acetonitrile	230 U	230 U	220 U	250 U	230 U
1,2-Dibromo-3-chloropropane	11 U	12 U	11 U	12 U	11 U
Dibromomethane	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
trans-1,4-Dichloro-2-butene	11 U	12 U	11 U	12 U	11 U
cis-1,3-Dichloropropene	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
trans-1,3-Dichloropropene	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
Ethyl methacrylate	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
Iodomethane	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
Methacrylonitrile	110 U	120 U	110 U	120 U	110 U
Methyl methacrylate	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
Pentachloroethane	29 U	29 U	28 U	31 U	29 U
1,1,1,2-Tetrachloroethane	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
Trichlorofluoromethane	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
1,2,3-Trichloropropane	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
Vinyl chloride	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
Dibromochloromethane	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
Chloroethane	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
Acetone	57 U	58 U	55 U	63 U	57 U
Bromodichloromethane	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS, SUBSURFACE SOIL - ORGANICS
ECP SITE 5 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	5E-01	5E-02	5E-03	5E-04	5E-05
Sample ID	5E-SB01-03	5E-SB02-02	5E-SB03-02	5E-SB04-02	5E-SB05-01
Sample Date	05/03/04	05/03/04	05/03/04	05/03/04	05/04/04
Sample Depth (ft bgs)	5.00 - 7.00	3.00 - 5.00	3.00 - 5.00	3.00 - 5.00	1.00 - 3.00
Volatile Organic Compounds (ug/kg) (Cont.)					
Bromomethane	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
Chloromethane	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
Carbon disulfide	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
1,2-Dibromoethane	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
Propionitrile	110 U	120 U	110 U	120 U	110 U
Isobutanol	230 U	230 U	220 U	250 U	230 U
4-Methyl-2-pentanone	29 U	29 U	28 U	31 U	29 U
Styrene	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
Trichloroethene	5.7 U	5.8 U	5.5 U	6.3 U	5.7 U
Vinyl acetate	11 U	12 U	11 U	12 U	11 U
Xylene	11 U	12 U	11 U	12 U	11 U
Semivolatile Organic Compounds (ug/kg)					
Phenol	390 U	430 U	380 U	420 U	390 U
bis(2-Chloroethoxy)methane	390 U	430 U	380 U	420 U	390 U
2,4,6-Trichlorophenol	390 U	430 U	380 U	420 U	390 U
bis(2-Chloroethyl)ether	390 U	430 U	380 U	420 U	390 U
bis(2-Chloroisopropyl)ether	390 U	430 U	380 U	420 U	390 U
bis(2-Ethylhexyl)phthalate	390 U	430 U	380 U	420 U	390 U
4-Bromophenylphenyl ether	390 U	430 U	380 U	420 U	390 U
Butylbenzylphthalate	390 U	430 U	380 U	420 U	390 U
2-Chloronaphthalene	390 U	430 U	380 U	420 U	390 U
4-Chlorophenyl phenyl ether	390 U	430 U	380 U	420 U	390 U
Chrysene	390 U	430 U	380 U	420 U	390 U
Dibenzo(a,h)anthracene	390 U	430 U	380 U	420 U	390 U
2-Chlorophenol	390 U	430 U	380 U	420 U	390 U
Acenaphthene	390 U	430 U	380 U	420 U	390 U
3,3'-Dichlorobenzidine	780 U	870 U	760 U	850 U	780 U
Diethylphthalate	390 U	430 U	380 U	420 U	390 U
Dimethyl phthalate	390 U	430 U	380 U	420 U	390 U
2,4-Dinitrotoluene	390 U	430 U	380 U	420 U	390 U
2,6-Dinitrotoluene	390 U	430 U	380 U	420 U	390 U
Di-n-octylphthalate	390 U	430 U	380 U	420 U	390 U
2,4-Dichlorophenol	390 U	430 U	380 U	420 U	390 U
Acenaphthylene	390 U	430 U	380 U	420 U	390 U
2-Methylnaphthalene	390 U	430 U	380 U	420 U	390 U
Fluoranthene	390 U	430 U	380 U	420 U	390 U
Fluorene	390 U	430 U	380 U	420 U	390 U
Hexachlorobenzene	390 U	430 U	380 U	420 U	390 U
Hexachlorobutadiene	390 U	430 U	380 U	420 U	390 U
Hexachlorocyclopentadiene	390 U	430 U	380 U	420 U	390 U
Hexachloroethane	390 U	430 U	380 U	420 U	390 U
Indeno(1,2,3-cd)pyrene	390 U	430 U	380 U	420 U	390 U

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SUMMARY OF ANALYTICAL RESULTS, SUBSURFACE SOIL - ORGANICS
ECP SITE 5 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	5E-01	5E-02	5E-03	5E-04	5E-05
Sample ID	5E-SB01-03	5E-SB02-02	5E-SB03-02	5E-SB04-02	5E-SB05-01
Sample Date	05/03/04	05/03/04	05/03/04	05/03/04	05/04/04
Sample Depth (ft bgs)	5.00 - 7.00	3.00 - 5.00	3.00 - 5.00	3.00 - 5.00	1.00 - 3.00
Semivolatile Organic Compounds (ug/kg) (Cont.)					
Isophorone	390 U	430 U	380 U	420 U	390 U
Naphthalene	390 U	430 U	380 U	420 U	390 U
2,4-Dimethylphenol	390 U	430 U	380 U	420 U	390 U
Anthracene	390 U	430 U	380 U	420 U	390 U
4,6-Dinitro-2-methylphenol	2,000 U	2,200 U	2,000 U	2,200 U	2,000 U
Nitrobenzene	390 U	430 U	380 U	420 U	390 U
N-Nitrosodimethylamine	390 U	430 U	380 U	420 U	390 U
N-Nitrosodiphenylamine	390 U	430 U	380 U	420 U	390 U
Phenanthrene	390 U	430 U	380 U	420 U	390 U
Pyrene	390 U	430 U	380 U	420 U	390 U
1,2,4-Trichlorobenzene	390 U	430 U	380 U	420 U	390 U
4-Nitroquinoline-1-oxide	3,900 U	4,300 U	3,800 U	4,200 U	3,900 U
2,4-Dinitrophenol	2,000 U	2,200 U	2,000 U	2,200 U	2,000 U
Benzo(a)anthracene	390 U	430 U	380 U	420 U	390 U
Benzo(a)pyrene	390 U	430 U	380 U	420 U	390 U
2,6-Dichlorophenol	390 U	430 U	380 U	420 U	390 U
Benzo(b)fluoranthene	390 U	430 U	380 U	420 U	390 U
4-Aminobiphenyl	390 U	430 U	380 U	420 U	390 U
p-(Dimethylamino)azobenzene	390 U	430 U	380 U	420 U	390 U
7,12-Dimethylbenz(a)anthracene	390 U	430 U	49 J	420 U	390 U
3,3'-Dimethyl benzidine	2,000 U	2,200 U	2,000 U	2,200 U	2,000 U
alpha,alpha-Dimethylphenethylamine	80,000 U	88,000 U	77,000 U	86,000 U	80,000 U
1,4-Dioxane	390 U	430 U	380 U	420 U	390 U
n-Nitrosodi-n-propylamine	390 U	430 U	380 U	420 U	390 U
Aniline	390 U	430 U	380 U	420 U	390 U
Ethylmethanesulfonate	390 U	430 U	380 U	420 U	390 U
Acetophenone	390 U	430 U	380 U	420 U	390 U
Aramite	3,902 U	430 U	380 U	420 U	390 U
Hexachlorophene	200,000 U	220,000 U	200,000 U	220,000 U	200,000 U
Hexachloropropene	390 U	430 U	380 U	420 U	390 U
Isosafrole	390 U	430 U	380 U	420 U	390 U
Methapyrilene	80,000 U	88,000 U	77,000 U	86,000 U	80,000 U
3-Methylcholanthrene	390 U	430 U	64 J	420 U	29 J
Methyl methanesulfonate	390 U	430 U	380 U	420 U	390 U
1,4-Naphthoquinone	390 U	430 U	380 U	420 U	390 U
1-Naphthylamine	390 U	430 U	380 U	420 U	390 U
2-Naphthylamine	390 U	430 U	380 U	420 U	390 U
N-Nitrosodi-n-butylamine	390 U	430 U	380 U	420 U	390 U
N-Nitrosodiethylamine	390 U	430 U	380 U	420 U	390 U
N-Nitrosomethylethylamine	390 U	430 U	380 U	420 U	390 U
N-Nitrosomorpholine	390 U	430 U	380 U	420 U	390 U
N-Nitrosopiperidine	390 U	430 U	380 U	420 U	390 U
N-Nitrosopyrrolidine	390 U	430 U	380 U	420 U	390 U

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SUMMARY OF ANALYTICAL RESULTS, SUBSURFACE SOIL - ORGANICS
ECP SITE 5 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	5E-01	5E-02	5E-03	5E-04	5E-05
Sample ID	5E-SB01-03	5E-SB02-02	5E-SB03-02	5E-SB04-02	5E-SB05-01
Sample Date	05/03/04	05/03/04	05/03/04	05/03/04	05/04/04
Sample Depth (ft bgs)	5.00 - 7.00	3.00 - 5.00	3.00 - 5.00	3.00 - 5.00	1.00 - 3.00
Semivolatile Organic Compounds (ug/kg) (Cont.)					
5-Nitro-o-toluidine	390 U	430 U	380 U	420 U	390 U
Pentachlorobenzene	390 U	430 U	380 U	420 U	390 U
Pentachloronitrobenzene	390 U	430 U	380 U	420 U	390 U
Phenacetin	390 U	430 U	380 U	420 U	390 U
2-Picoline	390 U	430 U	380 U	420 U	390 U
Pronamide	390 U	430 U	380 U	420 U	390 U
Pyridine	390 U	430 U	380 U	420 U	390 U
Safrole	390 U	430 U	380 U	420 U	390 U
1,2,4,5-Tetrachlorobenzene	390 U	430 U	380 U	420 U	390 U
2,3,4,6-Tetrachlorophenol	390 U	430 U	380 U	420 U	390 U
2,4,5-Trichlorophenol	390 U	430 U	380 U	420 U	390 U
1,3,5-Trinitrobenzene	390 U	430 U	380 U	420 U	390 U
2-Acetylaminofluorene	390 U	430 U	46 J	420 U	390 U
Dinoseb	390 U	430 U	380 U	420 U	390 U
4-Chloroaniline	780 U	870 U	760 U	850 U	780 U
4-Chloro-3-methylphenol	390 U	430 U	380 U	420 U	390 U
Benzo(g,h,i)perylene	390 U	430 U	380 U	420 U	390 U
Pentachlorophenol	2,000 U	2,200 U	2,000 U	2200 U	2,000 U
Benzo(k)fluoranthene	390 U	430 U	380 U	420 U	390 U
Benzyl alcohol	390 U	430 U	380 U	420 U	390 U
Diallate	390 U	430 U	380 U	420 U	390 U
Dibenzofuran	390 U	430 U	380 U	420 U	390 U
Di-n-butylphthalate	390 U	430 U	380 U	420 U	390 U
Cresol, m & p	390 U	430 U	380 U	420 U	390 U
m-Dichlorobenzene	390 U	430 U	380 U	420 U	390 U
m-Dinitrobenzene	390 U	430 U	380 U	420 U	390 U
3-Nitroaniline	2,000 U	2,200 U	2,000 U	2200 U	2,000 U
Cresol (ortho)	390 U	430 U	380 U	420 U	390 U
o-Dichlorobenzene	390 U	430 U	380 U	420 U	390 U
2-Nitroaniline	2,000 U	2,200 U	2,000 U	2200 U	2,000 U
2-Nitrophenol	390 U	430 U	380 U	420 U	390 U
o-Toluidine	390 U	430 U	380 U	420 U	390 U
p-Dichlorobenzene	390 U	430 U	380 U	420 U	390 U
4-Nitroaniline	2,000 U	2,200 U	2,000 U	2200 U	2,000 U
4-Nitrophenol	2,000 U	2,200 U	2,000 U	2200 U	2,000 U
1,4-Phenylenediamine	2,000 U	2,200 U	2,000 U	2200 U	2,000 U
Pesticides/PCBs (ug/kg)					
Dieldrin	3.9 U	4.3 U	3.8 U	4.2 U	3.9 U
Endosulfan sulfate	3.9 U	4.3 U	3.8 U	4.2 U	3.9 U
Endrin	3.9 U	4.3 U	3.8 U	4.2 U	3.9 U
Endrin aldehyde	3.9 U	4.3 U	3.8 U	4.2 U	3.9 U
Heptachlor	2 U	2.2 U	2 U	2.2 U	2 U

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SUMMARY OF ANALYTICAL RESULTS, SUBSURFACE SOIL - ORGANICS
ECP SITE 5 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	5E-01	5E-02	5E-03	5E-04	5E-05
Sample ID	5E-SB01-03	5E-SB02-02	5E-SB03-02	5E-SB04-02	5E-SB05-01
Sample Date	05/03/04	05/03/04	05/03/04	05/03/04	05/04/04
Sample Depth (ft bgs)	5.00 - 7.00	3.00 - 5.00	3.00 - 5.00	3.00 - 5.00	1.00 - 3.00
Pesticides/PCBs (ug/kg) (Cont.)					
Heptachlor epoxide	2 U	2.2 U	2 U	2.2 U	2 U
Aldrin	2 U	2.2 U	2 U	2.2 U	2 U
Toxaphene	200 U	220 U	200 U	220 U	200 U
alpha-BHC	2 U	2.2 U	2 U	2.2 U	2 U
beta-BHC	2 U	2.2 U	2 U	2.2 U	2 U
gamma-BHC	2 U	2.2 U	2 U	2.2 U	2 U
delta-BHC	2 U	2.2 U	2 U	2.2 U	2 U
Chlordane	20 U	22 U	20 U	22 U	20 U
4,4'-DDT	3.9 U	4.3 U	4 U	36	3.9 U
Endosulfan I	2 U	2.2 U	2 U	2.2 U	2 U
Endosulfan II	3.9 U	4.3 U	4 U	4.2 U	3.9 U
Kepone	200 U	220 U	200 U	220 U	200 U
Chlorobenzilate	20 U	22 U	20 U	22 U	20 U
4,4'-DDE	3.9 U	4.3 U	4 U	4.9	3.9 U
4,4'-DDD	3.9 U	4.3 U	4 U	2 J	3.9 U
Isodrin	3.9 U	4.3 U	4 U	4.2 U	3.9 U
Methoxychlor	20 U	22 U	20 U	22 U	20 U
Aroclor-1242	39 U	43 U	38 U	42 U	39 U
Aroclor-1254	39 U	43 U	38 U	42 U	39 U
Aroclor-1221	80 U	88 U	77 U	86 U	80 U
Aroclor-1232	39 U	43 U	38 U	42 U	39 U
Aroclor-1248	39 U	43 U	38 U	42 U	39 U
Aroclor-1260	39 U	43 U	38 U	42 U	39 U
Aroclor-1016	39 U	43 U	38 U	42 U	39 U
OP-Pesticides (ug/kg)					
Thionazin	390 U	430 U	380 U	420 U	390 U
Famphur	390 U	430 U	380 U	420 U	390 U
Dimethoate	390 U	430 U	380 U	420 U	390 U
Disulfoton	390 U	430 U	380 U	420 U	390 U
Parathion (Ethyl parathion)	390 U	430 U	380 U	420 U	390 U
Methyl parathion	390 U	430 U	380 U	420 U	390 U
O,O,O-Triethyl phosphorothioate	390 U	430 U	380 U	420 U	390 U
Phorate	390 U	430 U	380 U	420 U	390 U
Sulfotepp	390 U	430 U	380 U	420 U	390 U
Chlorinated Herbicides (ug/kg)					
2,4,5-TP	9.9 U	11 U	9.5 U	0.84 J	9.9 U
2,4-D	9.9 U	11 U	9.5 U	11 U	9.9 U
2,4,5-T	9.9 U	11 U	9.5 U	11 U	9.9 U

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SUMMARY OF ANALYTICAL RESULTS, SUBSURFACE SOIL - ORGANICS
ECP SITE 5 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	5E-06	5E-07	5E-07	5E-08	5E-08
Sample ID	5E-SB06-02	5E-SB07-01	5E-SB07-06	5E-SB08-02	5E-SB08-04
Sample Date	05/04/04	05/04/04	05/04/04	05/04/04	05/04/04
Sample Depth (ft bgs)	3.00 - 5.00	1.00 - 3.00	11.00 - 13.00	3.00 - 5.00	7.00 - 9.00
Volatile Organic Compounds (ug/kg)					
Chloroform	1.4 J	6.2 U	6.7 U	5.4 U	7 U
Dichlorodifluoromethane	5.4 U	6.2 U	6.7 U	5.4 U	7 U
1,1-Dichloroethane	5.4 U	6.2 U	6.7 U	5.4 U	7 U
1,2-Dichloroethane	5.4 U	6.2 U	6.7 U	5.4 U	7 U
1,1-Dichloroethene	5.4 U	6.2 U	6.7 U	5.4 U	7 U
1,2-Dichloropropane	5.4 U	6.2 U	6.7 U	5.4 U	7 U
Ethyl benzene	5.4 U	6.2 U	6.7 U	5.4 U	7 U
Acrolein	110 U	120 U	130 U	110 U	140 U
Methylene chloride	5.4 U	6.2 U	6.7 U	5.4 U	7 U
1,1,2,2-Tetrachloroethane	5.4 U	6.2 U	6.7 U	5.4 U	7 U
Tetrachloroethene	5.4 U	6.2 U	6.7 U	5.4 U	7 U
Toluene	5.4 U	6.2 U	6.7 U	5.4 U	7 U
trans-1,2-Dichloroethene	5.4 U	6.2 U	6.7 U	5.4 U	7 U
1,1,1-Trichloroethane	5.4 U	6.2 U	6.7 U	5.4 U	7 U
1,1,2-Trichloroethane	5.4 U	6.2 U	6.7 U	5.4 U	7 U
2-Butanone	27 U	31 U	34 U	23 J	7.7 J
Chloroprene	5.4 U	6.2 U	6.7 U	5.4 U	7 U
2-Hexanone	27 U	31 U	34 U	27 U	35 U
Acrylonitrile	110 U	120 U	130 U	110 U	140 U
3-Chloro-1-propene	5.4 U	6.2 U	6.7 U	5.4 U	7 U
Benzene	5.4 U	6.2 U	6.7 U	5.4 U	7 U
Bromoform	5.4 U	6.2 U	6.7 U	5.4 U	7 U
Carbon tetrachloride	3.7 J	6.2 U	6.7 U	5.4 U	7 U
Chlorobenzene	5.4 U	6.2 U	6.7 U	5.4 U	7 U
Acetonitrile	220 U	250 U	270 U	220 U	280 U
1,2-Dibromo-3-chloropropane	11 U	12 U	13 U	11 U	14 U
Dibromomethane	5.4 U	6.2 U	6.7 U	5.4 U	7 U
trans-1,4-Dichloro-2-butene	11 U	12 U	13 U	11 U	14 U
cis-1,3-Dichloropropene	5.4 U	6.2 U	6.7 U	5.4 U	7 U
trans-1,3-Dichloropropene	5.4 U	6.2 U	6.7 U	5.4 U	7 U
Ethyl methacrylate	5.4 U	6.2 U	6.7 U	5.4 U	7 U
Iodomethane	5.4 U	6.2 U	6.7 U	5.4 U	7 U
Methacrylonitrile	110 U	120 U	130 U	110 U	140 U
Methyl methacrylate	5.4 U	6.2 U	6.7 U	5.4 U	7 U
Pentachloroethane	27 U	31 U	34 U	27 U	35 U
1,1,1,2-Tetrachloroethane	5.4 U	6.2 U	6.7 U	5.4 U	7 U
Trichlorofluoromethane	5.4 U	6.2 U	6.7 U	5.4 U	7 U
1,2,3-Trichloropropane	5.4 U	6.2 U	6.7 U	5.4 U	7 U
Vinyl chloride	5.4 U	6.2 U	6.7 U	5.4 U	7 U
Dibromochloromethane	5.4 U	6.2 U	6.7 U	5.4 U	7 U
Chloroethane	5.4 U	6.2 U	6.7 U	5.4 U	7 U
Acetone	54 U	62 U	67 U	84	36 J
Bromodichloromethane	5.4 U	6.2 U	6.7 U	5.4 U	7 U

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SUMMARY OF ANALYTICAL RESULTS, SUBSURFACE SOIL - ORGANICS
ECP SITE 5 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	5E-06	5E-07	5E-07	5E-08	5E-08
Sample ID	5E-SB06-02	5E-SB07-01	5E-SB07-06	5E-SB08-02	5E-SB08-04
Sample Date	05/04/04	05/04/04	05/04/04	05/04/04	05/04/04
Sample Depth (ft bgs)	3.00 - 5.00	1.00 - 3.00	11.00 - 13.00	3.00 - 5.00	7.00 - 9.00
Volatile Organic Compounds (ug/kg) (Cont.)					
Bromomethane	5.4 U	6.2 U	6.7 U	5.4 U	7 U
Chloromethane	5.4 U	6.2 U	6.7 U	5.4 U	7 U
Carbon disulfide	5.4 U	6.2 U	6.7 U	5.4 U	7 U
1,2-Dibromoethane	5.4 U	6.2 U	6.7 U	5.4 U	7 U
Propionitrile	110 U	120 U	130 U	110 U	140 U
Isobutanol	220 U	250 U	270 U	220 U	280 U
4-Methyl-2-pentanone	27 U	31 U	34 U	27 U	35 U
Styrene	5.4 U	6.2 U	6.7 U	5.4 U	7 U
Trichloroethene	5.4 U	6.2 U	6.7 U	5.4 U	7 U
Vinyl acetate	11 U	12 U	13 U	11 U	14 U
Xylene	11 U	12 U	13 U	11 U	14 U
Semivolatile Organic Compounds (ug/kg)					
Phenol	380 U	460 U	470 U	430 U	460 U
bis(2-Chloroethoxy)methane	380 U	460 U	470 U	430 U	460 U
2,4,6-Trichlorophenol	380 U	460 U	470 U	430 U	460 U
bis(2-Chloroethyl)ether	380 U	460 U	470 U	430 U	460 U
bis(2-Chloroisopropyl)ether	380 U	460 U	470 U	430 U	460 U
bis(2-Ethylhexyl)phthalate	380 U	460 U	470 U	430 U	460 U
4-Bromophenylphenyl ether	380 U	460 U	470 U	430 U	460 U
Butylbenzylphthalate	380 U	460 U	470 U	430 U	460 U
2-Chloronaphthalene	380 U	460 U	470 U	430 U	460 U
4-Chlorophenyl phenyl ether	380 U	460 U	470 U	430 U	460 U
Chrysene	380 U	460 U	470 U	430 U	44 J
Dibenzo(a,h)anthracene	380 U	460 U	470 U	430 U	460 U
2-Chlorophenol	380 U	460 U	470 U	430 U	460 U
Acenaphthene	380 U	460 U	470 U*X1	430 U	460 U*X1
3,3'-Dichlorobenzidine	770 U	920 U	940 U	870 U	930 U
Diethylphthalate	380 U	460 U	470 U	430 U	460 U
Dimethyl phthalate	380 U	460 U	470 U	430 U	460 U
2,4-Dinitrotoluene	380 U	460 U	470 U	430 U	460 U
2,6-Dinitrotoluene	380 U	460 U	470 U	430 U	460 U
Di-n-octylphthalate	380 U	460 U	470 U	430 U	460 U
2,4-Dichlorophenol	380 U	460 U	470 U	430 U	460 U
Acenaphthylene	380 U	460 U	470 U	430 U	460 U
2-Methylnaphthalene	380 U	460 U	470 U	430 U	460 U
Fluoranthene	380 U	460 U	470 U	40 J	98 J
Fluorene	380 U	460 U	470 U	430 U	460 U
Hexachlorobenzene	380 U	460 U	470 U	430 U	460 U
Hexachlorobutadiene	380 U	460 U	470 U	430 U	460 U
Hexachlorocyclopentadiene	380 U	460 U	470 U	430 U	460 U
Hexachloroethane	380 U	460 U	470 U	430 U	460 U
Indeno(1,2,3-cd)pyrene	380 U	460 U	470 U	430 U	460 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS, SUBSURFACE SOIL - ORGANICS
ECP SITE 5 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	5E-06	5E-07	5E-07	5E-08	5E-08
Sample ID	5E-SB06-02	5E-SB07-01	5E-SB07-06	5E-SB08-02	5E-SB08-04
Sample Date	05/04/04	05/04/04	05/04/04	05/04/04	05/04/04
Sample Depth (ft bgs)	3.00 - 5.00	1.00 - 3.00	11.00 - 13.00	3.00 - 5.00	7.00 - 9.00
Semivolatile Organic Compounds (ug/kg) (Cont.)					
Isophorone	380 U	460 U	470 U	430 U	460 U
Naphthalene	380 U	460 U	470 U	430 U	460 U
2,4-Dimethylphenol	380 U	460 U	470 U	430 U	460 U
Anthracene	380 U	460 U	470 U	430 U	460 U
4,6-Dinitro-2-methylphenol	2,000 U	2,400 U	2,400 U	2,200 U	2,400 U
Nitrobenzene	380 U	460 U	470 U	430 U	460 U
N-Nitrosodimethylamine	380 U	460 U	470 U	430 U	460 U
N-Nitrosodiphenylamine	380 U	460 U	470 U	430 U	460 U
Phenanthrene	380 U	460 U	470 U	430 U	76 J
Pyrene	380 U	460 U	470 U	30 J	78 J
1,2,4-Trichlorobenzene	380 U	460 U	470 U	430 U	460 U
4-Nitroquinoline-1-oxide	3,800 U	4,600 U	4,700 U	4,300 U	4,600 U
2,4-Dinitrophenol	2,000 U	2,400 U	2,400 U	2,200 U	2,400 U
Benzo(a)anthracene	380 U	460 U	470 U	430 U	460 U
Benzo(a)pyrene	380 U	460 U	470 U	430 U	460 U
2,6-Dichlorophenol	380 U	460 U	470 U	430 U	460 U
Benzo(b)fluoranthene	380 U	460 U	470 U	430 U	460 U
4-Aminobiphenyl	380 U	460 U	470 U	430 U	460 U
p-(Dimethylamino)azobenzene	380 U	460 U	470 U	430 U	460 U
7,12-Dimethylbenz(a)anthracene	380 U	460 U	470 U	430 U	460 U
3,3'-Dimethyl benzidine	2,000 U	2,400 U	2,400 U	2,200 U	2,400 U
alpha,alpha-Dimethylphenethylamine	78,000 U	93,000 U	96,000 U	88,000 U	94,000 U
1,4-Dioxane	380 U	460 U	470 U	430 U	460 U
n-Nitrosodi-n-propylamine	380 U	460 U	470 U	430 U	460 U
Aniline	380 U	460 U	470 U	430 U	460 U
Ethylmethanesulfonate	380 U	460 U	470 U	430 U	460 U
Acetophenone	380 U	460 U	470 U	430 U	460 U
Aramite	380 U	460 U	470 U	430 U	460 U
Hexachlorophene	200,000 U	240,000 U	240,000 U	###### U	240,000 U
Hexachloropropene	380 U	460 U	470 U	430 U	460 U
Isosafrole	380 U	460 U	470 U	430 U	460 U
Methapyrilene	78,000 U	93,000 U	96,000 U	88,000 U	94,000 U
3-Methylcholanthrene	380 U	460 U	470 U	430 U	460 U
Methyl methanesulfonate	380 U	460 U	470 U	430 U	460 U
1,4-Naphthoquinone	380 U	460 U	470 U	430 U	460 U
1-Naphthylamine	380 U	460 U	470 U	430 U	460 U
2-Naphthylamine	380 U	460 U	470 U	430 U	460 U
N-Nitrosodi-n-butylamine	380 U	460 U	470 U	430 U	460 U
N-Nitrosodiethylamine	380 U	460 U	470 U	430 U	460 U
N-Nitrosomethylethylamine	380 U	460 U	470 U	430 U	460 U
N-Nitrosomorpholine	380 U	460 U	470 U	430 U	460 U
N-Nitrosopiperidine	380 U	460 U	470 U	430 U	460 U
N-Nitrosopyrrolidine	380 U	460 U	470 U	430 U	460 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS, SUBSURFACE SOIL - ORGANICS
ECP SITE 5 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	5E-06	5E-07	5E-07	5E-08	5E-08
Sample ID	5E-SB06-02	5E-SB07-01	5E-SB07-06	5E-SB08-02	5E-SB08-04
Sample Date	05/04/04	05/04/04	05/04/04	05/04/04	05/04/04
Sample Depth (ft bgs)	3.00 - 5.00	1.00 - 3.00	11.00 - 13.00	3.00 - 5.00	7.00 - 9.00
Semivolatile Organic Compounds (ug/kg) (Cont.)					
5-Nitro-o-toluidine	380 U	460 U	470 U	430 U	460 U
Pentachlorobenzene	380 U	460 U	470 U	430 U	460 U
Pentachloronitrobenzene	380 U	460 U	470 U	430 U	460 U
Phenacetin	380 U	460 U	470 U	430 U	460 U
2-Picoline	380 U	460 U	470 U	430 U	460 U
Pronamide	380 U	460 U	470 U	430 U	460 U
Pyridine	380 U	460 U	470 U	430 U	460 U
Safrole	380 U	460 U	470 U	430 U	460 U
1,2,4,5-Tetrachlorobenzene	380 U	460 U	470 U	430 U	460 U
2,3,4,6-Tetrachlorophenol	380 U	460 U	470 U	430 U	460 U
2,4,5-Trichlorophenol	380 U	460 U	470 U	430 U	460 U
1,3,5-Trinitrobenzene	380 U	460 U	470 U	430 U	460 U
2-Acetylaminofluorene	380 U	460 U	470 U	430 U	460 U
Dinoseb	380 U	460 U	470 U	430 U	460 U
4-Chloroaniline	770 U	920 U	940 U	870 U	930 U
4-Chloro-3-methylphenol	380 U	460 U	470 U	430 U	460 U
Benzo(g,h,i)perylene	380 U	460 U	470 U	430 U	460 U
Pentachlorophenol	2,000 U	2,400 U	2,400 U	2,200 U	2,400 U
Benzo(k)fluoranthene	380 U	460 U	470 U	430 U	36 J
Benzyl alcohol	380 U	460 U	470 U	430 U	460 U
Diallate	380 U	460 U	470 U	430 U	460 U
Dibenzofuran	380 U	460 U	470 U	430 U	460 U
Di-n-butylphthalate	380 U	460 U	470 U	430 U	460 U
Cresol, m & p	380 U	460 U	470 U	430 U	460 U
m-Dichlorobenzene	380 U	460 U	470 U	430 U	460 U
m-Dinitrobenzene	380 U	460 U	470 U	430 U	460 U
3-Nitroaniline	2,000 U	2,400 U	2,400 U	2,200 U	2,400 U
Cresol (ortho)	380 U	460 U	470 U	430 U	460 U
o-Dichlorobenzene	380 U	460 U	470 U	430 U	460 U
2-Nitroaniline	2,000 U	2,400 U	2,400 U	2,200 U	2,400 U
2-Nitrophenol	380 U	460 U	470 U	430 U	460 U
o-Toluidine	380 U	460 U	470 U	430 U	460 U
p-Dichlorobenzene	380 U	460 U	470 U	430 U	460 U
4-Nitroaniline	2,000 U	2,400 U	2,400 U	2,200 U	2,400 U
4-Nitrophenol	2,000 U	2,400 U	2,400 U	2,200 U	2,400 U
1,4-Phenylenediamine	2,000 U	2,400 U	2,400 U	2,200 U	2,400 U
Pesticides/PCBs (ug/kg)					
Dieldrin	3.8 U	4.6 U	4.7 U	4.3 U	4.6 U
Endosulfan sulfate	3.8 U	4.6 U	0.67 JP	4.3 U	4.6 U
Endrin	3.8 U	4.6 U	4.7 U	4.3 U	4.6 U
Endrin aldehyde	3.8 U	4.6 U	4.7 U	4.3 U	4.6 U
Heptachlor	2 U	2.4 U	2.4 U	2.2 U	2.4 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS, SUBSURFACE SOIL - ORGANICS
ECP SITE 5 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	5E-06	5E-07	5E-07	5E-08	5E-08
Sample ID	5E-SB06-02	5E-SB07-01	5E-SB07-06	5E-SB08-02	5E-SB08-04
Sample Date	05/04/04	05/04/04	05/04/04	05/04/04	05/04/04
Sample Depth (ft bgs)	3.00 - 5.00	1.00 - 3.00	11.00 - 13.00	3.00 - 5.00	7.00 - 9.00
Pesticides/PCBs (ug/kg) (Cont.)					
Heptachlor epoxide	2 U	2.4 U	2.4 U	2.2 U	2.4 U
Aldrin	2 U	2.4 U	2.4 U	2.2 U	2.4 U
Toxaphene	200 U	240 U	240 U	220 U	240 U
alpha-BHC	2 U	2.4 U	2.4 U	2.2 U	2.4 U
beta-BHC	2 U	2.4 U	2.4 U	2.2 U	2.4 U
gamma-BHC	2 U	2.4 U	2.4 U	2.2 U	2.4 U
delta-BHC	2 U	2.4 U	2.4 U	2.2 U	2.4 U
Chlordane	20 U	24 U	24 U	22 U	24 U
4,4'-DDT	3.8 U	4.6 U	4.7 U	4.3 U	4.6 U
Endosulfan I	2 U	2.4 U	2.4 U	2.2 U	2.4 U
Endosulfan II	3.8 U	4.6 U	4.7 U	4.3 U	4.6 U
Kepone	200 U	240 U	240 U	220 U	240 U
Chlorobenzilate	20 U	24 U	24 U	22 U	24 U
4,4'-DDE	3.8 U	4.6 U	4.7 U	4.3 U	4.6 U
4,4'-DDD	3.8 U	4.6 U	4.7 U	1 JP	0.56 JP
Isodrin	3.8 U	4.6 U	4.7 U	4.3 U	4.6 U
Methoxychlor	20 U	24 U	24 U	22 U	24 U
Aroclor-1242	38 U	46 U	47 U	43 U	46 U
Aroclor-1254	38 U	46 U	47 U	43 U	46 U
Aroclor-1221	78 U	93 U	96 U	88 U	94 U
Aroclor-1232	38 U	46 U	47 U	43 U	46 U
Aroclor-1248	38 U	46 U	47 U	43 U	46 U
Aroclor-1260	38 U	46 U	47 U	43 U	46 U
Aroclor-1016	38 U	46 U	47 U	43 U	46 U
OP-Pesticides (ug/kg)					
Thionazin	380 U	460 U	470 U	430 U	460 U
Famphur	380 U	460 U	470 U	430 U	460 U
Dimethoate	380 U	460 U	470 U	430 U	460 U
Disulfoton	380 U	460 U	470 U	430 U	460 U
Parathion (Ethyl parathion)	380 U	460 U	470 U	430 U	460 U
Methyl parathion	380 U	460 U	470 U	430 U	460 U
O,O,O-Triethyl phosphorothioate	380 U	460 U	470 U	430 U	460 U
Phorate	380 U	460 U	470 U	430 U	460 U
Sulfotepp	380 U	460 U	470 U	430 U	460 U
Chlorinated Herbicides (ug/kg)					
2,4,5-TP	9.6 U	12 U	12 U	11 U	12 U
2,4-D	9.6 U	12 U	12 U	11 U	12 U
2,4,5-T	9.6 U	12 U	12 U	11 U	12 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS, SUBSURFACE SOIL - INORGANICS
ECP SITE 5 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	5E-01	5E-02	5E-03	5E-04	5E-05	5E-06	5E-07	5E-07	5E-08	5E-08
Sample ID	5E-SB01-03	5E-SB02-02	5E-SB03-02	5E-SB04-02	5E-SB05-01	5E-SB06-02	5E-SB07-01	5E-SB07-06	5E-SB08-02	5E-SB08-04
Sample Date	05/03/04	05/03/04	05/03/04	05/03/04	05/04/04	05/04/04	05/04/04	05/04/04	05/04/04	05/04/04
Sample Depth (ft bgs)	5.00 - 7.00	3.00 - 5.00	3.00 - 5.00	3.00 - 5.00	1.00 - 3.00	3.00 - 5.00	1.00 - 3.00	11.00 - 13.00	3.00 - 5.00	7.00 - 9.00
Appendix IX Inorganics (mg/kg)										
Silver	0.18 B	1.2 U	0.16 B	0.16 B	1.1 U	1.1 U	0.17 B	1.3 U	1.2 U	1.3 U
Arsenic	1.6	1.2 U	1 U	1.2 U	1.1 U	1.4	1.3 U	1.3 U	1.2 U	1.4
Barium	210 N	130 N	89 N	190 N	130 N	160 N	110 N	100 N	140 N	54 N
Beryllium	0.27 B	0.18 B	0.17 B	0.16 B	0.29 B	0.23 B	0.22 B	0.46 B	0.27 B	0.16 B
Cadmium	0.35 B	0.6 U	0.67	0.4 B	0.56 U	0.23 B	0.67 U	0.64 U	0.62 U	0.65 U
Cobalt	27	19	39	36	19	39	5.1	54	23	2.4
Chromium	77	52	68	55	30	29	41	46	70	56
Copper	21 N	79 N	110 N	55 N	63 N	110 N	99 N	100 N	85 N	85 N
Nickel	30	26	28	24	18	14	8.6	19	21	8.1
Lead	6.6	3.3	0.87	6.2	0.97	30	36	44	14	21
Antimony	2.2 UN	2.4 UN	2.1 UN	2.3 UN	2.2 UN	2.2 UN	2.7 UN	2.6 UN	2.5 UN	2.6 UN
Selenium	2.2 U	1.2 U	1 U	1.2 U	1.1 U	1.1 U	1.3 U	1.3 U	1.2 U	1.3 U
Tin	1.2 B	1 B	2.4 B	2.5 B	3 B	2.8 B	3.9 B	2.5 B	6.2 U	3.3 B
Thallium	1.1 U	1.2 U	1 U	1.2 U	1.1 U	1.1 U	1.3 U	1.3 U	1.2 U	1.3 U
Vanadium	270 N	120 N	220 N	240 N	130 N	210 N	200 N	410 N	160 N	300 N
Zinc	200	80	88	95	59	100	55	140	140	42
Cyanide	0.58 U	0.63 U	0.55 U	0.62 U	0.57 U	2.1	0.67 U	0.69 U	0.63 U	0.7 U
Sulfide	30 U	33 U	29 U	32 U	30 U	29 U	35 B	36 U	33 U	35 U
Mercury	0.022 UN	0.024 UN	0.02 UN	0.0053 BN	0.0093 BN	0.022 UN	0.036 N	0.028 UN	0.017 BN	0.064 N

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS, GROUNDWATER - ORGANICS
ECP SITE 5 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	13MW04	13MW04	5E-05	5E-08
Sample ID	13GW04	13GW04D	5E-GW05	5E-GW08
Sample Date	05/06/04	05/06/04	05/07/04	05/06/04
Volatile Organic Compounds (ug/L)				
Chloroform	1 U	1 U	1 U	1 U
Dichlorodifluoromethane	1 U	1 U	1 U	1 U
1,1-Dichloroethane	1 U	1 U	1 U	1 U
1,2-Dichloroethane	1 U	1 U	1 U	1 U
1,1-Dichloroethene	1 U	1 U	1 U	1 U
1,2-Dichloropropane	1 U	1 U	1 U	1 U
Ethyl benzene	1 U	1 U	1 U	1 U
Acrolein	20 U	20 U	20 U	20 U
Methylene chloride	5 U	5 U	5 U	5 U
1,1,2,2-Tetrachloroethane	1 U	1 U	1 U	1 U
Tetrachloroethene	1 U	1 U	1 U	1 U
Toluene	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene	1 U	1 U	1 U	1 U
1,1,1-Trichloroethane	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	1 U	1 U	1 U	1 U
2-Butanone	10 U	10 U	1.4 J	10 U
Chloroprene	1 U	1 U	1 U	1 U
2-Hexanone	10 U	10 U	10 U	10 U
Acrylonitrile	20 U	20 U	20 U	20 U
3-Chloro-1-propene	1 U	1 U	1 U	1 U
Benzene	1 U	1 U	1 U	1 U
Bromoform	1 U	1 U	1 U	1 U
Carbon tetrachloride	1 U	1 U	1 U	1 U
Chlorobenzene	1 U	1 U	1 U	1 U
Acetonitrile	40 U	40 U	40 U	40 U
1,2-Dibromo-3-chloropropane	1 U	1 U	1 U	1 U
Dibromomethane	1 U	1 U	1 U	1 U
trans-1,4-Dichloro-2-butene	2 U	2 U	2 U	2 U
cis-1,3-Dichloropropene	1 U	1 U	1 U	1 U
trans-1,3-Dichloropropene	1 U	1 U	1 U	1 U
Ethyl methacrylate	1 U	1 U	1 U	1 U
Iodomethane	1 U	1 U	1 U	0.41 J
Methacrylonitrile	20 U	20 U	20 U	20 U
Methyl methacrylate	1 U	1 U	1 U	1 U
Pentachloroethane	5 U	5 U	5 U	5 U
1,1,1,2-Tetrachloroethane	1 U	1 U	1 U	1 U
Trichlorofluoromethane	1 U	1 U	1 U	1 U
1,2,3-Trichloropropane	1 U	1 U	1 U	1 U
Vinyl chloride	1 U	1 U	1 U	1 U
Dibromochloromethane	1 U	1 U	1 U	1 U
Chloroethane	1 U	1 U	1 U	1 U
Acetone	25 U	25 U	21 J	25 U
Bromodichloromethane	1 U	1 U	1 U	1 U
Bromomethane	1 U	1 U	1 U	1 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS, GROUNDWATER - ORGANICS
ECP SITE 5 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	13MW04	13MW04	5E-05	5E-08
Sample ID	13GW04	13GW04D	5E-GW05	5E-GW08
Sample Date	05/06/04	05/06/04	05/07/04	05/06/04
Volatile Organic Compounds (ug/L) (Cont.)				
Chloromethane	1 U	1 U	1 U	1 U
Carbon disulfide	1 U	1 U	1 U	0.69 J
1,2-Dibromoethane	1 U	1 U	1 U	1 U
Propionitrile	20 U	20 U	20 U	20 U
Isobutanol	40 U	40 U	40 U	40 U
4-Methyl-2-pentanone	10 U	10 U	10 U	10 U
Styrene	1 U	1 U	1 U	1 U
Trichloroethene	1 U	1 U	1 U	1 U
Vinyl acetate	2 U	2 U	2 U	2 U
Xylene	2 U	2 U	2 U	2 U
Semivolatile Organic Compounds (ug/L)				
Phenol	10 U	10 U	15 U	10 U
bis(2-Chloroethoxy)methane	10 U	10 U	15 U	10 U
2,4,6-Trichlorophenol	10 U	10 U	15 U	10 U
bis(2-Chloroethyl)ether	10 U	10 U	15 U	10 U
bis(2-Chloroisopropyl)ether	10 U	10 U	15 U	10 U
bis(2-Ethylhexyl)phthalate	10 U	10 U	15 U	10 U
4-Bromophenylphenyl ether	10 U	10 U	15 U	10 U
Butylbenzylphthalate	10 U	10 U	15 U	10 U
2-Chloronaphthalene	10 U	10 U	15 U	10 U
4-Chlorophenyl phenyl ether	10 U	10 U	15 U	10 U
Chrysene	10 U	10 U	15 U	10 U
Dibenzo(a,h)anthracene	10 U	10 U	15 U	10 U
2-Chlorophenol	10 U	10 U	15 U	10 U
Acenaphthene	10 U	10 U	15 U	1.1 J
3,3'-Dichlorobenzidine	20 U	20 U	30 U	20 U
Diethylphthalate	10 U	10 U	15 U	10 U
Dimethyl phthalate	10 U	10 U	15 U	10 U
2,4-Dinitrotoluene	10 U	10 U	15 U	10 U
2,6-Dinitrotoluene	10 U	10 U	15 U	10 U
Di-n-octylphthalate	10 U	10 U	15 U	10 U
2,4-Dichlorophenol	10 U	10 U	15 U	10 U
Acenaphthylene	10 U	10 U	15 U	10 U
2-Methylnaphthalene	10 U	10 U	15 U	10 U
Fluoranthene	10 U	10 U	15 U	1.5 J
Fluorene	10 U	10 U	15 U	10 U
Hexachlorobenzene	10 U	10 U	15 U	10 U
Hexachlorobutadiene	10 U	10 U	15 U	10 U
Hexachlorocyclopentadiene	10 U	10 U	15 U	10 U
Hexachloroethane	10 U	10 U	15 U	10 U
Indeno(1,2,3-cd)pyrene	10 U	10 U	15 U	10 U
Isophorone	10 U	10 U	15 U	10 U
Naphthalene	10 U	10 U	15 U	10 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS, GROUNDWATER - ORGANICS
ECP SITE 5 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	13MW04	13MW04	5E-05	5E-08
Sample ID	13GW04	13GW04D	5E-GW05	5E-GW08
Sample Date	05/06/04	05/06/04	05/07/04	05/06/04
Semivolatile Organic Compounds (ug/L) (Cont.)				
2,4-Dimethylphenol	10 U	10 U	15 U	10 U
Anthracene	10 U	10 U	15 U	0.57 J
4,6-Dinitro-2-methylphenol	50 U	50 U	75 U	50 U
Nitrobenzene	10 U	10 U	15 U	10 U
N-Nitrosodimethylamine	10 U	10 U	15 U	10 U
N-Nitrosodiphenylamine	10 U	10 U	15 U	10 U
Phenanthrene	10 U	10 U	15 U	3 J
Pyrene	10 U	10 U	15 U	10 U
1,2,4-Trichlorobenzene	10 U	10 U	15 U	10 U
4-Nitroquinoline-1-oxide	20 U	20 U	30 U	20 U
2,4-Dinitrophenol	50 U	50 U	75 U	50 U
Benzo(a)anthracene	10 U	10 U	15 U	10 U
Benzo(a)pyrene	10 U	10 U	15 U	10 U
2,6-Dichlorophenol	10 U	10 U	15 U	10 U
Benzo(b)fluoranthene	10 U	10 U	15 U	10 U
4-Aminobiphenyl	10 U	10 U	15 U	10 U
p-(Dimethylamino)azobenzene	10 U	10 U	15 U	10 U
7,12-Dimethylbenz(a)anthracene	10 U	10 U	15 U	10 U
3,3'-Dimethyl benzidine	20 U	20 U	30 U	20 U
alpha,alpha-Dimethylphenethylamine	2,000 U	2,000 U	3,000 U	2,000 U
1,4-Dioxane	10 U	10 U	15 U	10 U
n-Nitrosodi-n-propylamine	10 U	10 U	15 U	10 U
Aniline	20 U	20 U	30 U	20 U
Ethylmethanesulfonate	10 U	10 U	15 U	10 U
Acetophenone	10 U	10 U	15 U	10 U
Aramite	10 U	10 U	15 U	10 U
Hexachlorophene	5,000 U	5,000 U	7,500 U	5,000 U
Hexachloropropene	10 U	10 U	15 U	10 U
Isosafrole	10 U	10 U	15 U	10 U
Methapyrilene	2,000 U	2,000 U	3,000 U	2,000 U
3-Methylcholanthrene	10 U	10 U	15 U	10 U
Methyl methanesulfonate	10 U	10 U	15 U	10 U
1,4-Naphthoquinone	10 U	10 U	15 U	10 U
1-Naphthylamine	10 U	10 U	15 U	10 U
2-Naphthylamine	10 U	10 U	15 U	10 U
N-Nitrosodi-n-butylamine	10 U	10 U	15 U	10 U
N-Nitrosodiethylamine	10 U	10 U	15 U	10 U
N-Nitrosomethylethylamine	10 U	10 U	15 U	10 U
N-Nitrosomorpholine	10 U	10 U	15 U	10 U
N-Nitrosopiperidine	10 U	10 U	15 U	10 U
N-Nitrosopyrrolidine	10 U	10 U	15 U	10 U
5-Nitro-o-toluidine	10 U	10 U	15 U	10 U
Pentachlorobenzene	10 U	10 U	15 U	10 U
Pentachloronitrobenzene	10 U	10 U	15 U	10 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS, GROUNDWATER - ORGANICS
ECP SITE 5 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	13MW04	13MW04	5E-05	5E-08
Sample ID	13GW04	13GW04D	5E-GW05	5E-GW08
Sample Date	05/06/04	05/06/04	05/07/04	05/06/04
Semivolatile Organic Compounds (ug/L) (Cont.)				
Phenacetin	10 U	10 U	15 U	10 U
2-Picoline	10 U	10 U	15 U	10 U
Pronamide	10 U	10 U	15 U	10 U
Pyridine	50 U	50 U	75 U	50 U
Safrole	10 U	10 U	15 U	10 U
1,2,4,5-Tetrachlorobenzene	10 U	10 U	15 U	10 U
2,3,4,6-Tetrachlorophenol	10 U	10 U	15 U	10 U
2,4,5-Trichlorophenol	10 U	10 U	15 U	10 U
1,3,5-Trinitrobenzene	10 U	10 U	15 U	10 U
2-Acetylaminofluorene	10 U	10 U	15 U	10 U
Dinoseb	10 U	10 U	15 U	10 U
4-Chloroaniline	20 U	20 U	30 U	20 U
4-Chloro-3-methylphenol	10 U	10 U	15 U	10 U
Benzo(g,h,i)perylene	10 U	10 U	15 U	10 U
Pentachlorophenol	50 U	50 U	75 U	50 U
Benzo(k)fluoranthene	10 U	10 U	15 U	10 U
Benzyl alcohol	10 U	10 U	15 U	10 U
Diallate	10 U	10 U	15 U	10 U
Dibenzofuran	10 U	10 U	15 U	10 U
Di-n-butylphthalate	10 U	10 U	15 U	10 U
Cresol, m & p	10 U	10 U	15 U	10 U
m-Dichlorobenzene	10 U	10 U	15 U	10 U
m-Dinitrobenzene	10 U	10 U	15 U	10 U
3-Nitroaniline	50 U	50 U	75 U	50 U
Cresol (ortho)	10 U	10 U	15 U	10 U
o-Dichlorobenzene	10 U	10 U	15 U	10 U
2-Nitroaniline	50 U	50 U	75 U	50 U
2-Nitrophenol	10 U	10 U	15 U	10 U
o-Toluidine	10 U	10 U	15 U	10 U
p-Dichlorobenzene	10 U	10 U	15 U	10 U
4-Nitroaniline	50 U	50 U	75 U	50 U
4-Nitrophenol	50 U	50 U	75 U	50 U
1,4-Phenylenediamine	2,000 U	2,000 U	3,000 U	2,000 U
Pesticides/PCBs (ug/L)				
Dieldrin	0.1 U	0.1 U	0.1 U	0.1 U
Endosulfan sulfate	0.1 U	0.1 U	0.1 U	0.1 U
Endrin	0.1 U	0.1 U	0.1 U	0.1 U
Endrin aldehyde	0.1 U	0.1 U	0.1 U	0.1 U
Heptachlor	0.05 U	0.05 U	0.05 U	0.05 U
Heptachlor epoxide	0.05 U	0.05 U	0.02 JP	0.05 U
Aldrin	0.05 U	0.05 U	0.05 U	0.05 U
Toxaphene	5 U	5 U	5 U	5 U
alpha-BHC	0.05 U	0.05 U	0.05 U	0.05 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS, GROUNDWATER - ORGANICS
ECP SITE 5 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	13MW04	13MW04	5E-05	5E-08
Sample ID	13GW04	13GW04D	5E-GW05	5E-GW08
Sample Date	05/06/04	05/06/04	05/07/04	05/06/04
Pesticides/PCBs (ug/L) (Cont.)				
beta-BHC	0.05 U	0.05 U	0.05 U	0.05 U
gamma-BHC	0.05 U	0.05 U	0.05 U	0.05 U
delta-BHC	0.05 U	0.05 U	0.05 U	0.05 U
Chlordane	0.5 U	0.5 U	0.5 U	0.5 U
4,4'-DDT	0.1 U	0.1 U	0.1 U	0.1 U
Endosulfan I	0.05 U	0.05 U	0.05 U	0.05 U
Endosulfan II	0.1 U	0.1 U	0.1 U	0.1 U
Kepone	1 U	1 U	1 U	1 U
Chlorobenzilate	0.5 U	0.5 U	0.5 U	0.5 U
4,4'-DDE	0.1 U	0.1 U	0.1 U	0.1 U
4,4'-DDD	0.1 U	0.1 U	0.1 U	0.1 U
Isodrin	0.05 U	0.05 U	0.05 U	0.05 U
Methoxychlor	0.5 U	0.5 U	0.5 U	0.5 U
Aroclor-1242	1 U	1 U	1 U	1 U
Aroclor-1254	1 U	1 U	1 U	1 U
Aroclor-1221	2 U	2 U	2 U	2 U
Aroclor-1232	1 U	1 U	1 U	1 U
Aroclor-1248	1 U	1 U	1 U	1 U
Aroclor-1260	1 U	1 U	1 U	1 U
Aroclor-1016	1 U	1 U	1 U	1 U
OP-Pesticides (ug/L)				
Thionazin	10 U	10 U	16 U	10 U
Famphur	10 U	10 U	16 U	10 U
Dimethoate	10 U	10 U	16 U	10 U
Disulfoton	10 U	10 U	16 U	10 U
Parathion (Ethyl parathion)	10 U	10 U	16 U	10 U
Methyl parathion	10 U	10 U	16 U	10 U
O,O,O-Triethyl phosphorothioate	10 U	10 U	16 U	10 U
Phorate	10 U	10 U	16 U	10 U
Sulfotepp	10 U	10 U	16 U	10 U
Chlorinated Herbicides (ug/L)				
2,4,5-TP	0.5 U	0.5 U	0.5 U	0.5 U
2,4-D	0.5 U	0.5 U	0.5 U	0.5 U
2,4,5-T	0.5 U	0.5 U	0.5 U	0.5 U

APPENDIX B

SUMMARY OF ANALYTICAL RESULTS, GROUNDWATER - INORGANICS
ECP SITE 5 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
PHASE II ECP REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	13MW04	13MW04	5E-05	5E-08
Sample ID	13GW04	13GW04D	5E-GW05	5E-GW08
Sample Date	05/06/04	05/06/04	05/07/04	05/06/04
Dissolved Metals (mg/L)				
Silver	0.01 U	0.01 U	0.01 U	0.005 U
Arsenic	0.01 U	0.01 U	0.01 U	0.01 U
Barium	0.029	0.027	0.095	0.27
Beryllium	0.004 U	0.004 U	0.004 U	0.004 U
Cadmium	0.005 U	0.005 U	0.005 U	0.005 U
Cobalt	0.01 U	0.01 U	0.01 U	0.0042 B
Chromium	0.01 U	0.01 U	0.0055 B	0.01 U
Copper	0.02 U	0.02 U	0.01 B	0.0048 B
Nickel	0.04 U	0.04 U	0.0028 B	0.004 B
Lead	0.005 U	0.005 U	0.005 U	0.005 U
Antimony	0.02 U	0.02 U	0.02 U	0.02 U
Selenium	0.01 U	0.01 U	0.01 U	0.01 U
Tin	0.05 U	0.05 U	0.05 U	0.05 U
Thallium	0.01 U	0.01 U	0.01 U	0.01 U
Vanadium	0.035	0.04	0.017	0.017
Zinc	0.004 B	0.0046 B	0.0072 B	0.0038 B
Mercury	0.0002 UN	0.0002 UN	0.000084 B	0.002 U
Total Metals (mg/L)				
Silver	0.01 U	0.01 U	NA	NA
Arsenic	0.01 U	0.01 U	NA	NA
Barium	0.026	0.025	NA	NA
Beryllium	0.004 U	0.004 U	NA	NA
Cadmium	0.005 U	0.005 U	NA	NA
Cobalt	0.01 U	0.01 U	NA	NA
Chromium	0.01 U	0.01 U	NA	NA
Copper	0.02 U	0.02 U	NA	NA
Nickel	0.04 U	0.04 U	NA	NA
Lead	0.005 U	0.005 U	NA	NA
Antimony	0.02 U	0.02 U	NA	NA
Selenium	0.01 U	0.01 U	NA	NA
Tin	0.05 U	0.05 U	NA	NA
Thallium	0.01 U	0.01 U	NA	NA
Vanadium	0.043	0.042	NA	NA
Zinc	0.023	0.021	NA	NA
Cyanide	0.01 U	0.01 U	NA	0.01 U
Sulfide	1 U	1 U	NA	1 U
Mercury	0.0002 UN	0.0002 UN	NA	NA

IDW DATA

CompuChem, a division of Liberty Analytical

Client: BAKER ENVIRONMENTAL, INC. **Work:** 1005191

Project: NAPR SWMU59/DO#119197.7.2 ON ISLAND/JM01 **Sdg:** 1005191

Lab ID	Client ID	Matrix	Date Sampled	Date Received
1005191-01	59IDW01	Soil	05/24/2010 08:50	05/25/2010 09:20
1005191-02	59IDW01	Soil	05/24/2010 08:50	05/25/2010 09:20

1BCWC
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

Client Project ID:
Client SDG No: 1005191
Client Sample ID: 59IDW01

Lab Project Number:
Method: 8270C-1311S
Date Collected: 05/24/10

Lab Sample ID: 1005191-01
Sample wt/vol: 100 (g/mL) ML
Level: (low/med) LOW

Date Received: 05/25/10
Lab File ID: 1005191-01A60
Analyst: MEW

% Moisture: _____ decanted: (Y/N)___
Concentrated Extract Volume: 500(uL)
Injection Volume: 2.0(uL)

Date Extracted: 06/08/10
Date Analyzed: 07/12/10
Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 1.0 Method Blank: 0060803-BLK1

CAS NO.	COMPOUND	MDL	Reporting Limit UG/L	Results UG/L	Q
110-86-1	Pyridine	4.9	25	ND	U
106-46-7	1,4-Dichlorobenzene	4.1	25	ND	U
95-48-7	2-Methylphenol	2.5	50	ND	U
108-39-4	3-Methylphenol	3.2	40	ND	U
106-44-5	4-Methylphenol	3.2	40	ND	U
67-72-1	Hexachloroethane	4.3	25	ND	U
98-95-3	Nitrobenzene	4	25	ND	U
87-68-3	Hexachlorobutadiene	4.3	25	ND	U
88-06-2	2,4,6-Trichlorophenol	2.8	50	ND	U
95-95-4	2,4,5-Trichlorophenol	3.8	50	ND	U
121-14-2	2,4-Dinitrotoluene	2.9	25	ND	U
118-74-1	Hexachlorobenzene	3.2	25	ND	U
87-86-5	Pentachlorophenol	4.2	50	ND	U

ND = Not Detected
Q = Qualifier

FORM I SV-1

SW846 - METALS

-1-

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

59IDW01

Lab Name: COMPUCHEM Contract:

Lab Code: LIBRTY Case No.: SAS No.: SDG No.: 1005191

Matrix (soil/water): LEACHATE Lab Sample ID: 1005191-01

Level (low/med): LOW Date Received: 5/25/2010

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7440-38-2	Arsenic	19.5	B		P
7440-39-3	Barium	32.6	B		P
7440-43-9	Cadmium	1.5	B		P
7440-47-3	Chromium	6.1	B		P
7439-92-1	Lead	2.2	B		P
7439-97-6	Mercury	0.091	U		CV
7782-49-2	Selenium	16.0	B		P
7440-22-4	Silver	0.64	U		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

1AWC
VOLATILE ORGANICS ANALYSIS DATA SHEET

Client Project ID:
Client SDG No: 1005191
Client Sample ID: 59IDW01

Lab Project Number:
Method: 8260B-1311S
Date Collected: 05/24/10

Lab Sample ID: 1005191-01
Sample wt/vol: 5 (g/ml) ML
Level: (low/med) LOW

Date Received: 05/25/10
Lab File ID: 1005191-0159
Analyst: TD

% Moisture: not dec. _____
GC Column: SPB-624 ID: 0.32 (mm)

Date Analyzed: 06/05/10
Dilution Factor: 5.0

Soil Extract Volume:_____(uL)
Method Blank: 0060421-BLK1

Soil Aliquot Volume: _____(uL)

CAS NO.	COMPOUND	MDL	Reporting Limit UG/L	Results UG/L	Q
75-01-4	Vinyl Chloride	2.4	25	ND	U
75-35-4	1,1-Dichloroethene	2.7	25	ND	U
78-93-3	2-butanone	7.5	63	ND	U
67-66-3	Chloroform	1.4	25	ND	U
56-23-5	Carbon Tetrachloride	1.6	25	ND	U
71-43-2	Benzene	1.4	25	ND	U
107-06-2	1,2-Dichloroethane	1.2	25	ND	U
79-01-6	Trichloroethene	1.4	25	ND	U
127-18-4	Tetrachloroethene	2.1	25	ND	U
108-90-7	Chlorobenzene	1.4	25	ND	U

ND = Not Detected
Q = Qualifier

FORM I VOA

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BAKER ENVIRONMENTAL, INC.	Project: NAPR SWMU59/DO#119197.7.2 ON ISLAND/JM01	
AIRSIDE BUSINESS PARK 100 AIRSIDE DRIVI	Project Number: NAPR SWMU59/DO#119197.7.2 ON ISLAND/J	**Reported:**
MOON TOWNSHIP PA, 15108	Project Manager: MARK KIMES	06/18/2010 15:52

59IDW01
1005191-02 (Soil)

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method
COMPUCHEM								
***** DEFAULT GENERAL METHOD *****								
% Solids	**67**	0	% by Weight	1	0061812	06/18/2010 11:01	06/18/2010 14:35	% Calculation
WET CHEMISTRY PARAMETERS								
Corrosivity-pH	**8.7**		pH Units	1	0060141	06/01/2010 11:35	06/04/2010 20:30	EPA 9040B
Ignitability by Flashpoint	>140		degree F dry	1	0060142	06/01/2010 11:36	06/04/2010 21:00	EPA 1010
Reactive Cyanide	ND	187	mg/kg dry	1	0060139	06/01/2010 11:33	06/04/2010 21:00	EPA 9014
Reactive Sulfide	ND	187	mg/kg dry	1	0060140	06/01/2010 11:34	06/04/2010 21:30	EPA 9034

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Preeti Khare For Cathy Dover, Project Manager

SW846 - METALS

-1-

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

59IDW02

Lab Name: COMPUCHEM Contract:

Lab Code: LIBRTY Case No.: SAS No.: SDG No.: 1005192

Matrix (soil/water): LEACHATE Lab Sample ID: 1005192-01

Level (low/med): LOW Date Received: 5/25/2010

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7440-38-2	Arsenic	2.5	U		P
7440-39-3	Barium	33.2	B		P
7440-43-9	Cadmium	0.64	U		P
7440-47-3	Chromium	1.3	B		P
7439-92-1	Lead	1.6	U		P
7439-97-6	Mercury	0.091	U		CV
7782-49-2	Selenium	2.1	U		P
7440-22-4	Silver	0.64	U		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

1AWC
VOLATILE ORGANICS ANALYSIS DATA SHEET

Client Project ID:
Client SDG No: 1005192
Client Sample ID: 59IDW02

Lab Project Number:
Method: 8260B-1311W
Date Collected: 05/24/10

Lab Sample ID: 1005192-01
Sample wt/vol: 5 (g/ml) ML
Level: (low/med) LOW

Date Received: 05/25/10
Lab File ID: 1005192-0169
Analyst: JAO

% Moisture: not dec. _____
GC Column: SPB-624 ID: 0.32 (mm)

Date Analyzed: 06/11/10
Dilution Factor: 1.0

Soil Extract Volume:_____(uL)
Method Blank: 0061104-BLK1

Soil Aliquot Volume: _____(uL)

CAS NO.	COMPOUND	MDL	Reporting Limit UG/L	Results UG/L	Q
75-01-4	Vinyl Chloride	0.48	5	ND	U
75-35-4	1,1-Dichloroethene	0.53	5	ND	U
78-93-3	2-butanone	1.5	13	ND	U
67-66-3	Chloroform	0.27	5	0.49	J
56-23-5	Carbon Tetrachloride	0.31	5	ND	U
71-43-2	Benzene	0.28	5	ND	U
107-06-2	1,2-Dichloroethane	0.23	5	ND	U
79-01-6	Trichloroethene	0.28	5	ND	U
127-18-4	Tetrachloroethene	0.42	5	ND	U
108-90-7	Chlorobenzene	0.27	5	ND	U

ND = Not Detected
Q = Qualifier

FORM I VOA

1BCWC
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

Client Project ID:
Client SDG No: 1005191
Client Sample ID: 59IDW01

Lab Project Number:
Method: 8270C-1311S
Date Collected: 05/24/10

Lab Sample ID: 1005191-01
Sample wt/vol: 100 (g/mL) ML
Level: (low/med) LOW

Date Received: 05/25/10
Lab File ID: 1005191-01A60
Analyst: MEW

% Moisture: _____ decanted: (Y/N)___
Concentrated Extract Volume: 500(uL)
Injection Volume: 2.0(uL)

Date Extracted: 06/08/10
Date Analyzed: 07/12/10
Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: 1.0 Method Blank: 0060803-BLK1

CAS NO.	COMPOUND	MDL	Reporting Limit UG/L	Results UG/L	Q
110-86-1	Pyridine	4.9	25	ND	U
106-46-7	1,4-Dichlorobenzene	4.1	25	ND	U
95-48-7	2-Methylphenol	2.5	50	ND	U
108-39-4	3-Methylphenol	3.2	40	ND	U
106-44-5	4-Methylphenol	3.2	40	ND	U
67-72-1	Hexachloroethane	4.3	25	ND	U
98-95-3	Nitrobenzene	4	25	ND	U
87-68-3	Hexachlorobutadiene	4.3	25	ND	U
88-06-2	2,4,6-Trichlorophenol	2.8	50	ND	U
95-95-4	2,4,5-Trichlorophenol	3.8	50	ND	U
121-14-2	2,4-Dinitrotoluene	2.9	25	ND	U
118-74-1	Hexachlorobenzene	3.2	25	ND	U
87-86-5	Pentachlorophenol	4.2	50	ND	U

ND = Not Detected
Q = Qualifier

FORM I SV-1

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BAKER ENVIRONMENTAL, INC.	Project: NAPR SWMU59/DO#119197.7.2 ON ISLAND/JM01	
AIRSIDE BUSINESS PARK 100 AIRSIDE DRIVE	Project Number: NAPR SWMU59/DO#119197.7.2 ON ISLAND/J	**Reported:**
MOON TOWNSHIP PA, 15108	Project Manager: MARK KIMES	06/17/2010 15:39

59IDW02

1005192-02 (Water)

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method
COMPUCHEM								
WET CHEMISTRY PARAMETERS								
Corrosivity-pH	**7.64**		pH Units	1	0060145	06/01/2010 11:41	06/04/2010 20:30	EPA 9040B
Ignitability by Flashpoint	>140		degree F	1	0060146	06/01/2010 11:42	06/04/2010 21:00	EPA 1010
Reactive Cyanide	ND	250	mg/L	1	0060143	06/01/2010 11:39	06/04/2010 21:00	EPA 9014
Reactive Sulfide	ND	250	mg/L	1	0060144	06/01/2010 11:40	06/04/2010 21:30	EPA 9034

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Preeti Khare For Cathy Dover, Project Manager

COMPUCHEM SUPPORTING INFORMATION

Laboratory Quality Assurance Plan

Quality Manual

CompuChem
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Revision 14
January 25, 2011

501 Madison Ave.
Cary, North Carolina 27513
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CompuChem's mission is to work towards a cleaner environment, providing quality analytical services economically and efficiently. Our highly trained staff members work as partners to our clients to support and facilitate environmental solutions.

CompuChem
A Division Of
Liberty Analytical Corp.

Quality Manual for
CompuChem, a Division of Liberty Analytical Corporation

501 Madison Avenue
Cary, NC 27513

Revision **14**

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1.0 Statement of Policy

This Quality Manual summarizes the policies and operational procedures associated with CompuChem, a Division of Liberty Analytical Corporation, in Cary, North Carolina. Specific protocols for sample handling and storage, chain-of-custody, and laboratory analyses, data reduction, corrective action, and reporting are described. All policies and procedures have been structured in accordance with the National Environmental Laboratory Accreditation Conference (NELAC), Department of Defense Environmental Laboratory Accreditation Program (DoD-ELAP) based on Quality Systems Manual 4.2 (QSM 4.2), ISO 17025, and applicable EPA requirements, regulations, guidance, and technical standards. This manual has been prepared in accordance with the guidance documents listed further in Section 14. Further details on these policies and procedures are contained in SOPs and related documents. This Quality Manual, SOPs, and related documentation describe the quality system for CompuChem. This Quality Manual is not for use with Ohio VAP projects. Please see Ohio VAP specific Quality Assurance Manual.

CompuChem performs chemical analyses for inorganic and organic constituents in water, soil, and biological tissue samples. CompuChem's goal, and primary QA objective, is to produce data that meet customer requirements and are scientifically valid, defensible, and of known and documented quality in accordance with standards adopted by NELAC, DoD-QSM 4.2, any applicable state or EPA regulations or requirements, **individual state certifications,** and in accordance with CompuChem's Code of Ethics (Figure 1-1).

CompuChem analyzes Proficiency Test (PT) samples at a minimum of two times per year for each field of proficiency testing following the requirements for PT providers and laboratories in Chapter 2.0 of the NELAC standards. Samples are obtained from a**n** A2LA accredited PT provider. The specific analytes and matrices analyzed are based on the current scope of the laboratory services and accreditations and are documented in a laboratory SOP on PT sample analyses **reports** and in QA PT study files.

CompuChem has been a participant in the Contract Laboratory Program (CLP) since its inception and has established a long-standing rapport with the U.S. Environmental Protection Agency (USEPA) Program Office in Washington, DC, through our CLP Project Officer, and with the Region IV support division office. The EPA administers organic and inorganic Quarterly Blind PT studies for CLP analytes.

The technical and service requirements of all requests to provide analytical services are thoroughly evaluated and summarized by the Vice President and General Manager. Marketing, Customer Services, Project Management, and Laboratory Operations review the summary before commitments are made to accept the work and before the project begins. This includes a review of facilities and instrumentation, current sample load, staffing, and any special method, QC or reporting requirements. All measurements are made using published reference methods or methods developed by CompuChem. Competence with all methods is demonstrated according to the procedure described in Appendix B of this Quality Manual prior to use.

The management of CompuChem is fully and firmly committed to the quality assurance program described in this Quality Manual. The company's policies on ethical practices and its organizational hierarchy ensure that all of its employees are free from undue pressures that may adversely affect the quality of their work. Each director, manager and supervisor, as well as their staff, is assigned, in accordance with this plan, responsibilities and objectives. Key aspects of procedures for sample receiving, chain-of-custody, sample preparation, laboratory analysis, data verification, and reporting are described in this Quality Manual and detailed **in** the laboratory's SOPs. This manual and the SOPs document the elements of CompuChem's QA program.

The QA program is maintained and expanded or modified as necessary, to ensure all reported data are of uncompromising quality. In order to determine whether QA objectives are met, sufficient quality control will be generated. To meet the objectives of the QA program, senior management supports a program designed to:

- assess the capabilities of analytical methods for meeting users' needs in terms of accuracy, precision, completeness, representativeness, and comparability.
- establish and monitor the routine operational performance of the laboratory through appropriate systems checks to ensure that all aspects of the QA program are operative.
- assure that corrective actions are taken and that system control has been restored before resuming sample analysis whenever QC acceptance criteria are not met.

CompuChem has developed a proactive program for prevention of improper, unethical or illegal actions. Components of this program include the following:

- proficiency testing (single blinds)
- electronic data audits and post-analysis data audits by the QA staff
- QA audit of the data management software audit trail for organics analyses
- a signed Code of Ethics statement (Figure 1-1) issued and signed at employee orientation and reaffirmed annually by each employee with their signature
- reaffirmation through an annual review and sign-off by all technical and support staff of the laboratory policies pertaining to manual integrations, instrument data system time, and SOP compliance
- annual supplemental company-wide ethics training
- written SOPs addressing issues such as performing manual peak integrations and proper ethical conduct.

1.1 CODE OF ETHICS

CompuChem, a Division of Liberty Analytical Corporation, provides analytical services to a variety of clients involved in the assessment of toxicants in environment samples. Our commitment to meeting client expectations and providing data of the highest quality has been, and will continue to be, a distinguishing feature of our service. Consistent with the commitment to quality data is the underlying, assumed attribute of integrity as it relates to all aspects of our service business. Because clients put their trust in the testing laboratory's ability to provide impeccable results, CompuChem's policies and philosophy will be never to put that trust in jeopardy.

CompuChem's Standard Operating Procedures (SOPs) provide appropriate instructions for completing the required tasks in the laboratory and support areas. Additional guidance is provided by Good Laboratory Practice (glp) standards, the Quality Manual and appropriate laboratory policy memos. Training programs within each area also supply added assistance that supplements the direction provided by the SOPs. Within the contents of the aforementioned documentation, and in any training programs, provisions are included which govern the situations that allow for changes to written data (including chain-of-custody documentation) or instrument output. Situations requiring change must be appropriately documented and the requirements for this are set forth in the Quality Manual or appropriate SOPs.

In absolutely no circumstances do CompuChem's policies, philosophy, SOPs, or training programs allow for inappropriate manipulation (falsification) within the analytical testing process that would compromise the validity of that process. This practice constitutes fraud and is grounds for termination. CompuChem's management feels very strongly about this position since we value the trust that clients place in the quality and integrity of the data we produce for them.

_____
Vice President & General Manager

I, _____, have read and understand this Code of Ethics, and will act appropriately.

_____ _____
Employee Signature Date

1.2 Scope of the Quality Assurance Program Outlined in this Manual

The quality assurance plan described in this document applies specifically to CompuChem, a Division of Liberty Analytical Corporation, at 501 Madison Avenue in Cary, North Carolina. The plan pertains to the following major topics:

Policy
Organization and Responsibilities
Quality Assurance Objectives
Sample Handling
Test Methods and Standard Operating Procedures
Reference Standard Preparation and Instrument Calibration
Data Quality
Data Reduction, Review, and Reporting
Performance and System Audits and Frequency
Corrective Action
Facilities, Equipment, Security and Waste Management
Subcontracting and Support Services and Supplies

1.3 Concurrence with Quality Assurance program

The management of CompuChem is committed to the laboratory's quality system and to its continued improvement. The management of CompuChem understands and acknowledges that the laboratory is required to be continually in compliance with the National Environmental Laboratory Accreditation Program (NELAP) Standards and ISO 17025. All of CompuChem's responsible parties document their concurrence with the policies and procedures detailed in this document by their signatures on its Title Page.

1.4 Procedures for Review of Requests, Tenders, and Contracts

Prior to CompuChem entering into a contract to provide analytical testing services, the Vice President of Sales and Marketing reviews the request for bid (tender) and the Request for Proposal (RFP) or Scope of Work (SOW) presented by the client. The RFP or SOW details the technical and service requirements associated with requests to provide analytical services. During, or prior to, the bidding process the Vice President of Sales and Marketing forwards the RFP or SOW to the Vice President and General Manager or the Manager of Quality Assurance, **who thoroughly review the technical aspects of the request,** if non-routine technical or service requirements are requested. After the review has been completed, a written summary is prepared and distributed to Laboratory Operations, Marketing, and Project Management for review. This summary documents the review of the following:

- Verification that the sample container and preservation requirements and the extraction and analyses holding times are consistent with method requirements.
- Verification that the laboratory has the requisite laboratory instrumentation, equipment, and personnel to perform the analytical services.
- Verification that the laboratory performs the analytical methods required for the project.

- Verification that the QC requirements presented are consistent with the method and that the laboratory has the ability to achieve them.

- Verification that the laboratory meets any identified accreditation/certification requirements.

- Verification that **the** laboratory can meet all specific State and/or permit specified methodology, QC criteria, and reporting limit requirements.

- Verification that the laboratory can achieve all method detection limit (MDL) and practical quantitation limit (PQL) requirements.

- Verification that the laboratory is able to meet the hard copy and electronic data deliverable (EDD) requirements.

- The review also identifies any items that need to be resolved with the client. Any differences must be resolved before work is allowed to commence. These may include errors identified during the review of the client-supplied documentation or suggestions on alternative analytical approaches that would meet the project objectives. These observations and suggestions are also documented in the summary. All information pertaining to requests, tenders and contracts are maintained by the laboratory in the applicable project file, the Laboratory Information Management System (LIMS), the intranet server, and the quality assurance department.

- If a contract must be amended after work has commenced, the same contract review process is repeated and all amendments communicated to all affected personnel. Any work which is to be subcontracted must be reviewed by the prospective subcontract laboratory. Work may only be subcontracted to laboratories which posses the requisite accreditation/certification requirements. Subcontracted laboratories must additionally receive project specific approval from the client prior to any samples being analyzed, preferably in writing if at all possible. **In addition, subcontract laboratories are bound by the same ethical standards adopted by CompuChem.**

2.0 Organization and Responsibility

2.1 Introduction

CompuChem offers the scientific and technical expertise needed to service the chemical laboratory needs of our customers. In addition to experienced analytical laboratory personnel who have skills in organic and inorganic methodologies, CompuChem utilizes a computer systems staff that manages software systems for data reporting and sample scheduling and control. To ensure that all the needs of our clients are met, a project manager is assigned to each account, providing a liaison between the customer and the laboratory.

An organizational chart of management personnel is shown in Figure 2-1. This chart includes all individuals discussed further in this section. The Human Resources department maintains job descriptions for all employees. Job descriptions for key technical positions and key management positions shown on the organizational chart are found in Figure 2-**2**. Resumes of key technical and management staff are found in Figure 2-**3**.

This section describes the operational and functional responsibilities of key lab personnel, including the duties and services performed for product quality. The roles and responsibilities of the Quality Assurance Department and its organizational relationship to lab management are identified.

The Quality Assurance staff monitors and reviews all laboratory units and operates independently of production. All quality control criteria are documented and compliance is verified at each level of laboratory data review. Standard Operating Procedures (SOPs) for in-lab data evaluation and independent QA auditing describe the details of these quality control functions. The QA Department is responsible for verifying the integrity of these functions and documenting performance for lab management review.

2.2 Assignment of Responsibilities

The following is a brief summary of the responsibilities and authorities assigned to each of the QA staff, laboratory management staff, and laboratory technical staff:

2.2.1 Vice President and General Manager

Assuring the laboratory achieves all QA Program objectives, the Vice President and General Manager monitors and directs quality activities of QA Department and lab personnel. The Vice President and General Manager acts in strict adherence to the procedures and requirements stated in the Quality Manual. He works closely with laboratory supervisors and staff to address data quality issues. The Vice President and General Manager reports directly to the President. The Vice President and General Manager and QA have oversight responsibilities for all lab operations as depicted in the organization chart. The Vice President and General Manager and QA Manager have the authority to terminate non-conforming work.

The Vice President and General Manager and the QA manager conduct annual assessments of the total QA program. Based on the assessments, a written status report of QA activities and progress is forwarded to management. Additional monthly reports include information regarding the effectiveness of the quality management systems are prepared. Included are:

- status of or changes to the QA program and Quality Manual
- measures of data quality

- significant QA problems, accomplishments and recommendations
- results of performance audits
- results of system audits
- status of QA requirements for contracts and QA Project Plans
- summary of QA training (internal and external QA/QC seminars and courses)
- overall effectiveness of the QA program

2.2.2 Manager of Quality Assurance (*QA Officer*)

The Manager of Quality Assurance reports to the Vice President and General Manager and is organizationally and functionally independent of direct job involvement and day-to-day laboratory operations. The QA Officer serves as the focal point for QA/QC and oversees and/or reviews quality control data **and** is primarily responsible for auditing the implementation of the quality system and carrying out the directives of the Vice President and General Manager.

2.2.3 Director, Laboratory Operations

The **Director,** Laboratory **Operations** reports directly to the President and is responsible for all aspects of laboratory operations. All laboratory section supervisors report directly to the **Director**. **The Director** is responsible for ensuring that all laboratory technical staff are qualified and properly trained to perform their job functions. **The Director** is also responsible for the timely delivery of client data reports that meet all quality control and project requirements.

2.2.4 Laboratory Supervisors

The laboratory section supervisors report directly to the **Director, Laboratory Operations** and are responsible for sample receipt, sample preparation, sample analysis, reference standard preparation, instrument calibration, instrument maintenance, corrective action, data report preparation, and waste disposal.

2.2.5 Laboratory Technical Staff

Laboratory technical staff report directly to section supervisors and are responsible for performing their various job functions utilizing current, approved laboratory standard operating procedures, EPA methods and EPA CLP statements of work. Laboratory technical staff are also responsible for the preparation and analysis of quality control samples and adherence to quality control and safety procedures.

2.2.6 Project Management and Customer Support Services

Project Management representatives are responsible for communicating client and project-specific requirements to the laboratory in order to ensure that data quality objectives are met. The Project Manager is the internal customer representative and the primary contact for the client. Details of the project requirements are reviewed and discussed prior to the receipt of samples. The Laboratory Information Management System (LIMS) allows the Project Manager (PM) to list detailed requirements for a given project. The LIMS is also available to all appropriate personnel.

2.3 Training of Technical Staff

CompuChem's training program is administered by the Human Resources (HR) department, the QA Department, and laboratory supervisors, and applies to all full-time, temporary, and part-time employees. Prospective employees must meet all job description requirements in order to be hired. Current employees must meet all job description requirements in order to be promoted. Checklists are used to document that requirements are met. All hiring and subsequent changes in personnel status are documented through the use of the Personnel Action Form (PAF).

Various types of training are provided for employees new to a position, and the training records are maintained in the individual's permanent training files. Initial and on-going performance is measured through indicators such as precision and accuracy in replicate spiked quality system matrices, performance evaluation or single blind proficiency test samples, and surrogate recoveries. Employees who fail to maintain acceptable performance standards must be retrained. Retraining must be documented before the employee may work independently. Training proficiency records are maintained for each employee.

Trainees are not allowed to process samples independently before they have demonstrated capability. See Appendix B of this manual for the policy on performing a Demonstration of Capability. During the training period, any work performed by a trainee is directly supervised by a senior qualified analyst, and any worksheets, forms, or other analytical data are reviewed and co-signed by the senior qualified analyst. The training period varies in length of time depending on the position and on the prior experience and knowledge level of the individual. As needed, the QA staff provides training in certain quality aspects of the operation such as correct chain of custody documentation, proper error correction protocols, etc. A signatory review of the Quality Manual by all staff documents their familiarization with, and agreement to implement, all policies and procedures in their work.

In order to provide adequate staff to perform all of the laboratory's job functions, analysts are cross-trained, typically within their departments, to perform other job functions. These cross-trained analysts serve as backup in the absence of the primary analyst, or as additional help, if the work load is heavy in a particular area. Crossed-trained analysts are required to demonstrate capability as described in Appendix B in all job functions for which they perform.

Each employee is required to read and understand the SOPs relative to their job responsibilities. They must agree to follow the most current version of the controlled SOP. Signatory evidence of this agreement is maintained in each employee's training file or within the QA Department.

All job functions are fully described in formalized job descriptions. The employee job descriptions include minimum acceptable levels of formal education, training, prior experience, and special requirements for certifications or licenses. Some contracts, client agreements, or external agencies specify minimum qualifications for technical, administrative, computer, and management positions. Certain positions require auxiliary training, including viewing of training videotapes, on-site training classes, or off-site attendance of specialized training or certification courses.

Formal training at CompuChem also involves safety and chemical hygiene training. The Vice President and General Manager has the ultimate responsibility for chemical hygiene in the laboratory and provides continuing support of the program. The Safety Officer/Chemical Hygiene Officer (CHO), and Safety Committee have the responsibility of coordinating and

enforcing the laboratory safety program at CompuChem. Each employee in the laboratory is responsible for ensuring an effective chemical hygiene plan. The safety program involves the following key elements:

- safety training programs for all personnel
- documentation of safety training
- the Chemical Hygiene Plan (CHP), approved by the Vice President and General Manager
- the Emergency Action Plan, approved by the Vice President and General Manager
- monthly inspections of the facilities for compliance with safety regulations
- verification that all safety equipment is operable and in good working condition (including inspection and recharging of all fire extinguishers, and monthly inspection of fume hoods and eye washes)
- initial testing of all new safety equipment
- annual fire/evacuation drills
- the safety committee, which is comprised of safety facilitators representing key sections of the operation
- right-to-know seminars held for all laboratory personnel to discuss chemical hazards, safety precautions, medical treatment, and spill procedures

The CHO and the safety committee are responsible for conducting internal safety inspections, covering all aspects of laboratory safety including fire, hazardous materials, personal dress, electrical safety, posted evacuation routes, and condition of all safety equipment. Laboratory department managers/supervisors are responsible for any corrective actions identified in the inspections or during safety drills.

Laboratory department managers/supervisors are responsible for safety briefings for all employees in their department. Employees receive technical assistance from the CHO in complying with the CHP. Training includes safety for fire, electricity, compressed gases, chemical hazards, safety equipment, and hazardous sample and waste handling, depending on the responsibilities of the department or laboratory. New employees must be trained in all aspects of safety concerned with their job responsibilities and the laboratory in which they work. Human Resources, along with department managers/supervisors and the CHO must maintain documentation of safety training. The documentation must include a completed training form, a list of the attendees, the training subject(s), the time spent in training, and the date.

A variety of local seminars, workshops, and lectures are also made available to employees. Workshop and seminar attendees usually relate their experiences in the form of trip reports or in-house presentations to appropriate staff members.

2.4 Laboratory Capabilities

CompuChem analyzes waste water, soil, and solid and liquid waste samples, and biological tissue. Table 2.1 lists the parameters, analytes, and method references, **while Table 2.2 presents a list of method references**. Unless otherwise indicated in the SOP, the laboratory performs the published method as written.

Figure 2-1:

CompuChem, a Division of Liberty Analytical Corporation
Key Personnel Organizational Chart

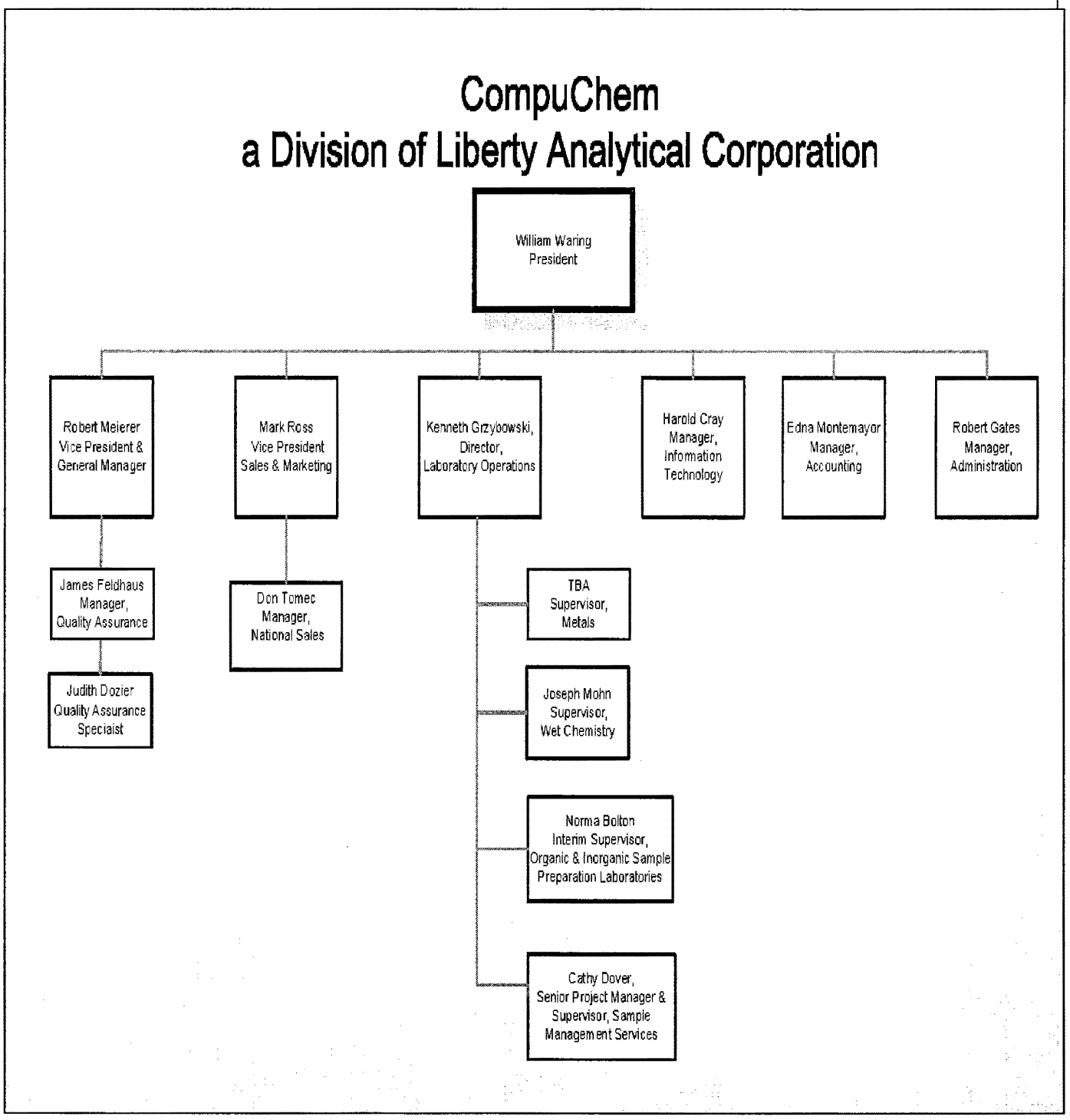


Figure 2-2: ***Job Descriptions of Key Positions listed on Organization Chart***

COMPUCHEM, a division of Liberty Analytical Corporation
DESCRIPTIVE TITLE: ***Vice President & General Manager*** **JOB NO.**:370008
DEPARTMENT: 3700 – Quality Assurance & Technology **F.L.S.A.** Exempt
IMMEDIATE SUPERVISOR: President **LOCATION**: Cary, NC

I. BASIC FUNCTION:

Develop and implement strategic processes and practices within the company. Manage and guide the overall organization. Provide guidance in analyzing and appraising the effectiveness of overall operations. Assure all EPA CLP **and DoD** contractual requirements and federal and state agency certification requirements are met by the company. Assure that the company consistently produces data of known and documented quality.

II. SCOPE OF THE POSITION:

A. Organizational Relationships

This position reports to and receives direction from the President. This position works closely with **the L**aboratory **Director, Supervisors, Customer Service Representatives,** and the Marketing/Sales personnel concerning the nature and quality of work performed.

Outside of CompuChem, this position works closely with personnel from government agencies on analytical methodologies, customers and potential customers, on the technical aspects of projects, and vendors on project information.

B. Major Functions Reporting to this Position

Quality Assurance Manager

C. Know How, Training and Experience

This position requires an advanced degree in analytical chemistry or equivalent, and a minimum of five (5) years experience in Quality Control/Quality Assurance functions. Extensive management experience and strong management capabilities are required. Experience in EPA and other agency requirements and regulations are required, as is an understanding of government agency interactions. Experience in GC, GC/MS and inorganic analyses **is** also required.

- Plan, develop and manage the Quality Assurance program assuring that all laboratory operations and standards meet the necessary requirements for continuing compliance with accreditation agencies.
- Monitor the effectiveness of the Quality Assurance program, assuring that appropriate QC standards are established and met, implementing changes or new programs as conditions require.
- Resolve quality control problems, explaining or directing the explanation of abnormal sample data, and recommending sample rework or corrective action when necessary.

Vice President & General Manager ***JOB No.: 370008 (continued)***

- Establish the conditions and programs necessary to meet certification and licensing standards on new products/analyses as they are developed.
- Work with laboratories to develop appropriate methodologies and standards for new products or special projects.
- Provide evaluation and approval for all method validation study programs and SOPs.
- Direct in-house systems and performance audits of laboratories and data audits
- Oversee and direct the efforts of the Quality Assurance staff activities to ensure that SOPs and the Quality Manual are current and documented.
- Assess findings in EPA CLP Contract Compliance Screening (CCS) Reports.
- Oversee responses to CCS Reports.
- Assess the feasibility of CLP modified analysis projects requested by the EPA
- Oversee and/or respond to EPA inquiries, data/tape audit reports, and on-site audit reports
- Review available RFP, RFQ and SOW documents for commercial clients and the EPA to understand the analytical and QC requirements
- **Review Proficiency Test (PT) submittal packages and assess any failures, as warranted.**

COMPUCHEM, a division of Liberty Analytical Corporation
DESCRIPTIVE TITLE: ***Vice Pres. – Sales/Marketing*** **JOB NO.**: 730001
DEPARTMENT: 7300 - Sales & Marketing **F.L.S.A.** E-17
IMMEDIATE SUPERVISOR: President **LOCATION:** Cary

I. BASIC FUNCTION:

Responsible for development of new business (sales) from the industrial, governmental and architect/engineering sectors, and increasing established base business from existing traditional markets/accounts. The position is national in scope, however, specific markets (i.e., CLP) and national areas/regions may be given primary focus (e.g., Atlanta, New York, New Jersey) in terms of sales penetration/concentration. The position will also be responsible for assisting in the selection, training and management of additional staff. This position is responsible for representing the company at Trade Seminars, Conventions, Sales Shows, etc., as may be required to maintain a positive, viable and highly visible corporate image in the market place.

II. SCOPE OF THE POSITION:

A. Organizational Relationships

This position reports directly to the President. A vital role is the interface between client and laboratory, specifically, lab operations, customer service and project management personnel in the development of customer specific plans.

B. Major Functions Reporting to this Position

National and Local Sales Representatives

C. Know How, Training and Experience

This position requires a Bachelor of Science in Business Administration, or Science, or equivalent, and prior customer service/sales experience in a technical environment. A demonstrated ability to deal effectively with the public via telephone and in personal face-to-face meetings is absolutely essential as is a sound knowledge of laboratory and general organizational procedures. Excellent interpersonal skills are a must as are strong communication skills and meticulous attention to detail. A positive attitude, proactive problem solving ability and good judgment are absolute requirements given the requirement of the position to effectively manage multiple activities. Efficient time management skills are highly necessary in the performance of this position.

III. ACCOUNTABILITIES:

- Make contact with target audience and qualify prospects, sell and close new and existing customer accounts.
- Provide monthly Sales Forecasts, identifying sold and awarded work anticipated for receipt, "possibles" (awarded work) which may come in and "could-be's" (i.e., projects with submitted proposal not yet awarded) for distribution to management.
- **Discuss and prepare of Annual Sales and Marketing Business and Strategy Plans and formulate new product lines, market penetrations, directions, etc.**

Vice Pres. – Sales/Marketing **JOB NO.**: 730001 (continued)

- Attend Executive Staff Meetings with reports on activities and new business when not traveling.
- Assist Customer Service in getting set-up information gathered and entered accurately, and facilitating generation of customer accounts for review and approval of client and laboratory operations personnel.
- Develop and monitor a successful in-house telemarketing program that compliments direct outside sales efforts by providing established, qualified leads for expert sales attention and closure.
- Maintain awareness of all Federal, State, and local rules and regulations that pertain to employment practices, i.e., wage & hour laws, EEO, and other OSHA regulations.
- Participate in special development projects as required.
- Forecasting - The Territory Overview Report is an essential tool for laboratory operations and is necessary in determining staffing needs (i.e., work schedules/rotations for lab personnel) based on work which is anticipated for receipt on a weekly basis. Control of sample receipts at the back door in an accurate manner is essential to the success of the laboratory. Forecasts by Week, Month and Quarter are required to the extent possible. This will require frequent contact with clients in order to determine where they are with plans for mobilization and sampling on events which have either been awarded outright, or tentatively so, to the company.
- Sales Quotations - Sales quotations, when issued, will be the responsibility of the incumbent. Without exception, any quotation issued which results in an award must be forwarded by fax or otherwise, with appropriate account set-up information to Customer Service prior to shipment of glassware to the client's site.
- Proposals - Submissions necessitate bid package integration requiring the company's communal resources of sales/marketing, customer service, project management, QA, and laboratory personnel. Submissions which require this effort should be date stamped, when received, with a copy forwarded to management for distribution and review ASAP. Ideally, the package should be brought in for review with staff at Executive or Operations Meetings in order that assignments for review.
- Office Attendance - Travel, if planned properly should take place for the most part between Monday and Friday.

COMPUCHEM, a division of Liberty Analytical Corporation
DESCRIPTIVE TITLE: ***Director, Laboratory Operations*** **JOB NO.: 500009**
DEPARTMENT: 5000 Lab Support **F.L.S.A. E-17**
IMMEDIATE SUPERVISOR: President **LOCATION:** Cary, NC

I. BASIC FUNCTION:

Direct the overall day-to-day activities of the GC/MS, GC, Inorganics/Wet Chem. **and** Extractions Laboratories, which are comprised of various technical departments **that** function in a multi-shift production environment. The major responsibility of **the Director of** Laboratory **Operations** is to produce accurate and timely data packages based on the analyses of environmental samples. Additionally, a major responsibility is to develop new methods and/or techniques **that** enhance CompuChem's product line and/or improves its process techniques and production through-put. Further duties include monitoring standards of performance in quality control and quality assurance, and monitoring the validity of the analyses performed and data generated in the laboratory to assure reliable data.

II. SCOPE OF THE POSITION:

A. Organizational Relationships

This position reports to and receives direction from the President. This position works closely with the Laboratory Technical Managers, as well as Managers from other CompuChem departments, such as Sales & Marketing, Management Information System, Accounting, and Quality Assurance .

Outside of CompuChem, contact is with CompuChem's customers concerning laboratory practices, status of analyses, explanation of analytical results, etc. This position also has contact with equipment manufacturers, vendors, and consultants utilized by CompuChem.

B. Major Functions Reporting to this Position

Volatile and Semi-Volatile GC/MS Laboratories – Responsible for the preparation and analysis of environmental samples and for the generation of complete data packages.

Extractions Laboratory – Responsible for the preparation of sample extracts for analysis by other laboratories.

GC/HPLC Laboratory – Responsible for the analysis of environmental samples and for the generation of complete data packages.

Inorganics/Wet Chemistry Laboratory – Responsible for the preparation and analysis of inorganics samples, preparation of samples for metals, mercury, cyanide, phenols, fluoride, sulfate, chloride, and other wet chemistry parameters for the generation of complete data packages.

C. Know How, Training and Experience

The position requires a Bachelor's Degree in the chemical, environmental, biological, or physical sciences, or engineering, with at least 24 college credit hours in chemistry and/or at least two years experience in the environmental analysis of representative inorganic and organic analytes for which the laboratory maintains accreditation. A Master's or doctoral degree in one of the above disciplines may be substituted for one year of experience.

Director, Laboratory Operations **JOB NO.: 500009 (continued)**

III. ACCOUNTABILITIES:

- Responsible for directing the Extractions, GC, HPLC, GC/MS, and Inorganics/Wet Chem. Laboratories in the preparation, analysis, and generation of technical data packages of environmental samples within prescribed quality limits and specified timeframes in order to meet production requirements for shipments.
- Direct the development and implementation of new methods/processing improvements in order to allow CompuChem to expand its product line and/or to maximize instrument/processing capability and efficiency. The new methods/processing improvements may deal with analytical procedures, software enhancements or process flow improvements.
- Responsible for the preparation of the annual budget in order to accurately anticipate the cost associated with producing our products and to provide a framework for managing and controlling departmental resources and expenses.
- Develop annual goals and objectives within Laboratory Operations in order to provide a methodical systematic approach to planning and achieving business plan objectives.
- The position will have Profit & Loss (P&L) responsibility for the operation of the laboratory and will be charged with exercising control over various laboratory cost centers in order to accentuate efficiency and the use of purchased materials, reduce expenses to the extent possible, and maximize company profit.
- Responsibility for managing direct reports in the area of P&L responsibility and for assisting in the development of individual supervisors for accepting accountability for controlling costs in their respective lab areas.
- Responsible for ensuring that all pertinent information gleaned in executive staff meetings is disseminated to direct reports in order that communication may be provided on a real-time basis, openly and accurately.
- Participate in special assignments/projects as required.

IV. MAJOR CHALLENGES OF THIS POSITION:

- The most difficult and/or complex part of this position is to integrate a production orientation into a scientific environment which is highly dynamic due to the growth of the business. In combination with the previous statement, the blending of multiple technologies, i.e., analytical chemistry, computers, production, and management expertise to increase the quality of the total organic data package (i.e., reduce reworks of all types) and simultaneously increase productivity is also extremely complex.
- The position will be directly responsible for meeting monthly production quotas in order that shipments may be made in order to allow company to meet monthly revenue and profit goals.

COMPUCHEM, a division of Liberty Analytical Corporation
DESCRIPTIVE TITLE: ***Manager, Purchasing, Admin., Facilities & Chemical Hygiene Officer*** **JOB NO.**: 600005
DEPARTMENT: 6000 Gen. Management **F.L.S.A.** Exempt
IMMEDIATE SUPERVISOR: *President* **LOCATION**: Cary, NC

I. *BASIC FUNCTION*

Responsible for the purchase of materials, supplies, etc. for all the departments.

Manage facility related activities, including building systems maintenance, telephone system installation and maintenance, and installation of CRT wiring; develop and implement facility renovation plans to provide proper work areas for both office, laboratories, manage hazardous waste collection and disposal program and company wide safety program; design, build and coordinate laboratory support equipment; coordinate cafeteria and vending machine service with contractor.

II. SCOPE OF THE POSITION

A. Organizational Relationships

This position reports to and receives direction from the President. This position works closely with managers/supervisors and all other employees across the Company concerning purchasing, facility and safety issues. The position also serves as contact for CompuChem with vendors for facilities-related projects, telecommunications and Government Regulatory Agencies.

B. Major Functions Reporting to This Position

Building Maintenance

C. Know How, Training and Experience

This position requires a minimum of five (5) years experience in facilities and instrumentation management, including the design and construction of new and existing office and laboratory facilities as well as coordinating and scheduling work with outside contractors and the installation and service of laboratory instruments. Must have knowledge of plumbing system, electrical systems, HVAC systems, telecommunications systems and services, CRT systems, security and fire alarm systems, and Halon systems equipment repair practices. The ability to read and develop blueprints is required. An understanding of safety practices and regulations is required. Knowledge of hazardous waste disposal requirements is also required.

III. ACCOUNTABILITIES

- Operate and maintain laboratory and office heating, ventilating, air conditioning systems and fume hoods. Also responsible for installation and renovation of new and existing systems to meet facility requirements.
- Operate and maintain laboratory and office electrical systems. Also responsible for installation and renovation of new and existing systems to meet facility requirements.
- Operate and maintain plumbing and water systems and the installation and renovation of new and existing systems to meet facilities requirements.

Manager, Purchasing, Admin., Facilities & Chemical Hygiene Officer ***JOB NO.: 600005 (continued)***

- Operate and maintain telecommunications equipment. Audit monthly telecommunications invoices for accuracy and approve for payment. Maintain state-of-the-art telecommunications equipment and services.
- Maintain laboratory appliances.
- Responsible for hiring, training and development of maintenance staff.
- Operate and maintain facility fire suppression systems and fire alarm equipment.
- Manage the facilities shop, assuring that parts and supplies are ordered in a cost-effective manner and making changes in suppliers and/or equipment as required.
- Responsible for the design and construction of new and existing space as required to meet facility needs.
- Work with the laboratory operations management on the adaptations and/or development of special equipment or projects as needed.
- Operation and maintenance of building security systems and personnel.
- Design, fabricate and/or coordinate laboratory support apparatus and equipment.
- Coordinate operations of cafeteria and food vending services.
- Install laboratory gas supply systems.
- Responsible for accounts payable inquiries and remittances.
- Assist in accounts receivable inquiries.
- Responsible for the purchase of all materials & supplies.
- Provide recommendation for promotion and lateral transfers. Conduct performance appraisals, recommend and review merit increases.

COMPUCHEM, a division of Liberty Analytical Corporation
DESCRIPTIVE TITLE: ***Manager of Quality Assurance*** **JOB NO.:** 370002
DEPARTMENT: 3700- Quality Assurance & Technology **F.L.S.A.** Exempt
IMMEDIATE SUPERVISOR: Vice President & General Manager **LOCATION:** Cary, NC

I. BASIC FUNCTION:

Manage and improve the laboratory's quality assurance program by conducting internal systems audits and coordinating corrective actions with laboratory management and staff.

II. SCOPE OF THE POSITION:

A. Organizational Relationships

This position reports to and receives direction from the Vice President and General Manager in matters relating to data quality.

Outside of CompuChem, contact is with State and Federal Regulatory agencies and clients.

B. Major Functions Reporting to this Position

Quality Assurance Specialist

C. Know How, Training and Experience

This position requires an undergraduate degree in Chemistry or related science or equivalent and a minimum of five (5) years laboratory experience, preferably in organic/analytical/clinical chemistry and five (5) years involvement in QA/QC.

III. ACCOUNTABILITIES:

- Develop and evaluate methods for evaluating the quality of data being generated to ensure method and contract compliance.
- Represent the laboratory and the Quality Assurance Department, when required, during on-site audits and laboratory evaluations.
- Perform data and system audit functions and report findings to laboratory management.
- Oversee and participate in the requirements for State Certification programs and PE sample programs.
- Coordinate/perform subcontractor lab audits and provide recommendations for approval of such labs, if required.
- Maintain QA/QC databases, including control limits, MDL and reporting limits, and Corrective Action Reports (CARs).
- Review client QA Project Plans, contracts and statement-of-work, and provide other supplemental Marketing Department support as needed.
- Review and approve Standard Operating Procedures and Method Validation Study data.
- Perform special project functions at the direction of the Vice President and General Manager

COMPUCHEM, a division of Liberty Analytical Corporation
DESCRIPTIVE TITLE: ***Supervisor, Inorganics*** **JOB NO.:** 430001
DEPARTMENT: 4300 Inorganics **F.L.S.A.** Exempt
IMMEDIATE SUPERVISOR: Director, Laboratory Operations **LOCATION:** Cary, NC

I. BASIC FUNCTION:

Responsible for the preparation and analysis of various types of environmental samples utilizing instrumental and wet-chemistry procedures for the generation of complete data packages, ensuring that timely and accurate production is achieved. Responsible for analysis of environmental inorganic samples utilizing ICP/**AES**, ICP/MS, Cold Vapor Atomic Absorption spectroscopy, and the generation and transfer of complete data in an accurate and timely manner.

II. SCOPE OF THE POSITION:

A. Organizational Relationships:

This position reports to and receives direction from the **Director,** Laboratory **Operations**. This position works closely with other **supervisors** for the purpose of coordinating production and special projects.

Outside of CompuChem, contact is with vendors, equipment manufacturers, and consultants utilized by CompuChem. This position also provides technical guidance to customers concerning analyses performed and/or participates in on-site audits.

B. Major Functions Reporting to this Position:

None

C. Know How, Training and Experience

This position requires an undergraduate degree in chemistry or equivalent. A minimum of three (3) years of experience in applied analytical techniques (including ICP) for Inorganic Environmental analysis is required. Must have three years of supervisory experience with a strong production orientation.

III. ACCOUNTABILITIES:

- Responsible for ensuring the analytical quality of all data generated by the Inorganic Laboratory.
- Evaluate and develop methods for improving the quality and quantity of the data produced.
- Develop and monitor all training programs utilized in the Inorganic Laboratory for effectiveness and compliance with existing analytical quality standards.
- Plan and schedule work assignments according to analysis requirements. Assign individual work schedules based on analysis requirements and capabilities of the department staff.
- Responsible for interviewing, selecting, orienting, and training new employees.
- Determine training needs of current employees and define a plan of action to address the training requirements.
- **Provide recommendations for promotions and lateral transfers. Conduct performance appraisals, recommend merit increases and review merit increases with employees.**
- **Responsible for communicating and ensuring that all departmental employees understand and adhere to all company policies and procedures.**
- **Responsible for safety attitudes and practices; and for the overall housekeeping of the Inorganic Laboratory.**

Supervisor, Inorganics ***JOB NO.: 430001 (continued)***

- Maintain an accurate inventory of laboratory supplies and equipment. Reorder supplies when required and maintain appropriate records of purchase. Keep expenses to a minimum.
- Responsible for maintaining up-to-date Standard Operating Procedures for the Inorganic Laboratory.
- Assist other areas of the lab by providing personnel and cross-training whenever possible.
- Provide technical guidance and input as requested for new contract requirements, special, and/or new products.
- Ensure overtime is evenly distributed between staff and kept to a minimum.
- Maintain an awareness of all Federal, State, & local rules and regulations that pertain to employment practices, i.e., wage & hour laws, EEO and OSHA regulations
- Responsible for monitoring the absence and vacation utilization by departmental staff.
- Responsible for communicating & ensuring that all departmental employees understand & adhere to all Company's Work Rules; and Policies & Procedures.
- Participate in special assignments/projects as required.

COMPUCHEM, a division of Liberty Analytical Corporation
DESCRIPTIVE TITLE: ***Supervisor, Wet Chemistry*** **JOB NO.:** 440002
DEPARTMENT: 4400 Wet Chemistry **F.L.S.A.** Exempt
IMMEDIATE SUPERVISOR: Director, Laboratory Operations **LOCATION:** Cary, NC

I. BASIC FUNCTION:

Responsible for the analysis of various types of environmental samples utilizing Total Organic Carbon, **Ion Chromatography**, Colorimetric Automated Analyzers and wet-chemistry procedures for the generation of complete data packages ensuring that timely and accurate production **are** achieved.

II. SCOPE OF THE POSITION:

A. Organizational Relationships:

This position reports to and receives direction from the **Director,** Laboratory **Operations**. This position works closely with other **supervisors** for the purpose of coordinating production and special projects.

Outside of CompuChem, contact is with vendors, equipment manufacturers, and consultants utilized by CompuChem. This position also provides technical guidance to customers concerning analyses performed and/or participates in on-site audits.

B. Major Functions Reporting to this Position:

None

C. Know How, Training and Experience

This position requires an undergraduate degree in chemistry or equivalent. A minimum of three (3) years of experience in applied analytical techniques for Wet Chemistry Environmental analysis is required.

III. ACCOUNTABILITIES:

- Responsible for ensuring the analytical quality of all data generated by the Wet Chemistry Laboratory.
- Evaluate and develop methods for improving the quality and quantity of the data produced.
- Develop and monitor all training programs utilized in the Wet Chemistry Laboratory for effectiveness and compliance with existing analytical quality standards.
- Plan and schedule work assignments according to analysis requirements. Assign individual work schedules based on analysis requirements and capabilities of the department staff.
- Responsible for interviewing, selecting, orienting, and training new employees.
- Determine training needs of current employees and define a plan of action to address the training requirements.

Supervisor, Wet Chemistry Lab ***JOB NO.: 440002 (continued)***

- Provide recommendations for promotions and lateral transfers. Conduct performance appraisals, recommend merit increases and review merit increases with employees.
- Responsible for communicating and ensuring that all departmental employees understand and adhere to all company policies and procedures.
- Responsible for safety attitudes and practices; and for the overall housekeeping of the Wet Chemistry Laboratory.
- Maintain an accurate inventory of laboratory supplies and equipment. Reorder supplies when required and maintain appropriate records of purchase. Keep expenses to a minimum.
- Responsible for maintaining up-to-date Standard Operating Procedures for the Wet Chemistry Laboratory.
- Assist other areas of the lab by providing personnel and cross-training whenever possible.
- Provide technical guidance and input as requested for new contract requirements, special, and/or new products.
- Ensure overtime is evenly distributed between staff and kept to a minimum.
- Maintain an awareness of all Federal, State, & local rules and regulations that pertain to employment practices, i.e., wage & hour laws, EEO and OSHA regulations
- Responsible for monitoring the absence and vacation utilization by departmental staff.
- Responsible for communicating & ensuring that all departmental employees understand & adhere to all Company's Work Rules; and Policies & Procedures.
- Participate in special assignments/projects as required.

COMPUCHEM, a division of Liberty Analytical Corporation
DESCRIPTIVE TITLE: ***Senior Project Manager*** **JOB NO.**: 750010
DEPARTMENT: 7500 Lab Support **F.L.S.A.** Exempt
IMMEDIATE SUPERVISOR: Director, Laboratory Operations **LOCATION**: Cary, NC

I. BASIC FUNCTION:

Manage client projects and provide customer service.

II. SCOPE OF THE POSITION:

A. Organizational Relationships

This position reports to and receives direction from the **Director, Laboratory Operations**. The position will work closely with **other** members of Project Management**'s** personnel, in order to facilitate timely log-in of customer sample receipts. The position will interface daily with all laboratory areas and personnel relative to the distribution of samples for analysis. The position will work **to** ensure that subcontracted work is documented on a real-time basis and to insure performance of vendor network.

B. Major Functions Reporting to this Position

Project Managers

C. Know How, Training and Experience

The position requires a Bachelor's Degree or a minimum of 5-7 years experience involving the processing and scheduling of receipts in a production environment. Prior supervisory experience is also required as is a working knowledge of LIMS. An understanding of extractions and/or analytical instrumentation processes would be useful.

III. ACCOUNTABILITIES:

- Supervise and train personnel in the areas of responsibility, establish daily workload priorities on a six day schedule and assist in and direct the completion of the activities. Responsible for scheduling personnel and their work time to address and meet workload requirements.
- Responsible for interaction with subcontract **laboratories,** as required, in order to schedule shipments for all subcontracted parameters.
- Responsible for updating (as needed) and maintaining as current, all Standard Operating Procedures (SOPs) pertaining to the operation of the area. Responsible for having all personnel familiar with and adhering to them at all times.
- Responsible for preparation of glassware shipments via cooler or bulk distribution to clients as required by client. The position will ensure that clients receive appropriate bottleware, preservatives (if required), COCs, labels, etc. to ensure success of field sampling events.
- Responsible for maintaining a safe, healthy, clean and presentable work environment at all times.
- Maintain awareness of all Federal, State, and local rules and regulations that pertain to employment practices, i.e., wage and hour laws, EEO, and OSHA regulations.
- Responsible for communicating and ensuring that all departmental employees understand and adhere to all Company's Work Rules, and Policies and Procedures.
- Assist other areas of the lab by providing personnel and cross-training whenever possible.

Senior Project Manager ***JOB NO.:*** **750010** ***(continued)***

- Ensure compliance with client Scope of Work (SOW).
- Answer**, or oversee response to,** any technical inquiries from client.
- Sign outgoing reports.
- Gather information from client on project specific requirements.
- Communicate all issues and concerns with lab.
- Review project status and compliance.
- Prepare status reports and inquiry responses as required by client.
- Monitor financial compliance with client agreement.
- Ensure client is satisfied with lab.
- The position requires weekend work and overtime as may be required.

COMPUCHEM, a division of Liberty Analytical Corporation
DESCRIPTIVE TITLE: ***Supervisor, Sample Preparation Lab*** **JOB NO.:** 360001
DEPARTMENT: 3600 Sample Preparation Lab **F.L.S.A.** Exempt
IMMEDIATE SUPERVISOR: Director, Laboratory Operations **LOCATION**: Cary, NC

I. BASIC FUNCTION:

Preparation of various environmental matrices using liquid-liquid and liquid-solid chemical extraction techniques for analysis using SW-846, CLP, **and other published** methodologies. Supervising and training of sample preparation technicians and ensuring that timely and accurate production is achieved. Handling and coordinating the disposal of hazardous waste generated by the facility.

II. SCOPE OF THE POSITION:

A. Organizational Relationships

This position reports to and receives direction from the **Director,** Lab**oratory Operations**. This position works closely with the other supervisors and managers to coordinate sample processing throughout the laboratory.

B. Major Functions Reporting to this Position

Glassware Preparation – preparation and inventory of all glassware utilized by the various laboratory functions.

Organic Sample Preparation Technicians/analysts – preparation of samples for organic analyses.

C. Know How, Training and Experience

This position requires an undergraduate degree in chemistry or equivalent. A minimum of three (3) years in preparation of environmental samples, **and** one (1) year supervisory experience.

III. ACCOUNTABILITIES:

- Ensuring that the production of the sample preparation laboratory is conducted in a timely and accurate manner.
- Plan and schedule work assignments according to sample load.
- Assign individual work schedules based on sample load and capabilities of the department staff.
- Interview, select, and train new employees. Determine training needs of employees and define a plan of action to address the training requirements.
- Provide recommendation for promotions and lateral transfers. Conduct performance appraisals, recommend merit increases and review merit increases with employees.
- Practice overall good housekeeping of the sample and glassware preparation areas.
- Maintain an accurate inventory of laboratory supplies and equipment. Reorder supplies when required and maintain appropriate records of purchase.
- Maintain up-to-date Standard Operating Procedures for the preparation lab
- Monitor absence and vacation utilization by departmental staff.
- Participate in special development projects as required.

COMPUCHEM, a division of Liberty Analytical Corporation
DESCRIPTIVE TITLE: ***Supervisor, Sample Management Services*** **JOB NO.**: 500006
DEPARTMENT: 7500 **Customer Service/Project Management** **F.L.S.A. Non-**Exempt
IMMEDIATE SUPERVISOR: Director, Laboratory Operations **LOCATION**: Cary, NC

I. BASIC FUNCTION:

Supervise the daily activities in the Sample Receiving/Storage and Shipping Areas. Supervise and perform sample receipt, sample-login and order entry. Provide customer service.

II. SCOPE OF THE POSITION:

A. Organizational Relationships

This position reports to and receives direction from the Laboratory Manager. The position will work closely with **other** members of Project Management's personnel, in order to facilitate timely log-in of customer sample receipts. The position will interface daily with all laboratory areas and personnel relative to the distribution of samples for analysis. The position will work closely with Subcontract Coordinator to insure that subcontracted work is documented on a real-time basis, and to insure performance of vendor network.

Outside CompuChem, the position will communicate with shipping vendors to coordinate pick-ups, glassware shipment logistics, etc. This position will also communicate directly with clients as required to resolve issues related to sample receipt, log-in and/or order-entry.

B. Major Functions Reporting to this Position

Sample Custodian

C. Know How, Training and Experience

The position requires a Bachelor's Degree or a minimum of 5-7 years experience involving the processing and scheduling of receipts in a production environment. Prior supervisory experience is also required as is a working knowledge of LIMS. An understanding of extractions and/or analytical instrumentation processes would be useful.

III. ACCOUNTABILITIES:

- Supervise and train personnel in the areas of responsibility, establish daily workload priorities on a six day schedule and assist in and direct the completion of the activities. Responsible for scheduling personnel and their work time to address and meet workload requirements.
- Responsible for the completeness and correctness of all Chain of Custody documentation, including; ensuring proper COC procedures are followed for samples being received and internal COC guidelines are maintained.
- Responsible for identification of discrepancies between sample receipts and client COC documentation and for insuring that appropriate feedback is given clients in order to affect and facilitate timely corrections prior to entering client receipts into the LIMS. Responsible for ensuring those clients receive acknowledgment of sample receipt within 24 hours of order-entry.
- **Responsible for scheduling shipments for all subcontracted parameters.**
- **Responsible for updating (as needed) and maintaining as current, all Standard Operating Procedures (SOPs) pertaining to the operation of the area. Responsible for having all personnel familiar with and adhering to them at all times.**

Supervisor, Sample Management Services ***JOB NO.:*** ***500005 (continued)***

- Responsible for preparation of glassware shipments via cooler or bulk distribution to clients as required by client. The position will ensure that clients receive appropriate bottleware, preservatives (if required), COCs, labels, etc. to ensure success of field sampling events.
- Responsible for maintaining the organization of walk-in and extract coolers daily and for ensuring that all sample request sheets received from each laboratory area are responded to completely, accurately, and in a timely manner with all signature requirements. Ensure sample security at all times by maintaining internal COC.
- Responsible for the copy center, including the photocopying, scanning, and mailing of data packages
- Responsible for maintaining a safe, healthy, clean and presentable work environment at all times.
- Responsible for the hiring, training and development, and performance evaluations of employees in the department. Responsible for documenting sub-par work related performance with employees as may be necessary and for dealing with work related disciplinary problems on an as needed basis. Provide recommendation for promotions, lateral transfer, and merit increases.
- Responsible for maintaining temperature checks of thermometers for short and long-term storage areas and rotate sample stock to **affect** the SOP required purging process on a timely basis.
- Oversight of the purging process after samples have exceeded their retention times.
- Monitor inventory levels of warehouse stock items, glassware, coolers, components (COCs, labels, etc.) to ensure that appropriate levels are maintained on an ongoing basis.
- Maintain awareness of all Federal, State, and local rules and regulations that pertain to employment practices, i.e., wage and hour laws, EEO, and OSHA regulations.
- Responsible for communicating and ensuring that all departmental employees understand and adhere to all Company's Work Rules, and Policies and Procedures.
- Assist other areas of the lab by providing personnel and cross-training whenever possible.
- The position requires weekend work and overtime as may be required.

COMPUCHEM, a Division of Liberty Analytical Corporation
DESCRIPTIVE TITLE: ***Manager Information Technology*** **JOB NO.: 430007**
DEPARTMENT: 4070 Computer Operations **F.L.S.A. Exempt**
IMMEDIATE SUPERVISOR: President **LOCATION: Cary, NC**

I. BASIC FUNCTION:

Manage the computer operations function in support of Company's production, administration, and system management. **Provide technical expertise (hardware configurations, software revisions, user profiles, backup, and recovery) for system use and program development.**

II. SCOPE OF THE POSITION:

A. Organizational Relationships:

This position reports to and receives direction from the President. The position also interacts with any other user within the Company that relies on computerized production systems. This position works closely with the managers and supervisors throughout CompuChem and WearCheck USA.

Outside of CompuChem, the position has contact with hardware vendors and consultants, as well as hardware and software maintenance personnel.

B. Major Functions Reporting to this Position

Computer Support Specialist

C. Know How, Training and Experience

This position requires a minimum of B.S. degree in Computer Science or equivalent and 6 years of experience in computer operations management, a thorough understanding of integrated computer systems including computer maintenance. Also, effective human relation skills are also extremely important in managing and developing department personnel as well as interacting with the various users of the computer systems.

III. ACCOUNTABILITIES:

- Manage the Company's Computer Operations functions, assuring a fully functioning computer system adequate to support the Company's needs.
- Evaluate and select computer hardware and related products.
- Propose hardware configuration including migration/growth strategies.
- Participate in the selection of computer software and related products.
- Manage and control software installations, revisions, configuration and documentation.
- Manage system account structure setup.

Manager, Information Technology ***JOB NO.: 430007 (continued)***

- Ensure that system backup procedures are being followed and that a disaster plan exists.
- Oversee the installation, maintenance and monitoring of computer hardware including mainframes, printers, disk, modems, plotters, and personal computers, as well as the software and programs run on the hardware.
- Interview, select, and train new employees; provide recommendations for promotions and lateral transfers; conduct appraisals and recommend merit increases.
- Provide planned needs of all projects within the computer operations area.
- Maintain up-to-date Standard Operating Procedures for the department.
- Prepare job descriptions for each position or job title within the department. Ensure that all employees have a current job description in their training file. Ensure the written job descriptions have complete signatures including employee, immediate supervisor and next managerial level.
- Ensure that all departmental employees understand and adhere to all Company Policies and Procedures.
- Participate in special development projects are required.

Figure 2-3 Resumes of Key Laboratory Personnel and Technical Directors

Norma Bolton
Interim Supervisor, Sample Preparation Laboratories

Responsibilities: **Ms. Bolton is responsible for supervising and training of preparation technicians. Ms. Bolton's responsibilities also include preparation of various environmental matrices using liquid-liquid and liquid solid extraction techniques, use of various cleanup techniques to further prepare the resulting extracts for analysis by SW-846, CLP and other published methodologies.**

Education: **Ms. Bolton received a GED from Wake Technical Community College in 1984.**

Experience: **Previously Ms. Bolton was responsible for the preparation (digestion) of various environmental matrices for Cold Vapor and Spectrometer analysis. Her responsibilities include analysis of the resulting digestates using the Cold Vapor technique, along with various other Wet Chemistry techniques. Prior to moving to the Inorganics lab, Ms. Bolton was employed in the organic sample preparation lab from 1990 to 2007.**

Ms. Bolton joined CompuChem in February 1987 in the Forensic Drug Testing division as Clinical Laboratory Assistant. She was employed by that division until 1990 in the positions of Senior Clinical Laboratory Assistant, Clinical Sample Preparation Technician Trainee, and Clinical Sample Preparation Technician.

Seniority Date: **February 24, 1987**

Dover, Cathy
Supervisor of Project Management
Supervisor of Sample Management Services

Responsibilities: Ms. Dover is responsible for representing the laboratory as the primary contact with commercial clients, account setup and maintenance, tracking the status of projects within the production laboratory and providing technical evaluation and support. Ms. Dover ensures that client requirements are met and that proper customer service and technical support are provided during the course of projects.

Ms. Dover is also responsible for overseeing the daily operations of the Sample Management Services department. This department is responsible for receiving samples, providing daily assistance to Project Management in logging samples into the LIMS following their receipt, coordinating and shipping proper sampling media and supplies to clients, copying data for shipment to clients, providing services as Sample Custodians, disposing of date residual samples and the archiving, retrieval, and storage of scanned customer data.

Education: Ms. Dover earned diploma from Charles E. Jordan High School in Durham County in June 1980. She continued her studies at North Carolina State University where she focused on the curriculum in the schools of Chemical Engineering, Chemistry and Science Education.

Experience: Ms. Dover joined CompuChem in August 1983 as a Senior Laboratory Assistant. She earned her first promotion in February 1985 to Quality Control and Report Integration Clerk.

In January 1986, Ms. Dover became Laboratory Production Coordinator, and in August1989 she worked in the position of Production Scheduler/Planner.

In January 1994, as Account Administration Representative, she worked closely with clients on a service level. In April 1997, Ms. Dover was promoted to Special Project Coordinator (CELDM) and dedicated her efforts providing customer service to one of our most significant clients.

In September 1998 Ms. Dover was promoted to the position of Supervisor of Sample Control. In that capacity Ms. Dover was responsible for sample management, including receipt of samples, sample custody, storage and control, and shipping collection materials to the field.

In May 2005 Ms. Dover was promoted from Senior Project Manager to Supervisor of Project Management.

Seniority Date: August 15, 1983

Feldhaus, James C.
Quality Assurance Manager

Responsibilities: **Mr. Feldhaus is responsible for developing and maintaining the laboratory's quality system through the performance of internal systems and data audits and oversight of Proficiency Test sample analyses. He is also responsible for maintaining the laboratory's accreditations with state and federal agencies and the National Environmental Laboratory Accreditation Program (NELAP).**

Education: Mr. Feldhaus received his Bachelor of Science degree in Chemistry from North Carolina State University in 2000.

He has earned 51 credit hours in chemistry.

Experience: **Before being promoted to Quality Assurance Manager in August of 2010,** Mr. Feldhaus **was responsible for overseeing the daily operations of the inorganics department. This included sample preparation, sample analysis, verifying that quality control criteria are met, and the generation of client reports.**

Mr. Feldhaus began his career at CompuChem in May of 2005 as an Analyst III. In that position his responsibilities were the analyses of environmental matrices using ICP-AES and ICP-MS instrumentation, and review of the data produced from those analyses.

Prior to joining CompuChem, Mr. Feldhaus was employed as a Chemist by Chemical and Environmental Technology, Inc in Cary, North Carolina from 2000 to 2005. His responsibilities included environmental sample collection, analysis of environmental matrices using GC, Cold Vapor, ICP-MS, and classical chemistry techniques.

Mr. Feldhaus meets the requirements in Section 4.1.1.1 of NELAC to serve as a Technical Director.

Seniority Date: May 2, 2005

Gates, Robert (Rob) J.
Administrative Manager

Responsibilities: Mr. Gates is Administrative Manager for CompuChem. This position manages all purchasing functions. Mr. Gates also manages all facility related activities, including building systems maintenance. Mr. Gates also serves as the Safety Officer/**Chemical Hygiene Officer**.

Education: Mr. Gates received a B.S. degree in Public Recreation from Georgia Southern University in 1975.

Experience: Before joining CompuChem, Mr. Gates was the Health Physics Supervisor for Alara Engineer. Mr. Gates started this position in June 1992 where he tracked, scheduled, and audited health physics monitoring. From 1986 to 1992 Mr. Gates held the same position for Site Services at the Savannah River site.

Seniority Date: July 8, 1996

Grzybowski, Kenneth
Director, Laboratory Operations

Responsibilities: **Mr. Grzybowski is responsible for managing the laboratory operations and supervising all the departmental personnel in their various capacities. He is also instrumental in the Element LIMS process and provides directional oversight to the IT Department in determining its priorities. Grzybowski also provides data/case review, when time permits, and serves as EPA Project Manager.**

Education: Mr. Grzybowski earned a Bachelor of Science degree in Environmental Earth Science from Buffalo State College in Buffalo, New York.

Experience: **Mr. Grzybowski was named Laboratory Operations Manager in March of 2009 after being Co-Operations Manager since April of 2008. In October 2009, he returned to his former position in the Volatiles lab. In September 2010, he was once again named as Director, Laboratory Operations.**

Prior to rejoining CompuChem, Mr. Grzybowski was employed by Laboratory Corporation of America, Durham, North Carolina as a Senior Technician. His responsibilities included analysis of biological samples for drugs of abuse utilizing GC/MS instrumentation and the troubleshooting and maintenance of that instrumentation.

As VOA Mgr, Mr. Grzybowski was primary responsible for the analysis of environmental samples for volatile constituents utilizing GC and GC/MS instrumentation and the generation of complete and accurate data reports associated with these analyses. He also ensured that the data reported meets quality control and client requirements.

From April 2002 to September 2005, Mr. Grzybowski was employed by CompuChem as an Analyst II. His responsibilities included the analysis of environmental samples for volatile organic compounds using GCMS instrumentation. He ensured the instrument met all calibration and quality control requirements.

From December 1998 to April 2002, Mr. Grzybowski was employed at Severn Trent Laboratories in Amherst, New York, where he held the positions of Volatile Organic Chemist and Laboratory Waste Disposal Manager.

Seniority Date: April 15, 2002

Mohn, Joseph J.
Supervisor, Wet Chemistry

Responsibilities: Mr. Mohn is responsible for the daily operations of the Wet Chemistry Laboratory. This includes sample preparation, sample analysis, verifying that quality control criteria are met, and the generation of client reports.

Education: Mr. Mohn completed his AAS degree in the Environmental Science Technology at Wake Technical Community College in July 2004.

Experience: Prior to being promoted to Wet Chemistry Supervisor in October, 2008, Mr. Mohn held the position of Analyst I. In that position, his responsibilities included the preparation and analyses of environmental matrices using classical wet chemistry techniques.

Prior to joining CompuChem May 2001, Mr. Mohn was employed by Wake County Public School System. From 1998 to 1999, Mr. Mohn was employed by Dogwood Lane Farm as Farm Manager.

Seniority Date: May 30, 2001

Meierer, Robert (Bob) E.
Vice President & General Manager

Responsibilities: Develop and implement strategic processes and practices within the company. Manage and guide the overall organization. Provide guidance in analyzing and appraising the effectiveness of overall operations. Assure all EPA CLP contractual requirements and federal and state agency certification requirements are met by the company. Assure that the company consistently produces data of known and documented quality.

Education: Mr. Meierer received an Associate degree in Industrial Chemistry from the Erie County Technical Institute in 1963, and an undergraduate B.A. degree in Chemistry from the State University of New York at Buffalo in 1971. He has taken advanced studies in Analytical Chemistry and Business Administration from the State University at Buffalo.

During his studies Mr. Meierer earned 76 credit hours in chemistry toward his degree. No credit hours in microbiology were required for his degree program.

Experience: As Vice President of Quality Assurance and Technology at CompuChem Mr. Meierer was responsible for assuring that the laboratory consistently produced high quality and reliable data, and that all necessary certification and licensing requirements were met by the laboratory. Additional responsibilities included the implementation of change, defined by new technology or operational improvement needs.

Prior to joining CompuChem, Mr. Meierer held positions as Laboratory Manager with Radian Corporation and as Department Head, Analytical Laboratory; Special Contamination Monitoring, The Carborundum Company from 1969-1980.

In his previous position with CompuChem Corporation as Vice President of Quality, Mr. Meierer was responsible for overseeing the QA efforts for both the environmental analytical and forensic drug testing aspects of the company.

Through the variety of laboratory positions Mr. Meierer has held, he has gained fifteen (15) years of experience in the interpretation of GC/MS volatile and semivolatile data. In addition, Mr. Meierer has six (6) years of experience in the preparation of extracts from environmental or hazardous waste samples.

Further, he has gained ten (10) years of experience in organochlorine pesticide residue and PCB analysis, including clean-up procedures (such as column chromatography) for a variety of environmental sample matrices.

Mr. Meierer meets the requirements in Section 4.1.1.1 of NELAC to serve as a Technical Director.

Meierer, Robert (Bob) E.
Vice President & General Manager

Publications:

Meierer, R. E., "Non-Traditional Analyses on CLP Contracts." paper presented at the 19th Annual National Environmental Monitoring Conference, Crystal City Hilton, Arlington, VA, on July 23, 2003.

Meierer, R. E., "The Analytical Testing Laboratory: Its Role and Responsibility in Environmental Legislation." paper presented at the Environmental Science for Lawyers Seminar, NC Bar Center, Cary, NC, on February 10, 1995.

Meierer, R.E., "How to Maintain a High Level of Quality Assurance--and Still Make a Profit," paper presented at the Third Annual Conference of the International Association of Environmental Testing Laboratories, Virginia Beach, VA, on October 23, 1990.

Meierer, R.E., Whitehead, R.J. "Making an On-Site Evaluation of an Analytical Services Laboratory," Environmental Claims Journal, Vol. 1, 4 (Summer 1989)

L.R. Flynn, S.W. Bass, R.E. Meierer, "Headspace Screening/Capillary Column GC/MS Analysis for Volatile Organics: Validation Studies and Applications." paper presented at the Fifth Annual Waste Testing and Quality Assurance Symposium, Washington, DC, on July 24-28, 1989.

Meierer, R.E., Whitehead, R.J. "Quality Assurance: In Search of Excellence," Environmental Lab, November 1989.

Meierer, R.E., "Selecting and Evaluating An Analytical Service Laboratory: What the Client Should Do and What the Responsibilities of the Laboratory Are." paper presented at the Environmental-Analytical Teleconference on Quality, on November 10, 1988.

Meierer, R.E., Ragsdale, P.L. "Validation of Toxicity Characteristic Leaching Procedure (TCLP) and Application to Industrial Wastes," paper presented in Washington, DC at the USEPA Symposium on Solid Waste Testing and Quality Assurance, July 13, 1987.

Meierer, R.E., Myers R.L., Whitehead, R.J., "Quality Assurance Studies Based On Analytical Condition Codes," paper presented to the Fifth Annual EPA Contract Laboratory Program Conference, U.S. EPA, August 1, 1985.

Meierer, R.E., "GC/MS: Applications For The Determination of Organic Constituents In Hazardous Waste," paper presented at the Twelfth Annual Conference on Waste Technology, NSWMA, October 18, 1983.

Meierer, Robert (Bob) E.
Vice President & General Manager

Publications:

Meierer, R.E., Ragsdale P.L., and Mills, P.E., "Quality Assurance of Support Functions In A Large Hazardous Wastes Analytical Laboratory," paper presented before the division of Environmental Chemistry, American Chemical Society, March 29, 1982.

Meierer, R.E., "Laboratory Data Credibility and Reliability," paper presented in Milwaukee, Wisconsin on March 8, 1980, at the Federation of Environmental Technologists Conference.

Shaffer, P.T.B., Meierer, R.E., McGee, C.D., "Virus Recovery From Natural Water" JAWWA., 69 (10), 528-531 (1977).

Cook, G.A., Meierer, R.E., and Shields, B.M. "Combustibility Tests on Several Flame-Resistant Fabrics in Compressed Air, Oxygen Enriched Air, and Pure Oxygen." Textile Research, 37:591 (1967).

Seniority Date: October 2, 1980

Ross, Mark S.
Vice-President Sales and Marketing

Responsibilities: Mr. Ross is responsible for the marketing and sales of services among major Federal programs and commercial clients. He is responsible for directing the efforts of local and national sales staff. He also continues to maintain his involvement in the Waste Management Program, and is familiar with all regulations pertaining to transportation and handling of hazardous waste.

Education: Mr. Ross earned an AAS degree in Medical Technology from Biscayne Paramedical Institute (Miami, FL) in 1976. He also attended Otterbein College (Wasterville, OH) for two years and has completed various professional development courses in effective management, communication, chemical safety and storage, and atomic spectroscopy.

Experience: Before joining CompuChem, Mr. Ross was employed as Inorganic Analytical Chemistry Manager at Battelle (Columbus, OH) from April 1988 to February 1991. From February 1987 until March 1988, he was Inorganic and Water Chemistry Supervisor at Radian Corporation (Sacramento, CA), and from May 1984 to December 1986, he was a Senior Research Technician at Battelle. From December 1977 to May 1984, Mr. Ross was a Senior Research Technician at Owens Corning Fiberglass Technical Center (Granville, OH).

Mr. Ross joined CompuChem as an Inorganic Off-Shift Supervisor in February 1991, and was promoted to Inorganic Production Manager in November 1991. In October 1994 Mr. Ross expanded his duties to include waste management.

In November 1996 Mr. Ross was promoted to his current position.

Seniority Date: February 4, 1991

Table 2.1 - Analytical Methods Performed by CompuChem

Method ID	Type of Analysis	Analyte	Method References
Clean Water Act Methods			
130.1	Colorimetric, flow Injection analyzer, Lachat	total hardness as CaCO3	EPA, 1971 Lachat, 2/20/01
4500-H^+B	Electrometric	pH	Standard Method, 20th Ed. 1998
2540C	Gravimetric	filterable residue, total dissolved solids (TDS)	Standard Methods 20th Ed. 1998
2540D	Gravimetric	non-filterable residue, total suspended solids(TSS)	Standard Methods 20th Ed. 1998
2540B	Gravimetric	total solids	Standard Methods 20th Ed. 1998
300.0	Ion Chromatography	Bromide	EPA/6006R-93/100 EPA, Rev. 2.1, 1993
300.0	Ion Chromatography	Chloride	EPA/6006R-93/100 EPA, Rev. 2.1, 1993
300.0	Ion Chromatography Distillation	Fluoride	EPA/6006R-93/100 Std.Meth. 20th Ed. EPA, Rev. 2.1, 1993
300.0 353.2	Ion Chromatography Colorimetric, flow Injection analyzer, Lachat	nitrate N	EPA/6006R-93/100 EPA, Rev. 2.1, 1993
300.0 353.2	Ion Chromatography Colorimetric, flow injection analyzer, Lachat	nitrite N	EPA/6006R-93/100 EPA, Rev. 2.1, 1993 EPA, Rev. 2.0, 1993
300.0	Ion Chromatography	orthophosphate P	EPA/6006R-93/100 EPA, Rev. 2.1, 1993
300.0	Ion Chromatography	Sulfate	EPA/6006R-93/100 EPA, Rev. 2.1, 1993
310.2	Colorimetric, flow Injection analyzer, Lachat	Alkalinity	EPA, 1974 Lachat, January 2001
335.4 4500 Cn-**I** 10-204-00-1-A	Off-line manual distillation, colorimetric, flow injection analyzer, Lachat	Cyanide, total and free Cyanide, amenable	EPA, Rev. 1.0, 1993 Standards Methods 20th Ed. 1998 Lachat, March 1992
350.1 **10-107-06-1-A**	**Colorimetric** **flow injection analyzer, Lachat distillation**	**Ammonia N**	**EPA, Rev.2, 1993** **Lachat, November 1995**
351.2 **10-107-06-2-E**	**Colorimetric,** **flow injection analyzer, Lachat**	**Kjeldahl N, total**	**EPA, Rev. 2.1, 1993** **Lachat, June 1996**
3500-Fe D/B	**Phenanthroline method**	**Ferrous/ferric iron**	**Std.Meth. 19th/20th Ed.**

Table 2.1 - (cont.) Analytical Methods Performed by CompuChem

Clean Water Act Methods (cont.)

365.4 10-115-01-1-D	colorimetric, flow injection analyzer, Lachat	total phosphorus P	EPA, 1974 Lachat, May 1995
4500-S^2-F	titrimetric	Sulfide	Standard Methods 20th Ed. 1998
1664A	gravimetric	Hexane-extractable material, HEM	EPA-821-R-98-002
1664A	gravimetric	Silica-gel treated (SGT)-HEM	EPA-821-R-98-002
5310B	DC-180 total organic carbon analyzer	TOC	Standard Methods 20th Ed. 1998
420.4 10-210-00-1-A	manual distillation, automated colorimetric, 4-AAP, Lachat	Phenols	EPA, Rev. 1.0, 1993 Lachat, April 1987
3030C	aqueous filtration/acid digestion	Metals	Std.Meth. 20th Ed.
10-124-13-1-A 3500-CrD/B	automated colorimetric, flow injection analyzer, Lachat	Hexavalent chromium (Cr+) (Aqueous)	Lachat, October 1993 Std.Meth. 19th/20th Ed.
D3987-85	Leachate generation from soil	Wet chemistry Parameter	ASTM 1999
RSK-175	GC/FID, gas in water (headspace) analysis	Methane, ethane, ethene, propane	RSK-175

Table 2.1 - (cont.) Analytical Methods Performed by CompuChem

Method ID	Type of Analysis	Analytes	Method References

Resource Conservation & Recovery Act Methods

1010**A** ASTM-D93-**80**	Pensky-Martens closed cup	ignitability	EPA SW846, 3rd Ed., **Up. IIIB, 11/04**
1311	toxicity characteristic leaching procedure (TCLP)	semivolatiles, metals, herbicides, pesticides	EPA SW846, 3rd Ed., Up.I, 7/92
1311	TCLP w/ zero headspace extraction (ZHE)	volatile organics	EPA SW846, 3rd Ed., Up.I, 7/92
D3987-85	leachate generation from soil	Wet chemistry (S)	ASTM
1312	synthetic precipitation leaching procedure (SPLP)	semivolatiles, metals, herbicides, pesticides dissolved metals	EPA SW846, 3rd Ed., Up.II, 9/94 3rd Ed., Up.I, 7/92
3010A	aqueous acid block-digestion ICP	total metals (Aqueous)	EPA SW846, 3rd Ed., Up.I, 7/92
3050B	soil/sediment/sludge acid block-digestion	total metals (Solids)	EPA SW846, 3rd Ed., Up.III, 12/96
3510C	separatory funnel liquid/liquid extraction	organic extractables (Aqueous)	EPA SW846, 3rd Ed., Up.III, 12/96
3520C	continuous liquid/liquid extraction	organic extractables (Aqueous)	EPA SW846, 3rd Ed., Up.III, 12/96
3535**A**	solid phase extraction (SPE)	Explosives (Aqueous)	EPA SW846 3rd Ed., Up.III, 2/**07**
3540C	soxhlet extraction	extractable organics (Solids)	EPA SW846, 3rd Ed., Up.III, 12/96
3541	Automated Soxhlet Extraction (SoxTherm)	Semivolatiles & PCBs (Solids)	EPA SW846, 3rd Ed., Up.III,12/96
3550B, 3550C	sonication extraction	non-volatile & extractable organics (Solids)	EPA SW846, 3rd Ed., Up.III, 12/96 Up. IV (2/07)
3580A	waste dilution, dilute & shoot	non-aqueous waste	EPA SW846, 3rd Ed., Up.I, 7/92
3620B	florisil column cleanup	Organochlorine pesticides & PCBs	EPA SW846, 3rd Ed., Up.III, 12/96
3640A	gel permeation cleanup (GPC)	extractable organics	EPA SW846, 3rd Ed., Up.II, 9/94
3660B	sulfur cleanup	organochlorine pesticides & PCBs	EPA SW846, 3rd Ed., Up.III, 12/96
3665A	sulfuric acid cleanup	PCBs	EPA SW846, 3rd Ed., Up.III, 12/96
3005A	**Aqueous acid block digestion**	**Total recoverable or dissolved metals**	**EPA SW846, 3rd Ed., Up.I, 7/92**
5030B	**P&T**	**volatile organics**	**EPA SW846, 3rd Ed., Up.III, 12/96**

Table 2.1- (cont.) Analytical Methods Performed by CompuChem

Method ID	Type of Analysis	Analytes	Method References
Resource Conservation & Recovery Act Methods (cont.)			
5035, 5035A(draft)	Closed system P&T for soil	volatile organics	EPA SW846, 3rd Ed., Up.III, 12/96, 7/07
6010B, 6010C	ICP	metals	EPA SW846, 3rd Ed., Up.III, 12/96 Up. IV (2/07)
6020, 6020A	ICP-MS	metals	EPA SW846, 3rd Ed.,Up. III, 12/96 Up. IV (2/07)
7196A	automated colorimetric, flow injection analyzer, Lachat	Hexavalent chromium (Cr+) (Aqueous)	EPA SW846, 3rd Ed.,Up. III, 12/96
7470A, 7471A, 7471B	CVAA automated Leeman manual cold-vapor	Mercury	EPA SW846, 3rd Ed., Up. II, 9/94, Up. IV (2/07)
8015B, 8015C	GC/FID	Gasoline range organics, including TN-DEC Diesel range organics, including JP4, JP8,TN EPH (Aqueous & Solids)	EPA SW846, 3rd Ed., Up.III, 12/96 Up. IV (2/07)
8081A, 8081B	solvent extraction, GC/ECD	Organochlorine Pesticides	EPA SW846, 3rd Ed., Up.III, 12/96 Up. IV (2/07)
8082, 8082A	solvent extraction, GC/ECD	PCBs	EPA SW846, 3rd Ed., Up.III, 12/96 Up. IV (2/07)
8151A	solvent extraction, GC/ECD	chlorinated herbicides	EPA SW846, 3rd Ed., Up.III, 12/96
8260B	GC/MS P&T Selected ion monitoring (SIM)	purgeable volatile Organics	EPA SW846, 3rd Ed., Up.III, 12/96
8270C, 8270D	solvent extraction, GC/MS capillary column Selected ion monitoring (SIM)	semivolatile organic Extractables	EPA SW846, 3rd Ed., Up.III, 12/96 Up. IV (2/07)
8310	solvent extraction, HPLC/UV/fluorescence	polynuclear aromatic hydrocarbons (PAHs)	EPA SW846, 3rd Ed., 9/86
8330, 8330A, 8330B	solvent extraction; Solid and Aqueous (8330B – Aqueous only) HPLC,UV detector	Explosives	EPA SW846, 3rd Ed., Up.II, 9/94 Up. IV (2/07)
8332	solvent extraction, HPLC,UV detector	Nitroglycerin/PETN	EPA SW846, 3rd Ed., Up. III, 12/96
9010B, **9010C**	manual midi-distillation (followed by 9012A/**9012B**, flow injection analysis,Lachat)	total and free cyanide	EPA SW846, 3rd Ed., Up. III, 12/96, **3rd Ed., Up. IIIB, 11/04**

Table 2.1 - (cont.) Analytical Methods Performed by CompuChem

Method ID	Type of Analysis	Analytes	Method References

Resource Conservation & Recovery Act Methods (cont.)

9012A, **9012B**	off-line midi-distillation, flow injection analyzer, Lachat	total and free cyanide	EPA SW846, 3rd Ed., Up.III, 12/96, **3rd Ed., Up. IIIB, 11/04**
Chapter (7.3.3) 9014	HCN formation and release, titration	reactive (total releasable) cyanide	EPA SW846, 3rd Ed., Up.III, 12/96
Chapter (7.3.4) 9034	H2S formation and release, titration	reactive (total releasable) sulfide	EPA SW846, 3rd Ed., 9/86
9040B	electrometric	aqueous pH	EPA SW846, 3rd Ed., 1/95
9045C, **9045D**	electrometric	soil & waste pH (corrosivity)	EPA SW846, 3rd Ed., Up.IIB, 1/95, **3rd Ed., Up. IIIB, 11/04**
9060A, modified for soil/water Lloyd Kahn	DC-180 TOC analyzer	TOC (Aqueous & Solids)	EPA SW846, 3rd Ed., **11/04**
9066	manual off-line distillation, automated colorimetric, flow injection analyzer, Lachat	Phenol (Solids)	EPA SW846, 3rd Ed., 9/86, CE-81-1, 5/81
9070A (see Method 1664)	gravimetric	Oil and Grease (Aqueous)	EPA SW846, 3rd Ed.,Up.III, 12/96
9071B	soxhlet extraction, gravimetric Hexane-Extractable Material (HEM)	Oil and Grease (Solids)	EPA SW846, 3rd Ed., Up.III, 12/96 Rev.2, April 1998
9095A	filtration	paint filter liquids	EPA SW846, 3rd Ed., Up.III, 12/96

Table 2.1 - (cont.) Analytical Methods Performed by CompuChem

Superfund / Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), EPA Contract Laboratory Program (CLP)

Method ID	Type of Analysis	Analytes	Method References
EPA CLP	ICP/AES	inorganic metals, total & dissolved	CLP SOW **ILM05.4**
EPA CLP	ICP/MS	Inorganic metals, total & dissolved	CLP SOW ILM05.4
EPA CLP	CVAA	Mercury	CLP SOW **ILM05.4**
EPA CLP	manual distillation, flow injection analyzer, Lachat	Cyanide total	CLP SOW **ILM05.4**
EPA CLP	GC/MS P&T **megabore column** **Full-scan and SIM**	Trace & low-medium aqueous volatiles Low/**medium** solid volatiles	CLP SOW SOM01.2
EPA CLP	solvent extraction, GC/MS capillary column **Full-scan and SIM**	semivolatile organic aqueous Low/**medium** solid	CLP SOW SOM01.2
EPA CLP	solvent extraction, GC/ECD capillary column	organochlorine pesticides	CLP SOW SOM01.2
EPA CLP	solvent extraction, GC/ECD capillary column	Aroclors	CLP SOW SOM01.2

Table 2.2: Method References

Method Key	**Reference**
ASTM	American Society for Testing and Materials, D3987-85 (1999), Standard Test Method for Shake Extraction of Solid Waste with Water; D93-**80**, Standard Test Method for Flash-Point by Pensky-Martens Closed Cup Tester
40 CFR 136	Code of Federal Regulations 40, Part 122, 136 (March 12, 2007) "Guidelines Establishing Test Procedures for Analysis of Pollutants Under the Clean Water Act."
40 CFR 136, Appendix A	Appendix A. (since October 26, 1984, with subsequent updates.) "Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater."
40 CFR **136**, Appendix C	Appendix C. (since October 26, 1984, with subsequent updates.) "Inductively Coupled Plasma – Atomic Emission Spectrometric Method for Trace Element Analysis of Water and Wastes, Method 200.7"
EPA CLP SOW	U.S. EPA. Contract Laboratory Program Statement of Work for Organic and Inorganic Analysis, Multi-Media, Multi-Concentration. Documents number ILM05.4, **and** SOM01.2.
EPA MCAWW March 1983	U.S. EPA. (March 1983.) "Methods for Chemical Analysis of Water and Wastes". EPA-600/4-79-020.
Standard Methods, 19th, 20th Ed	APHA, AWWA, WEF. (Standard Methods for the Examination of Water and Wastewater", 19th, 20th Editions 1995, 1998.
Lachat	Lachat Instruments. "Method Manual for the QuikChem Automated Ion Analyzer". Milwaukee, WI, (periodic updates by method).
SW-846 3rd Edition	U.S. EPA (September, 1986) "Test Methods for Evaluating Solid Waste Physical/Chemical Methods", SW846, Third Edition (9/86), Update I (7/92), Update II (9/94), Update III (12/96), Update IV (2/07).
EPA/6006R-93/100	U.S. EPA "Methods for the Determination of Inorganic Substances in Environmental Samples", Method 300.0, Revision 2.1, August 1993
EPA-821-R-98-002	"Method 1664, Revision A: n-Hexane Extractable Material (HEM; Oil and Grease) and Silica Gel Treated n-Hexane Extractable Material (SGT-HEM; Non-polar Material) by Extraction and Gravimetry", EPA-821-R-98-002, February 1999
RSK-175	Dissolved Oxygen and Methane in Water by a GC Headspace Equilibration Technique", R.S. Kerr Environmental Research Laboratory, Ada, OK, RSK-175, March 15, 1989
EPA/4-81-054, page 115	U.S. EPA EMSL Cincinnati, Ohio, September 1978, "Methods for Benzidine, Chlorinated Organic Compounds, Pentachlorophenol and Pesticides in Water and Wastewater, page 115, "Method for Chlorophenoxy Acid Pesticides in Water and Wastewaters."
Lloyd Kahn Method	"Determination of Total Organic Carbon in Sediment," July, **1988 modified for soils**

3.0 Quality Assurance Objectives

The overall QA objective for CompuChem is to develop and implement procedures for laboratory analysis, chain-of-custody, and reporting that will provide results that are of known and documented quality. Data Quality Indicators (DQIs) are used as qualitative and quantitative descriptors in interpreting the degree of acceptability or utility of data. The principal DQIs are precision, bias (accuracy), representativeness, comparability, completeness and detection limits. DQIs are used as quantitative goals for the quality of data generated in the analytical measurement process. This section summarizes how specific QA objectives are achieved. The specific application of these various activities are contained in the method SOPs.

3.1 Precision and Accuracy

Statistically derived control limits, determined from laboratory-acquired historical data, are reviewed annually and updated if needed. These limits are used for the evaluation of the laboratory control sample (LCS) in the control chart program and at the bench for some procedures. For other procedures, control limits are established in the method, Statement of Work (SOW), or laboratory Standard Operating Procedures (SOPs).

Statistical control limits for matrix spikes and matrix spike duplicates (MS/MSD) have been generated for SW-846 and wet chemistry methods. Default limits have been established internally when statistical limits are broad. For matrix spikes and for laboratory control samples the default limits are 20-150%, with allowances for marginal exceedances.

While the statistical limits presented are goals to be achieved, a specific client or project may dictate the use of other limits. In these cases the laboratory exercises flexibility in applying these in order to meet client-specific requirements. For the Contract Laboratory Program (CLP), matrix spike recoveries are specified in the SOW.

An initial precision and accuracy demonstration is performed for each method. Four replicate control samples are spiked at concentrations near the calibration midpoint and processed through the entire analytical method. The mean percent recovery and percent relative standard deviation are calculated from the replicate results. Precision and accuracy studies are used to document analyst proficiency in performing methods. Data from these studies are maintained **by** the QA department and **electronically in** training files. The standard used in the preparation of the precision and accuracy determinations generally has a concentration within 20% to 80% of the linear calibration range.

The accuracy limits for surrogates are specified by the method or determined statistically for SW-846 and are applicable to laboratory QC samples, as well as field samples.

3.1.1 Precision

Precision is a measure of the degree to which two or more measurements are in agreement. Precision is assessed through the calculation of relative percent differences (RPDs) and relative standard deviations (RSDs) for replicate samples. For inorganic analyses, laboratory precision is assessed through the analysis of a sample/sample duplicate pair, a matrix spike/matrix spike duplicate (MS/MSD) pair, and/or field duplicate pairs. For organic analyses, precision is assessed through the analysis of MS/MSD and field duplicate samples.

When acceptance criteria for precision are not met, depending on the type of problem and sample holding time, corrective action may involve reporting data with a laboratory qualifying notice. An example is the poor precision between matrix spike duplicates when one of the extracts is not concentrated accurately or when matrix interference is evident. When an analyte does not meet criteria for RPD in inorganic duplicates, a data qualifying flag accompanies the result in associated samples in accordance with the U.S. EPA CLP reporting convention.

Formulas used to calculate precision of test measurements and the associated acceptance ranges are as follows.

3.1.1.1 Percent relative standard deviation (%RSD)

$$\% \text{ RSD} = \frac{s}{x} \times 100$$

where: x = average of the data points,
s = is the standard deviation

3.1.1.3 Relative Percent Difference (RPD)

$$\text{RPD} = \frac{|A-B|}{1/2\,(A+B)} \times 100$$

where: A = conc**entration** in sample A
B = conc**entration** in Sample B

3.1.2 Accuracy

Accuracy is the degree of agreement between an observed value and an accepted reference or true value.

Accuracy is assessed by the analysis of quality control samples and through the adherence to all sample handling and holding time requirements. Accuracy is demonstrated through the recovery of spiked compounds in the analysis of the MS/MSD and laboratory control samples (LCS), through surrogate recoveries in organic samples and QC **samples**, and through quality control check samples with known concentrations of target analytes.

3.1.2.1 Surrogate, Deuterated Monitoring Compounds and Spike Standard Recoveries

Evaluating the recoveries of spike, Deuterated Monitoring Compounds (DMC) and surrogate standards is a means to assess method accuracy in a specific sample matrix when subjected to specific method conditions. Samples are fortified before extraction, purging, and digestion or distillation.

The recovery of these standards is quantitatively measured during analysis. Records of the percent recovery for laboratory control samples are maintained in control chart databases. The statistical warning and control limits are updated annually, if needed. Surrogate, DMC, and spike compound recoveries must meet acceptance criteria before the

analytical data are reported. In some instances the sample matrix may produce interferences that adversely affect recoveries of surrogates, DMC or spike compounds. Re-preparation and/or reanalysis of the sample must confirm the results. When a matrix spike test fails spike recovery criteria, the LCS must be evaluated. If the LCS test fails, the entire batch must be reprocessed. If the LCS passes, the sample matrix effect is confirmed. The data **are** qualified in the narrative or with a flag.

The formulas used to calculate accuracy of test measurements follow:

3.1.2.2 Accuracy = Percent Recovery (%R)

$$\%R = \frac{SSR - SR}{SA} \times 100$$

where: SSR = conc**entration** of spiked sample
SR= conc**entration** in unspiked sample
SA = expected conc**entration** of spike

3.1.2.3 Control limits are calculated using the following formulas:

LCL = x – 3sd where: LCL = lower control limit
UCL = x + 3sd UCL = upper control limit
x = mean percent recovery
sd = standard deviation using n-1 degrees of freedom

3.2 Table of Concentration Levels for QC Samples

Type	*Purpose*	*Conc. Level*	*Method Reference*
MS/MSD	**Precision/Accuracy**	**Mid Level**	**CLP organics** **SW-846 organics** **Wet Chemistry**
MS	**Accuracy**	**Mid Level**	**Inorganics**
BS/LCS	**Accuracy**	**Mid Level**	**All analyses**
Duplicate	**Precision**	**Sample-dependent**	**Inorganics** **Wet Chemistry**

Mid level = Mean level between the minimum detection level and the upper end of the linear range

3.3 Representativeness

Representativeness expresses the degree to which the analytical results of one sample accurately and precisely represent results characteristic of a population, parameter variations at a sampling point, a process or an environmental condition within a defined spatial and/or temporal boundary. Representativeness is a qualitative characteristic, and is considered a goal to be achieved rather than a quantitative measurement.

Representativeness is dependent upon both the sampling program design and proper laboratory protocol.

For many sample types, careful collection planning, sample compositing, and/or sample splitting can accomplish true representativeness. Soil samples and samples of complex or heterogeneous matrix usually present the greatest difficulties for samplers and analysts. The sampler should make every effort to homogenize the sample during collection. Laboratory chemists must, whenever practical, homogenize or thoroughly mix the sample before removing aliquots for analysis. CompuChem's sample preparation SOPs include specific procedures for homogenizing as-received samples. Volatile soil samples may not be composited or mixed, **unless otherwise specified by the client,** due to the potential loss of analytes.

Representativeness is ensured by using the proper **field collection techniques,** analytical procedures, appropriate methods, meeting sample holding times, and analyzing field duplicate samples.

The manner in which the data are correlated to the particular sampling episode and sample site are major considerations when evaluating representativeness. When the laboratory is aware of conditions adversely affecting data representativeness, a QA Notice or Laboratory Notice is included in data packages to qualify results or discussion is made in the Sample Delivery Group (SDG) narrative to provide guidance in interpreting data usability.

3.4 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected under normal conditions.

Laboratory completeness is a measure of the amount of valid measurements obtained from all the measurements taken in the project. CompuChem's objective for completeness is to provide unqualified data of the highest quality for 100% of samples.

Factors beyond the laboratory's control that adversely affect attainment of completeness objectives include:

- receipt of samples in broken containers
- receipt of samples whose **Chain** of **Custody** (COC) or integrity is compromised in some way
- receipt of samples with insufficient volume to perform initial analyses or repeat analyses should initial efforts not meet QC acceptance criteria
- receipt of improperly preserved samples
- receipt of samples held in the field for longer than expected so that holding times are jeopardized
- receipt of incomplete or inaccurate information resulting in the application of incorrect methods
- assessment of sample data by end-users using criteria other than those stated in applicable method references or applicable data validation guidelines (Data validation guidelines may reject data although method criteria are met.)

When requested, the completeness of an analysis can be documented by including in the test report sufficient information to allow the data user to assess the quality of the results.

This information may include such items as chromatograms, mass spectra, a summary of QC sample results, and the tabulated analytical results.

Additional results, up to and including all data sufficient to recreate the entire analytical process, are optional deliverable items. These may include laboratory worksheets, calibration data, all QC sample data, and internal COC documents. The highest level document emulates that required under the U.S. EPA CLP and is intended as a legally defensible document in itself. The raw data are archived and stored electronically by scanning using Adobe Acrobat. Scanning allows for the accurate duplication of documents including signatures, affidavits, and all other information. The electronic data **are** then indexed for tracking on a **server** that is backed up daily. The images of the data are stored on duplicate data tape cassettes. One cassette is kept with the computer system for easy retrieval of data and the duplicate cassette is kept in a secure off-site location. The original hard copy report is shipped to the client, but a hard copy can be retained if requested or required.

Archived data are stored for a minimum of five years. Additional storage time may also be requested by the client for certain projects or required under certain programs such as the Ohio Voluntary Action Program (VAP). It is the responsibility of the laboratory project manager to oversee the extended retention of data reports. The auxiliary data field in the LIMS is able to record data retention time requirements for each client and to assist in tracking extended retention times. For the Ohio VAP, the laboratory must notify the agency by certified mail when the 10-year retention period has expired and retain the data until directed in writing by the agency whether they will, or will not, retain the data.

3.5 Comparability

Comparability is an expression of the confidence with which one data set can be compared with another. The analytical results can be compared to results of other laboratories because CompuChem's objectives for comparability are to:

- Demonstrate traceability of analytical/calibration standards to NIST, EPA, or other certified sources
- Use routine and approved analytical methodology
- Achieve sample holding time
- Adhere to instrument tuning and calibration procedures and frequency requirements
- Determine detection limits using Federal Register methodology consistently
- Apply appropriate levels of QC within the context of the QA program
- Report results in common units and use consistent rules in reporting data
- Participate in interlaboratory studies and independent proficiency testing programs to document laboratory performance

By using traceable standards and standard methods, the analytical results can be compared to other laboratories operating similarly. The internal QA program documents laboratory QC performance, and the inter-laboratory studies document performance compared to other laboratories.

3.5.1 QC Reference Standards Traceability

Calibration standards are traceable to the National Institute of Standards and Technology (NIST) or the EPA. EPA standards are purchased with certificates of purity and traceability.

Standards are received as neat materials and concentrated solutions with certificates of analysis (COA) for dilution into intermediate and working standard solutions.

Neat materials are logged into a receipt log and are assigned a sequential number. That number is placed on the COA and bottle label. Intermediate and working standards prepared from these materials are entered into a standard preparation logbook using the appropriate receipt log numbers to identify the components.

Concentrated standards are identified using the names and/or lot numbers which appear on the COA. Intermediate and working standards prepared from these solutions are entered into the standard preparation logbook using the name and/or lot number to identify the components.

In the standard preparation logbook, intermediate and working standard solutions are given unique identification numbers (lot numbers). These lot numbers are used to reference these solutions on all subsequent data such as instrument logs and sample preparation sheets.

Regarding standard(s) preparation, the following statement is contained in all appropriate SOPs: "all spiking standard information is entered into the LIMS. To obtain information on any standard, access Element, click on "Laboratory," and scroll down and access "Standards." Standards can be sorted by Department. Select the standard you would like to access. The view will show lot number, prepared dates, solvent, vendor, composition, and concentration."

COA for all standards are retained for traceability to NIST sources. All standard containers (neat materials, concentrated solutions, intermediate and working standards) are labeled with a lot number, preparation/receipt date, expiration date, and analyst's initials.

3.5.2 Proficiency Tests

Interlaboratory studies in the form of proficiency tests are performed on at least a semiannual basis (NELAC) or quarterly (EPA).

3.6 Limits of Detection and Reporting Limits

Method Detection Limits (MDLs) are determined for all analytes as specified in the NELAC standards.

3.6.1 Method Detection Limits

A statistical method detection limit (MDL) study **or MDL verification study** is performed yearly for all approved methods in use. The studies are performed following the design specified in the Federal Register, 40 CFR Part 136 (October 26, 1984).

The MDL is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero.

The MDL is determined from the analysis of a sample in a lab pure matrix containing the analyte.

At least seven replicate samples are prepared containing the analyte(s) to be tested at a concentration that is 3 to 5 times the estimated MDL for each analyte. The samples are processed through the entire analytical method.

The MDL is calculated using the standard deviation of the replicate measurements and the Student's T value at the 99% confidence level (n-1 degrees of freedom). The mean analyte value is also calculated. The Dixon outlier test or a similar one is used to eliminate any anomalous data point, but a minimum of seven replicate values are required for calculating the MDL.

Detailed MDL criteria are presented in the **method** specific SOP.

3.6.1.1 MDL Calculation

- MDL = $t(n-1, 1-\alpha = .99)(\sigma n-1)$

  where: $t(n-1, 1-\alpha = .99)$ = the student's value for a 99% confidence level and a standard deviation with n-1 degrees of freedom

  $\sigma n-1$ = standard deviation of the replicate analysis

- Standard Deviation

$$\sigma n-1 = \sqrt{\frac{\sum (x_i - x)2}{n-1}}$$

where: x_i = the data point
x = the mean
$\sigma n-1$ = standard deviation
n = number of samples

3.6.2 Instrument Detection Limits

To fulfill the requirements of **certain methods**, instrument detection limit (IDL) determinations are performed quarterly. This is accomplished by the analysis of seven replicate standards prepared in reagent water containing all target analytes at a concentration of 3 to 5 times the estimated IDL. These analyses must be performed over three non-consecutive days and the standard deviations of the replicates calculated. The IDL is calculated by multiplying the average of these standard deviations by three.

For SW-846 ICP analysis, the calculated IDL value must be less than or equal to **the** MDL for the analyte.

3.6.3 Method Detection Limit Default Cut-off Values

For organic methods, when the concentration of a detected target analyte is between the MDL and the reporting limit, it is reported with a "J" flag to indicate the result is estimated.

For projects that do not require the results to be reported down to the MDL, a cut-off value has been defined by the laboratory and may be used. The definition states that any analyte with an MDL <1/5 the RL will have a default cut-off value equal to 1/5 the RL. Any analyte with an MDL >1/5 the RL will have its actual MDL as the cut-off value. For the latter, the MDL has to be less than the RL.

Clients would receive prior notification from the project manager for analytes falling into the latter scenario and may require an elevation in the reporting limit.

The use of the MDL cutoff option is not utilized for the EPA Contract Laboratory Program Statement of Work or clients requiring the actual MDL value.

3.6.4 Reporting Limits

For CLP methods, the reporting limit is the Contract Required Quantitation Limit (CRQL). Results are reported down to the MDL for ILM05.4 and organic parameters. Results reported between the CRQL and the MDL are flagged to indicate the quantitated results are estimated.

For non-CLP methods using a multipoint calibration, the reporting limit is equivalent to or higher than the lowest calibration standard concentration. For ICP metals, the laboratory determines a practical quantitation limit (PQL) for each analyte to be used as the reporting limit..

3.7 Limit of Detection (LOD) for DoD Projects: Determination and Verification

The method detection limit as described in Section 3.6.1 is used to determine the LOD for each analyte, including surrogates, and matrix, as well as for all preparatory and cleanup methods routinely used on samples, as follows:

After each detection limit determination, the LOD is established immediately by spiking a quality system matrix at approximately two to three times the detection limit (for a single-analyte standard) or one to four times the detection limit (for a multi-analyte standard). This spike concentration establishes the LOD. It is specific to each combination of analyte, matrix, method (including sample preparation), and instrument configuration. The LOD is verified quarterly **for each quality system matrix and annually for each quality system matrix, method, and analyte**. The following requirements apply to the initial detection limit/LOD determinations and to the quarterly LOD verifications.

- The apparent signal to noise ratio at the LOD must be at least three and the results must meet all method requirements for analyte identification (e.g., ion abundance, second-column confirmation, or pattern recognition). For data systems that do not provide a measure of noise, the signal produced by the verification sample must produce a result that is at least three standard deviations greater than the mean

method blank concentrations.

- The LOD is verified on each instrument used for a given method.
- If the LOD verification fails, then two consecutive LOD verifications at a higher concentration are performed. If they pass, the LOD is then set at the higher concentration. If they fail, the detection limit determination and LOD verification are repeated at a higher concentration and the LOD is then set at the higher concentration
- All documentation for all detection limit determinations and LOD verifications is maintained by the laboratory.
- Detailed LOD criteria are presented in the specific **method** SOP.

3.8 Limit of Quantitation (LOQ) for DoD Projects: Establishment and Verification of LOQ

For DoD projects, the LOQ is set within the calibration range prior to sample analysis. The LOQ is verified quarterly **at a minimum**.

For methods using a multipoint calibration, **the** Limit of Quantitation (LOQ) is equivalent to or higher than the lowest calibration standard concentration. For ICP metals, the laboratory determines a practical quantitation limit (PQL) for each analyte to be used as the Limit of Quantitation (LOQ).

Four replicate control samples are spiked at concentrations at the LOQ and processed through the entire analytical method. The mean percent recovery and percent relative standard deviation are calculated from the replicate results. The LOQ and associated precision and bias must meet SOP and client requirements and is reported. If the method is modified, precision and bias at the new LOQ is demonstrated and reported.

Detailed LOQ criteria are presented in the specific **method** SOP.

3.9 Method Validation Studies

Prior to analysis of any samples for approved methods not previously offered for sale by the laboratory, a method validation study must first be performed. A chemist familiar with the extraction/preparation procedures and the instrumental detection systems reviews the as-written method. The chemist looks for safety hazards, applicability of available instrument systems, new equipment requirements, any discrepancies in the written method, and the QA/QC requirements. A plan of testing approach is discussed with the laboratory director, technical directors, and executive management. **Analyses** of laboratory spiked matrices **are** performed to determine overall method recoverability. A draft SOP is written after the method validation study has been performed.

Documentation includes an MDL study, a precision and accuracy determination, and a draft SOP. This and any other pertinent information, **such as published methodologies,** is then forwarded to the QA department for final approval. Any deviations from the published method must be noted in the SOP. Once approval by QA and SOP document control **are** completed, product codes can be developed and the new method can be offered to clients.

3.10 Data Quality Objectives

Data quality objectives (DQOs) are used in planning environmental data collection activities. They establish the level of data that is needed to support decisions regarding the site. They establish the level of uncertainty in results that a decision-maker is willing to accept. They can be used to define QA/QC programs specific to a project or data collection activity. DQOs have been established for programs under which the laboratory provides analytical services. Internal project support staff work closely with the client and regulatory agencies to ensure that DQOs will be met by the analytical results provided. The project management team at CompuChem conveys project and client-specific requirements to the laboratory by using the Laboratory Information Management System (LIMS).

4.0 Sampling Procedures

CompuChem does not perform field sampling services. We provide pre-preserved glassware with guidance on collection procedures, if requested, in compliance with program-specific and regulatory shipping requirements. Preservation and holding time requirements are listed in Tables 4.1 through 4.7. We offer shipping supplies that include a shipping container and requested glassware. Glassware supplied by CompuChem for sample collection is purchased pre-cleaned and certified from the vendor. Cleaning procedures are performed according to the U.S. EPA Office of Solid Waste Emergency Response (OSWER) directive published in the document *Specifications and Guidance for Obtaining Contaminant-Free Glassware* (current approved version). The vendor also provides results of analyses using low detection limit EPA methods to certify the glassware is free of contaminants. Certificates of analysis accompanying the glassware are kept on file in the Receiving department and made available upon request.

4.1 Quality Control Procedures

4.1.1 Quality Control of Bottles

Pre-cleaned and certified glassware lots, including all of the bottles, jars, and vials sent to clients for the purpose of sample collection, are purchased and stored at CompuChem. This glassware arrives at the laboratory with certificates of analysis **for each lot and** documents its level of contamination. The level of contamination must be less than the reporting limit (< ½ the reporting limit for **DoD** projects). Preservative is added to sample collection bottles prior to shipment to the client with the exception of volatile vials. Volatile **glassware is** received from the vendor containing preservative. Individually packaged EnCore™ sampling devices are provided for collection of 5 gram volatile soil samples for use with Method 5035 **sampling (including GRO)** and certain methanol preserved TPH analyses. **Terra Core sampling kits are also available.**

4.1.2 Quality Control of the Pure Water System and Vendor Pre-Cleaned and Certified Bottles

A U.S. Filter pure water system is used to generate ASTM Type II reagent grade water. This laboratory pure water is used in sample and method blank preparations.

In addition, we supply water to our clients for use as a source of field QC samples (trip blanks, rinsate blanks, etc.) This water is stored in the volatile instrumentation laboratory in a series of 45 liter glass carboys. Water used for this purpose and for the volatile analytical procedures is generated by a Millipore system located in the volatile sample preparation room.

For many years, the water collected in each carboy **had** been analyzed for volatile, semivolatile, pesticide/PCB and inorganic (metal and cyanide) analytes. An assessment of the results from these tests has demonstrated that, with the exception of common laboratory solvents, the water had not contained target analytes above any blank acceptance criteria. For that reason, the analytical testing of the carboy water was discontinued, unless requested by a client.

Water used to prepare laboratory QC samples, such as method blanks and LCS, must meet method **blank QC acceptance** requirements for acceptability.

4.1.3 Volatile Storage Blank Tests

Storage blank tests associated with CLP analyses and certain commercial clients analyses are performed on a routine basis. The storage blank is used to demonstrate that the refrigerated storage environments, for samples submitted for volatile organic analyses, are free from contamination. Cooler tests are not required for any refrigerators being used strictly for long-term storage of volatiles samples.

4.2 Shipping Coolers

4.2.1 Preparation

An Igloo-style container is provided as a service to customers who request that CompuChem supply bottles to the field **for sample collection**. A Customer Service representative determines, with the client, the required number and types of bottles and fills out a cooler request form (Figure 4-1) that includes the following information:

- address of the client
- special instructions: use of chain-of-custody **(COC)**, etc.
- method of shipment
- account number
- latest shipping date
- test codes for samples

The cooler is sent with instructional and necessary information such as**: COC** record (Figure 4-1), sample collection and preservation guidelines (Figure 4-2), bottle labels, custody seals (Figure 4-3), etc. When soil samples are to be imported into the USA, the US Department of Agriculture requires the receiver hold a valid permit to receive soil (Figure 4.4) and that the sample containers be labeled with "Restricted Entry" labels (Figure 4-5). CompuChem encloses these labels and instructions when sent outside the continental U.S.

For regulatory work done in the States of Florida and New Jersey and for some other clients, formal COC starts when the pre-cleaned sample containers are dispatched to the field from the laboratory. The required COC record is sent with these containers. It must be signed and dated by the individual who packs the cleaned and certified sample containers into the cooler and relinquishes custody of them. This initiates the COC process.

Protocol for sample collection is left to the discretion of the field sampling crew. In general, the use of "blue" ice for sample preservation is discouraged and is adequate <u>only</u> if the samples have been pre-cooled with wet ice.

Please note that Tables 4.1 to 4.7 list Preservation, Holding Times, and Recommended Sample Volumes published in a variety of federal documents. CompuChem does not perform all these methods in-house but supplies this

information for the benefit of our clients. See **Section** 2 of the Quality Manual for details on analyses performed at CompuChem.

Table 4.1

Requirements for Containers, Preservation, Holding Times, and Recommended Sample Volumes Published in the Clean Water Act, 40 CFR 136, *Federal Register, March 12, 2007*

(For a more detailed explanation of Holding Times, refer to note at end of table footnotes[1], page 5.)

Parameter	Preservation	Holding[a] Time (days)	Containers[b]	Volume (mL)
Acidity	Cool, ≤ 6°C[g]	14	P or G	200
Alkalinity	Cool, ≤ 6°C[g]	14	P or G	100
Ammonia	Cool, ≤ 6°C[g], H_2SO_4 to pH<2	28	P or G	500
Biochemical Oxygen Demand	Cool, ≤ 6°C[g]	48 hours	P or G	1000
Bromide	NR[c]	28	P or G	200
Chemical Oxygen Demand	Cool, ≤6° C[g], H_2SO_4 to pH<2	28	P or G	100
Chloride	NR	28	P or G	100
Chlorine, Total Residual	NR	0[d]	P or G	500
Chromium VI	Cool, ≤ 6°C[g]	24 hours	P or G	500
Coliform, fecal and total	Cool, < 10°C; 0.008% $Na_2S_2O_3$	6 hours	P or G	200
Color	Cool, ≤ 6°C[g]	48 hours	P or G	500
Cyanide, total	Cool, ≤ 6°C[g]; NaOH to pH>12 0.6 g ascorbic acid[f]	14[e]	P or G	1000
Cyanide, amenable to chlorination (free)	Cool, ≤ 6°C[g]; NaOH to pH>12 0.6 g ascorbic acid[f]	14[e]	P or G	500
Fluoride	NR	28	P	500
Hardness	HNO_3 to pH<2 H_2SO_4 to pH <2	180	P or G	250
Hydrogen Ion (pH)	NR[c]	0[d]	P or G	40
Kjeldahl Nitrogen	Cool, ≤ 6°C[g]; H_2SO_4 to pH <2	28	P or G	1000
Mercury	HNO_3 to pH<2	28	P or G	500
Metals (except Cr VI and Hg)	HNO_3 to pH<2	180	P or G	500
Nitrate (as N)	Cool, ≤ 6°C[g]	48 hours	P or G	100
Nitrite (as N)	Cool, ≤ 6°C[g]	48 hours	P or G	50
Nitrate-Nitrite (as N)	Cool, ≤6°C[g]; H_2SO_4 to pH <2	28	P or G	500
Oil and Grease	Cool, ≤ 6°C[g]C; H_2SO_4 to pH <2	28	G	1000
Organic Carbon, Total (TOC)	Cool, ≤ 6°C[g]°C HCl or H_2SO_4 to pH <2	28	P or G	100
Organic Nitrogen, Total	Cool, ≤ 6°C[g]; H_2SO_4 to pH <2	28	P or G	500
Orthosphosphate (as P)	Filter immediately, Cool, ≤ 6°C[g]	48 hours	P or G	50
Phenols (Total)	Cool, ≤ 6°C[g]; H_2SO_4 to pH <2	28	G	1000

Parameter	Preservation	Holding[a] Time (days)	Containers[b]	Volume (mL)
Phosphorus (Elemental)	Cool, ≤ 6°C[g]C	48 hours	G	500
Phosphorus (Total)	Cool, ≤ 6°C[g] H_2SO_4 to pH <2	28	P or G	200
Solids (Total and Filterable)	**Cool, ≤ 6°C**	**7**	**P or G**	**100**
Solids (Non-filterable)	**Cool, ≤ 6°C**	**7**	**P or G**	**300**
Solids (Settleable)	**Cool, ≤ 6°C**	**7 days**	**P or G**	**1000**
Silica	**Cool, ≤ 6°C**	**28**	**P**	**100**
Specific Conductance	**Cool, ≤ 6°C**	**28**	**P or G**	**250**
Sulfate	**Cool, ≤ 6°C**	**28**	**P or G**	**250**
Sulfide	**Cool, ≤ 6°C** **Add zinc acetate and NaOH to pH>9.**	**7**	**P or G**	
Sulfite	**NR[c]**	**0[d]**	**P or G**	**250**
Surfactants	**Cool, ≤ 6°C**	**48 hours**	**P or G**	**250**
Turbidity	**Cool, ≤ 6°C**	**48 hours**	**P or G**	**250**
Purgeable Halocarbons	**Cool, ≤ 6°C** **0.008% $Na_2S_2O_3$[e]**	**14**	**G**	**80**
Purgeable Aromatic Hydrocarbons	**Cool, ≤ 6°C** **0.008% $Na_2S_2O_3$[e]** **HCl to pH<2**	**14**	**G**	**80**
Phenols	**Cool, ≤6°C** **0.008% $Na_2S_2O_3$[e]**	**7/40[f]**	**P or G**	**2000**
Benzidines	**Cool, ≤ 6°C** **0.008% $Na_2S_2O_3$[e]**	**7/7[g]**	**P or G**	**2000**
Phthalate Esters	**Cool, ≤ 6°C**	**7/40[f]**	**G**	**2000**
Nitrosamines	**Cool, ≤ 6°C, dark** **0.008% $Na_2S_2O_3$[e]**	**7/40[f]**	**P or G**	**2000**
PCBs	**Cool, ≤ 6°C**	**7/40[f]**	**P or G**	**2000**
Nitroaromatics and isophorone	**Cool, ≤ 6°C, dark** **0.008% $Na_2S_2O_3$[e]**	**7/40[f]**	**P or G**	**2000**
Polynuclear Aromatic Hydrocarbons	**Cool, ≤ 6°C, dark** **0.008% $Na_2S_2O_3$[e]**	**7/40[f]**	**G**	**2000**
Haloethers	**Cool, ≤ 6°C** **0.008% $Na_2S_2O_3$[e]**	**7/40[f]**	**P or G**	**2000**
Chlorinated Hydrocarbons	**Cool, ≤ 6°C**	**7/40[f]**	**P or G**	**2000**
TCDD	**Cool, ≤ 6°C** **0.008% $Na_2S_2O_3$[e]**	**7/40[f]**	**P or G**	**2000**
Pesticides	**Cool, ≤ 6°C; pH 5-9**	**7/40[f]**	**P or G**	**2000**

[a] From time of sample collection
[b] Polyethylene (P) or glass (G)
[c] None required
[d] 0 days indicates that the sample must be analyzed immediately.
[e] Reduced to 24 hours if sulfide is present, unless sulfide is removed before preservation.
[f] Added if residual chlorine is present
[g] Aqueous samples must be preserved at ≤6 °C, and should not be frozen unless data demonstrating that sample freezing does not adversely impact sample integrity is maintained on file and accepted as valid by the regulating authority. Also, for purposes of NPDES monitoring, the specification of "≤°C" is used in place of the "4 °C" and "< 4 °C" sample temperature requirements listed in some methods.

[1] **Please note: all holding times without an "f" footnote are holding times from sample collection time until time of analysis. For "f" or "g" footnoted analytes, the number 7 refers to days from collection to extraction. The number following the 7 is the holding time in days from extraction to analysis.**

.Table 4.2

Requirements for Containers, Preservation, Holding Times, and Recommended Sample Volumes Published in the U.S. EPA CLP SOW for Inorganics Analysis ILM05.4

Parameter	Preservation[a]	Holding Time[b] (days)	Containers[c]	Volume (mL)
Cyanide, total	Cool, 4°C NaOH to pH>12 0.6 g of ascorbic acid[d]	12	P or G	1000
Metals (except Hg)	HNO_3 to pH<2, 4°± 2°C	180	P or G	500[e]
Mercury	HNO_3 to pH<2, 4°± 2°C	26	P or G	500[e]

[a] Water sample only; preservation performed by sampler immediately upon sample collection. Soil/sediment samples are maintained at 4 °C until analysis. Dissolved metals are filtered onsite by sampler before addition of preservative. Water samples received under the ILM04.1 SOW are stored at ambient temperature
[b] From validated time of sample receipt
[c] Polyethylene (P) or glass (G)
[d] Only used in the presence of residual chlorine
[e] Can be combined into a one-liter bottle.

Table 4.3

Requirements for Containers, Preservation, Holding Times, and Recommended Sample Volumes Published in the U.S. EPA CLP SOW for Organics Analysis SOM01.2

Parameter	Preservation	Holding Time (days)[a]	Containers[b]	Volume (mL)
Aqueous Volatiles	Cool, 4°± 2°C[e] HCl to pH ≤2	10[d]	G-TLSSL	80
Soil/Sediment Volatiles	4°± 2°C[c], sodium bisulfate < -7°C	10[d] 10	G-TLC, CET, EnCore™ samplers	4 oz 60 mL
Aqueous Semivolatiles	4°± 2°C[c]	5/40[e]	AG	2000
Soil/Sediment Semivolatiles	4°± 2°C[c]	10/40[e]	G	8 oz
Aqueous Pesticides/PCBs	4°± 2°C[c]	5/40[e]	AG	2000
Soil/Sediment Pesticides/PCBs	4°± 2°C[c]	10/40[e]	G	8 oz

[a] From validated time of sample receipt
[b] All containers are 1-liter amber glass (AG) bottles with Teflon-lined cap except aqueous volatiles (G-TLSSL = 40-ml glass bottle with Teflon-lined septum sealed lid), and soil/sediment volatiles (G-TLC = 4-oz glass jar with Teflon-lined cap or CET = closed-end tubes such as brass sleeves). Soil samples may also be collected under SOM01.2 for low level analysis in Encore™ samplers or as 5 gm sample in sodium bisulfate or medium level analysis in pre-weighed vials containing 10ml methanol. When this occurs, the sample vial, with 10 ml methanol and all labeling, is weighed to the nearest 0.1g prior to the addition of sample. Approximately 5 g of sample is added to the vial. The sample vial with sample is weighed to the nearest 0.1 g. The initial weight, final weight and sample weight are recorded and provided to the laboratory.
[c] Preserve samples at time of collection; samples should be stored in the dark until extraction/analysis.
[d] Until analysis
[e] To complete extraction/to complete analysis following extraction

Table 4.4

Requirements for Containers, Preservation, Holding Times, and Recommended Sample Volumes for Aqueous and Solid Matrices[a] Published in SW-846 Test Methods for Evaluating Solid Waste, Third Edition, Update IV, February 2007.

Parameter	Methods	References	Container	Preservation	Maximum Holding Times[b]
Volatile Organics in water	Purge and trap GC and GC/MS	8015A modified/ 8015B, 8015C 8260B	Glass, 40-ml vial with zero headspace	Cool to ≤ 6°C, HCl to pH <2, 0.008% $Na_2S_2O_3$	14 days (A) (see below for soil)
Semivolatile Organics	GC, HPLC, and GC/MS	8081A, 8081B, 8082, 8082A, 8151A, 8310, 8270C, 8270D, 8330, 8330A, 8332	Glass, amber (A) (1 liter sample); 8-oz wide mouth with PTFE-lined cap (S) (50-g min. ea. test)	Cool to ≤ 6°C, 0.008% $Na_2S_2O_3$	7 days to extract (A); 14 days to extract (S); 40 days to analyze (A/S)
Total Metals – except Mercury and Chromium VI	ICP AES, ICP/MS	6010B, 6010C, 6020, 6020A	Glass or plastic 500ml (A), 8-oz wide mouth (S) (200-g sample)	HNO_3 to pH<2 (A); filter dissolved on-site first; filter suspended-no acid	6 months (A/S)
Chromium VI	Colorimetric, automated	7196A	Glass or plastic, 500ml (A), 8-oz wide mouth (S) (200-g sample)	Cool to ≤ 6°C	24 hours (A); one mo. to extraction, 4 days after (S).
Mercury	Manual cold vapor AA	7470 7471A 7471B	Glass or plastic, 500ml (A), 8-oz wide mouth (200-g sample)	pH<2 HNO_3 (A); Cool to 4°C (S)	28 days (A/S)
Cyanide	Colorimetric automated	9012A	Glass or plastic	Cool to ≤ 6°C; pH >12 NaOH (A)	14days (A)
Phenols	Colorimetric, automated	420.2	Glass or plastic	Cool to ≤ 6°C; pH < 4 H2SO4 (A)	28 days (A)
Specific conductance	conductivity	9050A	Glass or plastic	NA	28 days (A)
Sulfide	distillation, titration	9034	Glass or plastic	Cool to ≤ 6°C; Zinc acetate (A/S)	7 days (A/S)
Oil & grease	Gravimetric	9070 9071A	Glass	Cool to 4°C (A/S); 5 ml diluted HCl(A)	28 days (A) 14 days (S)
TOC	Combustion analyzer	9060	Glass or plastic	Cool to ≤ 6°C; pH<2 HCl or H_2SO_4; Store in dark (A)	28 days

[a] Table originally excerpted, in part, from Table II, 40 CFR 136 Vol. 72, No. 47/Monday, March 12, 2007/Rules and Regulations.
[b] Holding time begins at time of sample collection.
[c] $Na_2S_2O_3$ added if residual chlorine is present; approx. equal to 1 ml of 10% thiosulfate / liter of sample.
(A) aqueous, (S) solid

Table 4.5

Sample Handling, Preservation and Holding Time Table for SW-846 Method 5035, Volatile Organics in Soil

Conc. Level	Sampling Device	Collection Procedure	Container Type	Container Preparation	Preservation	Maximum Holding Time[a]
≤ 200 ug/kg	Coring Device	5035-Section 6.2.1	Glass vial w/ PTFE-silicon septum	5035-6.1.1	Cool, ≤ 6°C, $NaHSO_4$	14 days
	Coring Device	5035-Section 6.2.1	Glass vial w/ PTFE-silicon septum	5035-6.1.1[b]	Cool, ≤ 6°C	48 hours
	Coring Device	5035-Section 6.2.1	Glass vial w/ PTFE-silicon septum	5035-6.1.1	Cool, ≤ 6°C/-10°C[d]	48 hours/ 14 days[e]
	Encore™ or equivalent	5035-Section 6.2.1	Encore™ or equivalent	5035-6.1.1[b,f,g]	Cool, ≤ 6°C	48 hours
	Encore™ or equivalent	5035-Section 6.2.1	Encore™ or equivalent	5035-6.1.1[f,g]	$NaHSO_4$, Cool, ≤ 6°C	48 hours, 14 days
	Encore™ or equivalent	5035-Section 6.2.1	Encore™ or equivalent	5035-6.1.1 [b,f,g]	Cool, ≤ 6°C /-10°C [c,d]	48 hours/ 14 days
> 200 ug/kg[h]	Encore™ or equivalent	5035-Section 6.2.2.3[f]	Encore™ or equivalent	5035-6.1.1 [f,g]	Cool, ≤6°C	48 hours 14 days
	Coring Device	5035-Section 6.2.2.3[i]	Glass vial w/ PTFE-silicon septum	5035-6.1.1 [i]	Methanol/PEG Cool, ≤ 6°C	14 days
	Conventional Devices	FLDEP SOP –Section 4.3	Glass vial w/ PTFE-silicon septum	5035-6.1.1	Cool, ≤ 6°C	14 days
Dry weight	Conventional Devices		Glass w/ teflon liner		Cool, ≤ 6°C	

[a] Maximum time allowed from time/date of collection to sample analysis.
[b] Eliminate 6.1.1.2; use only organic-free water.
[c] Contents of sampling device must be transported to the laboratory at ≤6 °C and stored at –10 °C; this option upon client request.
[d] In order to ensure that vials do not break during freezing, they should be stored on their side or at a slanted angle.
[e] Maximum allowed time at ≤6 °C is 48 hours; maximum allowed time to sample analysis is 14 days from collection.
[f] Conducted in the laboratory.
[g] Entire contents of sampling device is extruded into the sample analysis vial containing the appropriate solvent.
[h] Procedures are limited only to those situations or programs in which the maximum contamination level does not exceed 200 µg/kg.
[i] Methanolic preservation in the field is not recommended.

Table 4.6

Requirements for Holding Times for Hazardous Characteristics Indicators Published in SW-846 Test Methods for Evaluating Solid Waste, Third Edition, Update 3, December 1996.

Parameter	Methods	References	Container	Preservation	Maximum Holding Times
Reactivity-Total releasable cyanide	Reflux distillation, colorimetry	Chapter 7, 7.3.3, 9014	Glass, with zero headspace	≤6 °C in dark, pH>12 NaOH	ASAP
Reactivity-Total releasable Sulfide	Acid distillation, titration	Chapter 7, 7.3.4, 9034	Glass, with zero headspace	≤6°C in dark, pH>9 NaOH; zinc acetate	ASAP
Ignitability	Flash point	1010	Glass or plastic	NA	ASAP
Corrosivity	Electrometric	9040B	Glass or plastic	NA	ASAP
Paint filter liquids	filtration	9095A	Glass or plastic	NA	ASAP

Table 4.7

Requirements for Containers, Preservation, Holding Times, and Recommended Sample Volumes for Toxicity Characteristics Leaching Procedure, TCLP, Method 1311, and Synthetic Precipitation Leaching Procedure, SPLP, Method 1312, Published in SW-846 Test Methods for Evaluating Solid Waste, Third Edition, Update III, December 1996 and Update IV, February 2007.

Sample Maximum Holding Times				
Parameter	**From: Field collection** **To: TCLP Extraction**	**From: TCLP Extraction** **To: Preparative Extraction**	**From: Preparative extraction** **To: Determinative Analysis**	**Total elapsed time in days**
Volatiles	14	NA	14	28
Semivolatiles	14	7	40	61
Mercury	28	NA	28	56
Metals, no Hg	180	NA	180	360

Exceeding the holding time is not acceptable in establishing that a waste does not exceed the regulatory level. Exceeding the holding time will not invalidate characterization if the waste exceeds the regulatory level.

Holding time associated with the ASTM leachate generation method (D3987-85) is 14 days from collection to leachate generation, i.e., filtration, then the method holding time to preparation and/or analysis.

Figure 4-1

GLASSWARE/COOLER ORDER FORM

DATE: _____

REQUESTED BY: _____

CLIENT: _____

ADDRESS: _____

_____

_____

_____

PHONE #: _____

DATE NEEDED BY CLIENT: _____ (circle one) AM PM

**SHIP VIA: _____ (circle one) NDA NDAS 2nd DAY AM 2nd DAY AIR 3 DAY GROUND

PROJECT ID: _____

COOLER #s _____

BOTTLES PER ANALYSIS

Number of Samples*	Parameters Needed	Container	Bottle Lot Numbers	Pres.	Preservative Lot Number	Total Bottles

* includes QC

Circle items needed: Coc's Labels Seals ____TB's / carboy#____ ____Liters DIH2O / carboy#____

Additional items: _____

Prepared by/date: _____

** NDA = NEXT DAY AIR (by 10:30AM); NDAS = NEXT DAY AIR SAVER (by 3:00PM); 2nd DAY AM = 2nd DAY AIR AM (by 10:30AM); 2nd DAY AIR = 2nd DAY AIR (by 3:00PM); 3 DAY = 3 DAY SELECT (by 3rd DAY PM); GROUND = GROUND 3-5 DAYS (SLOW BOAT)

Figure 4-2

Sample Collection and Preservation Guidelines

Preservatives must be added in the field at the time of sample collection unless glassware are already pre-preserved. Preservatives should be recorded on the Chain-of-Custody form in the "Remarks" column on a per sample basis. For certain methods and parameters, the laboratory verifies upon receipt that the sample pH falls within an acceptable range. Improperly preserved samples or samples with pH values outside of the specified range are noted in the sample receiving documentation. The client is contacted and given the option of resampling, directing the laboratory to preserve the sample in-house, or processing the sample as it was received. To document the action taken, a Quality Assurance Notice is included in the data report for any occurrence.

When obtaining aqueous samples for the determination of volatile organics, the collector should ensure the absence of headspace by filling the 40 **mL** bottle to the top. This procedure should produce a positive meniscus across the surface of the vial. The Teflon®-lined septum should be placed gently over the sample surface, with the Teflon® side down, and the top screwed firmly on over the septum. A proper seal should be verified by inverting the sealed bottle and gently tapping on the sides with your finger, ensuring that no air bubbles appear.

The collector should designate which samples are to be used for Quality Control. For these designated samples, the recommended sample weight or volume should be doubled. If sufficient sample is not available to the laboratory, QC requirements may not be achievable. Excess sample will unnecessarily increase shipping costs.

Guidance on the EPA SW8-46 Method 5035 for the Closed System Purge and Trap and Extraction for Volatile Organics in Soil and Waste Samples.

CompuChem has the capabilities and supplies to provide any of the Method 5035 options. Because of some disadvantages, we favor the use of disposable En Core™ samplers, with zero headspace design, for the collection of soil samples for volatile analysis. The En Core™ sampler is available in 5 g and 25 g sizes. Some regulatory agencies may mandate the 5 g **sample** size. Three 5 g En Core™ samplers, with a 2 ounce jar for percent moisture, would be required per sampling site to include:

- a 5 g aliquot for the sample analysis
- a 5 g aliquot as a back-up for the sample analysis
- a 5 g aliquot for a methanol extraction used for screening and/or a high concentration analysis
- a 2 oz. aliquot for a % moisture determination

In most cases, the methanol aliquot (containing surrogates) will be used for screening purposes. Based on those results, other tests will be performed. Once aliquots of the soil sample, taken from the En Core™ sampler, are added to vials containing preservative, the remainder of the 14 day holding time is available.

During the initial transfer of sample aliquots to the vials containing the sodium bisulfate preservative solution, the presence of carbonates will be identified due to the observed effervescence. If this occurs, a 5 g aliquot of sample will be transferred to a vial containing only water. The sample will be immediately sealed and analyzed as soon as possible but no later than 48 hours from preparation. Alternatively, the analysis will be conducted on the methanol-preserved aliquot. For effervescence, with the client's approval, another option is to freeze the contents of the En Core™. Freezing the contents of En **Core™** samplers in closed system purge and trap vials with or without the addition of water is also

allowed by some EPA Regions and other regulatory agencies. The laboratory project manager conveys this type of information directly to the laboratory upon sample receipt. Advantages of use of the En Core™ include:

- No need to take or use a balance in the field
- No exposure of field personnel to corrosive sodium bisulfate or flammable/toxic methanol
- No additional shipping paperwork or cooler labeling
- No need to use the costly closed system purge and trap vials in the field
- No chance of volatile sample container breakage during shipment
- Significant decrease in man-hour requirements to complete the field sampling efforts

An alternate method 5035 option is available for collection of volatile soils uses a Terra **Core™** kit with pre-preserved vials, a disposable coring device (**Terra Core™**) and a 2 ounce jar for percent moisture. CompuChem provides 2 sodium bisulfate and one methanol pre-preserved vials, a 2 ounce jar and the disposable **Terra Core™** to the client for the collection a volatile soil sample. The advantages of this option are that the cost is lower for the client per sample and the client does not have to ship each day of sampling if the pre-preserved vials and jars are kept at 4 degrees Celsius (± 2 degrees).

Figure 4-3

Custody Seal

CompuChem
A Division Of
Liberty Analytical Corp.

CUSTODY SEAL

Signature

Date

Figure 4-4

Animal and Plant Health Inspection Service

Plant Protection & Quarantine

United States Department of Agriculture
Animal and Plant Health Inspection Service
4700 River Road
Riverdale, MD 20737

Permit to Receive Soil
Regulated by 7 CFR 330

This permit was generated electronically via the ePermits system.

PERMITTEE NAME:	Robert E. Meierer	**PERMIT NUMBER:**	P330-09-00066
COMPANY:	CompuChem	**APPLICATION NUMBER:**	P525-090127-007
RECEIVING ADDRESS:	501 Madison Avenue Cary, NC 27513	**DATE ISSUED:**	03/27/2009
MAILING ADDRESS:	501 Madison Avenue Cary, NC 27513		
PHONE:	(919) 379-4000		
FAX:	(919) 378-4050	**EXPIRES:**	**03/27/2012**

PORTS OF ARRIVAL/PLANT INSPECTION STATIONS: FL, Miami (Physical); GA, Atlanta; Various Ports of Entry Staffed by CBP-Agriculture Inspection
HAND CARRY: No

Under the conditions specified, this permit authorizes the following:
Quantity of Soil per Shipment and Treatment
Over 3 lbs

PERMIT CONDITIONS

1. This permit is issued only for Robert E. Meierer, the named permit holder with CompuChem located at 501 Madison Ave, Cary, NC 27513. This permit cannot be transferred or assigned nor does it fulfill or modify the requirements of any other federal or state regulatory authority (such as the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, the U.S. Food and Drug Administration, the Centers for Disease Control and Prevention, or your state's Department of Agriculture).

2. The permit holder verifies United States residency by initialing and accepting these permit conditions. If you are not a United States resident, it is unlawful for you to initial or accept these permit conditions because a USDA 525 Soil Permit can only be issued to United States residents.

3. The permit holder is solely responsible for ensuring compliance with all statutory requirements and specifically listed permit conditions. Failure to comply with the terms and conditions of this permit is cause for the following: (a) cancellation of this permit, (b) cancellation of other permits issued to the permit holder, (c) seizure and/or destruction of regulated soil, (d) denial of future permit applications by this permit holder, (e) liability for civil penalties, and (f) criminal prosecution under provisions in the Plant Protection Act.

Permit Number P330-09-00066

THIS PERMIT HAS BEEN APPROVED ELECTRONICALLY BY THE FOLLOWING PPQ HEADQUARTER OFFICIAL VIA EPERMITS.	DATE
Monica J O'Neal Monica Jones O Neil	03/27/2009

WARNING: Any alteration, forgery or unauthorized use of this Federal Form is subject to civil penalties of up to $250,000 (7 U.S.C.s 7734(b)) or punishable by a fine of not more than $10,000, or imprisonment of not more than 5 years, or both (18 U.S.C.s 1001)

Page 1 of 3

Figure 4-4 (Continued)

Animal and Plant Health Inspection Service

Plant Protection & Quarantine

4. Any alteration, forgery, unauthorized use of this permit and/or associated Federal Forms are subject to civil and criminal penalties including fines and imprisonment.

5. The permit holder must maintain a valid permit so long as the soil is in your possession. The permit holder must safeguard and dispose of the soil during the term of this permit. This permit cannot be extended. A new permit is required for uninterrupted authorization/use of regulated soil after this permit expires.

6. The permit holder must maintain an official permanent work assignment at the address identified on this permit. If the permit holder ceases assignment/affiliation at the address identified on this permit, or personnel circumstances change in any way, then a compliance officer must be notified at the PPQ permit unit immediately (that is, within one business day) by either (a) email to pest.permits@aphis.usda.gov, (b) fax to 301-734-4300 or 8700, or (c) conventional mail to USDA PPQ Permit Unit, 4700 River Road, Riverdale, MD 20737. The permit holder must destroy all regulated soil prior to departure unless the permit holder either (a) requests cancellation of this permit and complies with all permit-specific termination conditions, (b) applies for and receives a permit to move the soil to a new facility, or (c) relinquishes control of the regulated soil to a qualified individual who obtained a permit for the continued use of these regulated soil prior to this permit holder's departure. {rsj 04/08}

7. Without prior notice and during reasonable hours, authorized PPQ and/or State regulatory officials shall be allowed to inspect the conditions associated with the regulated article authorized under this permit.

8. This permit authorizes the importation of soil under the conditions specified below. Upon arrival into the United States, the articles, shipping container(s) and paperwork are subject to inspection by officials from Customs and Border Protection, Agriculture Inspection (CBP-AI) and USDA, APHIS, Plant Protection and Quarantine (PPQ).

9. Any person who unloads, lands or otherwise brings or moves into or through the United States any regulated plants, plant products, plant pests, soil or other products or articles in violation of the regulations will be subject to prosecution under applicable provisions of the law.

10. All foreign cargo of agricultural interest is inspected at the first port of arrival or the first port of unlading. If a shipment arrives at a port that lacks the official/personnel necessary to do the proper inspection and/or treatment, the shipment must be transferred by a bonded carrier to a nearest station staffed with proper CBP-AI or PPQ Officials at the expense of the permit holder. All subsequent movement, transfers and/or transloading, must be approved by CBP-AI.

11. A copy of this permit must accompany all shipments authorized under this permit.

12. The soil must be shipped in sturdy, leak-proof containers.

13. CBP-AI and PPQ have the authority to order and approve treatment, re-exportation or destruction of a shipment, a portion of a shipment or any other material associated with the shipment (i.e. pallets, packaging, means of conveyance). If an official of CBP-AI or PPQ determines that the shipment requires treatment as a condition of entry, is contaminated with a quarantine plant pest or pests, is commingled with prohibited plant material or the required documentation is incomplete or missing, then that official may order and approve treatment, re-exportation or destruction of a shipment, a portion of a shipment or any other material associated with the shipment (i.e. pallets, packaging, means of conveyance).

14. The shipment must be free from foreign matter or debris, plants, noxious weed seeds and living organisms such as parasitic plants, pathogens, insects, snails and mites. Material found to be commingled with unauthorized material will be subject to the same action (i.e. re-export, destruction) as unauthorized material.

Permit Number P330-09-00066

THIS PERMIT HAS BEEN APPROVED ELECTRONICALLY BY THE FOLLOWING PPQ HEADQUARTER OFFICIAL VIA EPERMITS.	DATE
Monica J O'Neil Monica Jones O Neil	03/27/2009

WARNING: Any alteration, forgery or unauthorized use of this Federal Form is subject to civil penalties of up to $250,000 (7 U.S.C.s 7734(b)) or punishable by a fine of not more than $10,000, or imprisonment of not more than 5 years, or both (18 U.S.C.s 1001)

Page 2 of 3

Figure 4-4 (Continued)

Animal and Plant Health Inspection Service

Plant Protection & Quarantine

15. All solid wood packing material (SWPM) accompanying the shipment must be in compliance with ISPM 15 treatment regulations and IPPC stamp requirements and enforcement. Noncompliant shipments will be treated, re-exported or destroyed at the consignee's expense.

16. All costs and arrangements for safeguarding and transportation of the cargo are the responsibility of the importer, broker or other parties associated with the shipment.

17. The shipment can be released without treatment at the port of entry to the permittee's address listed on the permit or label or to an authorized user only if the final destination is an approved facility listed at https://web01.aphis.usda.gov/PPQ/AuthSoilLabs.nsf/web?openform.

18. Further distribution of soil is not allowed without prior approval from the State and Federal Regulatory Officials. Soil is to be used strictly for analysis within a laboratory at CompuChem located in Cary, NC.

19. Upon receipt, all soil samples will remain within the approved soil laboratory identified on this permit. Laboratory access is restricted to individuals authorized by the permit holder.

20. This permit does not authorize the use of soil for growing purposes and for isolation or culture of organisms.

21. All unconsumed soil, containers and effluent is to be autoclaved, incinerated or properly sterilized by the permittee at the conclusion of the project as approved and prescribed by PPQ in the compliance agreement.

22. This permit is valid for shipments of soil not heat treated at the port of entry only if a Compliance Agreement (PPQ Form 519) has been completed and signed.

23. This permit authorizes importation of soil into the United Stated from [designated foreign sources] through U.S. ports of entry staffed by a United Stated Department of Homeland Security Customs and Border Protection Agricultural Specialist.

24. You must attach a PPQ Form 550 Black/White label to the exterior of each shipment being imported under this permit. We will send you the PPQ Form 550 Black/White labels upon issuance of this permit (i.e., a signed PPQ permit) by bonded courier.
You may request additional labels by email at:
Redandwhitelabelrequest@aphis.usda.gov. You must specify the type of label you are requesting, PPQ Form 550 Black/White labels, and the number of labels needed.

You must enclose the following supplemental information with each shipment:
- Permittee Name
- Permit number

END OF PERMIT CONDITIONS

Permit Number P330-09-00066

THIS PERMIT HAS BEEN APPROVED ELECTRONICALLY BY THE FOLLOWING PPQ HEADQUARTER OFFICIAL VIA EPERMITS.	DATE
Monica J O'Neal Monica Jones O Neil	03/27/2009

WARNING: Any alteration, forgery or unauthorized use of this Federal Form is subject to civil penalties of up to $250,000 (7 U.S.C.s 7734(b)) or punishable by a fine of not more than $10,000, or imprisonment of not more than 5 years, or both (18 U.S.C.s 1001)

Page 3 of 3

Figure 4-5

Soil Sample Cooler Restricted Entry Label

CompuChem
a division of Liberty Analytical Corporation

In order to remain in compliance with current United States Department of Agriculture regulations regarding the importation of soil samples of foreign origin into the Unites States for subsequent analysis, it is necessary to affix the attached USDA labels to every soil sample that is expected to enter the U.S.A. Each label should be placed in a highly visible position on the exterior surface of every cooler being sent. Failure to comply with this regulation can result in transportation delays and denials.

U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
PLANT PROTECTION AND QUARANTINE
4700 RIVER RD., UNIT 136
RIVERDALE, MD 20737-1236

SOIL SAMPLES
RESTRICTED ENTRY

The material contained in this package is imported under authority of the Federal Plant Pest Act of May 23, 1957.

For release without treatment if addressee is currently listed as approved by Plant Protection and Quarantine.

PPQ FORM 550
(MAR 95)

☆U.S.GPO: 1995–621-030

5.0 Sample Handling

This section summarizes policies and practices for sample **receipt** handling. Further details are contained in **receiving and sample management** SOPs. If any discrepancy is noted at sample receipt, or if there is any question about the sample's suitability for testing, the Project Manager or Customer Service Representative contacts the client for instructions on how to proceed. The condition of the samples is recorded on the Chain of Custody (COC) record, on the sample log-in form, and in the final report.

5.1 Sample Acceptance Policy

CompuChem's sample acceptance policy outlines the circumstances under which samples will be accepted by the laboratory. **Information and** data that do not meet the policy are noted in the laboratory report defining the nature and substance of the variation. Samples received by the laboratory for analysis require the following:

- Proper, full, and complete documentation, including:
  - unique sample identification,
  - location, date and time of collection,
  - collector's name,
  - preservation type,
  - matrix
  - analytical method
    - program area – CWA/RCRA/EPA
  - sample type- grab or composite
  - temperature of samples at time of collection for grab and at time of final aliquot collection for composite samples if required (CWA)
- special remarks concerning the sample – including references to permit specific concentration limits, if applicable
- Sample identified using durable label completed in indelible ink
- Proper preservation
  - time of preservation if required (CWA requires preservation within 15 minutes of time of collection)
- Intact, undamaged sample container
- Adequate sample volume
- Appropriate receipt temperature
- Receipt within holding time

It is the laboratory's policy to accept all samples including those that do not meet the requirements listed above. However, in cases where these requirements are not met, the project manager contacts the SMO (who contacts the EPA Region) or **other** clients via telephone or e-mail indicating any receiving issues. The laboratory will proceed with analysis or reject the sample as advised by the client or EPA Region. The laboratory cannot attest the data produced is "certified data" for Ohio VAP unless all samples are received in accordance with Ohio VAP approved document requirements.

5.2 Sample Tracking

CompuChem uniquely identifies each sample to be tested, to ensure that there can be no confusion regarding identity. The sample identification system includes identification for all samples, sub-samples and subsequent extracts and/or digestates. A unique

identification (ID) code is automatically **generated** by the LIMS **computer program**. A **unique** label is printed and affixed to the sample container.

Internal COC records accompany raw samples from the **storage** cooler to the **appropriate** laboratories and back, extracts and digestates to the instrument labs from preparation. **These records** are part of the data deliverables depending on the report style requested by the client.

5.2.1 Bench Log-In Procedure

The following steps are completed by the Receiving Clerk and Sample Custodian for all samples when received by CompuChem. If for any reason a sample requires special handling, the Project Manager is consulted for instructions for processing and documentation. Completed COC forms are part of the data deliverables.

Each employee is required to wear protective clothing (lab coat, safety glasses, and gloves) at all times when working in the **receiving** hood with samples. Upon receipt, the condition of the sample, including any abnormalities or departures from standard condition is observed and recorded. Each **shipping** container is opened carefully under the **safety** hood and inspected for damage and integrity. For clients using padlocks, sealing tape, or custody seals, these items are inspected to make sure that **the security measures** are intact and this observation is recorded on the COC form (Figure 5-1). If the custody seals, tapes, or padlocks are broken, a project manager contacts the client for instructions as to how to proceed.

The condition of the refrigerant (whether any ice remains or whether the cooling packs, if present, are solid) is checked. The temperature of a representative sample, taken from the middle of the cooler, or of the temperature blank, when present, is obtained by means of an infrared (IR) gun. The temperature is recorded on the COC. The temperature is also recorded on the log-in-sheet for EPA samples. All samples requiring thermal preservation are considered acceptable if the arrival temperature is either within +/- 2 degrees C of the required temperature (4 degrees C) or the method-specified range.

For EPA samples, the SMO has to be contacted if the as-received temperature exceeds 10 °C. Samples that are hand delivered to the laboratory immediately after collection may not meet criteria. In these cases, the samples will be considered acceptable if there is evidence that the chilling process has begun, such as arrival on ice. A Quality Assurance notice is completed and clients contacted for samples that exceed temperature requirements.

Samples are checked for breakage and removed from the shipping container. The sample identification information on the sample bottles is compared to the sample information on the traffic report, packing slip, and COC form included in the container. If discrepancies exist, the problem is noted on the COC form; the receiving clerk notifies the Project Manager.

Each 40 mL vial for volatile analysis is checked for air bubbles and headspace. Findings are noted on the Chain-of-Custody. Findings are also noted on the log-in-sheet for EPA samples. **An air** bubble up to the size of a pea is permitted.

Incoming EPA samples are checked against SMO scheduled receipts. Samples are logged in on the log-in-sheet using either an organic or inorganic EPA Receiving Log sheet (Figures 5-2 and 5-3) for EPA samples and the following items are noted:

- Case number/SDG
- CompuChem ID number (CC#)
- Client name or order number
- temperature
- field ID (Sample ID)
- receiving date (RD)
- sampling date (SD)
- test codes
- matrix
- volume received
- pH of inorganic samples
- residual chlorine and sulfide check for cyanides

Preservation checks include a residual chlorine check performed for cyanide and phenol samples **along with a** sulfide check**.** The pH is verified for inorganic samples **by placing** a small **sample** aliquot **into a disposable sample cup and by using** a disposable pipette **to drip a small amount of the sample onto a pH test strip**. If a sample has not been properly preserved, the client is notified and a standard QA notice (Figures 5-4 through 5-12) is completed and placed in the sample file. The results are documented on the log-in sheet and on the COC.

On each complete EPA COC, Traffic Report, and commercial client COC a statement as to the condition of samples upon receipt is documented. "Good Condition" indicates that the sample cooler was received with the custody seal intact and the sample or samples were received intact with all associated documentation. If there are any discrepancies in the documentation or other problems, the exceptions are noted on the appropriate documents, initialed and dated.

The statement 'Received in Good Condition' does not include sample temperature since EPA samples may be received at temperatures above the recommended 4 °C. The temperature is noted on the sample log-in sheet and COC. For EPA samples, each log-in sheet and COC is reviewed by the Receiving department supervisor or designee, who ensures that all information is properly documented. Each is signed as having been reviewed, initialed, and dated.

All COC and log-in sheets are forwarded to the Project Manager for the completion of the LIMS log-in procedures. Samples that must be preserved by refrigeration do not remain un-refrigerated for more than two hours. If the completion of order entry is delayed, the samples are placed in the walk-in cooler until labels are generated and the process can be completed.

5.2.2 Computer Log-in Procedure

For EPA and commercial samples, the Project Manage**ment Staff** enters the account data into the client setup section of the LIMS to generate the client's profile. This profile contains a listing of all requested **sample** analysis codes and project specific information.

The sample information is entered into the sample receipt portion of the LIMS in order to generate a unique laboratory identification code that consists of the work order number and a numerical suffix. EPA case and SDG numbers are associated with a specific work order number. The LIMS generated identification code (sample number) is added to the log-in sheet and the original COC form next to the client ID if possible. QC samples associated with an SDG are also assigned a unique laboratory identifier.

Sample labels print in numerical sequence based on the number of bottles received for each sample ID. The labels contain the LIMS generated identification code (sample number), client ID, receipt date, container ID, container type, and preservation. Samples are labeled by wrapping each sample bottle with its unique computer-generated label (Figure 5-13), leaving the field label exposed if possible.

The labeled samples are transferred to the appropriate **storage area**. Samples to be analyzed for extractable organics and soil inorganics are stored in cold storage units separate from samples to be analyzed for purgeable organics. For ILM05.4, aqueous inorganic samples need to be refrigerated. Standards are always stored in separate refrigerated storage units in the analytical laboratories. Aqueous inorganic samples, except for hexavalent chromium and ILM05.4 aqueous inorganics, are stored separately at room temperature.

File envelopes are used to assemble field and QC sample information for report preparation. EPA envelopes contain all information for the case including: the copy of the Organic Traffic Report (OTR), a copy of the COC, an original air bill, a copy of the log-in sheet, a copy of the EPA scheduling log, sample custody tags (if received), telephone logs, and "pull sheets" (internal chain of custody forms.) The white copy of the OTR is returned with the cover sheet to the EPA SMO. Commercial sample file folders contain the customer sample order information sheet and a copy of the COC record.

CompuChem sometimes receives raw samples from the EPA that should not have been sent to this location. These samples require a transfer. When this occurs, **and after notifying SMO,** a new COC form is filled out using the information on the sample tags. Custody is relinquished to the courier by signing and dating the "Relinquished by" section of the COC form. A copy of the COC is kept and the original COC and paperwork are sent with samples. Notations are made on Traffic Reports that samples are being sent to another laboratory.

A work-order number is assigned to a group of samples according to client and matrix not to exceed 20 samples received together or over a period of 7 days. (A 14 day receipt may be used, per client request.)

In the event that client samples are received by the laboratory unexpectedly, a Project Manager or sales person contacts the client documented on the sample **COC** by phone. During that call, the Project Manager or salesperson verifies the information documented on the COC, such as the project name, parameters to be tested, test methods to be used, client contact person, date the data report is due, and the data reporting requirements. The Project Manager documents the client information and project requirements in the LIMS and proceeds with sample login.

For samples hand-delivered after business hours, the actual date of sample receipt is recorded on the COC. The date and time of sample receipt and sample condition are recorded on the OTR. "Hand-Delivered" is recorded on the COC and OTRs.

5.3 Storage Conditions

The sample custodians and the supervisor of the Receiving department are responsible for the security of the sample storage units. Sample preparation and off-shift personnel also have access to the sample storage units. A roster is posted on each sample cold storage unit in the receiving department identifying personnel authorized to access samples. Samples are requested from the receiving department by lab staff by completing an internal COC form (Figure 5-14).

Under the NELAC standards, samples requiring thermal preservation are stored under refrigeration at ± 2 °C of the specified preservation temperature. For samples with a specified storage temperature of 4 °C, storage at a temperature above the freezing point of water to 6 °C is considered acceptable. Samples are segregated and stored in a manner that prevents cross contamination.

5.4 Chain of Custody

5.4.1 Sample Custody

COC records are used to document the collection of field samples and the transfer of the samples to the laboratory. The COC forms remain with the samples during transport or shipment. If shipping containers and/or individual sample containers are submitted with sample custody seals, and any seals are not intact, it is noted on the original COC. Internal COC records are used to document the storage, possession, transfer and disposal of samples, sub-samples, sample extracts and digestates with**in** the laboratory. The COC documents the identity of all individuals who physically handle samples and the time periods associated with the sample handling. Initials of individuals may be used since a cross-reference is maintained by QA that includes the initials and full names of all individuals signing COCs (except for work performed for the State of Florida, and other work when specified, where full signatures are required.) Any corrections to COC information must be made with indelible ink by using a single horizontal line to strike through the incorrect entry, and dating and initialing the correct entry written adjacent to it. Access to all samples is controlled. The laboratory area is maintained securely and is restricted to

authorized personnel only. The sample custodian relinquishes possession to the lab**oratory** staff.

Depending on client and regulatory requirements, COC**s** may originate at the time pre-cleaned sample containers are sent from **CompuChem** to the field, or when the sample containers are filled in the field and **placed** into the coolers. New Jersey and Florida are two states that require COC initiation in the laboratory with the loading of pre-cleaned empty containers into the cooler and before shipment to the field. A representative of the Receiving department is responsible for initiating a glassware release COC in such cases.

An internal COC form is generated to accompany the physical transfer of the sample (including its extract or digestate) through the lab (Figure 5-15). Internal COCs, sample preparation and analytical worksheets, and instrument run logs are used to document the individuals handling the samples at all times. When the analysis is complete, the sample is returned to the sample custodian for lo**n**g-term storage and disposal.

5.5 Sample Retention and Disposal

Unused raw samples are retained in a controlled temperature environment for 60 days after data submission to the client, or approximately 90 days after sample receipt. Extracts are stored refrigerated for one year after data submission. ILM05.4 requires a one year retention of metals digestates. Sample receipt and report dates are documented in the LIMS.

The sample custodian is responsible for purging raw samples from cold storage at the prescribed time. All samples, digestates, leachates, and extracts and other sample preparation products are disposed of in accordance with Federal and State laws and regulations. Sample identifications are recorded in designated Sample Disposal Logbooks at the time of purging (Figure 5-16.) Once segregated by the custodian, samples are processed for disposal by the hazardous waste technician. Client information is removed from bottles at the time of purging. If a sample is part of litigation, disposal of the physical sample occurs only with the concurrence of the client.

Figure 5-1
Chain of Custody

№ C05880

CompuChem
a division of Liberty Analytical Corp.

CHAIN OF CUSTODY

501 Madison Ave.
Cary, NC 27513
Phone: 919-379-4100 Fax 919-379-4040

Page ____ of ____

Courier
Airbill No.
Sampling Complete? Y or N

Client/Reporting Information	Project Information
Company Name	Project Name
Address	Sampling Location
City State Zip	Turnaround time
Project Contact	Batch QC or Project Specific? If Specific, which Sample ID?
Phone #	Are aqueous samples field filtered for metals? Y or N
Sampler's Name	Are high concentrations expected? Y or N? If yes, which ID(s)?

Requested Analysis (include method and bottle type)

Matrices
GW - Ground water
WW - Waste water
SW - Surface water
SO - Soil/Sediment
TB - Trip Blank
RI - Rinsate
WP - Wipe
O - Other

| Lab Sample ID (Compu Chem use only) | Field ID | Collection Date | Collection Time | Matrix | # of bottles | HCl | NaOH | HNO3 | H2SO4 | MEOH | Other | | |

Figure 5-2
EPA Organic Receiving Log

Page ____of ____

CompuChem, a Division of Liberty Analytical Corp.- EPA ORGANIC RECEIVING LOG

Client / Account EPA	Rec'd Date	Comments:
Case No:	Courier	
Temp Blk in cooler? Yes / No	Airbill No.	
Temperature:		
Tags? Yes / No		
Custody Seals? Yes / No Intact? Yes / No		

COOLER REC'D BY:	REVIEWED BY:
Samples Logged in by:	SDG #:
Number of TR's?	Work Order No.:
Return Airbill in cooler? Yes / No	

No.	Sample No.	Client ID	QC	Matrix	Sample Date	Sample Time	T. VOC	VOC	VOC SIM	SVOC	SIM	PEST	AR	Amount/Containers
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														
11														
12														
13														
14														
15														
16														
17														
18														
19														
20														

OrgRec log.doc-02/24/06

Figure 5-3
EPA Inorganic Receiving Log

Page ____of

CompuChem, a Division of Liberty Analytical Corp.- EPA INORGANIC RECEIVING LOG

Client / Account EPA	Rec'd Date	Comments:
Case No:	Courier	
Temp. Blk in cooler? Yes / No	Airbill No.	
Temperature:		
Tags? Yes / No		
Custody Seals? Yes / No Intact? Yes / No		

COOLER REC'D BY:	REVIEWED BY:
SAMPLE LOGIN:	SDG #:
Number of TR's?	Work Order No:
Return Airbill in Cooler? Yes / No	
Cyanide Samples checked for sulfide & chlorine? YES / NA	

No.	Sample No.	Client ID	QC	Matrix	Sample Date	Sample Time	Total Metals	Cyanide	Dissolved Metals	pH	Amount/Containers
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

InorgRecLog.doc-03/01/05

Figure 5-4
Quality Assurance Notice

CompuChem
a division of Liberty Analytical Corporation

QUALITY ASSURANCE NOTICE

CompuChem ID # _____
Client ID # _____
Case # _____
Type of Analysis _____
Receipt Date _____

A chlorine and sulfide check was performed on the above cyanide sample

The results are checked below.

Chlorine was detected _____
Sulfide was detected _____

A CompuChem customer service representative contacted the client. The client instructed the Receiving department to:

Analyze - qualify with notice _____

Dispose - client will resample _____

Supervisor Signature/ID _____/_____

Date _____

QAN-R-1
971022

Qanr1 – 10/22/97:llc

Figure 5-5
Quality Assurance Notice

CompuChem
a division of Liberty Analytical Corporation

QUALITY ASSURANCE NOTICE

CompuChem ID # _____
Client ID # _____
Case # _____
Type of Analysis _____
Receipt Date _____

The pH reading for the sample above was _____: the required pH level is _____.

A CompuChem Project Manager contacted the client who instructed the laboratory to:

Preserve in-house _____

Note: For samples preserved in house, certain clients require that the maximum amount of preservative added to a sample in an SDG also be added to the associated field or equipment blank. If neither blank is present, the appropriate laboratory must be notified so the proper amount of preservation can be added to the method blank.

Analyze - qualify with notice _____

Dispose - client will resample _____

Subcontract lab to preserve _____

Project Manager_____ Date _____

Preservation Type_____ Preservative Lot Number_____

Preserved By_____ Date_____

QAN-R-2
020529

QAN-R-2:052902:llc

Figure 5-6
Quality Assurance Notice

CompuChem
a division of Liberty Analytical Corporation

QUALITY ASSURANCE NOTICE

Client _____
Case # _____
Type of Analysis _____
Receipt Date

For some organic and/or inorganic determinations temperature preservation at 4 degrees Celsius is required for environmental samples during shipment to the laboratory and prior to analysis. A temperature tolerance range is generally allowed. Temperature of a representative sample from the shipping container is taken and recorded by the receiving clerk at the time of sample receipt. This temperature is representative of all samples contained in the cooler.

The EPA CLP program requires the laboratory make notification when the temperature exceeds 10° C.

The State of North Carolina requires that samples must be iced to above freezing but ≤ 6° C during shipment.

Notification to other clients is either client or project dependent.

Samples that are hand delivered to the laboratory immediately after collection may not meet this criteria. In these cases, the samples shall be considered acceptable if there is evidence that the chilling process has begun, such as arrival on ice.

The temperature of this sample at the time of receipt was determined to be _____.

A CompuChem customer service representative contacted the client. The client instructed the Receiving department to:

Hand Delivery/Received on ice _____

Analyze - qualify with notice _____

Dispose - client will resample _____

Supervisor Signature/ID _____/_____ Date _____

QAN-R-3
060308

Figure 5-7
Quality Assurance Notice

CompuChem
a division of Liberty Analytical Corporation

Quality Assurance Notice

CompuChem ID#_____
Client ID#_____
Case #_____
SDG# _____
Receipt Date_____
Method_____

A chlorine check was performed on the above phenol sample and was determined to be present. A member of CompuChem's Customer Service Department contacted the client. The Receiving Department was instructed as follows:

Analyze – Qualify with notice and address in narrative: _____
Dispose – Client will resample: _____

Supervisor Signature/ID _____/_____

Date _____

QAN-R-4
010702

Qanr4 – 07/2/01:dce

Figure 5-8
Quality Assurance Notice

CompuChem
A Division Of
Liberty Analytical Corp.

Quality Assurance Notice

Case # _____ SDG# _____
Receipt Date _____ Matrix _____

In the USEPA Contract Laboratory Program (CLP) "Statement of Work for Organic Analysis, Multi-Media, Multi-Concentration (Document Number SOM01.2),"directions are provided dealing with a temperature blank, termed the USEPA Cooler Temperature Indicator.

If a cooler temperature indicator bottle is not present in the cooler, the laboratory is required to contact the Sample Management Office (SMO), inform them of that fact and use an alternative means of determining the cooler temperature.

The following is a list of options employed by CompuChem to determine the cooler temperature. For the Case/ SDG presented above, the option(s) used have been indicated by a check mark.

Note: Any of the options performed are done so immediately after the cooler has been opened and the determination made that the cooler temperature indicator bottle is absent.

Water Samples
___An aliquot from a sample bottle designated for extractable organics is poured into a disposable container, a thermometer is inserted into the disposable container, and the temperature is taken and recorded after a 3-minute equilibration period. The contents of the disposable container are then properly discarded.

___A calibrated IR temperature gun is focused onto a sample container, contained in the cooler, and after a minimum of 5 seconds, a temperature reading is taken and recorded.

Soil Samples
___A calibrated IR gun is used, as indicated for water samples.

As required by the organic SOW, the alternative technique used to determine the cooler temperature must be documented in the SDG Narrative.

Signature_____
Date_____

QAN-R-5
011324

Qanr5 – 06/22/10:bm

Figure 5-9
Quality Assurance Notice

CompuChem
A Division of
Liberty Analytical Corp.

Quality Assurance Notice

Case # _____ SDG# _____
Receipt Date _____ Matrix _____

In the USEPA Contract Laboratory Program (CLP) "Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration (Document Number ILM05.4),"directions are provided dealing with a temperature blank, termed the USEPA Cooler Temperature Indicator.

If a cooler temperature indicator bottle is not present in the cooler, the laboratory is required to contact the Sample Management Office (SMO), inform them of that fact and use an alternative means of determining the cooler temperature.

The following is a list of options employed by CompuChem to determine the cooler temperature. For the Case/ SDG presented above, the option(s) used have been indicated by a check mark.

Note: Any of the options performed are done so immediately after the cooler has been opened and the determination made that the cooler temperature indicator bottle is absent.

Water Samples
___ An aliquot from a sample bottle is poured into a disposable container, a thermometer is inserted into the disposable container, and the temperature is taken and recorded after a 3-minute equilibration period. The contents of the disposable container are then properly discarded.

___ A calibrated IR temperature gun is focused onto a sample container, contained in the cooler, and after a minimum of 5 seconds, a temperature reading is taken and recorded.

Soil Samples
___ A calibrated IR gun is used, as indicated for water samples.

As required by the inorganic SOW, the alternative technique used to determine the cooler temperature must be documented in the SDG Narrative.

Signature_____
Date_____

QAN-R-6
0511159

Qan6 – 06/22/10:bm

Figure 5-10
Quality Assurance Notice

CompuChem
A Division Of
Liberty Analytical Corp.

QUALITY ASSURANCE NOTICE
(North Carolina Samples Only)

CompuChem ID # _____
Client ID # _____
Case # _____
Type of Analysis _____
Receipt Date _____

The pH reading for the sample above was _____: the required pH level is _____.

A CompuChem Project Manager contacted the client who instructed the laboratory to:

Preserve in-house _____

Note: For samples preserved in house, certain clients require that the maximum amount of preservative added to a sample in an SDG also be added to the associated field or equipment blank. If neither blank is present, the appropriate laboratory must be notified so the proper amount of preservation can be added to the method blank.

Analyze - qualify with notice _____

1. Client notified laboratory that data **would** be reported to the State of North Carolina. _____
2. Client notified laboratory that data **would not** be reported to the State of North Carolina. _____

Dispose - client will resample _____

Subcontract lab to preserve _____

Project Manager_____ Date _____

Preservation Type_____ Preservative Lot Number_____

Preserved By_____ Date_____

QAN-R-8
060126

QAN-R-8:012606:jad

Figure 5-11
Quality Assurance Notice

CompuChem
A Division Of
Liberty Analytical Corp.

QUALITY ASSURANCE NOTICE
(North Carolina Samples Only)

Client _____
Case # _____
Type of Analysis _____
Receipt Date _____

For some organic and/or inorganic determinations temperature preservation at 4° C is required for environmental samples during shipment to the laboratory and prior to analysis. A temperature tolerance range is generally allowed. Temperature of a representative sample from the shipping container is taken and recorded by the receiving clerk at the time of sample receipt. This temperature is representative of all samples contained in the cooler. The EPA CLP program requires the laboratory make notification when the temperature exceeds 10° C. The State of North Carolina requires that samples must be iced to above freezing but ≤ 6° C during shipment. Notification to other clients is either client or project dependent.

Samples that are hand delivered to the laboratory immediately after collection may not meet this criteria. In these cases, the samples shall be considered acceptable if there is evidence that the chilling process has begun, such as arrival on ice.

The temperature of this sample at the time of receipt was determined to be _____.

A CompuChem customer service representative contacted the client. The client instructed the Receiving department to:

Hand Delivery/Received on ice _____

Analyze - qualify with notice _____

1. Client notified laboratory that data **would** be reported to the State of North Carolina. _____
2. Client notified laboratory that data **would not** be reported to the State of North Carolina. _____

Dispose - client will resample _____

Project Manager/ID _____/_____ Date _____

QAN-R-9
060309

qanr9 – 3/09/06:jad

Figure 5-12
Quality Assurance Notice

CompuChem
A Division Of
Liberty Analytical Corp.

QUALITY ASSURANCE NOTICE
(North Carolina Samples Only)

CompuChem ID # _____
Client ID # _____
Case # _____
Type of Analysis _____
Receipt Date _____

A chlorine and sulfide check was performed on the above cyanide sample

The results are checked below.

Chlorine was detected _____
Sulfide was detected _____

A CompuChem customer service representative contacted the client. The client instructed the Receiving department to:

Analyze - qualify with notice _____

1. Client notified laboratory that data **would** be reported to the State of North Carolina. _____
2. Client notified laboratory that data **would not** be reported to the State of North Carolina. _____

Dispose - client will resample _____

Project Manager/ID _____/_____ Date _____

QAN-R-7
060126

Qanr7 – 1/26/06:jad

Figure 5-13
Example Bottle **Label**

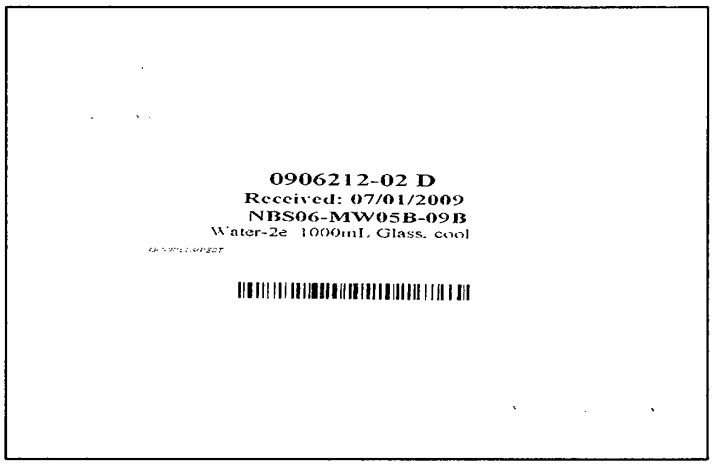


Figure 5-14
Internal Chain of Custody

CompuChem a Division of Liberty Analytical
INTERNAL CHAIN OF CUSTODY

Laboratory: _____ Requested By: _____

Water _____ Soil _____ P.E. _____ Date: _____ Shift: 1 2 Sat
circle one

EPA _____ Commercial _____ Time: _____

	SAMPLE NUMBER	RECEIPT DATE	PRES.	PARAMETER	RECEIVING USE ONLY BOTTLE NUMBER
1					of
2					of
3					of
4					of
5					of
6					of
7					of
8					of
9					of
10					of
11					of
12					of
13					of
14					of
15					of
16					of
17					of
18					of
19					of
20					of

Relinquished By: _____ Date: _____ Received By: _____ Date: _____ Reason: _____

Relinquished By: _____ Date: _____ Received By: _____ Date: _____ Reason: _____

Relinquished By: _____ Date: _____ Received By: _____ Date: _____ Reason: _____

Comments: _____

ic1 - 6/25/01:dce

Figure 5-15
Internal Extraction Chain of Custody

6/11/2009

Extractions Custody Sheet

Batch **Status:** **Analysis**

Lab Id	Client_Id	Received	Container	Extraction	Preservative	Matrix	Due Date	Cust Date

Relinquished By	Date	Received By	Date
Relinquished By	Date	Received By	Date
Relinquished By	Date	Received By	Date
Relinquished By	Date	Received By	Date

1

Figure 5-16
Example of a Sample Disposal Log

06/01/2010 through 06/30/2010 by DOVERC

Samples Ready for disposal; Biota, Oil, Soil, Soil Med, Tissue, Water, Wipe; 01_40mL VOA, cool, 01a_40mL VOA, cool, H2SO4, 01b_40mL VOA, cool, HCl, 01c_40mL VOA, cool, MeOH, 01d_40mL VOA, cool, Sodium Bisulfate, 01e_40mL VOA, cool, Sodium Thiosulfate, 01f_40ml VOA, Frozen, 100 mL Coliform

Disposed	Lab Number	Matrix	Container	Sample Name	Location	Hazard Info
-	1006152-01F	Water	3d_250mL Plastic, cool	PRGS-MH	Sample Receiving	
-	1006152-02E	Water	3h_250mL Plastic, cool, NaOH	TRENCH1	Sample Receiving	
-	1006152-02F	Water	3d_250mL Plastic, cool	TRENCH1	Sample Receiving	
-	1006152-03A	Water	2e_1000mL Glass, cool	TRENCH1-FD	Sample Receiving	
-	1006152-03B	Water	2e_1000mL Glass, cool	TRENCH1-FD	Sample Receiving	
-	1006152-04A	Water	2e_1000mL Glass, cool	TRENCH2	Sample Receiving	
-	1006152-04B	Water	2e_1000mL Glass, cool	TRENCH2	Sample Receiving	
-	1006152-04C	Water	2e_1000mL Glass, cool	TRENCH2	Sample Receiving	
-	1006152-04D	Water	2e_1000mL Glass, cool	TRENCH2	Sample Receiving	
-	1006153-01B	Water	01b_40mL VOA, cool, HCl	PRGS-MH	Sample Receiving	
-	1006153-01C	Water	01b_40mL VOA, cool, HCl	PRGS-MH	Sample Receiving	
-	1006153-02A	Water	01b_40mL VOA, cool, HCl	TRENCH1	Sample Receiving	
-	1006153-02B	Water	01b_40mL VOA, cool, HCl	TRENCH1	Sample Receiving	
-	1006153-04A	Water	01b_40mL VOA, cool, HCl	TRENCH2	Sample Receiving	
-	1006153-04B	Water	01b_40mL VOA, cool, HCl	TRENCH2	Sample Receiving	
-	1006153-04C	Water	01b_40mL VOA, cool, HCl	TRENCH2	Sample Receiving	
-	1006153-05A	Water	01b_40mL VOA, cool, HCl	TRIP BLANK	Sample Receiving	
-	1006154-01AC	Water	3d_250mL Plastic, cool	LS13-MW26S	Sample Receiving	
-	1006154-01AD	Water	3d_250mL Plastic, cool	LS13-MW26S	Sample Receiving	
-	1006154-01AE	Water	01a_40mL VOA, cool, H2SO4	LS13-MW26S	Sample Receiving	
-	1006154-01AF	Water	01a_40mL VOA, cool, H2SO4	LS13-MW26S	Sample Receiving	
-	1006154-01B	Water	01b_40mL VOA, cool, HCl	LS13-MW26S	Sample Receiving	
-	1006154-01C	Water	01b_40mL VOA, cool, HCl	LS13-MW26S	Sample Receiving	

Relinquished by coolers 1, 2A, 3, 5, 6, 8
Freezer 1, 3, 4 and ambient storage
Received by JAD Date 12/13/10 for disposal

6.0 Reference Standard Preparation and Instrument Calibration

6.1 Standard Preparation and Storage

Reference standard solutions including those used for both sample preparation and instrument calibration are prepared by individuals within the various laboratory sections.

Standards are purchased as neat materials and concentrated solutions and are diluted to intermediate and working standards. The frequency of standard preparation varies with method requirements, stability and rate of consumption.

With the exception of organic CLP standards, standard preparations are verified with the analysis of initial calibration verification standards prepared using a different source or standard lot than that used to prepare the initial calibration.

Standard storage conditions vary depending on the method requirements and **vendor** recommendations. All standards used for volatile organic analyses are stored at –10 to –20 °C **in the volatiles storage freezer located in the volatiles laboratory**. Standards used for inorganic analyses are stored at room temperature **in the inorganics laboratory**.

6.2 Analytical Support Equipment

Analytical support equipment includes balances, ovens, refrigerators, freezers, water baths, thermometers, and volumetric dispensing devices (such as Eppendorf®, or dilutor/dispensing devices, if quantitative results are dependent on their accuracy). All support equipment is maintained in proper working order. The records of all activities, including service calls, are retained.

Oven temperatures are checked daily and balances are checked prior to use on each working day with NIST traceable references in the expected range of use and documented. Acceptance criteria are documented in the applicable logbook.

The temperatures of cold storage units containing samples (including sample extracts and digestates) are monitored daily. Cold storage units containing reference standards are monitored on the lab's normal days of operation. Monitoring is documented in the applicable logbook. **Minimum/Maximum thermometers are used to monitor each cold storage unit over weekends.**

Balances are calibrated semiannually by a qualified outside service organization over the entire range of use. Balance calibrations are verified each day of use with certified Class-S (NBS circular 547 or ASTM E617 Class 1 and 2) weights. **The weights are calibrated annually at the North Carolina Department of Agriculture and Consumer Affairs, Standards Division.**

All thermometers are calibrated annually against a NIST-certified thermometer. An infrared (IR) gun is used to measure sample temperatures upon receipt and is calibrated quarterly. **The NIST thermometer is calibrated annually at the North Carolina Department of Agriculture and Consumer Affairs, Standards Division.**

Automatic pipettes are calibrated by weighing three aliquots of water dispensed into a container and calculating the accuracy of the pipettes. **Verification of automatic pipettes used in the inorganics laboratory occurs monthly, while those in the organics laboratories occurs quarterly.**

If calibration criteria are not met, the equipment is removed from service until repaired or replaced.

6.3 Instrument Calibration

Instruments used in the analysis of samples must be calibrated at regular intervals as specified by the analytical test method and manufacturer's recommendations. The calibration procedures, frequency, acceptance criteria, corrective actions and reference standards are specified in the applicable analytical SOPs.

For mass spectral analysis, tuning is required prior to calibration. Instrument calibration procedures for organic analysis consist of an initial calibration, initial calibration verification, and continuing calibration verification.

Instrument calibration procedures for inorganic analysis consist of (a minimum of) an initial calibration, initial calibration verification, initial calibration verification blank, continuing calibration verification, and continuing calibration verification blank. Continuing calibration verification is performed at a minimum of every ten sample analyses.

Initial calibration verification standard solutions are prepared using reference materials from a source other than that used to prepare the initial calibration.

Information relative to instrument calibration is documented in instrument run logs. This information includes instrument identification, data file names, standard lot numbers, analysis dates, analysis times, analyst identification, and calibration status.

7.0 Test Methods and Standard Operating Procedures

CompuChem maintains Standard Operating Procedures (SOPs) that accurately reflect laboratory activities such as assessing data integrity, corrective actions, handling customer complaints, and all test methods. Procedures for test methods describing how the analyses are performed are specified in analytical SOPs and include sample preparation, cleanup and analysis. These are based on referenced methods published primarily by the EPA. Internally developed methods will be validated according to the EPA Performance-Based Measurement System, although none have been developed at this time. Method validation is discussed in Section 3.0. Controlled **hard** copies of SOPs are accessible to all personnel in each laboratory area, as well as electronically on the company's intranet site. Each SOP indicates the effective date, revision number, and signatures of the person who initiates the revision and those who approve the revision. **All personnel involved in fulfilling the requirements of a specific SOP are required to read and sign a confirmation form attesting to their understanding of the latest revision.**

SOPs are useful in training staff, in ensuring consistency among staff in performing procedures, and in saving time and effort. Any deviation from an established procedure is documented. The SOP collection is outlined in Table 7.1. A listing of methods performed at CompuChem and the corresponding SOPs is located in Section 2.0 of this manual.

7.1 SOPs for Test Methods

CompuChem's analytical procedures are divided into two categories, sample preparation procedures (SPPs) and instrument procedures (IPs). The Quality Assurance department controls SOP revision and distribution ensuring that only the most current approved procedures are documented and distributed for laboratory use. Documentation of procedures is critical to the assurance of data quality. These SOPs contain or reference to the following information:

- identification of the test method
- applicable matrix or matrices
- detection limit
- scope and application, including components to be analyzed
- summary of the method
- definitions
- interferences
- safety
- equipment and supplies
- reagents and standards
- sample preservation and storage
- quality control
- calibration and standardization
- procedure
- calculations
- method performance
- pollution prevention
- data assessment and acceptance criteria for quality control measures
- corrective actions for out-of-control data
- contingencies for handling out-of-control or unacceptable data
- waste management
- **additional** references
- tables, diagrams, and flowcharts,

7.2 Distribution Control of Standard Operating Procedures

SOPs are distributed by location and each lab area receives its own set of **applicable** SOPs. **A** complete set of original SOPs **and Table of Contents** is maintained in the Quality Assurance department. A master copy of the complete set resides on the intranet and is available to all personnel in a read-only electronic format.

7.3 Document Control of Standard Operating Procedures

The Quality Assurance department is responsible for formalizing (editing, assigning document control information), distributing, and tracking all SOPs. **Additionally, the QA Department ensures the SOPs are read by all appropriate staff members.**

7.3.1 Creating and Revising SOPs

When laboratory staff **or the QA Department** drafts a new SOP**,** or a revision to an existing SOP, the individual must sign a SOP Documentation Form (Figure 7-1) and obtain approval and the signature of the supervisor or a qualified second party. This form, along with a copy of the SOP, is submitted to the QA department. After the SOP has been word processed by QA and has had document control information added, it is then distributed to the area in which it is used. All appropriate lab personnel read the SOP and sign the SOP Confirmation Form (Figure 7-2). The date that the SOP is distributed for use becomes the effective date of the SOP. The original, master, and controlled copies are generated and distributed to the appropriate locations **including electronically on-line**. The SOP Confirmation Form is **scanned and** archived by QA.

7.3.2 Archiving SOPs

When a procedure becomes obsolete, the request is made to remove it from the SOP collection. The SOP is removed from the active SOP table of contents to the Archival SOP table. The SOP is then removed from each collection. Archived SOPs are maintained indefinitely electronically.

7.3.3 SOPs as Training Tools

All new employees are required to read SOPs pertinent to their job functions as part of their training. A SOP Signature Form is completed and signed by the employee and his/her immediate supervisor/manager to document that the employee has read the SOPs pertinent to his/her job function. Supervisors document various training aspects using checklists and most include a list of the required SOPs. **A copy of the signature form(s) are maintained in an individual's training file.**

7.4 Document Control of the Quality Manual

The Quality Manual is revised and edited solely by the QA department. Revision numbers are provided with each update, and each section may be updated independently of others. There are controlled copies of the Quality Manual available to all laboratory

staff. Quality Manuals that are sent off-site are for informational purposes only and are not controlled documents unless requested by the client. In that event, the issue is assigned a tracking number and a copy of the Quality Manual is sent to the recipient with each revision. On an annual basis, the Quality Manual is distributed laboratory-wide for all staff to read. Signature sheets are maintained to document this review. **In general, the QA manual is updated yearly.**

7.5 Document Control of Laboratory Logbooks and Sample Preparation Worksheets

The QA department has primary responsibility for document and distribution control of over **200** logbooks used in the laboratory. To ensure document uniformity and compliance with NELAC standards, the U.S. EPA, good laboratory practices, and other certifying agency protocol, specific document control procedures are used for all laboratory logbooks and run logs.

Document control header information appears along the top of each logbook page and identifies the laboratory or administrative area, the logbook, and the issue number. Each logbook issue is consecutively paginated and permanently bound.

A logbook is developed cooperatively by the area manager and the QA department. The requestor submits a completed Logbook Request Form to the QA department. They confer to design a prototype logbook page that meets the needs of the laboratory and contains the key elements required by the QA department. These elements are:

- **Unique logbook identifier**
- The identity of the task
- The name CompuChem, a Division of Liberty Analytical Corporation
- A "Reviewed by" signature field
- A date of review field
- Any applicable measurement acceptance ranges with instructions for reporting out-of-range readings
- A corrective action statement
- Model specifications for equipment
- Standard lot number fields

An alphanumeric identifier is assigned to each logbook. The laboratory notifies QA when the logbook is ready for archival. Before turning over the logbook issue to QA, the manager of the area in which the logbook is used or a designee must review the contents of the logbook and sign the Logbook Authorization form, which is the last bound page.

The laboratory staff must complete the logbooks with the proper quality details. Any changes made must not obliterate or overwrite the original entry. Personnel make a single strike through the entry and initial and date the correct entry that is made adjacent to the original. Correction tapes and fluids are not allowed when completing laboratory logbooks or other records.

When completed, the laboratory returns the logbook to QA for archival. The issue is then logged into the Logbook Archival **Excel spreadsheet** and assigned to a unique **storage** box number. The logbook is then **maintained in a waterproof, ziplock bag, and placed** into the appropriate box for archival.

The QA department also **oversees** laboratory sample preparation worksheets, which include the same elements as logbooks. Logbook pages are included as attachments in SOPs. These are not bound nor paginated for ease in photocopying for data reports. When completed the sample preparation staff return the worksheets to QA for archival. The worksheets are then paginated and logged into the Worksheet Archival Log. The worksheets are assigned to a unique box number. The worksheets are then placed into the appropriate box for archival.

7.6 Records Retention and Purging

Archived laboratory records are stored on site **in a secured location** for a period of five years, or longer per client request. (Data retention is 10 years for the Ohio Voluntary Action Program.) **Purged data are processed by a shredding company specializing in destroying confidential material.**

7.7 Method Modifications

7.7.1 Total Organic Carbon in Soil -- Method 9060

The water method is adapted for soil matrices. Soil samples are analyzed using a boat sampler attachment in which the samples are introduced into a 900°C combustion zone, where all carbonaceous matter is oxidized to carbon dioxide. The carbon dioxide level is then determined using the non-dispersive infrared analyzer.

7.7.2 Aqueous Metals Digestion – Method 3010A

The block digestion technique utilizing an aqueous 50 ml sample aliquot, adjusted to a final volume of 50 ml, is used in the preparation procedure.

7.7.3 pH – Method 4500 H+ B

Samples should be analyzed immediately. Since the sample pH is measured in the laboratory and not in the field, the method holding time cannot be met.

Figure 7-1

501 Madison Avenue
Cary, NC 27513

NELAP accredited

SOP DOCUMENTATION FORM

This form must accompany all new and revised Standard Operating Procedures (SOPs) when you turn them in to Quality Assurance for review. Please fill out the entire block below (except effective date).

This is a new procedure _____ revised procedure _____ outdated procedure (archive) _____

- Procedure Code:_____ SOP Section #: _____ Revision #:_____

SOP Title: Effective date: (QA fills in)

_____ _____

_____

_____

- Procedure prepared by: Date:

_____ _____

- Procedure approved by: (If the manager prepared the SOP, a qualified second party should sign) Date:

_____ _____

- Reason for change:_____

_____

- This procedure meets the requirements of the following approved method references:

_____

_____

_____

Procedure approved by a QA Representative (unless QA Representative signed above):

_____ Date:_____

On an annual basis: Lab managers are required to review lab practices and revise the SOP if necessary. If no revision is necessary, indicate by your signature that the SOP has been reviewed.

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Sopdocform2-1/19/07: tr

Figure 7-2

CompuChem
A Division Of
Liberty Analytical Corp.

SOP Confirmation Form

A new or revised version of the SOP documented below has been placed in your SOP collection. Take the time to read the procedure. For revised SOPs, new text is in **bold** print. After reading the new or revised procedure, sign and date this form in the spaces provided below. After all personnel that perform the procedure have signed this form, please return it to the Quality Assurance Department.

_____ _____
Manager/Supervisor Signature Date

SOP Title: _____

_____

Section # _____

Rev. # _____ Area/Lab_____

Effective Date_____
(QA fills in)

Department Signatures

I acknowledge review of the SOP documented above and agree to adhere to the procedures outlined in that document.

Printed Name	Signature	Date

sopcf1 r4.doc.doc
3/19/10:jad

Table 7.1

SOP OUTLINE

ANALYTICAL STANDARD OPERATING PROCEDURES

1.0 Purgeable Organics
- 1.1 VOA GC
- 1.2 VOA GC/MS CLP
- 1.3 VOA GC/MS Non-CLP
- 1.4 VOA GC/MS Miscellaneous

2.0 Extractable Organics
- 2.1 GC CLP
- 2.2 GC Non-CLP
- 2.3 HPLC
- 2.4 SV GC/MS CLP
- 2.5 SV GC/MS Non-CLP
- 2.6 Clean-up Procedures
- 2.7 Leachate Generation Procedures
- 2.8 Miscellaneous Preparation Procedures

3.0 Inorganics
- 3.1 Metals CLP
- 3.2 Metals Non-CLP
- 3.3 Mercury
- 3.4 Cyanide
- 3.5 Wet Chemistry
- 3.6 Organic Characterization

NON-ANALYTICAL STANDARD OPERATING PROCEDURES

4.0 Sample Control
5.0 Customer Services
6.0 Sample Scheduling
8.0 Organic Sample Preparation Laboratory
9.0 Inorganic Sample Preparation Laboratory
10.0 Glassware Preparation Room

Table 7.1 (continued)

OUTLINE OF NON-ANALYTICAL STANDARD OPERATING PROCEDURES

- 11.0 Instrument Laboratories
  - 11.1 Purgeable Organics
  - 11.2 Extractable Organics
    - 11.2.1 GC
    - 11.2.2 SV GC/MS
  - 11.3 Inorganics
    - 11.3.1 Metals
    - 11.3.2 Wet Chemistry & Organic Characterization
- 12.0 Hazardous Waste Management & Safety
- 13.0 Quality Control
- 14.0 Data Review
  - 14.1 Purgeables
    - 14.1.1 VOA GC and GC/MS
  - 14.2 Extractable Organics
    - 14.2.1 GC
    - 14.2.2 SV GCMS
  - 14.3 Inorganics
    - 14.3.1 Metals
    - 14.3.2 Wet Chemistry & Organic Characterization
  - 14.4 Data Release, Storage &Archival
- 15.0 Computer Operations
- 16.0 Human Resources
- 17.0 Quality Assurance

8.0 Data Quality Indicators

The data acquired from quality control (QC) procedures are used to estimate the quality of the analytical data, determine the need for corrective action in response to identified deficiencies, and to assess the effectiveness of the corrective actions implemented. Each analytical SOP includes a QC section that documents the specific QC requirements for that procedure.

8.1 Quality Control Samples

8.1.1 Blanks

8.1.1.1 Method Blanks

Method blanks are prepared and analyzed at a rate of one per **client** sample batch not to exceed 20 field samples, of the same matrix and test method. Method blanks are used to **assess** the batch for possible contamination during sample processing. Samples associated with a blank that does not meet quality control acceptance criteria are re-prepared and analyzed.

8.1.1.2 Storage Blanks

Storage blanks are generated each day CLP SDGs are received for volatile analysis. These blanks are stored with each SDG and are analyzed after all samples in the SDG have been analyzed. The results of the storage blank indicate whether contamination occurred during sample storage. While storage blanks are required for CLP SDGs, they may also be associated with non-EPA client samples stored in the sample cold storage unit.

8.1.1.3 Trip Blanks

For volatile analyses, a blank is placed in each cooler that is delivered to the client for sample collection. The blank remains with the samples during transport to the lab for analysis. The results of the trip blank indicate whether contamination occurred during sample transport.

8.1.2 Laboratory Control Samples

A Laboratory Control Sample (LCS) is prepared and analyzed with each sample batch not to exceed 20 field samples. An LCS is not required for those analytes **when** spiking solutions are not available such as pH. The LCS is used to assess whether the total analytical system is in control. The results of the LCS determine batch acceptance. Samples associated with an out of control LCS are re-prepared and analyzed.

8.1.3 Matrix Spikes

Matrix spikes are prepared and analyzed at the frequency required by the client, **Quality Assurance Project Plan** (QAPP), or EPA region. The compounds

spiked should be specified in the client QAPP or EPA CLP SOW. Matrix spikes are used to assess the effect the sample matrix has on the precision and accuracy of the test method. The results of the matrix spikes are expressed in percent recovery and relative percent difference between duplicate matrix spikes. The results of the matrix spikes do not determine the acceptance of the sample batch.

8.1.4 Sample Duplicates

Sample duplicates are prepared and analyzed at the frequency required by the client, QAPP, or EPA region. The sample duplicate is used to assess the precision of the test method. The results of the sample duplicate do not determine acceptance of the batch. Matrix spike duplicates may be used as sample duplicates.

8.2 Surrogates and DMCs

Surrogates and DMCs are added to all samples, standards, and blanks for all organic analyses. The surrogate recoveries are used to assess preparation/extraction efficiency. Surrogate percent recovery acceptance criteria used by the laboratory are presented in the test method or are derived statistically by the laboratory. Surrogate failures may indicate poor extraction efficiency or matrix interferences. Field and QC samples that do not meet surrogate acceptance criteria are reanalyzed or re-prepared and analyzed.

8.3 Internal Standards

Internal standard solutions are added to all calibration standards and field and QC samples for mass spectral analyses. Internal standards are used to quantitate results. The laboratory's acceptance criteria for internal standard responses are those specified in the applicable analytical method.

8.4 Spiking Solutions

The compositions of spiking solutions used vary according to method and client requirements. Typically the solutions will contain all compounds of interest in a project and that are commercially available. For some clients (EPA Region), a representative subset of compounds may be used. Spike percent recovery criteria are presented in the test method or are derived statistically by the laboratory.

8.5 Calibration Verification

Initial instrument calibration verification is performed using a reference standard solution acquired from a second manufacturer or lot **other** than the solution used for the initial calibration. Initial calibration verification is required for inorganic methods and organic non-CLP methods. The initial calibration verification (ICV) standard is analyzed after the initial calibration and generally before any samples are analyzed.

When an initial calibration is not performed on the day of sample analysis, the initial calibration is verified by the analysis of the continuing calibration verification (CCV)

standard. If the solution used for the CCV standard is from a second manufacturer or lot, analysis of an ICV is not required.

8.6 Selectivity

Selectivity is evaluated by using the checks established within the analytical methods.

GC/MS and ICP-MS instrumentation is tuned to meet method requirements and these acceptance criteria are documented in SOPs.

Retention time window are established for GC and HPLC analyses and second column confirmation is performed. Acceptance criteria for retention time windows are documented in **the method specific** SOPs.

Inter-element interference checks are analyzed for ICP and ICP-MS methods. Acceptance criteria are documented in **the method specific** SOP.

8.7 Quality Control Sample Management

The analytical and quality control requirements for each sample are documented in the LIMS. The LIMS uses a **structured** system of test codes to schedule the appropriate analytical procedures and the QC samples required for each **unique** work-order or sample delivery group (SDG). The test codes have the analytical methods associated with them and are assigned to each sample upon receipt. Product codes may be defined to allow for specific requirements of a client or Quality Assurance Project Plan (QAPP).

8.7.1 Batching

8.7.1.1 Preparation Batch

A preparation batch is a group of no more than 20 field samples prepared (extracted or digested) together with a method blank. A Laboratory Control Sample (LCS) is required for **all** non-CLP samples.

8.7.1.2 Analytical Batch

An analytical batch is a group of no more to 20 samples, sample extracts, or sample digestates (including QC samples) that are analyzed together on the same instrument. For analyses that have no preparation step (volatiles), the method blank, LCS, matrix spike and matrix spike duplicate are included in the 20 samples.

9.0 Data Reduction, Review and Reporting

Computer software used for data reduction is validated before use. A test set of data, with manually calculated or previously validated results, is used to validate the new or revised software routine. Procedures for software validation are documented in SOPs. All data used in producing the final report are retained either as a hard copy or electronic file to insure that all results can be reproduced. These data include all instrument tune files, calibration files, sample files, QC sample files, standard preparation records, and sample preparation records. The following is a summary of the data review process. The analyst review responsibilities may vary slightly between the individual laboratory groups.

9.1 Data Review for Organic Analyses

Data collected by GC, GC/MS, and HPLC instrumentation software are transferred to Hewlett Packard UNIX servers for processing and review. The data **are** accessed by analysts and data reviewers through their personal intranet log-on **and through state-of-the-art data processing software**.

All data are subjected to a three-tier review before being reported to the client.

The analyst documents all analyses on the instrument run log. The analyst insures that all tune, calibration, method blank, QC sample and field sample data meet acceptance criteria. The analyst prints hard copies of the tune and calibration data generated by the instrument. The analyst signs (initials) and dates any manual integration he, or she, performed.

The data reviewer insures that all weights, volumes, and percent moistures are transcribed accurately into the raw data for calculation purposes. The data reviewer insures that the proper preparation and analysis methods have been used and that all the compounds of interest have been included in the analysis. The data reviewer insures that all tune, calibration, method blank, QC sample and field sample data meet acceptance criteria. The data reviewer assesses the spectra of target and tentatively identified compounds. The data reviewer prints hard copies for all method blanks, QC samples and field samples included in the work-order/SDG. The data reviewer signs (initials) and dates the hard copy reports as well as any manual integration he or she performed.

Manual integrations are performed according to the procedures outlined in SOP 13.18 "Manual Chromatographic Peak Integration Procedures".

A senior level staff member or a supervisor performs the final review. The final reviewer insures that all weights, volumes, and percent moistures are transcribed accurately into the raw data for calculation purposes. The final reviewer prints hard copies of all report forms and generates any electronic data deliverable (EDD). The final reviewer summarizes the data in the work-order/SDG narrative documenting any anomalies in sample collection, receipt and analysis. **The finalized hard copy is then ready for scanning, paginating, and delivery to the client as specified by their SOW requirements.**

9.2 Data Review for Inorganic Analyses

Metals data collected on the ICP and ICP-MS instrumentation software are transferred to **the** LIMS for review and reporting. Wet Chemistry data collected on the Lachat instruments are transferred to the LIMS for review and reporting. Wet Chemistry data not collected on the Lachat are manually entered into Excel spreadsheets by the analyst. The information entered into these spreadsheets is transferred to the LIMS for reporting.

Data for inorganic parameters **are** subjected to a two-tier review before being reported to the client.

The analyst documents all analyses on the instrument run log. The analyst insures that all weights, volumes, and percent solids are transcribed accurately into the raw data for calculation purposes. The analyst insures that all calibration, method blank, QC sample and field sample acceptance criteria are met. The analyst insures that all raw data transcribed into spreadsheet **are** accurate.

A senior level staff member or a supervisor performs the final review. The final reviewer insures that all weights, volumes, and percent solids are transcribed accurately into the raw data for calculation purposes. The final reviewer insures that all calibration, method blank, QC sample and field sample acceptance criteria are met. The final reviewer summarizes the data in the work-order/SDG narrative, documenting any anomalies in sample collection, receipt and analysis. **The final reviewer prints all reporting forms and generates the EDD, and prepares the hard copy for scanning, paginating, and delivery to the client as specified by their SOW requirements.**

9.3 Data Reporting

It is CompuChem's policy to report data that meet all quality control criteria, to the extent possible. If deficiencies are identified at any point in the review process, corrective action is taken. Documentation of any corrective action or data qualification is done by the final reviewer in the narrative.

Each fraction is reviewed separately and the individual reports that make up the final report are produced. The final report is scanned, paginated, saved in a portable document format (pdf), printed and the pdf archived. The printed final report **and/or CD** is sent to the client.

The final report format and detail are tailored to the specific client needs.

Figure 9-1 shows how data flow through the laboratory, from sample receipt to final report.

9.4 Confidentiality

Results of sample analyses and associated raw data are reported to the customer request**ing** the analyses. Confidentiality is preserved to the extent possible when clients

require transmission of test results via telephone, fax, e-mail, **or data upload through an internet portal**.

A version of the following statement accompanies out-going fax and electronic mail correspondence:

> "This e-mail and any information contained or attached to this e-mail are privileged, confidential and proprietary information intended only/solely for the individual or entity to which it is addressed. It is a PRIVATE e-mail message and the sender does not waive any related rights and obligations. Kindly notify the sender immediately by e-mail if you have received this e-mail in error. You are notified that disclosing, copying, distributing or taking any action in reliance on contents of the information is strictly prohibited."

Access to data reports and other laboratory records is available to external auditors (representatives of accrediting bodies and agencies) during on-site assessment. Data reports and other laboratory records are provided **confidentially and anonymously** upon request to auditors off-site to support the laboratory's certifications.

9.5 Data Security

The Information Technology department assures the security of the computer systems by assigning log-on accounts and individual passwords for individuals to access data. The user is restricted to certain menu options through the log-on account, and only authorized staff has access to editing capabilities. A software product controls menus and uses local attributes consisting of specific options available to authorized users. These attributes are created and maintained by the Information Technology staff. Access levels vary and depend on the user job functions. **Individual** log-on passwords are required to be changed every six months **and** workstations are set up to lock after 10 minutes of inactivity.

The data servers located in the Information Technology department are linked to an Uninterruptible Power Supply (UPS). All data saved on the data servers and personal computers are backed up at varying frequencies. The HP UNIX servers are backed up incrementally on a nightly basis and fully once each week. Selected directories on personal computers are backed up monthly. Archiving procedures are performed in compliance with Information Technology SOPs. The archive storage media are stored in a restricted area within the facility, secured by locked doors, with limited access. Access is allowed only by means of an electronic security access key. The storage area is air-conditioned and kept free of debris. An additional copy of the archive storage media is maintained off-site.

9.6 Hard Copy Data Retention

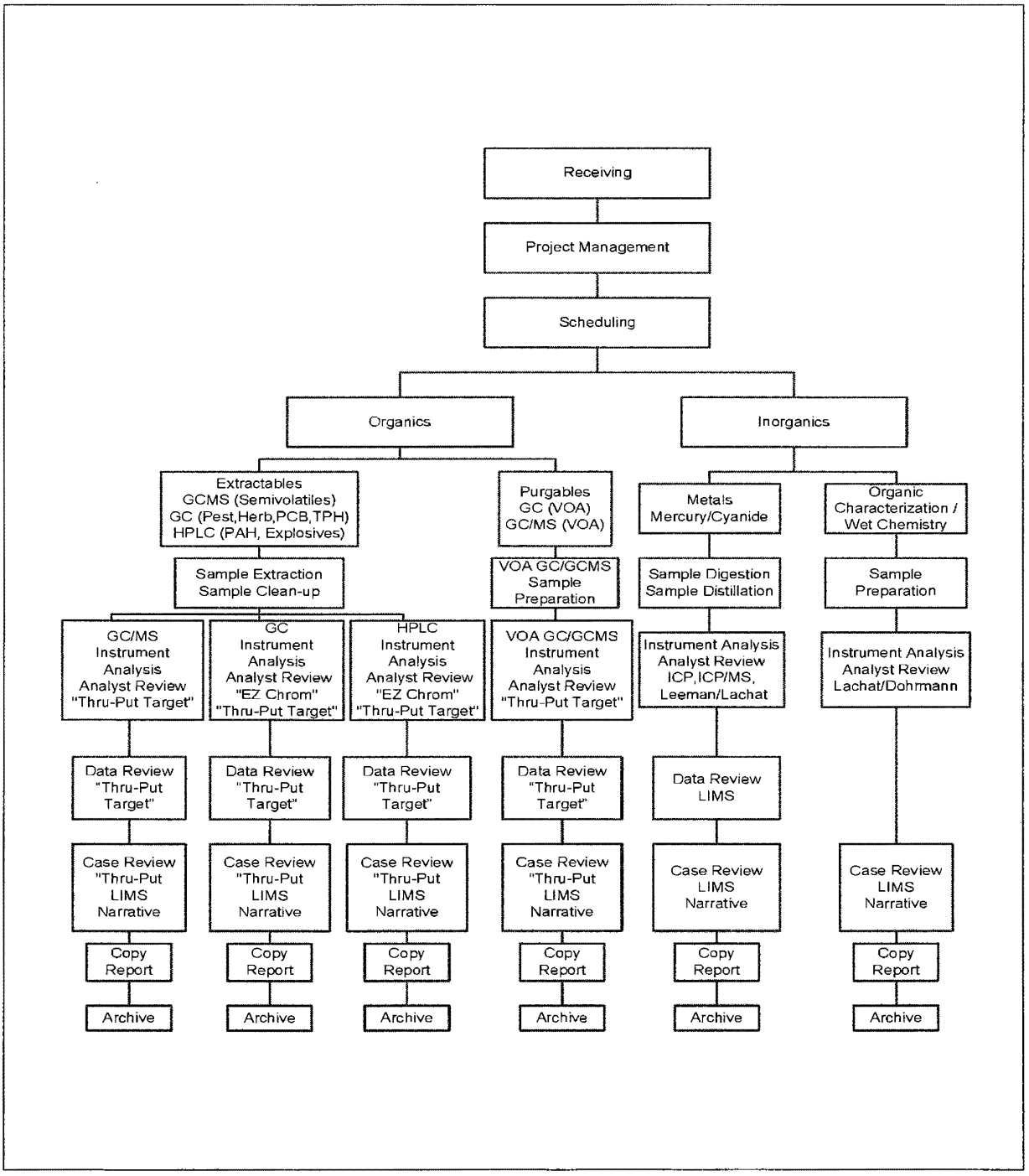
The laboratory scans the hard copy data, paginates it, and sends it to the client. Only the scanned copy is retained on **a** database at the laboratory, unless the client requires otherwise. If the client requires that a hard copy of the final report and associated data

be retained by the laboratory, the data are boxed and placed in a secure room within the facility. The laboratory retains the data for 5 years, or as specified by the client.

9.7 Electronic Data Retention

Archived data are stored for a minimum of five years, except for EPA who requires one year **retention**. Additional storage time may also be requested by the client for certain projects or required under certain programs such as the Ohio Voluntary Action Program (VAP) **or certain commercial clients who** require a data retention time of at least 10 years. It is the responsibility of the laboratory project manager to oversee the extended retention of project files. **An** auxiliary data field in the LIMS is able to record data retention time requirements for each client and to assist in tracking extended retention times. For the Ohio VAP, the laboratory must notify the agency by certified mail when the 10-year retention period has expired and retain the data until directed in writing by the agency whether they will or will not retain the data.

Figure 9-1
Sample Data Flow Chart



10.0 Performance and System Audits and Frequency

10.1 Quality Assurance Audit Unit

The QA department staff consists of senior scientists with Bachelor of Science or Bachelor of Arts degrees **with an emphasis on chemistry and a combination of other biological or environmental academic disciplines**, ten or more years of environmental analytical laboratory experience, and at least five years of experience using laboratory QA/QC techniques.

The QA **staff** conduct internal system audits. The auditor applies specific audit methods, evaluates audit findings, and reports these findings to laboratory management.

10.2 Systems Audits

A systems audit is an on-site inspection or self-assessment of the laboratory's control systems. System audits are performed both by internal and external auditors. Clients and federal and state certifying agencies perform external system audits. A system audit is performed to qualitatively assess the laboratory's control systems and is intended to provide evidence of the laboratory's competence.

The objectives of a systems audit include ensuring that:

- management is committed to creating a work environment dedicated to quality and that a structured management system is in place to support an effective QA program,
- the QA program is documented and implemented to assess work to ensure **ethical,** technical, administrative, and quality objectives are met,
- personnel are adequately trained and qualified to do their jobs,
- procured items and services meet established requirements and perform adequately,
- procedures are established and maintained for the preparation, review, revision, and issuance of laboratory documents, including SOPs, logbooks, and data reports
- records are retained for evidentiary purposes,
- computer hardware is maintained to support data processing and reporting software
- computer software is developed, documented, validated and any changes are controlled and documented
- **equipment and instrumentation is maintained and serviced at appropriate intervals**
- work performed complies with established documented procedures, as well as safety policies, and
- procedures are established for detecting and preventing quality problems and for ensuring quality improvement.

10.2.1 Internal Systems Audits

Internal systems audits are used to verify that laboratory operations continue to comply with the requirements of the quality system. Systems audits include a review of laboratory documentation on sample receiving, sample log-in, sample storage, chain-of-custody procedures, sample preparation, sample analysis, instrument operating records, etc. While performance audits are a quantitative appraisal, system audits are more qualitative in nature, intended to provide evidence of the laboratory's competence.

Upon completion of an internal system audit, the auditor discusses **their** findings with the responsible manager or supervisor. The auditor summarizes **their** findings in an audit report that is distributed to laboratory management. A Corrective Action Report (CAR) is issued for each finding**, if warranted**. The responsible manager corrects the deficiency, documents the correction in the CAR, and returns the completed CAR to the auditor. Completed CARs are retained in the QA department. Implementation of the documented corrective actions is verified by subsequent follow-up audits. If an audit finding were to cast doubt on the correctness or validity of the laboratory's results, an immediate corrective action would be initiated and any client whose work may have been affected would be notified.

Preventative Action Reports (PARs) can be initiated by any individual and submitted to their supervisor or QA. PARs are similar to CARs, but function to address potential non-conformances.

A full internal systems audit is performed semi-annually. The following components comprise a complete system audit. Below is a summary of the audit activities performed by QA staff. Figures 10-1 through 10-5 are example checklists used to document these activities.

10.2.1.1 **Documentation and Record Keeping** – Review logbooks that document refrigerator temperature, instrument analysis, balance calibration, and standard preparation. Verify that records are complete, that documented observations are current, that any errors are corrected properly, and that completed pages and logbooks were peer reviewed as evidenced by a review signature. **For organics, supervisor review and signature is required for every twenty pages of a run log.**

10.2.1.2 **Sample storage/Chain of Custody** – Review temperature logs for refrigerators that store samples and sample extracts. Verify that samples are stored and controlled properly and that COC procedures are followed through documented transfers.

10.2.1.3 **SOP compliance** – Observe a procedure being performed by an analyst to verify that the procedure being performed follows the written SOP. Also verify that the written SOP is compliant with the referenced methods.

10.2.1.4 **Reagent (solvent and chemical) storage and control** – Observe and verify the proper storage conditions of reagents and solvents. Verify that proper control documentation is written on

the container label such as the receipt date, expiration date, **and standard lot identifier**.

10 2.1.5 **Standard storage and control** – Observe and verify the proper storage conditions of reference standards. Verify that proper control documentation is written on the container label such as the standard lot number and expiration date. Review standard logbooks to verify that standard preparations are properly documented and traceable to primary standards. Also verifies that standards are traceable to NIST sources.

10.2.2 **QC test sample analyses** – Review of data associated with the analysis of new solvent lots.

10.2.3 **Data audits** – QA staff routinely audit all data associated with the analyses of proficiency test samples. EPA CLP data are reviewed routinely by the Vice President and General Manager as a result of EPA CCS reports. During these audits, QA staff verify the data for accuracy, completeness, and test method and program compliance. Software data reduction routines are verified during data audits by performing manual calculations or by reviewing the calculation verification provided with the data report. Hard copy to diskette results may be compared in the course of a data audit, but are typically verified by automated software routines.

10.2.4 **ThruPut systems Audit Trail** – The audit trail in ThruPut systems is checked semi-annually to verify changes to the processed files are correct, documented, allowed and performed by authorized individuals, **and that manual integrations are initialed and dated by the data reviewer**.

10.2.5 **Corrective Action Report (CAR) follow-up** – Verifies that corrective actions have taken place, are still in effect, and that recurrence is controlled.

10.2.6 **Facilities maintenance** – Verifies that facilities and equipment are adequate and properly maintained and that laboratory areas are free from interference or contaminants **and that safety measures are being observed and compliant**.

10.2.7 **Subcontract laboratory audits** – In lieu of on-site audits, a paper audit may be performed involving a review of the quality assurance plan, SOPs, data reports, and PE study results. On-site audits can be performed upon client request, but no routine audit is performed by our lab.

10.2.8 **Employee training file audit** – Verifies that training records are current and that personnel meet the **educational and experience** requirements stated in the current USEPA CLP SOW, as well as those specified by individual states.

10.2.9 **External Systems Audits**

CompuChem's systems are also inspected extensively by external agencies, contractors, and third parties. The laboratory's primary NELAC accrediting authority conducts an assessment of the laboratory every two years. As a laboratory in the USEPA CLP, CompuChem is audited annually by representatives of the EPA. Many clients conduct inspections or **use** third party

QA auditors to inspect the laboratory before start-up and during the course of larger, more critical, or sensitive projects.

CompuChem prefers a two-week notification before a scheduled audit to ensure that management and QA staff are available. However, an external audit may be conducted (announced or unannounced) at any time during normal business hours. To protect client confidentiality, some documents (particularly those identifying clients, sites, or projects) will not be made available for inspection except to those directly involved in such projects or authorized state or federal officials or authorized third parties.

Any deficiencies or non-conformances observed by the auditors are included in an audit report. Corrective action reports are initiated as needed in response to the audit findings. Once the corrective action responses are completed, a formal response is compiled by a QA staff member and submitted to the external agency by the required due date. Copies of the response are circulated to laboratory management. Follow-ups are performed to ensure implementation of stated corrective actions.

10.3 Proficiency Test(PT) and Performance Evaluation (PE) Samples

Laboratory performance is evaluated using proficiency test and performance evaluation samples.

CompuChem analyzes water pollution (WP), solid matrix (SM), **and underground storage tank (UST)** proficiency test (PT) samples semiannually in support of its NELAC accreditation. The laboratory analyzes single blind performance evaluation (PE) samples quarterly in support of its participation in the EPA's contract laboratory program.

As part of its data audit function, the QA department audits all PT and PE sample data before results are submitted. PT and PE sample results are summarized in memoranda that are distributed to laboratory management. **CARs are initiated for root cause of failed results.**

10.4 Management Review

The results of the annual internal systems audit performed by the QA staff are reported to the laboratory management. Corrective action reports are distributed to the managers documenting any deficiencies. Corrective actions for these deficiencies are documented on the reports and returned to the QA department. **CARs are tracked for trending purposes.**

The QA Manager **and QA Specialist** report on activities done in support and development of the laboratory's quality system in writing on a monthly basis to the Vice President and General Manager.

The Vice President and General Manager also writes a report on activities done in support of the laboratory's quality system and discusses quality system issues with senior management during staff meetings.

Figure 10-1

CompuChem
A Subsidiary of
Liberty Analytical Corp

SYSTEM AUDIT CHECKLIST
Sample Storage/Chain of Custody

Auditor_____Date_____Department_____

1. Are refrigerators well organized?	Yes	No
2. Is ID Label on door?	Yes	No
3. For SOM01.2, is the SOP posted on the door?	Yes	No
4. Is temperature range posted?	Yes	No
5. Is corrective action stated in logbook?	Yes	No
6. Are temperatures within range?	Yes	No
7. Are standards and samples stored separately?	Yes	No
8. Are logbook errors corrected properly?	Yes	No
9. Has the supervisor reviewed and signed off?	Yes	No
10. Are logbooks completed to the point of inspection?	Yes	No
11. Are samples under proper chain of custody?	Yes	No
12. Is chain of custody record completed?	Yes	No
13. Are samples left out of refrigeration more than 2 hrs since receipt?	Yes	No

Comments:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____

SAC1:1/10/11: bm

Figure 10-2

CompuChem
A Division Of
Liberty Analytical Corp.

DOCUMENTATION AND RECORD KEEPING AUDIT CompuChem

Auditor _____ Date _____ Laboratory _____

Logbook Name and ID #	Page # or Date	Detailed Documentation? Yes/No	Corrective Action Documented? Yes/No	Proper Error Correction? Yes/No	Page z'd-out? Yes/No	Review sign-off? Yes/No	Comments

SAC2:2/11/10:jr

Figure 10-3

CompuChem
A Division Of
Liberty Analytical Corp

SYSTEM AUDIT CHECKLIST
SOP Compliance

Auditor_____Date_____Department_____
SOP Title:_____
Instrument Procedure No._____ or Sample Preparation Procedure No. _____

1. Is the procedure performed according to the SOP?	Yes	No
2. Is the SOP compliant with referenced methods?	Yes	No
3. Does the SOP require revision?	Yes	No
4. Is corrective action necessary?	Yes	No
5. Is there documentation of training for this chemist and procedure?	Yes	No

Comments

1. _____
2. _____
3. _____
4. _____
5. _____

Corrective Action Follow-up

1. _____
2. _____
3. _____
4. _____
5. _____

SAC1:1/10/11: bm

Figure 10-4

CompuChem
A Division Of
Liberty Analytical Corp.

SYSTEM AUDIT CHECKLIST

Standard Storage and Control

Auditor_____Date_____Department_____

1. Is the standards refrigerator/freezer well organized?	Yes	No
2. Is ID Label on door?	Yes	No
3. Is temperature range posted?	Yes	No
4. Is corrective action stated in logbook?	Yes	No
5. Are temperatures within range?	Yes	No
6. Are standards and samples separated?	Yes	No
7. Are logbook errors corrected properly?	Yes	No
8. Has the supervisor reviewed and signed off?	Yes	No
9. Are logbooks completed to the point of inspection?	Yes	No
10. Are shelves or racks clearly labeled and are active standards segregated from expired/unapproved/special standards?	Yes	No
11. Are standards left out of refrigeration more than 2 hrs?	Yes	No

List below standard lot numbers currently in use for traceability to the standards preparation logbooks.

Standard ID _____ Lot Number _____ Expiration date _____
Standard ID _____ Lot Number _____ Expiration date _____
Standard ID _____ Lot Number _____ Expiration date _____
Standard ID _____ Lot Number _____ Expiration date _____
Standard ID _____ Lot Number _____ Expiration date _____

List below any standard Ids and lot numbers of expired standards, if any, stored with current standards.

Standard ID _____ Lot Number _____ Expiration date _____
Standard ID _____ Lot Number _____ Expiration date _____
Standard ID _____ Lot Number _____ Expiration date _____
Standard ID _____ Lot Number _____ Expiration date _____
Standard ID _____ Lot Number _____ Expiration date _____

Comments

1. _____
2. _____
3. _____

SAC2:2/11/10:jr

Figure 10-5

CompuChem
A Division Of
Liberty Analytical Corp

SYSTEM AUDIT CHECKLIST

Reagent (Solvent and Chemical) Storage and Control

Auditor_____Date_____Department_____

1. Are chemicals stored properly (ether in flammables cabinet, etc.)?	Yes	No
2. Are bottles labeled with date received, opened, and initials?	Yes	No
3. Are expiration dates determined (i.e., 5 yr. from receipt or manufacturer recommendation)?	Yes	No
4. Are any beyond the expiration period?	Yes	No
5. Are materials logged into the materials receipt log (inorganics)?	Yes	No
6. Are materials traceable to the receipt log (inorganics)?	Yes	No
7. Are all bottles labeled with the identity of the contents?	Yes	No
8. Are reagents being made at the required frequency?	Yes	No
9. Are proper safety equipment worn when handling reagents?	Yes	No
10. Is the area clean of debris or spills?	Yes	No

List below reagent lot numbers currently found to be in use.

Reagent ID _____ Lot Number _____ Expiration date _____
Reagent ID _____ Lot Number _____ Expiration date _____
Reagent ID _____ Lot Number _____ Expiration date _____
Reagent ID _____ Lot Number _____ Expiration date _____
Reagent ID _____ Lot Number _____ Expiration date _____

List below any expired reagents, or those stored or labeled improperly.

Reagent ID _____
Reagent ID _____
Reagent ID _____
Reagent ID _____
Reagent ID _____

Comments

1. _____
2. _____
3. _____

SAC1:1/10/11: bm

11.0 Facilities, Equipment, Security, Safety and Waste Management

11.1 Facilities, Security, and Safety

CompuChem is located in Cary, North Carolina on an eleven-acre site. The laboratory facility has over 30,000 square feet of office and laboratory space (Figure 11.1). An adjacent 1,000 square foot concrete block storage building is used for waste containment. This building is vented and has a four-inch concrete berm designed to contain at least a 10% capacity spill.

Laboratory areas are separated as outlined below. A comprehensive instrument and support equipment list is found in Tables 11.1 to 11.7.

11.1.1 Sample Receiving Area

Located in the sample receiving area **are** a large walk-in refrigerator and several reach-in refrigerators for sample storage, an ambient storage unit for sample storage, and fume hooded bench space used to unpack and inventory samples received for analysis. **Freezers are also located in the area for biological tissue storage and long-term soil sample storage, if requested by the client.**

11.1.2 Sample Preparation Laboratory

The sample preparation laboratory houses both organic and inorganic sample preparation areas. Fume hoods separate the two areas. A Liebert air handling system conditions the air by heating, cooling, filtering, humidifying and de-humidifying as needed. The room is maintained under a negative pressure to isolate any solvent vapors from the analytical laboratories.

11.1.3 Semivolatile and GC Analytical Laboratory

The semivolatile/**GC** analytical laboratory houses the GC and GC/MS instrumentation used to analyze sample extracts for semivolatile, pesticide, herbicide, polychlorinated biphenyl, and diesel range organic **and RSK** compounds. A Liebert air handling system conditions the air by heating, cooling, filtering, humidifying and de-humidifying as needed.

11.1.4 High Performance Liquid Chromatography Laboratory (HPLC)

The HPLC laboratory houses the HPLC instrumentation used to analyze sample extracts for polycyclic aromatic hydrocarbons and explosives. A Comfort Maker air conditioning unit cools the space.

11.1.5 Volatile Analytical Laboratory

The volatile analytical laboratory houses the GC and GC/MS instrumentation used to analyze samples for volatile organics and gasoline range organics. A **Carrier** air handling system conditions the air by heating, cooling, filtering, humidifying and de-humidifying as needed. In an effort to eliminate cross-contamination, the **air handling system** is equipped with carbon filters and the laboratory is under positive air pressure.

11.1.6 Organic Standards Laboratory

Located in the organic standards laboratory are reach-in refrigerators and **a** freezer used for standard storage **that are segregated depending on the laboratory for which the standards are intended**. A Mettler analytical balance is used to weigh neat materials **and all standards are prepared in a fume hood**. A NIST-traceable thermometer is used for laboratory thermometer and IR gun calibrations.

11.1.7 Inorganic Analytical Laboratories

The inorganic analytical laboratories house ICP, ICP-MS, cold vapor, ion chromatograph and spectrophotometric instrumentation used to analyze sample digestates for trace metals, cyanide, minerals, nutrients, and anions. A Lennox air handling system conditions the air in the ICP lab by heating, cooling, filtering, humidifying and de-humidifying as needed.

11.1.8 Preventive and Routine Maintenance of Analytical Instrumentation and Support Equipment

The laboratory has an analytical instrument specialist on-site. He performs preventive and/or major maintenance (e.g. replacement of turbo pump oil or replacement of circuit boards) on the laboratory's analytical instrumentation. Routine instrument maintenance (e.g., replacement of injector liners and septa) **are** preformed by the analysts. Procedures for routine instrument maintenance are detailed in the SOPs for the particular analytical method and in the manufacturers instrument manuals.

Analytical support equipment such as balances, ovens, and refrigerators are monitored by the analysts using NIST-traceable reference materials. Qualified outside servicepersons calibrate each balance on-site semiannually. The NIST-traceable reference thermometer and **all** weight **sets** are calibrated annually by the North Carolina Department of Agriculture and Consumer Services Standards Division.

Any analytical instrument that cannot be successfully calibrated before the next work shift must be identified as out of service. The failed calibration is documented in the instrument run log. If the instrument cannot be returned to service after maintenance by the analyst, instrument specialist, or outside service person, a **tag-out** sign indicating the instrument is out of service is affixed to the instrument.

11.1.9 Documentation

The QA department issues bound and paginated log books to the laboratory areas. These log books include run logs, **equipment** maintenance **and repair** logs, temperature logs, standard preparation logs, and balance calibration logs. The analysts make entries in to these logs and return the completed logs to the QA department for archival **by the QA specialist**.

11.2 Facilities Maintenance and Security

The facility is maintained under the direction of the Manager, Purchasing, Administration, and Facilities. Preventive maintenance, repair and/or replacement of facility environmental systems such as heating and cooling units are accomplished by maintenance personnel and outside contractors under his supervision. Plans for facility renovations and improvements developed by laboratory management and staff are coordinated and implemented under his supervision.

The facility is secured by locked doors accessed by electronic and manual keys. An electronic security system monitors access. A chain link fence surrounds the entire acreage. The fence is equipped with two gates secured by pad locks during non-business hours. Only authorized personnel have unsupervised access to the facility. Security cameras have been installed at various locations on the premises and inside the laboratory.

11.3 Safety

Laboratory personnel **are required to** wear protective eyewear, lab coats, and gloves while handling samples. Emergency showers are located in the sample preparation laboratory. Eye wash stations and fire extinguishers are located throughout the facility. The safety committee performs monthly safety inspections and reports observations to management. A list of safety equipment is presented in **Table** 11.8.

11.4 Contingency

Progress Energy Carolinas, Inc. supplies electrical service to CompuChem. The laboratory also maintains an uninterruptible power supply (UPS), that powers computers, instruments, and hoods for approximately two hours in case of a temporary power outage. The laboratory has at its disposal a refrigerated tractor trailer for maintaining samples at the required storage temperature. Dry ice would be used to maintain freezer temperatures.

Qualified subcontracting laboratories are available to perform analyses on short notice in emergencies. In such a case, CompuChem notifies clients and gains approval before allowing a subcontractor laboratory to perform analyses.

11.5 Reagent Storage Control, Documentation and Labeling

The receipt date, open date, expiration date, and the initials of the person recording the information are placed on reagent bottle labels after receipt by the laboratory. If the vendor does not supply an expiration date, a period of **five** years from date of receipt is used. Table 11-9 summarizes the reagents present at the laboratory and under what conditions they are stored. Before a solvent lot is purchased, it is analyzed and approved by the laboratory. Once the lot is approved, the vendor supplies the laboratory with reagents until that lot is depleted.

In methods where the purity of reagents is not specified, **American Chemical Society (ACS)** grade is used. Reagents of lesser purity than those specified by the method are not used. Reagent container labels are checked to verify that the purity meets the requirements of the particular method. Reagent lot numbers are documented on preparation sheets and instrument run logs **and through the LIMS**.

11.6 Hazardous Waste

Waste handling and disposal procedures are carried out in compliance with CompuChem's waste disposal SOP (SOP 12.1: "Hazardous Waste Disposal"). This SOP includes procedures for training of personnel, identification, segregation, storage, and details of disposal procedures. Disposal of samples, sample digestates, and sample extracts is detailed in sample control SOPs. Waste disposal is performed in compliance with all applicable local, state, and federal regulations. A licensed hazardous waste contractor handles all recycling and arrangements for final disposal. (See Table 11-10.)

CompuChem is subject to yearly RCRA inspections by the State of North Carolina Hazardous Waste Section. CompuChem is a large quantity waste generator (in excess of 1000 kg per month) and must comply with all applicable parts of the following regulations:

- Resource Conservation and Recovery Act (RCRA)(40 CFR 261-271)
- Occupational Safety and Health Administration (OSHA)(29 CFR 1910.120 and 1910.1200)
- Hazardous Material Transportation Act (HMTA)(49 CFR 171-180: HM-181 and HM126F)
- Clean Water Act (CWA)(40 CFR 403.5)
- Superfund Amendments Reauthorization Act (SARA)(40 CFR 355, 370)
- NC Hazardous Waste Rules(15A NCAC 13A)

CompuChem pursues waste minimization efforts and makes every effort to recycle the materials and chemicals that are well suited for this purpose. After analysis and following a 90 day holding period, all residual solid and aqueous samples are disposed of as hazardous waste. Wastes are segregated into various waste streams which fall under RCRA codes F001, F002, F003, F005, D001, and D018. Table 11.10 represents general waste disposal procedures.

Any additional wastes not listed above are evaluated by the hazardous waste technician, safety officer, and/or contracted disposal company to determine the appropriate means of disposal.

Each satellite accumulation container must have a hazardous waste label. Shipment containers must be labeled according to HM-181 and must include the generator's name and address, EPA ID number, manifest document number, accumulation start date, and EPA waste number. All hazardous waste shipments are accompanied by a North Carolina Hazardous Waste Manifest. One copy of the manifest is kept on file at CompuChem at the time of shipment by the hazardous waste technician. Additional copies accompany the waste to the hazardous waste contractor. After disposing of the waste, the contractor returns a signed copy of the manifest to CompuChem verifying disposal. These final copies of the manifests are kept on file by the hazardous waste technician. Logbooks are maintained for daily inspections of the outside 90-day waste storage building and manifest tracking and are located inside the waste storage area. To prevent any improper disposal, the licensed hazardous waste contractors perform additional testing on the contents of the shipment containers before disposal.

Figure 11-1
Laboratory Floor Plan

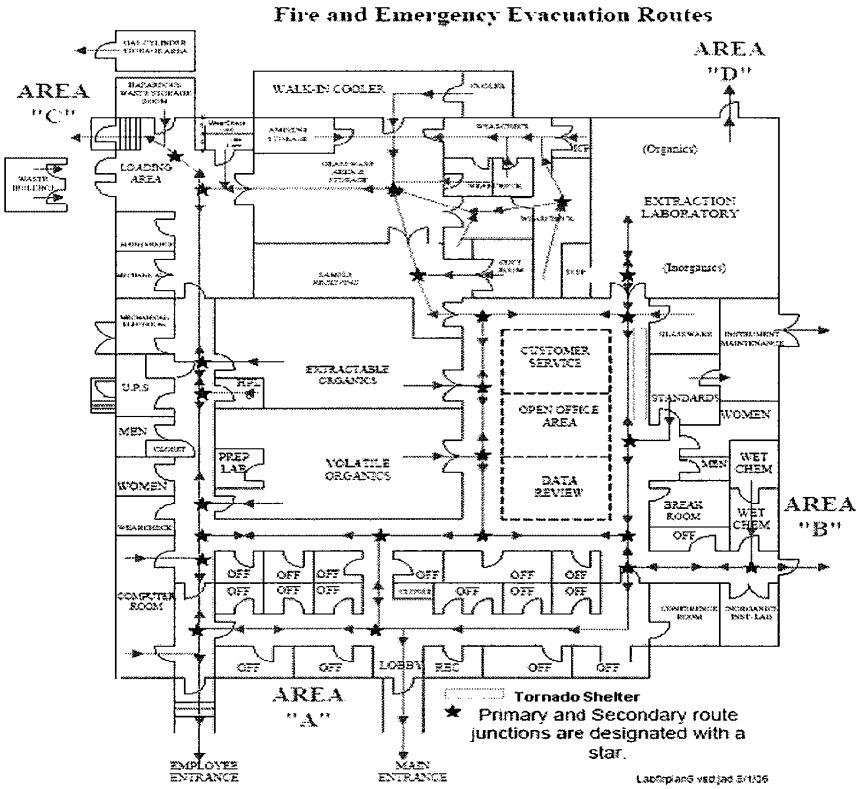


Table 11.1 GC Laboratory Equipment

Model No.	Serial No./Channel No.	Type	Installation Date
GC			
Varian 3400	#54	NPD	
Varian 3400	6949 #37/42	Dual ECD	1989
Varian 3400	3623 #39/41	Dual ECD	1987
Varian 3400	17403 #44	FID	
Varian 3400	3356 #59	FID	
Trace GC 20011612	#86/87	Dual ECD	2000
Trace GC	TR101370/#80/81	Dual ECD	2000
Trace GC	TR101369/#82/83	Dual ECD	2000
Trace GC	TR101375/#84/85	Dual ECD	2000
Hewlett Packard P5890	Series II GC LR47359C #67	FID	2002
Hewlett Packard 5890	Series II GC #32/33	Dual ECD	
Agilent Technologies 6890N	CN10552045 #90/91	Dual ECD	2006
Agilent Technologies 6890N	CN10522046 #92/93	Dual ECD	2006
Autosampler			
CTC A2000S	1304/89(#37/42)	Autosampler	1991
CTC A2000S	13013(#39/41)	Autosampler	1991
CTC A2000S	1301/89(#44)	Autosampler	1991
CTC A2000S	12371(#54)	Autosampler	1989
CTC A2000S	1792/90(#59)	Autosampler	
CTC A2000S	1915/90(#86/87)	Autosampler	1991
CTC A2000S	12369(#80/81)	Autosampler	2000
CTC A2000S	1804/90(#82/83)	Autosampler	1990
CTC A2000S	12387(#84/85)	Autosampler	2000
CTC HS500	30135(#67)	Autosampler	2002
CTC A2000S	12371 (#32/33)	Autosampler	
Agilent Technologies 7683B	CN54637426 #90/91	Autosampler	2006
Agilent Technologies 7683B	CN62940489 #92/93	Autosampler	2006
Refrigerators			
Refrigerator #2	GC Lab Refrigerator #2	8 ft^3	
Refrigerator #7	GC Lab Refrigerator #7	8 ft^3	
Refrigerator #8	GC Lab Refrigerator #8	22,7 ft^3	
Refrigerator #3	GC Lab Refrigerator #3	8 ft^3	
Refrigerator #4	GC Lab Refrigerator #4	22 ft^3	
Refrigerator #9	GC Lab Refrigerator #9	22 ft^3	

Table 11.2 HPLC Laboratory Equipment

Model No.	Serial No./Channel No.	Type	Installation Date
Agilent 1100 Series HPLC Micro Vacuum Degasser Quaternary Pump ALS Sampling System Thermo Column Compartment Multiple Wavelength Detector	a11001 JP40714429 DE40926792 DE33224733 DE405384472 JP43826437	HPLC	2004
Agilent 1100 Series HPLC Micro Vacuum Degasser Quaternary Pump ALS Sampling System Thermo Column Compartment Multiple Wavelength Detector	a11002 JP40721307 DE43631227 DE43627396 DE43644464 JP43826438	HPLC	2005
Refrigerators			
Baxter Explosion-Proof		Precision 814, 8 ft^3	
Marvel #1		8 ft^3	

Table 11.3 SV GC/MS Laboratory Equipment

Model No.	Serial No./ID No.	Type	Installation Date
Hewlett Packard HP5972 GCMS 5890 Series II GC HP 7673 autosampler	#60 3244A32866	SV	1994
Hewlett Packard HP5972 GCMS 5890 Series II GC HP 7673 autosampler	#66 3442A40444	SV	1996
Hewlett Packard HP5972 GCMS 5890 Series II GC HP 6890 autosampler	#70 3529A43269	SV	1998
Hewlett Packard HP5972 MSD 5890 Series II GC 6890 Series injector	#62 3404A37674	SV	2005
Hewlett Packard **HP5972 GCMS** **5890 Series II GC** **6890 Series injector**	**#64** **3415A38536**	**SV**	**GCMS 1996 in SV as #64; moved to VOA in 2008 as #69 Returned to SVOA as #64 in 2010**
Agilent Technologies 6890N Network GC System (G1530N) Agilent 5973 Network Mass Selective Detector (G1530N) **Agilent Autosampler (7683B)**	#68 US10143053 CN 83150389	SV	2002 in VOA as #61/62; moved to SVOA in 2008 as #68
Refrigerators			
Refrigerator #1	GC/MS SVOA Lab Ref. #1	8 ft^3	
Refrigerator #3	GC/MS SVOA Lab Ref. #3	22 ft^3	

Table 11.4 VOA GC/MS Laboratory Equipment

Model No.	Serial No./ID No.	Type	Installation Date
Finnigan INCOS 500 GCMS Tekmar 3000 concentrator Archon autosampler	#55 IN001125 95107004	VOA	1991
Hewlett Packard HP6890 MSD 6890 Series GC Tekmar 3000 P&T concentrator Varian Archon autosampler	#71 US00004710 95097006 610701	VOA	2000
Hewlett Packard HP5972 MSD 5890 Series II GC Varian Archon autosampler, closed system P&T Tekmar LCS 3000	#59	VOA	2000
Hewlett Packard HP5973 MSD Varian Archon autosampler Tekmar/Dohrmann 3100 sample concentrator	#90	VOA	2005
Hewlett Packard HP5972 MSD 5890 Series II Plus GC Tekmar 3000 P&T concentrator Varian Archon autosampler	#73 700758 94293001 507204	VOA	1/2001
Agilent Technologies Inert 5975 MSD 6890N Network GC System	#91 US54431647 CN10604034	63172A G1530N	2006
Varian 3400 Tekmar LCS2000 Tekmar ALS2016	6952 (#68) 90163020	FID Purge & Trap	1989
Varian 3400 Tekmar LCS2000 Tekmar ALS2016	6954 (#58) 90038029 91158005	FID Purge & Trap	1990

Table 11.4 VOA GC/MS Laboratory Equipment (continued)

Model No.	Serial No./ID No.	Type	Installation Date
Refrigerators			
Refrigerator #2B			
Refrigerator #4/Freezer #3		22 ft^3	
Refrigerator #5	880101750		
Refrigerator #6	9910245654	5 ft^3	
Freezer #6		22 ft^3	
Water System			
Millipore Milli Q	06731-C		
Oven			
Blue M			
Weights			
Troemner	45823	Class 1	
Balance			
Sartorius B410	40010010	Electronic	

Table 11.5 Inorganics Laboratory Equipment

Model No.	Serial No./ID No.	Type	Installation Date
TJA Trace ICAP P3 Trace ICAP RF Generator Chiller Autosampler ThermoSPEC software	303490 Revision 6.20	**61E Trace Vacuum** Simultaneous	1994
TJA Trace ICAP P4 36161 System **RF Generator** **Chiller** **Autosampler** **ThermoSPEC software**	10670/13685200 **Revision 6.20**	61E Trace purge, **Simultaneous**	2000
Perkin Elmer Sciex Elan **DRC-e PEMS** Elan Software Polyscience Recirculator **Elemental** Autosampler	AH13950808 **Version 3.4**	ICP-MS **DRC-e**	2008
Mercury Analyzer Leeman Labs **V4** Hydra AA **WinHg Software**	7031 **Version 1.7**	CVAA Automated Mercury Analysis System	2007
Buck Scientific Oil in Water IR Analyzer	506	**IR Analyzer**	**1994**
Dionex Ion Chromatograph **IC2** AS40 Automated Sampler **Chromeleon Software**	U503481/IC2 **Version 1.2**	**Ion Chromatograph**	2005

Table 11.5 Inorganics Laboratory Equipment (continued)

Model No.	Serial No./ID No.	Type	Installation Date
TOC Analyzer			
Shimadzu TOC-V	H51104335168	VCSH	2006
Shimadzu Solid Sample Module	H52504300074	SM-5000A	
Shimadzu Autosampler	H52104301662	ASI-V	
Client Pro PC	4169020-001		
Lachat Instruments	A5000-415	Ion Chromatograph	
IC A5000			
CETAC ASX-510 Auto Sampler	100124 ASX		2009
Quickchem	2000-0076	2300-000	1990
Proportioning Pump	2000/12	2200-00	
PC Hewlett Packard	3024A01573	Vectra 286/12	
Printer Hewlett Packard	2935A70310	LaserJet Series II	
Zellweger Analytics, Inc.			
QuickChem FIA+			
8000 series	A83000-1605		2000
Spectrophotometer			
Spectronic 21D	3152073028	Spectrophometer	
Milton Roy			
Balances			
Sartorius	10505094	LC2200P/Electronic	1993
American Scientific	2904542	S/P 180/Electronic	1993
O'Haus E400	2061	Electronic	1993
O'Haus E400I	6371	Electronic	1993
Demoer		Electronic 4 place	
Mettler	H50747	PJ300	
Denver Instruments	B034903	300	
Weights			
Troemner	NCSN050	Class 1	
Fisher	NCSN054	Class 1	
Wet Chemistry Lab Refrigerator #1		8 ft^3	
Ovens			
Fisher ISO Temp200 Series	00143		
Fisher ISO Temp200 Series	00179		
Miscellaneous			
Electrothermal		10 place midi	
Midivap system (2)		distillation	
Distillation apparatus (6 units)			

Table 11.5 Inorganics Laboratory Equipment (continued)

Model No.	Serial No./ ID No.	Type	Installation Date
Miscellaneous (continued)			
Hot Plates (seven units)			
Fisher pH Meter	50/PH1	Accumet	
Block Digestors			
Lachat	BD46		
Environmental Express SC100 w/SC200 racks		36 well block digestor	10/97
Baths			
Digestion (2) turkey roasters Fisher Versa Bath, Precision Stainless		183	
Pyrex Burets		10, 25, 50 mL	1999
Ovens			
Fisher Isotemp Oven	00700173	Mode 500 Series	
Fisher Isotemp Oven	472	Mode 200 Series	
Fisher Scientific Dessicator Unit		**12" x 12" x 10 3/4"**	**2010**
Flash Point Instrument Koehler Instruments, Inc.	R02291814	K16200	2006
Electrothermal Electromantles (4 units, 15 place)		ME	
Fisher Centrifuge	00200499	Centrific 228	
Corrosivity testing apparatus		Glass vessel	
Refrigerators			
American Scientific Products	NY 79522-2	SPR 24 A-O-A	
Gerald	6081295V	GR 17A	
Microwave Digestion			
Acid Distillation Unit			

Table 11.6 Organic Sample Preparation Laboratory

Model No.	Serial No./ ID No.	Type	Installation Date
Balances			
O'Haus E400	3156	Electronic	
Sartorius BL310	13008591	Electronic	3/2000
Weights			
Troemner	45824	Class 1	
pH Meters			
pH Meter - Beckman	2721	Hand held	
pH Meter – WTW	3204	Hand held	
Baths			
Branson ultrasonic bath	B-22-4		
Branson ultrasonic bath 8510	RPA 9806516E		
Hot water baths (2 units/cp. 24)			
Ovens			
Fisher Econotemp	477	55G	
Wilt Furnace	90870	210	
Refrigerators			
Whirlpool	EE02722440	Compact	
Centrifuges			
IEC	24760668	Centra 8	
IEC	24760672	Centra 8	
Fisher Centrifuge	1041	225	
Water Purification System			
US Filter DI Water System (250 gal)			
Other			
Fisher Dessicator			
YSI Conductivity Meter	1422	Model 35	
Sonifiers			
Branson Sonifier	NH10245B	350 Four Tips	
Branson Sonifier	NH20102B	350 Four Tips	
Tekmar	11896E2	Model TM 600-2	
Tekmar	10500	Model VC 600-2	
Tekmar	13771B	Model TM375	
Nitrogen Evaporators			
Organomation	8373	115	
Separatory Funnel Shaker			
Glas-Col® Funnel Holders	**471150,-51,-52, -53/Cat. # 099A VH2000DS**	**Capacity for Eight 2 L Separatory Funnels**	**2010**
Glas-Col® Floor Shaker Base	**471162/Cat. # 099A VS5504**	**Variable Speed, 3D Motion**	**2010**

Table 11.6 Organic Sample Preparation Laboratory (continued)

Model No.	Serial No./ ID No.	Type	Installation Date
Environmental Express Extraction Vessels and rotation units			
ZHE			
3 rotation units/8 vessels each			
TCLP/EP Toxicity			
3 rotation units/8 vessels each			
Gel Permeation Chromatograph			
ABC GPC #1	834B-234	1002B	1990
ABC GPC #2	879B-279	1002B	1991
GPC #6	GPC-6	J2 Scientific	2007
Autosampler Model # J2AIM3310	4738A12420		
AccuPrep MPS GPC Unit	07J-1273-4.1DI		
GPC #5	GPC-5		
Autosampler Model # J2AIM3310	4738A12422	J2 Scientific	2007
AccuPrep MPS GPC Unit	07K-1275-4.1DI		
Recirculating Chillers			
Neslab	8005036	Cool flow 75	
Neslab		Cool flow CFT-75	
Neslab		HX-75	
Automated Soxhlet			
Gerhardt Soxtherm	4032297/4032044	SE-416	
Gerhardt Soxtherm	4022028/4022069	SE-3A/S306A	2003

Table 11.7 Organic Standards Laboratory Equipment

Model No.	Serial No./ ID No.	Type	Installation Date
Weights			
Permas	A302	Class 1	
Balance			
Mettler H31AR	794794	Electronic Analytical	

Table 11.8 Safety Equipment

Model No.	Serial No./ ID No.	Type	Availability
Fire Extinguishers	Various	General Fire Ext., Inc.	**Throughout the facility**
Eye Protection			
Safety glasses		Safety glasses	One per person plus surplus
Eye-wash stations		Model 3729	**Six** portable; two permanent
Protective Clothing		Lab coats North Safety Equipment	One per person, plus surplus
Respirators			Two
Safety Showers		Water	Two in the sample prep lab

Table 11.9 Reagent Storage

Reagent	Storage	Location	Conditions
Halogenated solvents	Vented storage cabinets	Inorganics Extractions Extractable GC/GCMS Standards Electronics	Air conditioning
Non-halogenated solvents	Vented storage cabinets	Inorganics Extractions Extractable GC/GCMS Standards Lab Electronics	Air conditioning
Alcohols	Vented storage cabinets	Inorganics Extractions Volatile Preparations Extractable GC/GCMS Standards Electronics	Air conditioning
Inorganic chemicals	Shelving cabinets	Inorganics Extractable GC/GCMS Standards Electronics	Air conditioning
Trace metals	Shelving cabinets	Inorganics	Air conditioning
Peroxides (H_2O_2)	Vented storage cabinets	Inorganics	Air conditioning
Acids (Inorganic)	Vented storage cabinets	Inorganics	Air conditioning
Acids (Organic)	Vented storage cabinets	Extractions Inorganics	Air conditioning
Organic standards	Explosion-proof refrigerators	Volatile GC/GCMS Extractable GC/GCMS Standards	Air conditioning
Stock organic solvents	Vented storage cabinet	Extractions	Air conditioned
Stock inorganic chemicals (NaOH)	Vented storage room	Solvent storage building	Vented ambient outside storage
Stock acids	Vented storage room	Solvent storage building	Vented ambient outside storage

Table 11.10 Waste Disposal

Waste Stream	Storage	Disposal
Dichloromethane	55-gallon steel drums	Reclaimed
Freon 113	55-gallon steel drums	Reclaimed
Used oil	55-gallon steel drums	Reclaimed
Mixed flammable solvents	55-gallon steel drums	Disposed by HW contractor
Vials with flammable solvents	55-gallon steel drums	Disposed by HW contractor
Plant scraps with solvents	55-gallon steel drums	Disposed by HW contractor
019 waste water	55-gallon polyethylene drums	Disposed by HW contractor
Purged soil	55-gallon polyethylene drums	Disposed by HW contractor
Acid water and vials	55-gallon polyethylene drums	Disposed by HW contractor
Mixed acids	55-gallon polyethylene drums	Disposed by HW contractor
NaOH waste	55-gallon polyethylene drums	Disposed by HW contractor
Oil and acid	55-gallon polyethylene drums	Disposed by HW contractor
Cyanide standards	55-gallon polyethylene drums	Disposed by HW contractor
Pyridine and barbituric acid	55-gallon polyethylene drums	Disposed by HW contractor
Metal standards	55-gallon polyethylene drums	Disposed by HW contractor

12.0 Corrective Action

Corrective action is the process of identifying the root cause and implementing the procedures to correct nonconforming work and departures from the policies and procedures of the laboratory's quality system. The need for corrective action may arise from the identification of any of the following:

- Nonconformance issues identified during sample processing and analysis
- Deficiencies in the laboratory's quality system as identified as a result of internal and external audits
- Failure to achieve acceptable proficiency testing (PT) results
- Client inquires and complaints

Corrective actions are documented in Corrective Action Reports (CARs) (Figure 12-1), memoranda, management reports (including responses to external audit reports), instruments logs, and work-order/SDG narratives.

If issues arise that potentially compromise the integrity of the validity of test results, the issues are immediately brought to the attention of either the QA Manager or the Vice President for resolution. If an issue cannot be resolved internally and/or satisfactorily, the client is contacted within 72 hours of the identification of the event.

12.1 Nonconformance Issues Identified During Sample Processing and Analysis

12.1.1 Sample Receipt

Nonconformance issues identified during sample receipt may include but are not limited to the following:

- Samples received at temperatures outside of acceptable range
- Samples received improperly preserved
- Samples received in damaged or broken containers

In cases such as those listed above, receiving personnel document the nonconformance on the client chain-of-custody (COC) and advise the **appropriate** project manager of the problem. The project manager then immediately contacts the client. The project manager documents the client's instructions in writing on the client COC or separate document. **See Section 5.0 for further details on sample receipt and handling.**

When the lab receives a sample from a site in North Carolina, which does not meet the requirements for shipping temperature, preservation, volume, or holding time, the lab will inform the client. If the client chooses not to resample but will accept the qualified results from the laboratory, the North Carolina Department of Environment and Natural Resources Division of Water Quality must be notified. This written notification must include the sampling site, client name, client address, and the non-compliance issue.

12.1.2 Sample Preparation

Nonconformance issues identified during sample preparation may include, but are not limited, to the following:

- Insufficient sample volume for the desired test method
- Sample matrix not amenable to the desired test method
- Laboratory accident during sample handling resulting in loss of sample extract/digestate
- Improper addition of QC reference standards during sample preparation

In cases such as those listed above, the sample preparation technician advises the project manager of the problem and the procedure continues as stated above.

The technician documents instances such as an alternate sample volume used for preparation, a laboratory accident, or the addition of the incorrect volume of QC reference standard on the preparation worksheet.

12.1.3 Sample analysis

Nonconformance issues identified during sample analysis may include but are not limited to the following:

- Initial or continuing calibration fails acceptance criteria
- Field samples fail QC acceptance criteria
- QC samples fail acceptance criteria
- Sample preparation or analysis holding time exceeded

In the case of the failing initial or continuing calibration, the analyst evaluates the results and may perform instrument maintenance before recalibration. This is documented in the appropriate instrument log book. Failed QC acceptance criteria for field and QC samples are documented in the instrument run log. Corrective actions for QC sample failure are detailed in the appropriate analytical SOP.

All corrective actions performed during the processing and analyses of samples are documented in the final report to the client. The work-order/SDG narrative summarizes the nonconformance issues and corrective actions taken.

12.2 Deficiencies in the Laboratory's Quality System Identified as a Result of Internal and External Audits or Proficiency Testing Results

The laboratory's quality system is monitored through the periodic performance of internal and external audits and proficiency testing (PT) samples. Deficiencies in the laboratory's quality system affecting its ability to produce data of known and documented quality may be identified as a result these audits.

Deficiencies identified as a result of internal and external audits may include, but are limited to, the following:

- Deviations from established laboratory policies and procedures
- Deviations from the requirements of the NELAC standards or other external agency requirements
- Deviations from the requirements of the appropriate CLP statement of work

Deficiencies identified during internal audits are documented in internal CARs, interoffice memoranda, internal audit reports, and monthly management reports.

Deficiencies identified during external audits, both on-site and through data and electronic media audits, are documented in external audit reports prepared by the auditing body and internal CARs.

For both internal and external audits and PT deficiencies, QA **Department** issues an internal CAR to the responsible manager/supervisor. The responsible manager/supervisor then identifies the root cause of the deficiency and **initiates** a plan of correction. The **root cause and** plan of correction **are** documented on the CAR **report form and** is returned to the QA department for approval. For an external audit, the laboratory's plan of correction for deficiencies is documented in a written response to the auditing body for its acceptance. Additionally, corrective action reports for failed PT results are submitted to the appropriate accreditation bodies. All records are **tracked and** retained.

12.3 Client Inquiries or Complaints

CompuChem's clients are represented at the laboratory by Project Managers. The Project Manager **or Vice President of Sales and Marketing are** the client's point of contact for any questions and/or complaints.

For issues that arise between the time that the client samples are received by the laboratory and the time the final report is completed, the client contacts the Project Manager with any questions or changes. The Project Manager relays the information to the responsible manager/supervisor. This client correspondence is documented in the Project Manager's **message notebooks and e-mail communications.**

For issues that arise after the final report has been delivered, the client again contacts the Project Manager. The issue is **initiated via the** Client Inquiry **system** that is forwarded to the responsible supervisor/manager for resolution.

Issues cited by the client may include but are not limited to the following:

- Missing or illegible page(s) in the final report
- Errors in sample processing and analysis
- Request for further analysis on sample previously analyzed
- Request for further information such as a more detailed report style than originally requested and electronic disk deliverable (EDD)
- Request an additional copy of the report

Once the issue has been **addressed** and the resolution documented**,** any supporting documents are returned to the Project Manager **or designee**. The Project Manager forwards the information to the client. If an amendment of the final report is required, it is identified as such before being submitted to the client.

12.4 Permitting Departures from Laboratory Policies and Procedures

12.4.1 Sample Deviations

The Vice President and General Manager and the Manager of QA write laboratory policies as the need arises. There are instances, during the course of normal operations, when the laboratory may be allowed to deviate from routine standard operating procedures, internal laboratory policies, or client

specifications. An example of this would be if an analyte fails to meet QC limits in the LCS and is of **no** interest to the client for **a particular** project. In these instances, the laboratory staff must speak directly with, and obtain permission from, the Vice President and General Manager or the Manager of QA and the client, if there is questionable impact on the data. Laboratory staff **are expected to consult the** QA **Department** to seek clarification and direction on situations that occur outside normal **operating** procedures. Project Managers maintain regular communication with clients regarding status of projects, sample analysis, **and report criteria**.

A laboratory supervisor or analyst who has a question or **concern** about a **procedural or protocol** deviation is appropriate contact**s the** QA **department** to discuss resolution of the matter. The QA staff member will evaluate the situation relative to documented policies and procedures to determine if the data may be reported, or **if** corrective action must occur. A recommendation is made regarding the course of action including contacting the client, **if necessary**. In general, any allowed deviation is discussed in the SDG narrative **of the client's final report**.

12.4.2 Logbook Deviations

The following statement has been added to all logbooks, "The presence of the Chemist's/Analyst's employee ID number, or signature, on this run log attests that strict compliance with the method's SOP has occurred. Any SOP deviations require documentation by the responsible chemist/analyst together with the chemist's/analyst's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation."

Please Note: This section does not apply to samples analyzed for the Ohio Voluntary Action Program (Ohio VAP). Deviations from Ohio VAP approved laboratory SOPs are not permitted. The Ohio VAP must approve any proposed revisions to previously approved SOPs prior to implementing any changes in the laboratory.

12.5 Preventative Action Report

Preventative action is the process of identifying root causes and implementing the procedures to identify and address potential nonconforming work and departure from the policies and procedures of the laboratory's quality system before corrective action has to be taken. The identification of a preventative action is similar to that of a CAR. Preventative actions are documented in Preventative Action Reports (PARs) (Figure 12-2).

Figure 12-1

CORRECTIVE ACTION REPORT

CompuChem
A Division Of
Liberty Analytical Corp.

CORRECTIVE ACTION REPORT

INITIATION

Project:	Date Initiated:
Client Name:	Required Response Date:
Initiator:	CAR#
Deficiency Type: (circle one) CERT – GLP – MDL – NARR – PT – RPT – REV – SOP – SOW – QC	
Recipient:	Lab Area:

NON-CONFORMANCE

Description of Non-Conformance:

ROOT CAUSE

Signature of Responsible Supervisor/Manager:	Date:
Reason for Non-conformance:	

CORRECTIVE ACTION

Signature of Responsible Supervisor/Manager:	Date:
Plan of Correction (Must Address the Root Cause):	
Target Implementation Date:	

IMPLEMENTATION OF CORRECTIVE ACTION

Auditor:
Does SOP need revision? If so, target date of draft revision?
CAR Response Date:
CAR Closure Date:

FOLLOW-UP (completed by QA)

Auditor:	**Audit Date:**
Follow-up findings:	

Car4 –12/07/09: jr

Figure 12-2

PREVENTATIVE ACTION REPORT

CompuChem
A Division Of
Liberty Analytical Corp.

PREVENTATIVE ACTION REPORT

INITIATION

Initiator:	Date Initiated:
Recipient:	
Lab Area:	PAR#
Deficiency Type: (circle one) CERT – GLP – MDL – NARR – PT – RPT – REV – SOP – SOW – QC	

POTENTIAL NON-CONFORMANCE

Description of Potential Non-Conformance:

ROOT CAUSE

Signature of Responsible Supervisor/Manager:
Reason for Potential Non-conformance:

PREVENTATIVE ACTION

Signature of Responsible Supervisor/Manager:	Date:
Plan of Action (Must Address the Root Cause):	
Target Implementation Date:	

IMPLEMENTATION OF PREVENTATIVE ACTION

Auditor:
Does SOP need revision? If so, target date of draft revision?
PAR Submittal Date:
PAR Closure Date:

FOLLOW-UP (completed by QA)

Auditor:	Audit Date:
Follow-up findings:	

PAR2 –6/25/10; jr

13.0 Subcontracting and Support Services and Supplies

CompuChem only uses those outside support services and supplies that are of **satisfactory** quality to sustain confidence in the laboratory's tests. Records of all suppliers, for support services or supplies required for tests, are maintained.

13.1 Control of Subcontracted Analytical Services

CompuChem performs a wide array of analytical methodologies, and **occasionally** the laboratory must locate a suitable alternate laboratory to perform methods not performed in house. Only NELAP accredited laboratories are used to perform subcontracted analyses. In addition to NELAP accreditation, subcontract laboratories utilized by the lab must be assessed and approved by the Department of Defense **(DoD)** component for **DoD projects**. CompuChem's client agrees to the use of a qualified laboratory for subcontracted analytical services before the samples are sent off-site. The Project Management team coordinates subcontract laboratories on a project-by-project basis through agreement and approval of our client. An evaluation of the laboratory may include a review of standard operating procedures, Quality Manual, Statement of Qualifications, and recent PT study scores. The **contracted** lab's performance may be monitored through data evaluation.

13.2 Material Procurement and Control

Two prime objectives **for** CompuChem's purchasing are maintain**ing** sufficient **levels of** supplies **and evaluating** the best total value in a combination of supply, price, required quality, and service. Department and laboratory supervisors have primary responsibility for maintaining adequate inventory of supplies and ensuring that all supplies/equipment meet or exceed quality requirements. Supervisors work through the purchasing agent to meet these objectives. **Records of all suppliers for support services or supplies required for tests are maintained.**

CompuChem uses competitive inquiries or requests for bids, along with appropriate negotiation, to provide equal opportunities for potential and current suppliers to earn CompuChem's business and to allow the laboratory to seek the best overall value. Long-term considerations include reliability, price, required quality, and service. Suppliers must maintain the confidentiality of competitively sensitive information that is obtained from the Accounting department or other CompuChem personnel. Prices and related information, whether accepted or not, are not disclosed.

13.3 Material Quality Inspection, Outside Support Services and Supplies

Laboratory personnel consult the QA department when purchasing supplies/equipment that could potentially affect data quality, and therefore results of sample analyses, before use in production. The Vice President and General Manager or Manager of QA determines the appropriate test procedures and evaluates the resulting test data. A similar validation process is used in testing new instrumentation. When variability is exhibited in the quality of vendor-supplied materials or services, the laboratory **manager or** department supervisor is responsible for working with Purchasing **in** find**ing** a suitable alternative source.

Information on new chemicals must be supplied to the chemical hygiene officer, safety officer, **and**/or the waste management officer. Items and services have been identified that are known to affect quality. Documentation of material quality inspections for solvent lot tests, is maintained in the QA department. Laboratory supervisors maintain other documentation.

Material Safety Data Sheets (MSDS) are maintained by the QA department and are required reading by staff members using a particular chemical substance.

14.0 References

14.1 2003 NELAC Standard, **July 1, 2003**

14.2 ASTM D-5283-92. Generation of Environmental Data Related to Waste Management Activities: Quality assurance and Quality Control Planning and Implementation

14.3 EPA 2185 – Good Automated Laboratory Practices, 1995

14.4 ISO 17025: 2005. General requirements for the competence of testing and calibration laboratories

14.5 Guidance for Developing Quality Systems for Environmental Programs (QA/G-1), EPA/240/R-02/008, November 2002

14.6 Guidance on Assessing Quality Systems (QA/G-3), EPA/240/R-03/002, March 2003

14.7 QA/R-5: EPA Requirements for Quality Assurance Project Plans EPA/240/B-01/003, March 2001

14.8 QA/G-5: Guidance for Quality Assurance Project Plans EPA/240/R-02/009, December 2002

14.9 U.S. EPA Contract Laboratory Program Statements of Work SOM01.2 and ILM05.4

14.10 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Update III, 12/96

14.11 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Update IV, 2/07

14.12 Department of Defense Quality Systems Manual for Environmental Laboratories, Version 4.**2**, **10/25/10**

Appendix A

Demonstration of Capability

A demonstration of capability is made prior to using any test method, and at any time there is a significant change in instrument type, personnel or test method.

All demonstrations are documented through the use of the Demonstration of Capability Certification Statement in this Appendix.

The following steps are performed.

a) A quality control sample is obtained from an outside source. If not available, the QC sample is prepared by the laboratory using stock standards that are prepared independently from those used in instrument calibration.

b) The analyte(s) are diluted in a volume of clean matrix sufficient to prepare four aliquots at the concentration specified, or if unspecified, to a concentration approximately 1-4 times the limit of quantitation.

c) Four aliquots are prepared and analyzed according to the test method either concurrently or over a period of days.

d) Using all of the results, the mean recovery and standard deviation are compared to the corresponding acceptance criteria for precision and accuracy in the test method (if applicable) or in laboratory-generated acceptance criteria (if there are not established mandatory criteria). If all parameters meet the acceptance criteria, the analysis of actual samples may begin. If any one of the parameters do not meet the acceptance criteria, the performance is unacceptable for that parameter.

f) When one or more of the tested parameters fail at least one of the acceptance **criterion**, the laboratory repeats the test for all parameters that failed to meet criteria. If repeated failure occurs, the laboratory will locate and correct the source of the problem and repeat the test for all compounds of interest beginning with c).

Certification Statement:

The following certification statement is used to document the completion of each demonstration of capability. A copy of the certification statement is retained in the training files of each affected employee.

CompuChem
A Division Of
Liberty Analytical Corp.

Demonstration of Capability
Certification Statement

Study Date:
Laboratory Name: CompuChem, a Division of Liberty Analytical Corporation
Laboratory Address: 501 Madison Avenue, Cary, NC 27513
Analyst Name/Employee ID#:

Matrix:
Method Number:
SOP No./Rev#:
Analyte/Class of Analytes/Measured Parameters:

We, the undersigned, CERTIFY that:

1. The analyst identified above, using the cited test method, which is in use at this facility for the analyses of samples under the National Environmental Laboratory Accreditation Program, have met the Demonstration of Capability.

2. The test method was performed by the analyst identified on this certification.

3. A copy of the test method and the laboratory-specific SOPs are available for all personnel on-site.

4. The data associated with the demonstration capability are true, accurate, complete and self-explanatory.

5. All raw data (including a copy of this certification form) necessary to reconstruct and validate these analyses have been retained at the facility, and that the associated information is well organized and available for review by authorized assessors.

Technical Director's Name and Title	Signature	Date
Quality Assurance Officer's Name	Signature	Date

This certification form must be completed each time a demonstration of capability study is completed.

(1)	True:	Consistent with supporting data.
	Accurate:	Based on good laboratory practices consistent with sound scientific principles/practices.
	Complete:	Includes the results of all supporting performance testing.
	Self-Explanatory:	Data properly labeled and stored so that the results are clear and require no additional explanation.

Name:Date
Analysis: DOC
Prep:DOC

DOC1 02/25/10:jr

Appendix B

Procedure for Demonstration of Capability

CompuChem's Initial and On-going Demonstrations of Capability (Analyst Qualification) Policy

This policy details procedures for documenting the initial demonstration of capability (IDOC) and the on-going demonstration of capability (ODOC) for analysts in the laboratory following the rules listed below.

Initial Demonstration of Capability

General

1) Trainees are not allowed to process samples independently before they have demonstrated capability to perform the method through acceptable precision and accuracy testing with adequate documentation.

2) During the on-the-job training period no trainee is allowed to sign for his or her work without the signature of a manager/supervisor or an approved analyst, i.e., one who has documented capability for the method and has received approval to process samples independently. The approved analyst must cosign with the trainee on the instrument run logs or extraction worksheets.

3) The manager/supervisor, or designee, will provide the IDOC documentation to the QA department. Documentation includes all associated raw data, log sheets, and precision and accuracy statistics.

4) The precision and accuracy statistics must include the replicate values **expressed in concentration, standard deviation as % relative standard deviation (RSD) of the concentrations, the true value, and a mean percent recovery from the true value**.

5) The acceptance criteria for precision and accuracy are those stated in the methods or in CompuChem's Standard Operating Procedures (SOP) and Quality Manual. Percent recovery criteria for the LCS and RSD values for **second source** initial calibration **verification (ICV)** standards will be applied to **ICV standards for instrument analysts** where the extracted LCS recovery may be inappropriate. The Initial Calibration Verification (ICV) criteria are appropriate in this application.

   If any failure occurs, the error must be corrected and the study repeated for the failed analyte(s). This may involve only a reanalysis or a re-preparation followed by analysis. Approval is based on an individual analyte basis.

6) Approval must be made by the QA Department and documented through the NELAC Demonstration of Capability Certification Statement. This form must be signed by both the supervisor and QA Department and is maintained in the employee's training files.

7) Failure to have an IDOC on file for an employee who processes samples **may** result in rejected data.

8 **Major revisions to methods will require new IDOCs.**

9 **Department of Defense (DoD) criteria must be met to satisfy the IDOC requirement for DoD methods.**

10 **The successful performance of a Limit of Quantitation Study (LOQ) can be used to satisfy the IDOC requirement.**

11 **Work orders are required to be generated for all IDOCs performed in order that the appropriate data package is generated.**

11

GC/MS and GC Volatiles

1) For GC and GC/MS volatiles, **four consecutive continuing standards may be used to compile the IDOC, if the LCS is prepared from second source standards. Four analyses of a second source ICV may also be used to compile the IDOC.**

2) For GC/MS volatile, analysis of an IDOC by any current method will give the analyst credit for all **remaining** water methods based upon similarities in technologies, methods, and procedures. **The same is true for soil samples provided the data are quantitated as both.**

Organic Extractions

1) For sample preparation staff, four LCSs will be prepared, following the 40 CFR Part 136 Appendix A guidelines, either concurrently or over a period of days, **using second source spiking standards, i.e., standards prepared from a source different than the calibration standards, if available**.

2) Precision and accuracy must be demonstrated for all steps of an extraction procedure by the same analyst. The five critical steps are extraction (separatory funnel shake, etc.), KD, nitrogen evaporation or derivatization, bottle up to final volume, **and spike standard additions**.

3) **Separatory funnel extractions require a separate IDOC from continuous liquid-liquid extractions.**

4) **Soxhlet extractions require a separate IDOC from sonication extractions.**

5) For DRO waters, 8015, TN DRO, JP4, and JP8 each require a unique IDOC.

GC/MS Semivolatile and GC/HPLC

1) For GC/HPLC and GC/MS semivolatiles (extractables), each analyst must make four separate **injections of the appropriate second source ICV standard. For semivolatiles, four aliquots of the ICV standard are taken, internal standards are added, and the standards injected. For GC/HPLC, four replicates of the ICV standard are taken, 1:1 dilutions made, and the standards injected**. Statistics can be calculated for precision and accuracy from the injections of these dilution replicates. The performance of an IDOC using the **ICV** standards can count for both water and soil methods.

Criteria used to evaluate replicates prepared from **the ICV standard analyses** are those used to evaluate the **normal** (ICV) **standards**. For methods with no requirement for an ICV, such as CLP, **dilutions of the high level ICAL standard are to be made and** the **acceptance** criteria are 70-130%. Sporadic marginal failures may be allowed in some instances and on a case-by-case basis. For these compounds, criteria of 50-150% are used.

2) Analysis of four extracted LCSs can also be used to demonstrate capability. The analysis of an extractor's IDOC will also count as an analyst's IDOC, but only for the method(s) and matrix approved under the extraction rules.

Inorganic Preparation

1) For mercury waters, analysis of an IDOC by any current method will give the analyst credit for all remaining water methods based upon similarities in technologies, methods, and procedures. The is true for soil samples.

2) For cyanide waters, analysis of an IDOC by any current method will give the analyst credit for all remaining water methods based upon similarities in technologies, methods, and procedures. The same is true for soil samples.

3) For metal waters, **analysis of an IDOC by any current method will give the analyst credit for all remaining water methods based upon similarities in technologies, methods, and procedures. The same is true for soil samples.**

Inorganic Instrumentation

1) For inorganic analyses, a precision and accuracy study can be generated from the analysis of four consecutive dilution analyses of the **second source** ICV standards. These may be collected over a period of days.

2) The performance of an IDOC using the diluted standard can count for both water and soils for mercury, cyanide**, and metals,** if the data is quantitated as both.

3) Analysis of four digested LCSs can also be used to demonstrate capability. The analysis of an extractor's IDOC will also count as an analyst's IDOC, but only for the method(s) and matrix approved under the inorganic preparation rules.

Wet Chemistry

1) For wet chemistry analysts, precision and accuracy studies can be generated using the LCS for all methods**, as long as the LCS is from a second source**. Preliminary preparative steps required by a method must be followed for the LCS.

2) Information regarding cyanide IDOCs is given in the inorganics section of this memo.

3) Whenever possible, IDOC credit will be given to multiple methods based upon similar technologies.

On-going Demonstration of Capabilities (ODOC)/ Continuing Demonstration of Capabilities (CDOC)

1) Annually, an analyst must demonstrate continued proficiency for a procedure. This proficiency must be documented and approved following the same approach as the IDOC. The ODOC must be in the analyst's training file to allow continued performance of a test.

2) ODOC credit can be given for the successful completion of a PT sample or QC reference **material**. The sample must be a single blind to count in this category. This credit can be given for all similar technologies for the specific matrix.

3) ODOC credit can be given for the acceptable performance of four consecutive LCSs. **The successful performance of a Limit of Quantitation Study (LOQ) can be used to satisfy the ODOC requirement .** ODOC credit can be given for multiple methods using the rules defined for an IDOC.

4) **For extractions, ODOC credit is needed for each step of an extraction procedure. The five critical steps are the same as those stated in the IDOC procedure.**

5) **On-going Demonstrations of Capability are commonly referred to as Continuing Demonstrations of Capability.**

6) **Department of Defense (DoD) criteria must be met to satisfy ODOC/CDOC requirements for DoD methods.**

The QA department maintains summary tables of IDOC and ODOC information. Copies are currently available upon request. The supervisors and analysts are responsible for satisfying these requirements, performing these tests in a timely manner, and providing the data to the QA department.

Appendix C

Table of Contents for Standard Operating Procedures

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1.2.3.1	Preparation of Low Concentration Soil Samples for the Analysis of Volatile Compounds by EPA CLP
1.2.3.4	GC/MS Analysis of Aqueous and Medium Level Solids for Volatile Organic Compounds using USEPA SOW SOM01.2
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1.2.4.2	GC/MS Analysis of Trace Level Volatiles in Water by Scan and Selected Ion Monitoring using EPA CLP SOW SOM01.2
1.3.2.2	Analysis of Volatile Organic Compounds in Aqueous and Medium/High Concentration Soil Samples by SW-846
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1.3.2.4	GC/MS Analysis of Low Concentration Volatiles in Soil/Sediment/Sludge Samples by SW-846 Method 8260B
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SOP#	Title
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4.7	Organizing and Designating Raw Samples for Disposal
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4.9	Preparing and Handling Storage Blanks
4.12	Final Client Data Report Storage and Control
4.13	Handling & Verifying Proper Preservation of Samples Being Analyzed for Cyanides, Phenols, Organic Parameters, Total Kjeldahl Nitrogen (TKN), and Ammonia
4.14	Complete SDG File Organization and Assembly
4.15	Training Procedures for Receiving Personnel
4.16	Data Scanning Procedures
4.17	Glassware Shipping Procedures
5.1	CompuChem Subcontracting Contingency Plan
5.2	Resolution of Complaints and Inquiries for Commercial Clients
5.3	Use and Selection of Subcontract Laboratories
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5.7	Client Requested Customized Electronic Deliverables
5.8	Creating the Gray Folder
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8.1	Diazomethane Generation
8.2	Sonication Procedure
8.4	Training for Sample Preparation Personnel (Organics)
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SOP#	Title
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9.5	Training Procedures for Inorganic Sample Preparation Personnel
9.10	Distillation of Acids
10.1	Preparing Glassware for the Organics Sample Preparation Laboratory (Organics, Acid B/N Extractables, and Pesticides/PCBs)
10.2	Preparing Glassware for the Inorganics Laboratory
10.4	Cleaning Procedure for the Zero Headspace Extractor (ZHE) and Associated Glassware
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11.2.1.3	Training for GC/HPLC Personnel
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11.2.2.11	Training Procedures for Semivolatile GC/MS Personnel
11.3.1.4	Instrument Maintenance Procedures
11.3.1.5	Performing Quarterly and Annual Verification Studies of Method and Instrument Parameters for Inorganics
11.3.2.1	Wavelength Calibration Check for Spectronic 21D Spectrophotmeter
12.1	Hazardous Waste Disposal
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13.1	Creating New Standard Operating Procedures
13.2	Revising Standard Operating Procedures
13.4	Numerical Data Reduction
13.5	Assessing Blank Water Purity
13.6	Proper Documentation Procedures
13.11	Performing Organic Method Detection Limit and Verification Studies
13.12	Equipment Maintenance Records and Tag-Out Procedures
13.13	Creating and Updating Control Limits
13.15	Documenting Refrigerator and Freezer Temperatures
13.16	Top-Loading Balance Calibration and Maintenance
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13.19	Traceability of Purchased and Prepared Standard Reference Material, Solvents and Reagents
14.1.1.2	ThruPut Method Creation
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14.2.2.9	Semivolatile Case Review
14.2.2.10	Thru-Put* Method Creation and Verification (Einstein: Target 3.5)
14.3.1.2	Data Review of Inorganic Cases/SDGs for EPA/CLP, SW846, and Commercial Non-CLP
14.3.1.3	Case Review of SW-846 and Commercial Non-CLP
14.3.1.4	Case Review of EPA and non-EPA CLP Cases
14.3.1.6	Using MARRs Software to Produce EPA CLP Data Package Deliverables and Electronic Data Deliverables (EDDs)
14.3.2.1	Data Management: Wet Chemistry Data Review and Verification
15.1	Data Security
15.2	Software Documentation

SOP#	Title
15.4	System Backup and Archival for all UNIX and Windows-based Computer Systems
15.5	Assigning User Classes in Promium Element
15.13	Software Validation
16.1	Hiring, Training, and Promotion Qualifications Program
17.1	SOP Review, Distribution, and Document Control
17.2	Corrective Action Reports (CARs), Preventative Action Reports (PARs), and Documenting Exceptions
17.3	Quality Assurance Audits
17.4	Performing an Audit Trail/ThruPut/Target Audit
17.6	Performing an Audit of Sample Storage and Chain-of-Custody Procedures
17.7	Performing an Annual Audit of Safety Practices and Equipment
17.8	Performing a Reagent (Solvent and Chemical) and Standard Storage and Control Audit
17.10	Performing a Logbook and Record-Keeping Audit
17.12	Calibrating Laboratory Temperature Measurement Devices
17.13	Corrective Action Response Procedures for EPA CLP Evidence Audit Reports
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17.16	Precision, Accuracy, and Estimation of Measurement Uncertainty in the Laboratory
17.17	Document Control
17.18	Process for Product Development
17.19	Ethical Conduct and Data Integrity
17.20	Compiling Electronic Data for Data/Tape Audit Submissions to the U.S. Environmental Protection Agency (EPA)

Appendix D

Certification Summary Table

Accrediting Body	ID Number	Type
Connecticut Department of Public Health	PH-0522	State
Florida Department of Health	E87047	Primary NELAP accreditation
State of Illinois Environmental Protection Agency	200034	Secondary NELAP accreditation
State of Louisiana Department of Environmental Quality	AI 8366 03071	Secondary NELAP accreditation
Kansas Department of Health and Environment	**E-10392**	**Secondary NELAP accreditation**
New Jersey Department of Environmental Protection	NC249	Secondary NELAP accreditation
New York Department of Health	10065	Secondary NELAP accreditation
North Carolina Department of Environment, and Natural Resources	79	Home state certification
Ohio EPA Voluntary Action Program (VAP)	CL0060	State
Pennsylvania Department of Environmental Protection	68-00672	Secondary NELAP accreditation
South Carolina Department of Health and Environmental Control	99055002	State
Wisconsin Department of Natural Resources	999314910	State
Department of **Defense ELAP accredited through Laboratory Accreditation Bureau**	**L2251**	Agency
U.S. EPA Contract Laboratory Program (CLP)	LIBRTY	Agency
National Environmental Laboratory Accreditation Program (NELAP)	E87047	NELAP accreditation based upon FLDOH primary accreditation. Accepted by states marked on this **table,** OR, UT and the non-NELAC states: GA, ME, VT, and WA
U.S. Department of Agriculture	P330-09-00066	Permit to receive soil from foreign sources

Appendix E

NORTH CAROLINA
Department of The Secretary of State

To all whom these presents shall come, Greetings:

I, ELAINE F. MARSHALL, Secretary of State of the State of North Carolina, do hereby certify the following and hereto attached to be a true copy of

ARTICLES OF INCORPORATION

OF

LIBERTY ANALYTICAL CORPORATION

the original of which was filed in this office on the 16th day of July, 1996.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal at the City of Raleigh, this 6th day of November, 2008

Elaine F. Marshall

Secretary of State

Certification# 88721335-1 Reference# 9477123-ea Page: 1 of 2
Verify this certificate online at www.secretary.state.nc.us/verification

Appendix E (Continued)

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EFFECTIVE
JANICE H. FAULKNER
SECRETARY OF STATE
NORTH CAROLINA

ARTICLES OF INCORPORATION
OF
715 CORP.

The undersigned hereby submits these Article of Incorporation for the purpose of forming a business corporation under the laws of the State of North Carolina:

1. The name of the corporation is: 715 Corp.

2. The number of shares the corporation is authorized to issue is 100,000 of common stock.

3. The address of the initial registered office of the corporation in the State of North Carolina is 4300 Six Forks Road, Suite 700, Raleigh, Wake County, North Carolina 27609; and the name of its initial registered agent at such address is: Stephani W. Humrickhouse.

4. The name and address of the incorporator are: Stephani W. Humrickhouse, 4300 Six Forks Road, Suite 700, Raleigh, NC 27609.

5. To the fullest extent permitted by the North Carolina Business Corporation Act as it exists or may hereafter be amended, no person who is serving or who has served as a director of the corporation shall be personally liable to the corporation or any of its shareholders for monetary damages for breach of duty as a director. No amendment or repeal of this article, nor the adoption of any provision to these Articles of Incorporation inconsistent with this article, shall eliminate or reduce the protection granted herein with respect to any mattery that occurred prior to such amendment, repeal, or adoption.

6. These article will become effective upon filing.

This the 15th day of July, 1996.

Stephani W. Humrickhouse
STEPHANI W. HUMRICKHOUSE INCORPORATOR

Appendix E (Continued)

NORTH CAROLINA
Department of The Secretary of State

To all whom these presents shall come, Greetings:

I, ELAINE F. MARSHALL, Secretary of State of the State of North Carolina, do hereby certify the following and hereto attached to be a true copy of

ARTICLES OF AMENDMENT

OF

LIBERTY ANALYTICAL CORPORATION

the original of which was filed in this office on the 17th day of September, 1996.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal at the City of Raleigh, this 6th day of November, 2008

Elaine F. Marshall

Secretary of State

Certification# 88721336-1 Reference# 9477123-ea Page: 1 of 2
Verify this certificate online at www.secretary.state.nc.us/verification

Appendix E (Continued)

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ARTICLES OF AMENDMENT

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EFFECTIVE

JANICE H. FAULKNER
SECRETARY OF STATE

Pursuant to Statute 55-10-06 of the General Statutes of North Carolina, the undersigned corporation hereby submits the following Articles of Amendment for the purpose of amending its Articles of Incorporation:

1. The name of the corporation is: 715 Corp.

2. The following amendment to the Articles of Incorporation of the Corporation was duly adopted by unanimous consent of the Board of Directors and Shareholder of the Corporation on the 28th day of August.

   The name of the Corporation is changed to Liberty Analytical Corporation. There are no other changes to the Articles of Incorporation.

3. These Articles will be effective upon filing.

This the 5th day of September, 1996.

715 CORP.

By: _____
William R. Gates, President

N:\C.11.C\LIBERTY\AMEND.ART

Certification# 88721336-1 Reference# 9477123-ea Page: 2 of 2

Laboratory SOPs

CompuChem
A Division Of
Liberty Analytical Corp.

501 Madison Avenue
Cary, NC 27513

NELAP accredited

SOP DOCUMENTATION FORM

This form must accompany all new and revised Standard Operating Procedures (SOPs) when you turn them in to Quality Assurance for review. Please fill out the entire block below (except effective date).

This is a new procedure _____ revised procedure ✓ outdated procedure (archive) _____

- Procedure Code: IP 480B SOP Section #: 1.3.2.2 Revision #: 15

SOP Title: Analysis of Volatile Organic Compounds in Aqueous and Medium/High Concentration Soil Samples by SW-846

Effective date: (QA fills in) 4-11-11

- Procedure prepared by: _____ Date: 4.8.11
- Procedure approved by: (If the manager prepared the SOP, a qualified second party should sign) _____ Date: 4.11.11
- Reason for change: add additional DoD-QSM protocols and parameters, annual review
- This procedure meets the requirements of the following approved method references: SW-846 3RD Edition, Update III, 12/96, Method 8260B, Method 5030B, Method 5035; Dept. of Defense Quality Systems Manual for Environmental Laboratories, Version 4.2, 10/25/2010

Procedure approved by a QA Representative (unless QA Representative signed above):

_____ Date: _____

On an annual basis: Lab managers are required to review lab practices and revise the SOP if necessary. If no revision is necessary, indicate by your signature that the SOP has been reviewed.

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Instrument Procedure 480B: Analysis of Volatile Organic Compounds in Aqueous and Medium/High Concentration Soil Samples by SW-846

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Instrument Procedure 480B: Analysis of Volatile Organic Compounds in Aqueous and Medium/High Concentration Soil Samples by SW-846

1.0 Scope and Application

This is a general purpose method for the identification and simultaneous measurement of purgeable volatile organic compounds in a variety of aqueous matrices following SW-846 Method 8260B. It is also used to analyze medium to high level soil samples that have been extracted with methanol. The method is applicable to a wide range of organic compounds. It incorporates Method 5030B and Method 5035 (for medium/high concentration soil samples, extracted with methanol). Target compounds for this method, along with their associated internal standards and quantitation ions, are listed in Attachment 1. Note, however, that many of these compounds are not routinely analyzed.

The reporting limit is the low level calibration standard concentration. Reporting limits for this method are shown in Attachment 2.

Staff members performing the procedures described in this SOP are responsible for reading, understanding, and complying with the SOP requirements. Supervisors are responsible for directing the analyst to the controlled SOP, and providing adequate explanation of the material contained therein.

This procedure is restricted to use by or under the supervision of analysts experienced in the instrumentation or preparative methods and who have demonstrated the ability to generate acceptable results through QC samples and analyst capability studies.

2.0 Summary of Method

An inert gas (helium) is bubbled through a 5 mL or 25 mL aqueous sample spiked with internal standard and surrogate compounds. For medium/high level soil samples, an aliquot (typically 100 µL) of the methanol extract containing surrogates (See SOP 1.1.4.1) is added to 5 mL nitrogen-sparged reagent water. The sample is purged in a 40 mL VOA vial at ambient temperature, causing the purgeable volatile organic compounds to be transferred from the aqueous phase to the vapor phase. The vapor is swept onto a sorbent column where the purgeables are trapped. After purging is completed, the sorbent column is heated and back-flushed with the inert gas to desorb the purgeables onto a gas chromatograph (GC) wide-bore capillary column. The GC is temperature-programmed to separate the purgeables that are then detected with a mass spectrometer (MS). This SOP is NOT for use with Ohio VAP projects. Please see Ohio VAP specific SOP.

Note: For Method 8260B, a heated purge is also allowed.

3.0 Definitions

3.1 Method detection limit (MDL) – The minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte (40 CFR, Part 136, Appendix B.) **A minimum of seven sample replicates is required to calculate a statistical MDL. The MDL is an approximation of the DL. Any analyte concentration result at or above the MDL must also meet all qualitative identification criteria required by the test method in order to be reported as present.**

3.2 Detection Limit (DL) - The DL is the smallest analyte that can be demonstrated to be different from zero or a blank concentration at the 99 % level of confidence. The false positive rate at the DL is 1% and the false negative rate is 50%. Any analyte concentration result at or above the DL must also meet all qualitative identification criteria required by the test method in order to be reported as present.

3.3 Limit of Detection (LOD) – The LOD is the smallest concentration of an analyte that must be present in a sample in order to be detected at a 99% confidence level. The false negative rate at the LOD is 1 %. For DoD-QSM, non-detect sample results are reported as < LOD. Numeric values of measurements between the DL and the LOQ are reported as estimates. The DL < LOD ≤ LOQ.

3.4 Limit of Quantitation (LOQ) – The Limit of Quantitation is the lowest concentration of a substance that produces a quantitative result within specified limits of precision and bias. The LOQ must be within the calibration range.

3.5 Reporting Limit (RL) –

3.5.1 For Non-DoD work, the laboratory reporting limit is based on the lowest multipoint calibration standard concentration. For organic methods, values detected below the reporting limit and above the MDL may be reported and qualified as an estimated concentration.

3.5.2 The DoD-QSM defines the reporting limit as being the lowest concentration value specified by the client that meets project requirements for reporting data with known precision and bias for a specific analyte in a specific matrix. The LOQ cannot be greater than

the RL. Data reported below the RL must be flagged as estimated values if they are also less than the LOQ.

3.**6** Reporting Units – µg/L for water and µg/Kg for soil

3.**7** A Sample Delivery Group (SDG) is defined by the following, whichever is more frequent:

- each 20 field samples received within a case, or
- each 7 calendar day period during which field samples in a case are received (14 calendar days if requested by the client) beginning with the receipt of the first sample.

NOTE: The **DoD**-QSM and South Carolina Department of Health and Environmental Control (SC DHEC) do not accept the SDG approach, unless the samples are prepared in a single batch. When a group of up to 20 field samples of a similar matrix are prepared as one batch, method-specified QC samples such as a method blank, laboratory control sample, matrix spike, matrix spike duplicate, and matrix duplicate must also be prepared together. If samples are batched together from different sites, project-specific QC must be processed.

3.**8** SC DHEC – South Carolina Department of Health and Environmental Control

3.9 **DoD**-QSM – Department of Defense Quality Systems Manual

3.10 Marginal Exceedance – Beyond the LCS control limit but within the marginal exceedance limits (set at 4 standard deviations around the mean). This outside boundary prevents a grossly out-of-control LCS from passing.

3.11 Batch – a group of up to 20 field samples of a similar matrix, method-specified QC samples such as a method blank, laboratory control sample, matrix spike, matrix spike duplicate, and matrix duplicate prepared together at the same time.

3.12 LIMS – Laboratory Information Management System

4.0 Interferences

4.1 Impurities in the purge gas or methanol, organic compounds out-gassing from the plumbing ahead of the trap, and solvent vapors in the laboratory account for the majority of contamination problems. Gas lines from the gas tanks to the

instrument must be either stainless steel or copper tubing. Non-polytetrafluoroethylene (PTFE) thread sealants, or flow controllers with rubber components are not to be used. When potential interfering peaks are noted in laboratory method blanks, it may be necessary to reduce solvent contamination in the laboratory, purge the methanol used to prepare standard solutions, purge the DI water with helium or nitrogen, change the purge gas source, or regenerate the molecular sieve purge gas filter.

4.2 Samples can be contaminated by diffusion of purgeable organics (particularly methylene chloride, fluorocarbons, and other common laboratory solvents) through the septum seal into the sample during storage and handling. Therefore, these samples are stored in GC/MS VOA laboratory refrigerators; separate from laboratory standards, and they must be analyzed in a room in which the atmosphere is demonstrated to be free of all potential contaminants that will interfere with the analysis. Because methylene chloride will permeate PTFE tubing, all GC carrier gas lines and purge gas plumbing are to be constructed from stainless steel or copper tubing.

4.3 Contamination by carryover can occur whenever a sample is analyzed after a sample that contains high levels of organic compounds. Whenever an unusually concentrated sample is encountered, it must either be followed by analysis of an instrument blank or the next sample must be closely monitored to check for cross-contamination. For samples containing large amounts of water soluble materials, suspended solids, high boiling compounds, or high purgeable levels, it may be necessary to clean the purge and trap apparatus. Do so by purging a 10-20% methanol solution, followed by baking the purge and trap apparatus and the analysis of a DI water blank to confirm that the system is free from contamination. The trap and other parts of the system are also subject to contamination; therefore, frequent bake out and purging of the entire system may be required.

4.4 Instrument Problems/Preventative Maintenance

Instrument problems may interfere with the analysis. If a low response is observed for the early eluting compounds such as the gases, replacement of the trap or septum may be necessary. In addition, adjustments to the purge flow may be necessary to achieve a desired response for these compounds. If such adjustments do not help, it may be necessary to check the fittings on the purge and trap device and on the column for leaks. This is done with a helium leak detector and certain software utility programs. Column maintenance or replacement may be necessary if peak tailing or broad chromatographic peaks are observed.

5.0 Safety

5.1 The toxicity and carcinogenicity of many chemicals used in this method have not been precisely determined. Each chemical should be treated as a potential health hazard. Exposure to these chemicals should be minimized. Preparation of calibration standards, blanks, and samples is performed in a fume hood to minimize risk.

5.2 The following method analytes have been tentatively classified as known or suspected human or mammalian carcinogens: benzene, carbon tetrachloride, 1,2- dichloroethane, 1,1,2,2-tetrachloroethane, 1,1,2- trichloroethane, chloroform, 1,2-dibromoethane, trichloroethene, and vinyl chloride.

5.3 Appropriate protective equipment and clothing must be used under the assumption that all samples are potentially hazardous. During sample preparation, safety glasses, gloves and lab coats are a minimum requirement. The persistent presence of noxious odors may be indicative of failure of the laboratory ventilation system and must be reported to a supervisor or manager.

5.4 Laboratory staff members are required to review the Chemical Hygiene Plan for general safety policies, and Material Safety Data Sheets (MSDS) for solvents and reagents used in the laboratory. The MSDS are located in the Quality Assurance department.

6.0 Equipment and Supplies

6.1 Syringes

6.1.1 1 mL Hamilton syringe

6.1.2 500 µL Hamilton syringe

6.1.3 100 µL Hamilton syringe

6.1.4 50 µL Hamilton syringe

6.1.5 25 µL Hamilton syringe

6.2 Volumetric Flasks and Pipets

6.2.1 Assorted volumetric flasks ranging from 50 mL to 1000 mL

6.2.2 10 mL graduated pipette in 1/10 mL graduations

6.2.3 One mL mininert vials

6.3 Vials

6.3.1 40 mL screw-top, PTFE-lined, septum-sealed vials, with and without magnetic stirring bars

6.4 Analytical Column

6.4.1 Supelco SPB-624 60-m, 0.32mm ID with 1.8 um film thickness

6.4.2 Descriptions of alternative capillary columns are presented in EPA CLP SOW documents. Columns other than those listed may be used if equivalency is demonstrated. Specifications for equivalency are also presented in the SOW documents. The equivalency documentation must be maintained and made available during on-site audits

6.5 Purge and trap Autosampler System

6.5.1 Tekmar LSC

6.5.1.1 Tekmar, LSC 3000, LCS 3100 and Velocity XPT with glass frit bottom liquid sample purging vessel and Luerlock valve

6.5.1.2 The absorption trap must be at least 25 cm long and have an internal diameter of at least 0.105 inches (0.2667 cm).

6.5.1.3 The Supelco K (VOCARB 3000) trap consists of the following:

- Carbopack B, 10 cm
- Carboxen-1000, 6 cm
- Carboxen-1001, 1 cm

6.5.1.4 Alternate sorbent traps may be used if they meet the QC acceptance criteria. Performance documentation must be maintained and made available during an on-site audit.

6.5.2 Archon ALS

6.5.2.1 The Archon Model 5100, 4552 Purge and trap autosampler, interfaces directly to a Tekmar Purge and Trap Concentrators.

6.5.2.2 The autosampler is designed for soil samples and utilizes 40 mL VOA vials with low bleed Teflon septa.

6.5.2.3 The Archon ALS has the capacity of up to 51 vials.

6.5.3 Purge and Trap Analysis

6.5.3.1 After preparation, load each standard, blank, and sample onto the closed-system autosampler interfaced with the purge-and-trap apparatus.

6.5.3.2 Purge for 11 minutes at 40 ºC.

6.5.3.3 Heat the trap to 180 ^{o}C and desorb the trapped contents onto the GC column by back flushing the trap with inert gas for 4.0 (± 0.1) minutes.

6.5.3.4 Bake the trap for 7.0 (± 0.1) minutes at 220 to 260 ^{o}C.

6.6 Gas Chromatograph / Mass spectrometer

6.6.1 Hewlett Packard 5890 Series

6.6.2 Hewlett Packard 6890 Series

6.6.3 Agilent 6890N Series

6.6.4 Hewlett Packard 5972 Mass Selective Detector (MSD)

6.6.5 Hewlett Packard 5973 MSD

6.6.6 Hewlett Packard 6890MSD

6.6.7 Agilent Technologies 5975 MSD

6.7 HP/ Agilent GC conditions listed below:

- Column: 30m

- Carrier Gas: Helium
- GC mode: Capillary
- Injection Port Temperature: 230°C
- Interface Temperature: 230°C
- Initial Temperature: 40° C
- Final Temperature: 225° C
- Flow Rate: 35ml/minute

The listed column flow rate is approximate. The flow rate is adjusted to optimize the linear velocity of an un-retained compound (butane) through the column. The optimum linear velocity for a SPB-624 column is 30 - 45 cm/second.

6.8. Temperature Program

These temperature program conditions are provided as an example and may vary.

- HP/Agilent: 40 °C for 4.50 minute
- Ramp: 40 °C – 100 °C @ 20 °C/minute
- Ramp: 100 °C – 150 °C @ 25 °C/minute
- Ramp: 150 °C – 225 °C @ 33 °C/minute

6.9 Interface (GC to mass spectrometer)

6.9.1 Direct capillary interface at 225° C is used for Hewlett Packard MSDs.

6.10 Data system

6.10.1 The Hewlett Packard GC/MS systems utilize ChemServer software, for data acquisition.

6.10.2 For data processing, CompuChem uses the Hewlett Packard HP 9000 series 735 Unix Workstation employing Target3 and Envision software by Thru-Put Systems.

6.10.3 The reference library used is the NIST Library (NIST129K.1), G1033A version D.0500 purchased from Quantum Analytics Inc.

6.11 Data storage

Data are stored on the Target3 Unix Workstation. The Workstation is backed up incrementally on a daily basis.

6.12 Element DataSystem® LIMS computer software by Promium is used for sample management and report generation.

7.0 Reagents and Standards

Note: Detailed standard preparation information may be found in the Standard Preparation Logbook 11D(4), "GCMS VOA Standard Preparation Logbook", located in the Volatile Laboratory or in LIMS.

All standards are prepared in the Volatile Organic Laboratory. Stock Standards are stored separately from samples in Teflon- sealed screw-cap bottles with zero headspace at -10 to -20 ^{o}C in the freezer units in the instrument laboratory when not in use. Protect the standards from light. Standards for gases usually need to be replaced after one week or as recommended by the manufacturer, unless the acceptability of the standard can be documented. Standards for the non-gases must be monitored and fresh standards prepared if a 20% drift is experienced. These standards need to be replaced after six months or as recommended by the manufacturer, unless the acceptability of the standard can be documented. 2-chloroethyl vinyl ether (CEVE) and styrene may have to be prepared more frequently. Secondary dilutions of Stock Standards must be checked frequently for signs of degradation or evaporation, especially just prior to their use in preparing the working calibration standards. Working standards must be prepared just prior to analysis unless they are to be purged by an autosampler. When an autosampler is used, the standards may be kept up to 12 hours in purge vessels connected via the autosampler to the purge and trap device.

Note: All spiking standard information is entered into the LIMS. To obtain information on any standard, access Element, click on "Laboratory," and scroll down and access "Standards." Standards can be sorted by Department. Select the standard you would like to access. The view will show lot number, prepared dates, solvent, vendor, composition, and concentration.

Note: **All reagents and standards must be ACS (American Chemical Society) grade or equivalent, unless otherwise denoted.** All standards and reagents are subject to change in vendor and in concentration. The Reporting Limits are also subject to change, but must remain at or above the lowest point in the calibration

7.1 Reagent Water-All water used in this procedure must be equivalent to ASTM Type II water (as it relates to specific conductance and specific resistance) which is subsequently purged with an inert gas and demonstrated to meet the blank contamination acceptance criteria contained in this Standard Operating Procedure (SOP). It is referred to throughout the remainder of this SOP as DI water.

7.2 Methanol (B&J Scientific, purge and trap grade)

7.3 Tuning Standard

7.3.1 4-Bromofluorobenzene - Standard ID# 7008 at 25 µg/mL. 2 µL yielding 50 ηg on column, are injected onto the column every 12 hours.

7.3.1.1 Prepare the standard by adding 50 µL Restek VOA Tuning Mix 5000 µg/mL) to an amount of purge and trap grade methanol in a 10 mL volumetric flask and bring to volume.

7.4.1.2 Prepare this standard monthly.

7.4 Calibration Standards

7.4.1 For the initial calibration, the internal standard solution is added automatically by the Archon Purge and Trap Autosampler. For all subsequent analyses, both the internal standard and the surrogate solutions are added automatically by the Archon autosampler.

Standard Preparation Table 2

Std. ID TCL4-High	005 µg/L	010 µg/L	020 µg/L	050* µg/L	100 µg/L	200 µg/L
8260 I.S.	5.0 µL	5.0 µL	5.0 µL	5.0 µL	5.0 µL	5.0 µL
8260 S.S.	1.0 µL	2.0 µL	5.0 µL	10.0 µL	15.0 µL	20.0 µL
TCL4-1&2	1.0 µL	2.0 µL	4.0 µL	10.0 µL	20.0 µL	40.0 µL
TCL4-gases	1.0 µL	2.0 µL	4.0 µL	10.0 µL	20.0 µL	40.0 µL
TCL4-ketones	1.0 µL	2.0 µL	4.0 µL	10.0 µL	20.0 µL	40.0 µL
TCL4-AppIX	1.0 µL	2.0 µL	4.0 µL	10.0 µL	20.0 µL	40.0 µL

* Continuing Calibration level

7.4.1.1 To prepare the standards at the concentrations shown in the column headers of the preceding table, add the µL amount of standard shown to a 100 mL volumetric flask containing nitrogen sparged DI water, then bring up to volume.

Alternatively, the standards may be prepared at the above concentrations by diluting the 200 µg/L standard directly into the purge and trap impingers. Dilute as follows:

- For a 100 µg/L standard, add 2.5 mL to 5 mL DI water;
- For a 50 µg/L standard, add 1.25 mL to 5 mL DI water;
- For a 20 µg/L standard, add 0.50 mL to 5 mL DI water;
- For a 10 µg/L standard, add 0.25 mL to 5 mL DI water;
- For a 5 µg/L standard, add 0.125 mL to 5 mL DI water.

For a 25 mL purge analysis, increase both volumes by a factor of 5 when preparing standards by making dilutions.

Note: For samples submitted to meet the regulatory requirements of the State of South Carolina, this initial calibration curve must include a standard at 2 µg/L.

7.4.1.2 The concentration of the compounds in the TCL4-1 & 2 High standard is 500 µg/mL. See Attachment 5 for the composition of this standard.

7.4.1.2.1 Prepare the standard by adding 1.25mL Restek 502.2 VOA 2000 MegaMix (2000 µg/mL) to an amount of purge and trap grade methanol in a 5 mL volumetric flask and bring to volume.

7.4.1.2.2 Prepare this standard every three months.

7.4.1.3 The concentration of the compounds in the TCL4-gases High standard is 500 µg/mL. See Attachment 5 for the composition of this standard.

7.4.1.3.1 Prepare each standard by adding 1.25 mL Restek 502.2 Calibration Mix #1 (2000 µg/mL) to an amount of purge and trap grade methanol in a 5 mL volumetric flask and bring to volume.

7.4.1.3.2 The method states that this standard usually needs to be replaced weekly, unless the standard manufacturer recommends otherwise, or unless the acceptability of the standard can be documented. This standard has generally proven to be more stable in the laboratory. The gas standard can be used for longer than a week if the gases in the continuing calibration (CCV) standard meet the CCV requirements when compared to the initial calibration standards that contain a gas standard

that has been prepared within a one week holding time. Prepare this standard monthly, or more frequently as need dictates, or when degradation is evident rendering the standard unacceptable.

7.4.1.4 The concentrations of the compounds in the TCL4-ketones standard are 500 µg/mL, 1250 µg/mL, or 5000 µg/mL. See Attachment 5 for the composition of this standard.

7.4.1.4.1 Prepare the standard by transferring AccuStandard custom VOA Mix #2 to a mininert vial.

7.4.1.4.2 Replenish this standard as needed and replace every three months.

7.4.1.5 The concentrations of the compounds in the TCL4-AppIX standard are 500 µg/mL, 5000 µg/mL, or 25000 µg/mL. See Attachment 5 for the composition of this standard.

7.4.1.5.1 Prepare the standard by transferring AccuStandard custom VOA Mix #1 to a mininert vial.

7.4.1.5.2 Replenish this standard as needed and replace every three months.

7.5 Initial Calibration Verification

7.5.1 The initial calibration curve must be verified using a standard from an independent source. The laboratory purchases the initial calibration verification (ICV) standard from a different vendor than the one used for the calibration standards. This is prepared in the same manner as described above.

7.5.2 The ICV contains the full list of target analytes at the same concentration as the continuing calibration verification (CCV) standard.

7.6 Internal Standards

Compounds in 8260 I.S. (Internal standard) at a concentration of 50 µg/ml (250 ug/ml for the Archon)

- Fluorobenzene
- D5-chlorobenzene

- D4-1,4-dichlorobenzene

7.6.1 Prepare the internal standard spiking solution by adding 0.2 mL Restek 8260A ampulated internal standard mix (2500 µg/L to an amount of purge and trap grade methanol in a 10 ml volumetric flask and bring to volume.

7.6.2 Prepare this standard every three months.

7.7 Surrogate Standard

Compounds in 8260 S.S. (Surrogate Standard) at a concentration of 50 µg/mL (250 µg/mL for the Archon)

- Dibromofluoromethane
- D4-1,2-dichloroethane
- D8-toluene
- 4-bromofluorobenzene

7.7.1 Prepare the surrogate spiking solution by adding 0.2 mL Restek 8260A ampulated surrogate mix (2500 µg/mLl) to an amount of purge and trap grade methanol in a 10 mL volumetric flask and bring to volume.

7.7.2 Prepare this standard every three months.

7.8 Spike Standard

Compounds in 8260 Spiking Mixture (1001C) at a concentration of 25 µg/mL

- 1,1-dichloroethene
- Trichloroethene
- Benzene
- Toluene
- Chlorobenzene

Note: The spiking cocktail is project dependent. This spiking mixture can also be used as a Laboratory Control Sample (LCS) spike. Some projects may require full analyte spike, and in that case, the standard used for the full analyte spike LCS is the ICV. For some programs, the CCV may be used in the place of the LCS.

7.8.1 Prepare this standard by adding 100 µL Restek VOA Matrix Spike Mix to an amount of purge and trap grade methanol in a 10 mL volumetric flask and bring to volume.

7.8.2 Prepare this standard every six months.

7.9 Standard Storage

7.9.1 Store the stock standards in Teflon- sealed screw-cap bottles with zero headspace at -10 °C to -20 °C. Protect the standards from light. Standards for gases usually need to be replaced after one week or as recommended by the manufacturer, unless the acceptability of the standard can be documented. Standards for the non-gases should be monitored and fresh standards prepared if a 20% drift is experienced. These standards need to be replaced after six months or as recommended by the manufacturer, unless the acceptability of the standard can be documented. CEVE and styrene may have to be prepared more frequently.

7.9.2 Store secondary dilution standards in Teflon®-sealed screw-cap bottles with minimal headspace at -10 °C to -20 °C. Protect the standards from light. The secondary dilution standards must be checked frequently for signs of degradation or evaporation, especially just prior to their use in preparing the working calibration standards.

7.9.3 Aqueous working standards must be prepared just prior to analysis unless they are to be purged by an autosampler. When an autosampler is used, the standards may be kept up to 12 hours in purge vessels connected via the autosampler to the purge and trap device. If premixed certified solutions are used store according to manufacturer's documented holding time and storage temperature recommendations.

7.9.4 Purgeable standards are stored in GC/MS VOA Freezer #1, separate from other standards and samples.

8.0 <u>Sample Preservation and Storage</u>

8.1 Samples are preserved and stored according to the tables in Sample Control SOPs 4.1, “Receiving Samples” and 4.6, “Storing Samples.” Sample holding times are also listed.

8.1.1 Note that if 2-chloroethyl vinyl ether (CEVE) is a target compound of interest for the project, an unpreserved sample must be analyzed within 7 days of collection.

8.2 All samples must be analyzed within 14 days of collection.

8.3 Prior to analysis, all samples must be stored under refrigeration at 2 – 6 ^{o}C in the reach-in storage unit in the laboratory. After analysis, samples are returned to Sample Control for long-term storage and disposal.

9.0 Quality Control

9.1 Surrogates

9.1.1 All field and QC samples are spiked with the surrogate standard. Surrogates are used to assess the efficiency of the analytical system.

9.1.2 Surrogate compounds must meet the following percent recovery criteria.

Surrogate Compound	**Aqueous and Med./High Conc. Soil**	**Aqueous**
	5 mL purge	**25 mL purge**
Dibromofluorobenzene	66-128; 71-141	65-150
1,2-Dichloroethane-d_4	55-147; 70-139	59-150
Toluene-d_8	50-150; 72-123	61-145
4-bromofluorobenzene	70-132; 65-131	63-143

9.1.2.1 The same surrogates and recovery criteria are to be used for samples submitted to meet the regulatory requirements of the State of South Carolina.

The following table contains the surrogate recovery limits required by the **DoD**-QSM.

Surrogate Compound	Aqueous	Solid
Dibromofluorobenzene	85-115	N/A
1,2-Dichloroethane-d_4	70-120	N/A
Toluene-d_8	85-120	85-115
4-Bromofluorobenzene	75-120	85-120

9.1.3 Samples with surrogate recovery failures must be reanalyzed to confirm a matrix effect. Surrogate recovery failures in method blanks and LCS require reanalysis of the entire batch. Similar surrogate failures in the MS/MSD and original sample confirm a matrix effect and do not require reanalysis.

9.2 Internal Standards

9.2.1 The integrated areas of the quantitation ions of the internal standards are monitored in continuing calibration verification checks, samples, and QC for a change in retention time and response or sensitivity. These should remain reasonably constant over time.

9.2.1.1 Internal standard retention time and area responses must be assessed in each continuing calibration verification standard by comparison to the corresponding internal standard in the most recent initial calibration mid-point standard. Internal standard responses in samples and QC are compared to the most recent continuing calibration verification.

9.2.2 The area responses of the internal standards must be within 50-200% difference of the area responses compared to.

9.2.3 The retention time shift for the internal standards must be less than 30 seconds.

9.2.4 If any of these criteria cannot be met, the analytical system must be checked for malfunctions and corrections made. Re-analysis of any affected sample is required.

9.3 Method/Instrument Blanks

9.3.1 Before any samples are analyzed, it must be demonstrated through a laboratory reagent blank that the system is free of contamination that would prevent the determination of any analyte of concern. Sources of background contamination are glassware, purge gas, sorbents, and equipment. Background contamination must be reduced to an acceptable level before proceeding with the next analysis. In general, background contamination from method analytes should be below the reporting limit.

9.3.2 All blanks must be analyzed on a GC/MS system meeting the BFB, initial calibration, and continuing calibration verification acceptance criteria.

9.3.3 A method blank is analyzed with each batch of up to 20 samples processed as a group within a 12-hour tune. If more than 20 samples are analyzed in a tune batch, a second method blank is required. Method blanks must be analyzed immediately following a valid continuing calibration verification analysis

9.3.4 The concentration of the target compounds in the blank must be less than the reporting limit for each target compound, with the exception of the common laboratory contaminants acetone, 2-butanone, and methylene chloride, which must be <2X the reporting limit..

9.3.4.1 The **DoD**-QSM requires that the target compounds in the blank must be at a concentration of <½ the reporting limit and < the reporting limit for lab contaminants.

9.3.4.2 The SC DHEC requires that all compounds in the blank be less that the reporting limits except for the **common laboratory contaminants**, which must be <2X the reporting limit.

9.3.5 All samples processed within the same 12-hour tune with a method blank that does not meet the blank technical acceptance criteria must be reanalyzed. The chromatographic system must be inspected for malfunctions, and corrections must be made as required before more samples are analyzed.

9.4 Laboratory Control Sample

9.4.1 A laboratory control sample (LCS) is prepared and analyzed with each tune batch of up to 20 samples. The LCS and matrix spikes are spiked with the same target analytes. The LCS is spiked at the same concentration as the matrix spike. The LCS is spiked with all compounds of interest in the project.

9.4.2 The percent recovery criteria, developed from in-house statistical data, for the analytes in the full LCS are listed in Attachment 3.

9.4.2.1 The LCS control limits required by the DOD-QSM are listed in Attachment 6 along with the marginal exceedances.

9.4.2.2 The following table presents the DOD-QSM and 2003 NELAC Standards allowed number of marginal exceedances governed by the number of compounds spiked into the LCS.

Number of analytes in the LCS	Allowed number of Marginal Exceedances
> 90	5
71-90	4
51-70	3
31-50	2
11-30	1
< 11	0

The LCS fails if the more than the allowed number of marginal exceedances occur or if a spike recovery is outside of the marginal exceedance limits. The SC DHEC does not allow for marginal exceedances

9.4.3. Gases and known poor purging compounds

- gases: bromomethane
  chloromethane
  chloroethane
  vinyl chloride
  dichlorodifluoromethane
  trichlorofluoromethane
- acetone
- 2-butanone
- carbon disulfide
- crotonaldehyde
- 1,2-dibromo-3-chloropropane
- 1,4-dioxane
- isobutyl alcohol
- 2-hexanone
- 4-methyl-2-pentanone
- vinyl acetate

9.4.4 For SC DHEC, an expanded subset of analytes, representative of the compounds being reported, is employed and all analytes must have recovery limits within 70-130%. The analytes are:

- vinyl chloride
- 1,1-dichloroethene
- methylene chloride
- 1,1-dichloroethane
- cis-1,2-dichloroethene

- 2-butanone
- carbon tetrachloride
- benzene
- trichloroethene
- 1,2-dichloropropane
- bromodichloromethane
- tetrachloroethene
- chlorobenzene
- ethylbenzene
- styrene
- bromoform
- 1,4-dichlorobenzene

9.4.5 When the LCS fails to meet the acceptance criteria, the entire batch associated with it must be re-prepared and reanalyzed.

9.5 Matrix Spikes

9.5.1 A matrix spike and matrix spike duplicate (MS/MSD) are prepared and analyzed with every SDG.

9.5.2 Matrix spikes have the following advisory recovery criteria:

Spike Compound	Aqueous & med./high conc. soil % Recovery
1,1-dichloroethene	61-145; 59-172
Trichloroethene	71-120; 62-137
Benzene	76-127; 66-142
Toluene	76-125; 59-132
Chlorobenzene	75-130; 78-122
All others	50-150

9.5.3 Matrix spikes have the following advisory relative percent difference (RPD) criteria as shown in the following table.

Spike Compound	Aqueous & med./high conc. soil % RPD

Spike Compound	Aqueous & med./high conc. soil % RPD
1,1-dichloroethene	14; 22
Trichloroethene	14; 24
Benzene	11; 21
Toluene	13; 21
Chlorobenzene	13; 21
All others	25

9.5.4 Most spike compounds should meet these criteria. If the criteria are not met in the MS/MSD but are met in the LCS, the results may be reported with the failures attributed to the matrix of the sample. If the LCS does not meet criteria, then all will have to be repeated as discussed above.

9.5.5 To meet the requirements of the **DoD**-QSM, the duplicate matrix spikes should meet the LCS control limits listed in Attachment 6. The RPD between the duplicate matrix spikes should be ≤ 30%.

9.5.5.1 If the duplicate matrix spikes fail **DoD**-QSM acceptance criteria, contact the client for guidance.

9.5.5.2 If the original sample results are associated with failing duplicate matrix spikes, qualify the results in the narrative as estimated concentrations. Refer to the **DoD**-QSM "J" flag.

9.6 Initial Calibration Verification

9.6.1 A second source initial calibration verification (ICV) standard is run after the initial calibration standards have met criteria.

9.6.2 The ICV must be within 20% of its expected value for each target analyte and surrogate or within 40% for the poor purgers and the gases. Sporadic failure of up to three target compounds is allowed but they must not exceed 40% of their expected value; gases and poor purgers are listed above.

9.6.2.1 To meet the requirements for the **DoD**-QSM, the ICV must be ≤ 25% of its expected value for each target analyte.

9.6.3 If the ICV fails to meet the criteria in **Sections** 9.6.2 or 9.6.2.1, take corrective action and reanalyze the standard. If the ICV fails again, repeat the initial calibration.

9.7 MDL Studies

9.7.1 On an annual basis and after major maintenance, a method detection limit (MDL) study is performed on at least one instrument per method and matrix. When multiple instruments are used, individual instrument MDL studies may be replaced by the analysis of an MDL check sample. The MDL check sample must be analyzed on all instruments, to demonstrate equivalent sensitivity.

9.7.1.1 The **DoD**-QSM requires that the MDL check sample be prepared at about 2x the MDL and is analyzed on a quarterly basis for each matrix. A response must be detected in the 2x MDL check sample. Additionally, qualifying ions of 50% or higher must also be present. For more information on MDL studies, refer to QC SOP 13.11, "Performing Annual Method Detection Limit (MDL) Studies."

9.8 Contingency

9.8.1 If due to a lab accident or to QC failures, a re-preparation and analysis are required for the sample and insufficient sample volume remains, the Project Manager must be alerted and will contact the client for direction on how to proceed.

9.8.2 If persistent contamination occurs in the laboratory, analysis must be halted until the source of the contamination can be identified and isolated. When the contamination issue is resolved, samples analysis may proceed.

9.8.3 Refer to the corresponding Data Review SOP (number will vary among sections) for information on how to handle reporting of data that are unacceptable or out-of-control.

9.8.4 Any other issues that potentially effect data quality should also be addressed with the Project Manager.

10.0 <u>Calibration **and** Standardization</u>

10.1 BFB Tuning

10.1.1 The analysis of the instrument performance check solution is performed by injecting 50 ηg of BFB (2 µL STD ID#7008) into the GC using a 10 µL Hamilton syringe. BFB may be analyzed simultaneously with a continuing calibration verification standard as long as all QC criteria are met.

10.1.2 The peak selection criteria for BFB analysis are as follows (in order of performance):

10.1.2.1 Average one scan prior to the apex of the BFB peak to one scan after the apex, subtracting a single background scan prior to the peak, but no more than 20 scans prior to the elution of BFB. Also, do not subtract part of the BFB peak.

10.1.2.2 Choose the apex of the BFB peak only and include background subtraction.

Note: Background subtraction is performed to eliminate interference and when performed, the subtracted scan must be no more than 20 scans prior to the elution of the BFB and no scans within the BFB peak may be subtracted.

10.1.2.3 Choose a single scan or a range of scans within the BFB peak and include background subtraction.

10.1.3 The analysis of the instrument performance check solution must meet the ion abundance criteria given in the following table.

BFB Key Ions and Ion Abundance Criteria

Mass	Ion Abundance Criteria
50	15-40% of m/z 95
75	30-60% of m/z 95
95	Base Peak; 100% relative abundance
96	5-9% of m/z 95
173	<2% of m/z 174
174	>50% of m/z 95
175	5-9% of m/z 174
176	>95% but less than 101% of m/z 174

Mass	Ion Abundance Criteria
177	5-9% of m/z 176

10.1.4 BFB technical acceptance criteria must be met before any standards, samples, or required blanks are analyzed. Tune criteria must be met 12 hours. GC/MS tuning and Mass Calibration forms must be printed and attached to the instrument run log page for each tune. The relative abundance for each ion is calculated to two decimal places.

10.1.5 If BFB technical acceptance criteria are not met, retune the GC/MS system. It may also be necessary to clean the ion source, clean the quadrupole rods, or take other corrective action to achieve the technical acceptance criteria.

10.2 Initial Calibration

10.2.1 Prior to the analysis of samples and required blanks, and after the instrument performance check solution (BFB) criteria have been met, each GC/MS system must be calibrated at six concentrations to demonstrate instrument sensitivity and the linearity of responses for the purgeable target compounds.

10.2.2 Prepare standards according to the Initial Calibration Standard Preparation Table 2 in Section 7.4. All initial calibration standards must be analyzed at the concentration levels and frequency described in this SOP on a GC/MS system that meets the BFB technical acceptance criteria.

10.2.3 The area response of the characteristic ions in the extracted ion current profile (EICP) is tabulated against the concentration for each compound and internal standard. Relative response factors (RRF) are calculated for each compound.

10.2.4 Minimum relative response factors for the System Performance Check Compounds (SPCC) must be met and are listed in the following table.

Relative Response Factor Criteria for SPCCs

Volatile Compound	**Minimum RRF**
Chloromethane	0.10
1,1-dichloroethane	0.10
Chlorobenzene	0.30

Volatile Compound	**Minimum RRF**
Bromoform	0.10
1,1,2,2-tetrachloroethane	0.30

10.2.5 The following Calibration Check Compounds (CCC) have maximum % RSD criteria of ≤ 30%.

- 1,1-dichloroethene
- chloroform
- 1,2-dichloropropane
- toluene
- ethylbenzene
- vinyl chloride

10.2.5.1 The remaining compounds must have an RSD of ≤ 15%. If the % RSD is 15% or less, the average relative response factor may be used for quantitation. If the % RSD is greater than 15% then an alternate method for quantitation, such as a linear calibration using least squares regression or quadratic fit, may be used. When one of these options is used, the line must not be forced through the origin. The SC DHEC does not allow the use of a quadratic regression for any methods that have previously shown linearity.

If the linear or quadratic regression fit is used, the correlation coefficient must be ≥ 0.990. These alternate methods of quantitation are available in the ThruPut system.

Note: The **DoD**-QSM requires that the linear least squares regression correlation coefficient must be ≥ 0.995 and does not allow the used of quadratic fit.

Note: If quadratic regression is used the compound must historically exhibit a nonlinear response.

10.2.5.2 If the initial calibration does not meet the criteria above, corrective action is necessary.

- Check the instrument operating conditions and perform maintenance as necessary. It may be necessary to clean the ion source, perform column maintenance, change the

column, service the purge and trap device, or take other corrective action to achieve the technical acceptance criteria.

- Compare responses for the analyte in each of the standard levels to verify that a single standard analysis is not presenting results significantly higher or lower then the other standard analyses, as this would indicate that the standard solution was prepared in error. If that is the case, re-prepare and reanalyze the standard.

10.2.6 The initial calibration may still be acceptable when some analytes exceed the 15% RSD criteria, if the following conditions are met and allowed by the client:

- The mean of all %RSD values for the analytes (grand mean) is less than or equal to 15%.

- All analytes in the calibration standard must be included in the calculation.

- Non-CCC target compounds have a warning limit of 50% RSD and an action limit of 90% RSD when the "grand mean" approach is used. These limits have been inserted as default values into the data reduction software program. This is based strictly on established U.S. EPA data validation guidelines where values greater than 90% RSD result in rejection of data.

10.2.6.1 A summary of the initial calibration data and/or a list of the analytes not meeting the 15% RSD criteria with their actual %RSD must be included as a deliverable to our client. If the conditions in 10.2.6 are met, then the average relative response factor may be used to determine the concentration of analytes in samples.

Note: For samples submitted to meet the regulatory requirements of the State of South Carolina and the **DoD**-QSM, the grand mean option is not allowed.

10.2.7 The initial calibration verification must be analyzed after each initial calibration and must meet the acceptance criteria. If the ICV fails, then a new initial calibration curve must be generated.

10.3 Continuing Calibration Verification

10.3.1 Before the analysis of samples and blanks, but after BFB and initial calibration acceptance criteria have been met, each GC/MS system must be routinely checked by analyzing a continuing calibration verification standard. This standard must contain all purgeable target analytes and surrogate compounds. It is used to ensure that the instrument meets the sensitivity and linearity requirements of the method throughout the analytical sequence.

10.3.2 A check of the calibration curve must be performed once every 12 hours, beginning with the injection of BFB. A percent difference of the response for each compound compared to the mean relative response factor from the initial calibration is calculated when performing the average response factor model.

10.3.3 The calculated percent difference must be less than or equal to 20% (%D) for the CCCs listed above in Section 10.2.5. Minimum response factor criteria for the continuing calibration verification standard are also shown in Section 10.2.4.

10.3.3.1 If a regression fit model was used for analytes in the initial calibration, the continuing calibration verification is performed using percent drift (difference) for the CCCs.

10.3.4 As indicated for the initial calibration acceptance criteria, for the continuing calibration verification, the remaining target analytes (non-CCC compounds) do not have defined % difference criteria. We have established a warning limit of 50%D and an action limit of 90%D. These values have been inserted as defaults into the data reduction software program. This is based strictly on established U.S. EPA data validation guidelines where values greater than 90% RSD result in rejection of data.

10.3.4.1 For samples submitted to meet the regulatory requirements of the State of South Carolina, all non-CCC target analytes must be within 30% acceptance criteria, with the exception of the poor purgers listed in Section 9.4.3. The poor purgers should fall within 40% acceptance criteria.

10.3.5 If continuing calibration verification acceptance criteria cannot be met after inspection and normal maintenance, a new initial calibration will have to be performed.

Note: Method 8260B indicates that if the CCCs are not required analytes, then all required analytes, must meet the 20% difference criterion. Our typical analysis includes all of the CCCs.

11.0 Procedure

Documentation must follow the requirements in QC SOP 13.6: "Proper Documentation Procedures". All injections must be recorded on the instrument run log (Attachment 4) along with the date, time (use a 24 hour clock), the volume injected, operator ID, and any comments relevant to the injection.

All standards, blanks, samples and other required runs must be injected within exactly 12 hours from the time of the injection of BFB.

11.1 Instrument Software Conventions

11.1.1 Quantitation method: Average response factor

11.1.2 File naming conventions:

11.1.2.1 Name calibration standards and instrument blanks as follows:

YMDDZZZ-XXX#

where: Y = Year

M = Month (A=Jan. B=Feb…)

DD = two digit day

ZZZ = three digit sequence number

XXX = QC Type (Tun=BFB, ICV= Initial calibration, CCV=continuing cal)

= numerical order

11.1.2.2 Name sample analyses as follows:

CCN-##R# or CCN##D#

where: CCN = work order number designated for the sample by LIMs

= the sample number (typically 01-20)

R# = indicating reanalysis of the sample (R1, R2…)

D# = indicating diluted analysis of the sample (D1, D2…)

11.2 Analytical Sequence

11.2.1 Order of analysis for the instrument calibration

- BFB (tune)
- initial calibration
- initial calibration verification

11.2.2 Order of analysis for the twelve-hour tune

- BFB
- continuing calibration verification
- instrument blank
- laboratory control sample
- samples

11.2.3 In some cases, if tune time remains after the initial calibration standards have been run, samples may be analyzed as long as they are preceded by an acceptable instrument blank and LCS.

11.2.4 All samples must be analyzed on a GC/MS system meeting the BFB, initial calibration, continuing calibration verification, and instrument blank criteria.

11.3 Preparations

11.3.1 Standards

11.3.1.1 Load the standard solutions onto the purge and trap apparatus. Purge for 11 minutes at ambient temperature, or 40° C for heated purge, and desorb for 4 minutes, analyzing all target compounds.

11.3.2 Method/Instrument Blanks

11.3.2.1 Method/instrument blanks are prepared by filling one 25 mL or 5 mL gastight syringe with DI water and spiking with internal standard solution and surrogate solution.

11.3.3 Laboratory Control Sample spikes

11.3.3.1 Laboratory control samples (LCS) are prepared at 5.0 µg/L, with 5 µg/L of surrogates for 25 mL samples and at 50 µg/L, with 50 µg/L of surrogates for 5 mL samples.

11.3.3.2 For certain projects and programs, a full list spike is required.

11.3.4 Samples

11.3.4.1 Liquid samples are collected with zero headspace and provided to the laboratory in 40 mL or 60 mL screw-cap vials with Teflon-lined silicon septa. To prepare liquid samples for analysis, pour the sample into a 5 mL or 25 mL Hamilton gastight syringe. Replace the plunger and adjust the volume to 5 mL or 25 mL. Spike each 25 mL sample with 2.5 µL of internal standard and 2.5 µL of surrogate solutions through the bore of the syringe. Spike each 5 mL sample with 5 µL of internal standard and 5 µL of surrogate solutions. Inject syringe contents into a 40 mL vial and place on the autosampler for analysis.

11.2.4.1.1 Take the pH of each water sample. After the sample aliquot is taken, add a couple of drops to pH paper. Do not add pH paper to sample vials. Record the pH of each sample on the batch sheet and GC/MS run log. No pH adjustment is to be performed.

11.3.4.2 Methanol extracts of medium/high concentration soil samples are contained in an autosampler vial capped with a Teflon-faced septum. The vial contains 1 mL of the methanol extract that also contains surrogates. A 5 mL Hamilton gastight syringe is filled with DI water and adjusted to 4.9 mL. The plunger is pulled back to 5.0 mL to allow for the addition of the methanol extract and internal standard solution. Add 100 µL of the methanol extract and 5.0 µL of internal standard solution to the syringe. Based on prior or screening results, if less than 100 µL of the methanol extract is required in order to get target analytes within the initial calibration range, add an additional amount of

methanol to total 100 µL. Inject the contents of the syringe into a 40 mL vial and place on the autosampler for analysis.

11.3.4.3 For further details, see Sample Preparation Procedure –238, "**Preparation of Soil/Sediment/Sludge/Non-aqueous Waste Samples for the Analysis of Volatile Organic Compounds by Closed-System Purge and Trap by SW-846 Methods 5035A and 3585, and EPA CLP SOW OLM04.3**", SOP 1.1.4.1**.**

11.3.6 Matrix Spikes

11.3.6.1 For matrix spikes, in addition to spiking internal standard solution and surrogate solution, also add 5.0 µL of 8260B spike solution. For certain projects, a full target list matrix spikes are required. For medium/high concentration soil samples, the spiking solution is added at the time of the methanol extraction.

11.4 Analysis

11.4.1 Purge the sample for 11.0 (± 0.1) minutes.

11.4.2 After purging, the purge and trap apparatus will desorb onto the GC column by elevating the trap temperature to 260 °C and back-flushing the trap with helium for 4 minutes at 20 to 60 mL/minute.

11.4.3 After desorbing, the trap is reconditioned by baking at 260 °C for at least 7 minutes. When the trap has finished baking and is cool, it is ready for the next sample to be purged.

11.4.4 In each analytical run, all analytes must fall below the maximum calibration range established by the highest standard in the initial calibration. If an analyte is present at a concentration higher than the highest initial calibration standard, it must be reanalyzed at a lesser amount or dilution. A valid dilution is one in which the compound in question falls within the mid and high point calibration standard concentration.

11.5 Target Compound Identification

11.5.1 Target compounds are identified in the samples by analyzing standards under the same condition. Resultant mass spectra are compared to established library spectra and GC retention times are compared to retention times from the most recent continuing calibration standard. The

mass spectrum of the sample compound and a laboratory library-generated spectrum must match according to the following criteria.

11.5.1.1 All ions present in the library mass spectrum at a relative intensity >10% must be present in the sample spectrum.

11.5.1.2 The relative intensities of ions specified above must agree within ± 20% between the library and sample spectra.

11.5.1.3 Ions >10% in the sample spectrum but not present in the library spectrum must be considered and accounted for. (These ions may be a result of co-eluting/closely-eluting compounds.)

11.5.2 If a compound analyzed by GC/MS techniques cannot be verified by all of the criteria listed above, but in the technical judgment of the mass spectral interpretation specialist the identification is correct, then the laboratory will report that identification.

11.5.3 Non-target compounds (tentatively identified compounds or TICs) are identified by comparing the mass spectra from the TICs to mass spectra contained in the National Institute of Standards and Technology (NIST) Mass Spectral Library.

11.6 Qualitative Analysis of Non-Target Compounds

11.6.1 Tentatively identify all compounds in the sample that have not already been identified as target compounds, or that are not surrogates, internal standards or semivolatile target compounds, by performing a computer-generated library search using the NIST 129K.1 mass spectral library (See Section 6.6.2). The library search must not be normalized.

11.6.2 Up to 30 tentatively identified compounds (TICs), including alkanes, of the greatest concentration are reported for each sample. The number of TICs required may vary, depending on project requirements.

11.6.3 Rules for making tentative identification:

11.6.3.1 TICs receiving a library search match of 85% or higher are considered a “probable match”. Report the compound identified.

11.6.3.2 For TICs receiving more than one library search match of 85% or higher, report the compound with the highest percent match.

11.6.3.3 For TICs receiving two or more library search matches of 85% or higher with the same percent match, report the first compound.

11.6.3.4 For TICs that are isomers receiving library search matches of 85% or higher, report the compound with the highest percent match.

Note: If in the opinion the experienced analyst/data reviewer there is sound technical evidence not to identify the compound as specified in sections 11.6.3.1 to 11.6.3.4 the justification must be documented in the narrative.

11.6.3.5 TICs receiving a library search match of < 85% are given a tentative identification by the analyst/data reviewer, if possible. If no identification can be made the TIC is reported as "unknown". If possible the unknown is further identified as part of a class of compounds (for example "unknown aromatic").

11.7 Quantitation

11.7.1 A relative response factor is established for each target and surrogate compound during the initial and continuing calibration verification procedures. Quantitation of target analytes is based on the mean relative response factor from the initial calibration curve.

11.7.2 Secondary ion quantitation is allowed only when there are sample matrix interferences with the primary ion. If secondary ion quantitation is performed, document the reasons in the SDG narrative.

11.7.3 TICs are quantified by comparing the mass spectral response from the reconstructed ion chromatogram (RIC) for the TIC peaks to the mass spectral response for a peak produced by the nearest internal standard compound. A response factor of 1 is assumed.

12.0 Data Analysis and Calculations

Calculations must be consistent with the QC SOP 13.4: "Numerical Data Reduction".

12.1 Calculation of the mean or average of a set of values:

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

where: n = total number of values
x_i = each individual value used to calculate the mean
x = the mean of n

12.2 Calculation of the standard deviation of a set of values:

$$\text{Standard deviation} = \sqrt{\frac{\sum_{i=1}^{n}\left(X_n - \overline{X}\right)^2}{n-1}}$$

12.3 Calculation of percent recovery:

12.3.1 LCS and surrogates:

$$\%R = \frac{Amount\ found}{Amount\ spiked}\ x\ 100$$

12.3.2 Matrix spikes:

$$\%\ R = \frac{Amount\ in\ spiked\ sample - Amount\ in\ unspiked\ (native)\ sample}{Amount\ spiked}\ x\ 100$$

12.4 Calculation of % RSD

$$\%RSD = \left(\frac{Standard\ deviation}{\overline{X}}\right) \times 100$$

12.5 Calculation of RPD

$$RPD = \frac{|Value\ 1\ -\ Value\ 2|}{\left(Value\ 1\ +\ Value\ 2\right)/2}\ x100$$

12.6 Calculation of %Difference (%D)

$$\%Diff = \frac{Value\ -\ \overline{Reference\ \ value}}{\overline{Reference\ \ value}}\ x\ 100$$

12.7 Relative Response Factor

$$RRF = \frac{Ax\ x\ C(is)}{A(is)\ x\ Cx}$$

where:
- Ax = Area of the characteristic ion (EICP) for the compound to be measured
- A(is) = Area of the characteristic ion (EICP) for the specific internal standard
- C(is) = Concentration of the internal standard (in µg/L)
- Cx = Concentration of the compound to be measured

12.8 Linear Calibration using Least Squares Regression

$$y = ax + b$$

where:
- y = Instrument response (peak area)
- a = Slope of the line (coefficient of x)
- x = Concentration of the calibration standard
- b = The intercept

12.9 Concentration

12.9.1 The area response of the characteristic ions in the extracted ion current profile (EICP) is tabulated against the concentration for each compound and internal standard.

12.9.2 Concentration of aqueous samples by GC/MS analysis using relative response factor:

$$\mu g / L = \frac{(Ax)(Is)(Df)}{(Ais)(\overline{RRF})(Vo)}$$

where:
- Ax = area of the characteristic ion from the EICP for the compound to be measured
- Ais = area of the characteristic ion for the EICP for the internal standard
- Is = amount of internal standard added (ng)
- $\overline{RRF}$ = mean relative response factor from initial calibration standards
- Vo = volume of water purged in milliliters
- Df = dilution factor. If no dilution, Df = 1.0

12.9.3 Concentration of medium level soil samples <u>(dry weight basis)</u> by GC/MS

$$\mu g / kg = \frac{(Ax)(Is)(Df)(Vt)(1000)}{(Ais)(\overline{RRF})(Ws)(Va)(D)}$$

where: Ax, Ais, Is, $\overline{RRF}$ are the same as given for water

Df = Dilution factor which, for medium/high concentration soil extract is defined by the following formula:

$$\frac{\mu L \text{ concentrated extract used for dilution} + \mu L \text{ clean solvent}}{\mu L \text{ concentrated extract used for dilution}}$$

Vt = Total volume of methanol extract, in mL

Note: This is typically 10 mL or 5 mL even though only 1 mL is transferred to the autosampler vial.

Ws = Weight of soil/sediment sample extracted, in grams (g)
Va = Volume of the aliquot of methanol extract

Note: Typically this is 100 µL but can be the volume of sample extract (not including the methanol added to equal 100 µL) in µL added to DI water.

Ws = weight of sample extracted, in grams

D (dry weight) = $\frac{100 - \%\text{ moisture}}{100}$

12.9.4 Concentration of aqueous and soil samples by GC/MS using quadratic (second order) fit in Target:

$$y = [n]\left[b + m^1\ (Rsp) + m^2\ (Rsp\text{^}2)\right]$$

where: b = constant
m^1 = multiplier for the unsquared term
m^2 = multiplier for the squared term
x = area of analyte/area of Internal Standard
n = amount of Internal Standard
y = concentration in ng on column
Rsp = area of analyte/area of Internal Standard

Example: Area of acetone = 35659

Area of IS = 613275
b = -0.0909161
m^1 = 9.605304
m^2 = 7.132688
ηg of IS = 250
response = 35659/613275 = 0.058145

Amount in ηg on column =

$$(250\,\eta g)[-0.0909161 + 9.605304 \;x\; 0.058145 + 7.132688 \;x\; 0.058145\;\text{^}2] = 122.9\eta g$$

Concentration (water) $\mu g / L = \dfrac{(122.9\eta g)(Df)}{(Vo)}$

Concentration (soil) $\mu g / Kg = \dfrac{122.9\eta g}{(Ws)(D)}$

12.9.5 Concentration of aqueous and soil samples by GC/MS using linear regression analysis:

$$\frac{A_s C_{is}}{A_{is}} = aC_s + b$$

$$C_s = \frac{\left[\dfrac{A_s C_{is}}{A_{is}} - b\right]}{a}$$

where:
As = Area of the target analyte peak in the sample
Ais = Area of the internal standard peak
Cs = Concentration of the target analyte in the calibration standard
Cis = Concentration of the internal standard
a = Slope of the line (coefficient of Cs)
b = The intercept

Concentration (water) $\mu g / L = \dfrac{(Cs)(Df)}{(Vo)}$

Concentration (soil) $\mu g / Kg = \dfrac{Cs}{(Ws)(D)}$

12.9.6 Tentatively Identified Compound (TIC) Estimation

$$TIC\ Amount\ (water)\ \mu g/L = \frac{(Area\,TIC)\ \text{x}\ Amount\ (Std)(Df)}{Area(IS)\ x\ 1(RF)\ \text{x}\ (Vo)}$$

$$TIC\ Amount\ (soil)\ \mu g/Kg = \frac{(Area\,TIC)\ \text{x}\ Amount\ (Std)(Df)(Vt)}{Area\ (IS)\ x\ 1(RF)\ \text{x}\ (Vi)(Ws)(D)}$$

where:

Area (TIC)	=	area response from RIC for non-target compound
Amount (Std)	=	amount of internal standard added to the sample, in µg/L.
Area (IS)	=	area response of the nearest internal standard in the reconstructed ion chromatogram
1(RF)	=	assumed response factor of 1

12.10 Calculating Dilutions

12.10.1 The dilution factor for analysis of water samples for volatiles by this method is defined as the ratio of the number of milliliters of water purged (i.e., Vo above) to the number of milliliters of the original water sample used for purging. For example, if 12.5 mL of sample is diluted to 25.0 mL with DI water and purged, Df = 25.0 mL/12.5 mL = 2.0. If no dilution is performed, Df = 1.0.

If a methanol extract contains an analyte that exceeds the high level standard a dilution must be performed. Determine a level of dilution that will result in a value within the upper half of the calibration range. This is an acceptable dilution. Example: A 10x dilution is performed using 1 mL sample plus 9 mL diluent for a total volume of 10 mL. It should be recorded on the run log as "10x (1 mL in 10 mL)."

13.0 Method Performance

This method was validated through in-house laboratory studies of method detection limits and precision and accuracy for single analyst. The data are retained by the QA department.

14.0 Pollution Prevention

The solvents used in this procedure pose little threat to the environment when recycled and managed properly. Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The EPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency recommends recycling as the next best thing. See SOP 12.1, "Hazardous Waste Disposal", regarding laboratory procedures for recycling solvent waste streams.

15.0 Waste Management

It is the laboratory's responsibility to comply with all federal, state, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions, and to protect the air, water, and land by minimizing and controlling all releases from fume hoods and bench operations. Compliance with all sewage discharge permits and regulations is also required.

Samples preserved with HCl, HNO_3, or H_2SO_4 to pH <2 are hazardous and must be neutralized before being disposed, or must be handled as hazardous waste.

Refer to the Hazardous Waste Management and Safety SOPs located in the lab.

16.0 References

16.1 "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", SW-846, 3rd Edition, Update III, 12/96, Method 8260B, Methods 5030B and 5035

16.2 Standard Methods for the Examination of Water and Wastewater, 20th Edition (1998), Method 1080

16.3 Code of Federal Register, 40 CFR, Part 136, "Guidelines for Establishing Test Procedures for Priority Pollutants"

16.4 QC SOP 13.6: "Proper Documentation Procedures"

16.5 QC SOP 13.4: "Numerical Data Reduction"

16.6 NELAC Standards, effective July 2003, plus revisions

16.7 QA/G6: Guidance for Preparing Standard Operating Procedures (SOPs) EPA/600/B-07/001, April 2007.

16.8 Department of Defense Quality Systems Manual for Environmental Laboratories, Version 4.**2**, **10**/**25**/**2010**

16.9 CompuChem Quality Manual, Revision 13, November 17, 2009

16.10 Sample Control SOP 4.1, "Receiving Samples"

16.11 Sample Control SOP 4.6, "Storing Samples"

16.12 QC SOP 13.11, "Performing Annual Method Detection Limit (MDL) Studies"

17.0 Attachments as Tables, Diagrams, and Flowcharts

17.1 Attachment 1 – Target Analyte List

17.2 Attachment 2 – Target Analyte Reporting Limits

17.3 Attachment 3 – In-house Statistical Control Limits

17.4 Attachment 4 – **Example** Instrument Run Log

17.5 Attachment 5 – Standard Certificate of Analysis

17.6 Attachment 6 – **DoD**-QSM LCS Control Limits

Attachment 1

Volatile Target Compounds

Compounds	Internal Standard	Primary Quantitation Ion	Secondary Quantitation Ion(s)
dichlorodifluoromethane	1	85	87
chloromethane	1	50	52
vinyl chloride	1	62	64
bromomethane	1	94	96
chloroethane	1	64	66
trichlorofluoromethane	1	101	103
diethyl ether	1	74	45, 59
1,1-dichloroethene	1	96	61, 98
methylene chloride	1	84	49, 86
trans-1,2-dichloroethene	1	96	61, 98
1,1-dichloroethane	1	63	65, 83
2,2-dichloropropane	1	77	97
cis-1,2-dichloroethene	1	96	61, 98
bromochloromethane	1	128	49, 130
chloroform	1	83	85, 47
1,1,1-trichloroethane	1	97	99, 61
carbon tetrachloride	1	117	119, 121
1,1-dichloropropene	1	75	110, 77
benzene	1	78	77, 51
1,2-dichloroethane	1	62	98, 64
trichloroethene	1	130	95, 97
1,2-dichloropropane	1	63	39, 41
dibromomethane	1	174	93, 95
bromodichloromethane	1	83	85, 127
2-chloroethyl vinyl ether	1	63	65, 106
cis-1,3-dichloropropene	1	75	77, 110
acrolein	1	56	55, 38
iodomethane	1	142	127, 141
1,1,1-trichloro-2,2,2,-trifluoroethane	1	117	151, 153
1,1,2-trichloro-1,2,2,-trifluoroethane	1	85	101, 151
carbon disulfide	1	44	78, 76
acetone	1	43	58
3-chloropropene	1	39	41, 76
acetonitrile	1	41	39, 38
acrylonitrile	1	53	52, 51

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Attachment 1 (continued)

Volatile Target Compounds

Compounds	Internal Standard	Primary Quantitation Ion	Secondary Quantitation Ion(s)
methyl-tert-butyl ether	1	73	41, 43
vinyl acetate	1	43	86
2-butanone	1	43	57, 72
propionitrile	1	54	55, 52
methacrylonitrile	1	41	39, 67
1,4-dioxane	1	88	58
methylmethacrylate	1	69	100, 41
Surrogate #1: dibromofluoromethane	1	113	111, 192
Surrogate #2: 1,2-dichloroethane-d_4	1	65	102, 67
4-methyl-2-pentanone	2	43	85, 100
toluene	2	92	91
trans-1,3-dichloropropene	2	75	77, 110
1,1,2-trichloroethane	2	97	83, 85
ethylmethacrylate	2	69	41, 99
tetrachloroethene	2	164	168, 129
1,3-dichloropropane	2	76	78
2-hexanone	2	43	58, 71
dibromochloromethane	2	129	127, 48
1,2-dibromoethane	2	107	109, 81
chlorobenzene	2	112	114, 77
1,1,1,2-tetrachloroethane	2	131	119, 133
ethylbenzene	2	106	91
m,p-xylene	2	106	91
o-xylene	2	106	91
styrene	2	104	78, 103
bromoform	2	173	175, 254
isopropyl benzene	2	105	120
bromobenzene	2	156	77,158
1,1,2,2-tetrachloroethane	2	83	85, 131
1,2,3-trichloropropane	2	110	75, 112
trans-1,4-dichloro-2-butene	2	53	88, 90
Surrogate #3: d_8-toluene	2	98	70, 100

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Attachment 1 (continued)

Volatile Target Compounds

Compounds	Internal Standard	Primary Quantitation Ion	Secondary Quantitation Ion(s)
n-propyl benzene	3	91	120
2-chlorotoluene	3	126	91
4-chlorotoluene	3	126	91
1,2,4-trimethyl benzene	3	105	120
1,3,5-trimethyl benzene	3	105	120
Pentachloroethane	3	167	130, 165
sec-butyl benzene	3	105	134
1,2-dichlorobenzene	3	146	111, 148
1,3-dichlorobenzene	3	146	111, 148
1,4-dichlorobenzene	3	146	111, 148
n-butyl benzene	3	91	92, 134
tert-butyl benzene	3	119	91, 134
p-isopropyl toluene	3	119	134, 91
1,2-dibromo-3-chloropropane	3	157	75, 39
1,2,4-trichlorobenzene	3	180	182, 145
hexachlorobutadiene	3	225	223, 227
naphthalene	3	128	64, 51
1,2,3-trichlorobenzene	3	180	182, 145
Surrogate #4: 4-bromofluorobenzene	3	95	174, 176
Internal Standard #1: fluorobenzene	NA	96	70
Internal Standard #2: chlorobenzene-d_5	NA	117	82, 119
Internal Standard #3: 1,4-dichlorobenzene-d_4	NA	152	150

Attachment 2

8260B Reporting Limits

CAS#	Compound	5-mL (µg/L)	25-mL (µg/L)	5-grams (µg/Kg)
630-20-6	1,1,1,2-Tetrachloroethane	5	0.5	5
354-58-5	1,1,1-Trichloro-2,2,2-trifluoroethane	5	0.5	5
71-55-6	1,1,1,-Trichloroethane	5	0.5	5
79-34-5	1,1,2,2-Tetrachloroethane	5	0.5	5
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane	5	0.5	5
79-00-5	1,1,2-Trichloroethane	5	0.5	5
75-34-3	1,1-Dichloroethane	5	0.5	5
75-35-4	1,1-Dichloroethene	5	0.5	5
563-58-6	1,1-Dichloropropene	5	0.5	5
87-61-6	1,2,3-Trichlorobenzene	5	0.5	5
96-18-4	1,2,3-Trichloropropane	5	0.5	5
120-82-1	1,2,4-Trichlorobenzene	5	0.5	5
95-63-6	1,2,4-Trimethylbenzene	5	0.5	5
96-12-8	1,2-Dibromo-3-Chloropropane	5	0.5	5
106-93-4	1,2-Dibromoethane	5	0.5	5
95-50-1	1,2-Dichlorobenzene	5	0.5	5
107-06-2	1,2-Dichloroethane	5	0.5	5
78-87-5	1,2-Dichloropropane	5	0.5	5
108-67-8	1,3,5-Trimethylbenzene	5	0.5	5
541-73-1	1,3-Dichlorobenzene	5	0.5	5
142-28-9	1,3-Dichloropropane	5	0.5	5
106-46-7	1,4-Dichlorobenzene	5	0.5	5
123-91-1	1,4-Dioxane	250	25	250
594-20-7	2,2-Dichloropropane	5	0.5	5
78-93-3	2-Butanone	12.5	2.5	12.5
110-75-8	2-Chloroethyl vinyl ether	5	5	5
95-49-8	2-Chlorotoluene	5	5	5
591-78-6	2-Hexanone	12.5	2.5	12.5
107-05-1	3-Chloropropene	5	5	5
106-43-4	4-Chlorotoluene	5	5	5
108-10-1	4-Methyl-2-pentanone	12.5	2.5	12.5
67-64-1	Acetone	12.5	2.5	12.5
75-05-8	Acetonitrile	5	5	5
107-02-8	Acrolein	50	5	50

N/A = Not Applicable to matrix

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Attachment 2 (continued)

8260B Reporting Limits

CAS#	Compound	5-mL µg/L	25-mL µg/L	5 grams µg/Kg
107-13-1	Acrylonitrile	50	5	50
71-43-2	Benzene	5	0.5	5
108-86-1	Bromobenzene	5	0.5	5
74-97-5	Bromochloromethane	5	0.5	5
75-27-4	Bromodichloromethane	5	0.5	5
75-25-2	Bromoform	5	0.5	5
74-83-9	Bromomethane	5	0.5	5
75-15-0	Carbon disulfide	5	0.5	5
56-23-5	Carbon Tetrachloride	5	0.5	5
108-90-7	Chlorobenzene	5	0.5	5
75-00-3	Chloroethane	5	0.5	5
67-66-3	Chloroform	5	0.5	5
74-87-3	Chloromethane	5	0.5	5
126-99-8	Chloroprene	5	0.5	5
156-59-2	cis-1,2-Dichloroethene	5	0.5	5
10061-01-5	cis-1,3-Dichloropropene	5	0.5	5
110-82-7	Cyclohexane	5	0.5	5
124-48-1	Dibromochloromethane	5	0.5	5
74-95-3	Dibromomethane	5	0.5	5
75-71-8	Dichlorodifluoromethane	5	0.5	5
100-41-4	Ethylbenzene	5	0.5	5
97-63-2	Ethylmethacrylate	50	5	50
87-68-3	Hexachlorobutadiene	5	0.5	5
74-88-4	Iodomethane	5	0.5	5
78-83-1	Isobutyl alcohol	250	25	250
89-82-8	Isopropyl Benzene	5	0.5	5
108-20-3	Isopropyl ether	5	0.5	5
108-38-3	m,p-Xylene	10	1	10
126-89-7	Methacrylonitrile	50	5	50
79-20-9	Methyl acetate	5	0.5	5
108-87-2	Methylcyclohexane	5	0.5	5
75-09-2	Methylene Chloride	5	0.5	5
80-62-6	Methylmethacrylate	50	5	50
1634-04-4	Methyl-tert-butyl ether	5	0.5	5
91-20-3	Naphthalene	5	0.5	5
104-51-8	n-Butyl Benzene	5	0.5	5
110-54-3	n-Hexane	N/A	0.5	N/A

N/A = Not Applicable to matrix

ORIGINAL MASTER COPY CONTROLLED COPY
If words above are not highlighted, this is an uncontrolled copy of this document.

Attachment 2 (continued)

8260B Reporting Limits

CAS#	Compound	5-mL µg/L	25-mL µg/L	5 grams µg/Kg
103-65-1	n-Propyl Benzene	5	0.5	5
95-47-6	o-Xylene	5	0.5	5
76-01-7	Pentachloroethane	5	0.5	5
99-87-6	p-Isopropyl Toluene	5	0.5	5
107-12-0	Propionitrile	250	0.5	250
135-98-8	sec-Butyl Benzene	5	0.5	5
100-42-5	Styrene	5	0.5	5
98-06-6	tert-Butyl Benzene	5	0.5	5
127-18-4	Tetrachloroethene	5	0.5	5
109-99-9	Tetrahydrofuran	N/A	2	20
108-88-3	Toluene	5	0.5	5
156-60-5	trans-1,2-Dichloroethene	5	0.5	5
10061-02-6	trans-1,3-Dichloropropene	5	0.5	5
110-57-6	trans-1,4-Dichloro-2-butene	100	20	100
79-01-6	Trichloroethene	5	0.5	5
75-69-4	Trichlorofluoromethane	5	0.5	5
108-05-4	Vinyl acetate	5	1	5
75-01-4	Vinyl Chloride	5	0.5	5
1330-20-7	Xylene (total)	15	1.5	15

N/A = Not Applicable to matrix

Attachment 3

Statistical Control Limits for the LCS

Compound	Percent Recovery Range	
	25 mL purge	**5 mL purge & med./high conc. Soil**
Dichlorodifluoromethane	50-150	50-150
Chloromethane	50-150	51-150
Vinyl chloride [2]	61-150	54-136
Bromomethane	50-150	59-150
Chloroethane	54-150	55-150
Trichlorofluoromethane	56-150	55-150
1,1-dichloroethene [1, 2]	74-143	70-130
Carbon disulfide	50-150	66-146
1,1,2-trichloro-1,2,2,-luoroethane	78-150	59-138
Methylene chloride [2]	50-139	72-123
trans-1,2-dichloroethene	50-137	39-130
Methyl-tert-butyl ether	68-134	62-135
1,1-dichloroethane [2]	59-138	70-126
cis-1,2-dichloroethene [2]	69-140	70-131
2-butanone [2]	65-134	64-127
Chloroform	67-147	65-133
1,1,1-trichloroethane	71-137	69-134
Carbon tetrachloride [2]	68-145	70-139
Benzene [1, 2]	68-138	69-130
1,2-dichloroethane	61-150	67-133
Trichloroethene [1, 2]	55-150	72-130
1,2-dichloropropane [2]	67-137	73-123
Bromodichloromethane [2]	73-142	71-126
cis-1,3-dichloropropene	74-134	63-136
4-methyl-2-pentanone	66-127	51-141
Toluene [1]	60-142	61-131
trans-1,3-dichloropropene	66-130	60-140
1,1,2-trichloroethane	68-130	63-131
Tetrachloroethene [2]	65-137	78-136
2-hexanone	53-140	50-143
Dibromochloromethane	68-137	70-129
1,2-dibromoethane	73-128	61-137
Chlorobenzene [1, 2]	68-129	76-121

ORIGINAL MASTER COPY CONTROLLED COPY
If words above are not highlighted, this is an uncontrolled copy of this document.

Attachment 3 (continued)

Statistical Control Limits for the LCS

Compound	**Percent Recovery Range**	
	25 mL purge	**5 mL purge & med./high conc. Soil**
Ethylbenzene [2]	67-127	68-131
Styrene [2]	66-139	73-127
Bromoform [2]	62-139	66-133
Isopropyl benzene	56-143	62-138
1,1,2,2-tetrachloroethane	63-122	63-135
1,3-dichlorobenzene	64-136	79-120
1,4-dichlorobenzene [2]	69-125	79-116
1,2-dichlorobenzene	71-127	62-143
1,2-dibromo-3-chloropropane	71-128	57-133
1,2,4-trichlorobenzene	52-147	57-142
Xylene (total)	60-140	61-150

Table displays statistical control limits calculated in 2002.

[1] Denotes Ohio VAP spike compounds. Each recovery must be within established control limits.

[2] SC DHEC spike compounds. Each of these analytes must be recovered within 70-130%.

Attachment 4

COMPUCHEM a Division of Liberty Analytical Corp DATE ____/____/____ INITIAL TIME OF TUNE_____ SHIFT/S(A)_____(B)_____(C)____
GC/MS VOLATILE RUN LOG TIME TUNE EXPIRES_____ LINKER /METHOD_____
COMPUCHEM LOGBOOK 11 NNN 29 (5972hp59) METHOD: 8260B SOM01.2 (Circle one) or Other: _____
MAINTENANCE_____

	REJECTED	FILE NAME	REPORTED	pH	Vial	DATE	TIME	Client ID	SDG#	INJ. VOL.*	DF+	CHEMIST	COMMENTS (ETC.)/ DISPOSITION
1						/ /							
2						/ /							
3						/ /							
4						/ /							
5						/ /							
6						/ /							
7						/ /							
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22						/ /							
23						/ /							
24						/ /							

*On-column sample aliquot +Not applicable to soil matrix

The presence of the Chemist's/Analyst's employee ID number, or signature, on this run log attests that strict compliance with the method's SOP has occurred. Any SOP deviations require documentation by the responsible chemist/analyst together with the chemist's/analyst's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation

Tune (ID #7008) Lot No.: _____ Calibration Group Code / Lot No.: _____
Internal Standard Lot No.: _____ Surrogate Lot No.: _____

REVIEWED BY: _____ Date_____

4/05/10: jad

Note: This page subject to change without notification.

Attachment 5

TCL4 1&2 HIGH

RESTEK

CERTIFICATE OF ANALYSIS

110 Benner Circle
Bellefonte, PA 16823-8812
Tel.: (800)356-1688
Fax: (814)353-1309

FOR LABORATORY USE ONLY–READ MSDS PRIOR TO USE.

Cat. No.: 30431 Lot No.: A027506
Description: 502.2 CAL 2000 Mega-Mix
Expiration Date[1]: August 2005 Storage: Freezer

Compound	CAS#	Percent Purity[3]	Concentration (weight/volume)[4]	Percent Uncertainty[5]
1,1-dichloroethane	75-34-3	99%	2,000 µg/ml	+/- .04%
1,1-dichloroethene	75-35-4	99%	2,000 µg/ml	+/- .04%
1,1-dichloropropene	563-58-6	99%	2,000 µg/ml	+/- .04%
1,1,1-trichloroethane	71-55-6	99%	2,000 µg/ml	+/- .04%
1,1,1,2-tetrachloroethane	630-20-6	99%	2,000 µg/ml	+/- .04%
1,1,2-trichloroethane	79-00-5	99%	2,000 µg/ml	+/- .04%
1,1,2,2-tetrachloroethane	79-34-5	99%	2,000 µg/ml	+/- .04%
1,2-dibromo-3-chloropropane	96-12-8	97%	2,000 µg/ml	+/- .04%
1,2-dibromoethane	106-93-4	99%	2,000 µg/ml	+/- .04%
1,2-dichlorobenzene	95-50-1	99%	2,000 µg/ml	+/- .04%
1,2-dichloroethane	107-06-2	99%	2,000 µg/ml	+/- .04%
1,2-dichloropropane	78-87-5	99%	2,000 µg/ml	+/- .04%
1,2,3-trichlorobenzene	87-61-6	99%	2,000 µg/ml	+/- .04%
1,2,3-trichloropropane	96-18-4	99%	2,000 µg/ml	+/- .04%
1,2,4-trichlorobenzene	120-82-1	99%	2,000 µg/ml	+/- .04%
1,2,4-trimethylbenzene	95-63-6	99%	2,000 µg/ml	+/- .04%
1,3-dichlorobenzene	541-73-1	99%	2,000 µg/ml	+/- .04%
1,3-dichloropropane	142-28-9	99%	2,000 µg/ml	+/- .04%
1,3,5-trimethylbenzene	108-67-8	99%	2,000 µg/ml	+/- .04%
1,4-dichlorobenzene	106-46-7	99%	2,000 µg/ml	+/- .04%
2-chlorotoluene	95-49-8	99%	2,000 µg/ml	+/- .04%
2,2-dichloropropane	594-20-7	99%	2,000 µg/ml	+/- .04%
4-chlorotoluene	106-43-4	99%	2,000 µg/ml	+/- .04%
p-isopropyltoluene	99-87-6	99%	2,000 µg/ml	+/- .04%
benzene	71-43-2	99%	2,000 µg/ml	+/- .04%
bromobenzene	108-86-1	99%	2,000 µg/ml	+/- .04%
bromochloromethane	74-97-5	99%	2,000 µg/ml	+/- .04%

[1]Expiration date of the unopened ampul stored at recommended temperature.

[2]Listed in alphabetical order.

[3]Purity was determined by one or more of the following techniques: GC/FID, HPLC, GC/ECD, GC/MS. Value rounded to the nearest LOWER whole percentage. In addition to detectors listed above, chemical identity and purity are confirmed using 1 or more of the following: MS, DSC, solid probe MS, GC/FPD, GC/NPD, GC/TC, FTIR, melting point, refractive index, and Karl Fisher. See data pack or contact Restek for further details.

[4]Based upon gravimetric preparation with balance calibration verified using NIST traceable weights (seven mass levels).

[5]Percent uncertainty based upon balance AND ASTM Class A volumetric glassware accuracy.

ISO 9001 REGISTERED RESTEK QUALITY SEPARATES US FROM THE REST

MANUFACTURED UNDER RESTEK'S ISO 9001 REGISTERED QUALITY SYSTEM: Certificate #97-HOU-AQ-8550 issued by DNV Certification, Inc.

Attachment 5 (continued)

TCL4 1&2 HIGH

RESTEK

CERTIFICATE OF ANALYSIS (cont.)

FOR LABORATORY USE ONLY–READ MSDS PRIOR TO USE.

PAGE 2

Cat. No.: 30431 Lot No.: A027506

Description: 502.2 CAL 2000 Mega-Mix

Compound	CAS#	Percent Purity[3]	Concentration (weight/volume)[4]	Percent Uncertainty[5]
bromodichloromethane	75-27-4	99%	2,000 µg/ml	+/- .04%
bromoform	75-25-2	99%	2,000 µg/ml	+/- .04%
carbon tetrachloride	56-23-5	99%	2,000 µg/ml	+/- .04%
chlorobenzene	108-90-7	99%	2,000 µg/ml	+/- .04%
chloroform	67-66-3	99%	2,000 µg/ml	+/- .04%
cis-1,2-dichloroethene	156-59-2	99%	2,000 µg/ml	+/- .04%
cis-1,3-dichloropropene	10061-01-5	99%	2,000 µg/ml	+/- .04%
dibromochloromethane	124-48-1	99%	2,000 µg/ml	+/- .04%
dibromomethane	74-95-3	99%	2,000 µg/ml	+/- .04%
ethylbenzene	100-41-4	99%	2,000 µg/ml	+/- .04%
hexachlorobutadiene	87-68-3	99%	2,000 µg/ml	+/- .04%
isopropylbenzene	98-82-8	99%	2,000 µg/ml	+/- .04%
methylene chloride	75-09-2	99%	2,000 µg/ml	+/- .04%
m-xylene	108-38-3	99%	2,000 µg/ml	+/- .04%
naphthalene	91-20-3	99%	2,000 µg/ml	+/- .04%
n-butylbenzene	104-51-8	99%	2,000 µg/ml	+/- .04%
n-propylbenzene	103-65-1	99%	2,000 µg/ml	+/- .04%
o-xylene	95-47-6	99%	2,000 µg/ml	+/- .04%
p-xylene	106-42-3	99%	2,000 µg/ml	+/- .04%
sec-butylbenzene	135-98-8	99%	2,000 µg/ml	+/- .04%
styrene	100-42-5	99%	2,000 µg/ml	+/- .04%
tetrachloroethene	127-18-4	99%	2,000 µg/ml	+/- .04%
tert-butylbenzene	98-06-6	99%	2,000 µg/ml	+/- .04%
toluene	108-88-3	99%	2,000 µg/ml	+/- .04%
trans-1,2-dichloroethene	156-60-5	99%	2,000 µg/ml	+/- .04%
trans-1,3-dichloropropene	10061-02-6	97%	2,000 µg/ml	+/- .04%
trichloroethene	79-01-6	99%	2,000 µg/ml	+/- .04%
Solvent: purge & trap methanol	67-56-1	99%		

[1]*Expiration date of the unopened ampul stored at recommended temperature.*

[2]*Listed in alphabetical order.*

[3]*Purity was determined by one or more of the following techniques: GC/FID, HPLC, GC/ECD, GC/MS. Value rounded to the nearest LOWER whole percentage. In addition to detectors listed above, chemical identity and purity are confirmed using 1 or more of the following: MS, DSC, solid probe MS, GC/FPD, GC/NPD, GC/TC, FTIR, melting point, refractive index, and Karl Fisher. See data pack or contact Restek for further details.*

[4]*Based upon gravimetric preparation with balance calibration verified using NIST traceable weights (seven mass levels).*

Attachment 5 (continued)

TCL4 - GASES HIGH

RESTEK

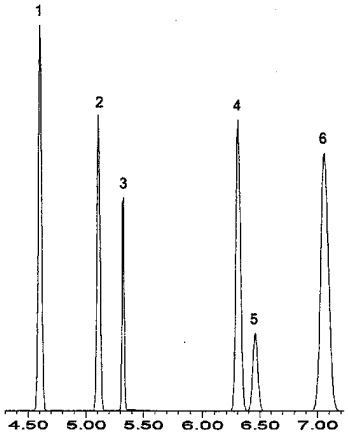
CERTIFICATE OF ANALYSIS

110 Benner Circle
Bellefonte, PA 16823-8812
Tel.: (800)356-1688
Fax: (814)353-1309

FOR LABORATORY USE ONLY--READ MSDS PRIOR TO USE.

Cat. No.: 30042 Lot No.: A028050
Description: 502.2 Calibration Mix #1
Expiration Date[1]: March 2010 Storage: Freezer

Elution Order	Compound	CAS#	Percent Purity[3]	Concentration (weight/volume)[4]	Percent Uncertainty[5]
1	Dichlorodifluoromethane	75-71-8	99%	1,997 µg/ml	± 1.9%
2	Chloromethane	74-87-3	99%	2,003 µg/ml	± 1.3%
3	Vinyl chloride	75-01-4	99%	2,003 µg/ml	± 1.4%
4	Bromomethane	74-83-9	99%	1,997 µg/ml	± 1.3%
5	Chloroethane	75-00-3	99%	2,003 µg/ml	± 1.5%
6	Trichlorofluoromethane	75-69-4	99%	2,000 µg/ml	± 0.3%
Solvent:	Purge and trap Methanol	67-56-1	99%		



Column: 105m .32mm 1.8µm
Rtx-502.2 (cat.#10921)
Carrier gas: helium @ 2.2 ml/min.
Temp. program: 50°C (hold 12 min.)
Isothermal
Inj. temp.: 240°C
Det. temp.: 240°C
Detector type: MSD

John Lidgett
John Lidgett—QA Analyst

ISO 9001 REGISTERED RESTEK QUALITY SEPARATES US FROM THE REST

MANUFACTURED UNDER RESTEK'S ISO 9001 REGISTERED QUALITY SYSTEM: Certificate #97-HOU-AQ-8550 issued by DNV Certification, Inc.

[1] *Expiration date of the unopened ampul stored at recommended temperature.*
[2] *Listed in alphabetical order.*
[3] *Purity was determined by one or more of the following techniques: GC/FID, HPLC, GC/ECD, GC/MS. Value rounded to the nearest LOWER whole percentage. In addition to detectors listed above, chemical identity and purity are confirmed using 1 or more of the following: MS, DSC, solid probe MS, GC/FPD, GC/NPD, GC/TC, FTIR, melting point, refractive index, and Karl Fisher. See data pack or contact Restek for further details.*
[4] *Based upon gravimetric preparation with balance calibration verified using NIST traceable weights (seven mass levels).*
[5] *Percent uncertainty based upon balance AND ASTM Class A volumetric glassware accuracy.*

Attachment 5 (continued)

TCL4- KETONES HIGH

AccuStandard Inc.

125 Market Street
New Haven, CT 06513
USA

Ph: 203-786-5290
Fax: 203-786-5287
E-mail: usa@accustandard.com
www.accustandard.com

CERTIFICATE OF ANALYSIS

PRODUCT: S-9863-R1
DESCRIPTION: Custom VOA Std #2
LOT #: B3110072
SOLVENT: Methanol

EXPIRATION: Feb 9, 2004

See reverse for additional certification information.

This product is guaranteed accurate to + 0.5% of the Certified Analyte concentration through the Expiration Date on the Label.

Component	CAS #	Purity % (GC/FID)	Prepared Concentration[1] (µg/mL)	Certified Analyte Concentration[2] (µg/mL)
Acetone	67-64-1	99.9	1261 ± 50.44	1260
Methyl ethyl ketone	78-93-3	100	1261 ± 50.44	1261
4-methyl-2-pentanone	108-10-1	99.4	1261 ± 50.44	1253
2-hexanone	591-78-6	100	1261 ± 50.44	1261
Vinyl acetate	108-05-4	99.9	500.8 ± 20.03	500.3
2-Chloroethylvinyl ether	110-75-8	99.7	500.3 ± 20.01	498.8
Acrolein	107-02-8	90.0	5575 * ± 223.00	5018
Acrylonitrile	107-13-1	99.9	5000 ± 200.00	4995

8 Components

1. All weights are traceable through NIST, Test No. 822/254480.
2. Certified Analyte Concentration = Purity x Prepared Concentration. The Uncertainty calculated for this product is the Combined Uncertainty $u_c(y)$. It represents an estimated standard deviation equal to the positive square root of the total variance of the uncertainty of components. The Expanded Uncertainty is U which is $U_c(y)$ *K where K is the coverage factor at the 95% confidence level (K=2). Values reported above are Expanded Combined Uncertainty.
3. A product with a suffix (-1A, -2B, etc.) on its lot# has had its expiration date extended and is identical to the same lot# without the suffix.

* Weight compensated to 100% purity

Certified by: R. Cooper

This product was manufactured to meet the quality system requirements of ISO 9001

QR-ORG/INO-00
Rev. 11/0

Attachment 5 (continued)

TCL4-APPIX H1

AccuStandard Inc.

125 Market Street
New Haven, CT 06513
USA

Ph: 203-786-5290
Fax: 203-786-5287
E-mail: usa@accustandard.com
www.accustandard.com

CERTIFICATE OF ANALYSIS

PRODUCT: S-9862-R1
EXPIRATION: Feb 27, 2004
DESCRIPTION: Custom VOA Std #1
LOT #: B3110080 **See reverse for additional certification information.**
SOLVENT: Methanol

This product is guaranteed accurate to ± 0.5% of the Certified Analyte concentration through the Expiration Date on the Label.

Component	CAS #	Purity % (GC/FID)	Prepared Concentration[1] (µg/mL)	Certified Analyte Concentration[2] (µg/mL)
Acetonitrile	75-05-8	99.9	500.3 ±20.01	499.8
Allyl chloride	107-05-1	99.6	500.0 ±20.00	498.0
1-Chlorohexane	544-10-5	99.0	500.3 ±20.01	495.3
Chloroprene	126-99-8	98	500.0 ±20.00	490.0
trans-1,4-Dichloro-2-butene	110-57-6	97.4	25,670 * ±1026.80	25003
p-Dioxane	123-91-1	99.2	25,010 ±1000.40	24810
Ethyl methacrylate	97-63-2	99.0	5010 ±200.40	4960
Isobutyl alcohol	78-83-1	100	25,010 ±1000.40	25010
Methacrylonitrile	126-98-7	99.9	5010 ±200.40	5005
Methyl iodide	74-88-4	100	500.3 ±20.01	500.3
Methyl methacrylate	80-62-6	99.8	5003 ±200.12	4993
Pentachloroethane	76-01-7	97.3	514.0 * ±20.56	500.1
Propionitrile	107-12-0	99.9	25,010 ±1000.40	24985

13 Components

1. All weights are traceable through NIST, Test No. 822/254480.
2. Certified Analyte Concentration = Purity x Prepared Concentration. The Uncertainty calculated for this product is the Combined Uncertainty $u_c(y)$. It represents an estimated standard deviation equal to the positive square root of the total variance of the uncertainty of components. The Expanded Uncertainty is U which is $U_c(y)$ *K where K is the coverage factor at the 95% confidence level (K=2). Values reported above are Expanded Combined Uncertainty.
3. A product with a suffix (-1A, -2B, etc.) on its lot# has had its expiration date extended and is identical to the same lot# without the suffix.

* Weight compensated to 100% purity

Certified by: R. Cooper

This product was manufactured to meet the quality system requirements of ISO 9001

QR-ORG/INO-00

Attachment 5 (continued)

RESTEK

CERTIFICATE OF ANALYSIS

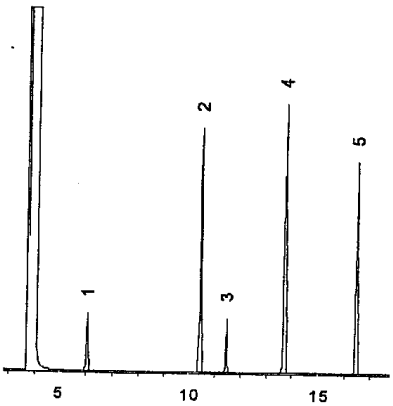
110 Benner Circle
Bellefonte, PA 16823-8812
Tel.: (800)356-1688
Fax: (814)353-1309

FOR LABORATORY USE ONLY—READ MSDS PRIOR TO USE.

Cat. No.: 30005 Lot No.: A019743
Description: VOA Matrix Spike Mix
Expiration Date[1]: January 2005

Elution Order	Compound	CAS#	Percent Purity[3]	Concentration (weight/volume)[4]	Percent Uncertainty[5]
1	1,1-dichloroethene	75-35-4	99%	2,500 µg/ml	± 0.2%
2	benzene	71-43-2	99%	2,500 µg/ml	± 0.2%
3	trichloroethene	79-01-6	99%	2,500 µg/ml	± 0.2%
4	toluene	108-88-3	99%	2,500 µg/ml	± 0.2%
5	chlorobenzene	108-90-7	99%	2,500 µg/ml	± 0.2%
Solvent:	purge and trap methanol	67-56-1	99%		

Column: 105m .53mm 3.0µm
Rtx®-502.2 (cat.#10910)
Carrier gas: hydrogen @ 40cm/sec
Temp. program: 40°C (hold 2 min.) to 240°C
@ 8°C/min. (hold 10 min.)
Inj. temp.: 200°C
Det. temp.: 250°C
Detector type: FID



John Lidgett
John Lidgett—QA Analyst

[1]Expiration date of the unopened ampul stored at recommended temperature.
[2]Listed in alphabetical order.
[3]As determined by capillary GC/FID unless otherwise noted. Value rounded to the nearest LOWER whole percentage. In addition to GC/FID, chemical identity and purity are confirmed using 2 or more of the following: GC/MS, solid probe MS, GC/ECD, GC/FPD, GC/NPD, GC/TC, HPLC, DSC, FTIR, melting point, refractive index, and Karl Fisher.
[4]Based upon gravimetric preparation with balance calibration verified using NIST traceable weights (seven mass levels).
[5]Percent uncertainty based upon balance AND ASTM Class A volumetric glassware accuracy.

ISO 9001 REGISTERED RESTEK QUALITY SEPARATES US FROM THE REST

MANUFACTURED UNDER RESTEK'S ISO 9001 REGISTERED QUALITY SYSTEM: Certificate #97-HOU-AQ-8550 issued by DNV Certification, Inc.

Attachment 6

Solid and Aqueous LCS Control Limits for 8260B Required by the DOD-QSM

CAS#	Compound	Water CL	Water ME	Soil CL	Soil ME
630-20-6	1,1,1,2-Tetrachloroethane	80-130	75-135	75-125	65-135
354-58-5	1,1,1-Trichloro-2,2,2-trifluoroethane	N/A	N/A	N/A	N/A
71-55-6	1,1,1,-Trichloroethane	65-130	55-140	70-135	55-145
79-34-5	1,1,2,2-Tetrachloroethane	75-125	65-135	55-130	40-145
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane	N/A	N/A	N/A	N/A
79-00-5	1,1,2-Trichloroethane	75-125	65-135	60-125	50-140
75-34-3	1,1-Dichloroethane	70-135	60-145	75-125	65-135
75-35-4	1,1-Dichloroethene	70-130	55-140	65-135	55-150
563-58-6	1,1-Dichloropropene	75-130	65-140	70-135	60-145
87-61-6	1,2,3-Trichlorobenzene	55-140	45-155	60-135	50-145
96-18-4	1,2,3-Trichloropropane	75-125	65-130	65-130	50-140
120-82-1	1,2,4-Trichlorobenzene	65-135	55-145	65-130	55-140
95-63-6	1,2,4-Trimethylbenzene	75-130	65-140	65-135	55-145
96-12-8	1,2-Dibromo-3-Chloropropane	50-130	35-145	40-135	25-150
106-93-4	1,2-Dibromoethane	80-120	75-125	70-125	60-135
95-50-1	1,2-Dichlorobenzene	70-120	60-130	75-120	65-125
107-06-2	1,2-Dichloroethane	70-130	60-140	70-135	60-145
78-87-5	1,2-Dichloropropane	75-125	65-135	70-120	65-125
108-67-8	1,3,5-Trimethylbenzene	75-130	65-140	65-135	55-145
541-73-1	1,3-Dichlorobenzene	75-125	65-130	70-125	65-135
142-28-9	1,3-Dichloropropane	75-125	65-135	75-125	70-130
106-46-7	1,4-Dichlorobenzene	75-125	65-130	70-125	65-135
123-91-1	1,4-Dioxane	N/A	N/A	N/A	N/A
594-20-7	2,2-Dichloropropane	70-135	60-150	65-135	55-145
78-93-3	2-Butanone	30-150	10-170	30-160	10-180
110-75-8	2-Chloroethyl vinyl ether	N/A	N/A	N/A	N/A
95-49-8	2-Chlorotoluene	75-125	65-135	70-130	60-140
591-78-6	2-Hexanone	55-130	45-140	45-145	30-160
107-05-1	3-Chloropropene	N/A	N/A	N/A	N/A
106-43-4	4-Chlorotoluene	75-130	65-135	75-125	65-135
108-10-1	4-Methyl-2-pentanone	60-135	45-145	45-130	30-165
67-64-1	Acetone	40-140	20-160	20-160	10-180
75-05-8	Acetonitrile	N/A	N/A	N/A	N/A
107-02-8	Acrolein	N/A	N/A	N/A	N/A

CL =control limit
ME = marginal exceedances
N/A = not included in DOD list

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Attachment 6

Solid and Aqueous LCS Control Limits for 8260B Required by the **DoD**-QSM

CAS#	Compound	Water CL	Water ME	Soil CL	Soil ME
107-13-1	Acrylonitrile	N/A	N/A	N/A	N/A
71-43-2	Benzene	80-120	75-130	75-125	65-135
108-86-1	Bromobenzene	75-125	70-130	65-120	55-130
74-97-5	Bromochloromethane	65-130	55-140	70-125	60-135
75-27-4	Bromodichloromethane	75-120	70-130	70-130	60-135
75-25-2	Bromoform	70-130	60-140	55-135	45-150
74-83-9	Bromomethane	30-145	10-165	30-160	10-180
75-15-0	Carbon disulfide	35-160	15-185	45-160	30-180
56-23-5	Carbon Tetrachloride	65-140	55-150	65-135	55-145
108-90-7	Chlorobenzene	80-120	75-130	75-125	65-130
75-00-3	Chloroethane	60-135	50-145	40-155	20-175
67-66-3	Chloroform	65-135	50-150	70-125	65-135
74-87-3	Chloromethane	40-125	25-140	50-130	40-140
126-99-8	Chloroprene	N/A	N/A	N/A	N/A
156-59-2	cis-1,2-Dichloroethene	70-125	60-135	65-125	55-135
10061-01-5	cis-1,3-Dichloropropene	70-130	60-140	70-125	65-135
110-82-7	Cyclohexane	N/A	N/A	N/A	N/A
124-48-1	Dibromochloromethane	60-135	45-145	65-130	55-140
74-95-3	Dibromomethane	75-125	65-135	75-130	65-135
75-71-8	Dichlorodifluoromethane	30-155	10-175	35-135	15-155
100-41-4	Ethylbenzene	75-125	65-135	75-125	65-135
97-63-2	Ethylmethacrylate	N/A	N/A	N/A	N/A
87-68-3	Hexachlorobutadiene	50-140	35-160	55-140	40-155
74-88-4	Iodomethane	N/A	N/A	N/A	N/A
78-83-1	Isobutyl alcohol	N/A	N/A	N/A	N/A
89-82-8	Isopropylbenzene	75-125	65-135	75-130	70-140
108-20-3	Isopropyl ether	N/A	N/A	N/A	N/A
108-38-3	m,p-Xylene	75-130	65-135	80-125	70-135
126-89-7	Methacrylonitrile	N/A	N/A	N/A	N/A
79-20-9	Methyl acetate	N/A	N/A	N/A	N/A
108-87-2	Methylcyclohexane	N/A	N/A	N/A	N/A
75-09-2	Methylene Chloride	55-140	40-155	55-140	40-155
80-62-6	Methylmethacrylate	N/A	N/A	N/A	N/A
1634-04-4	Methyl-tert-butyl ether	65-125	55-135	N/A	N/A
91-20-3	Naphthalene	55-140	40-150	40-125	25-140
104-51-8	n-Butylbenzene	70-135	55-150	65-140	50-150

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N/A = not included in DOD list

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Attachment 6

Solid and Aqueous LCS Control Limits for 8260B Required by the **DoD**-QSM

CAS#	Compound	Water CL	Water ME	Soil CL	Soil ME
110-54-3	n-Hexane	N/A	N/A	N/A	N/A
103-65-1	n-Propylbenzene	70-130	65-140	65-135	50-145
95-47-6	o-Xylene	80-120	75-130	75-125	70-135
76-01-7	Pentachloroethane	N/A	N/A	N/A	N/A
99-87-6	p-Isopropyltoluene	75-130	64-140	75-135	65-140
107-12-0	Propionitrile	N/A	N/A	N/A	N/A
135-98-8	sec-Butylbenzene	70-125	65-135	65-130	50-145
100-42-5	Styrene	65-135	55-145	75-125	65-135
98-06-6	tert-Butylbenzene	70-130	60-140	65-130	55-145
127-18-4	Tetrachloroethene	45-150	25-165	65-140	55-150
109-99-9	Tetrahydrofuran	N/A	N/A	N/A	N/A
108-88-3	Toluene	75-120	70-130	70-125	60-135
156-60-5	trans-1,2-Dichloroethene	60-140	45-150	65-135	55-145
10061-02-6	trans-1,3-Dichloropropene	55-140	40-155	65-125	55-140
110-57-6	trans-1,4-Dichloro-2-butene	N/A	N/A	N/A	N/A
79-01-6	Trichloroethene	70-125	60-135	75-125	70-130
75-69-4	Trichlorofluoromethane	60-145	45-160	25-185	10-215
108-05-4	Vinyl acetate	N/A	N/A	N/A	N/A
75-01-4	Vinyl Chloride	50-145	35-165	60-125	45-140
1330-20-7	Xylene (total)	N/A	N/A	N/A	N/A

CL =control limit
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N/A = not included on DOD list

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Cary, NC 27513

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SOP DOCUMENTATION FORM

This form must accompany all new and revised Standard Operating Procedures (SOPs) when you turn them in to Quality Assurance for review. Please fill out the entire block below (except effective date).

This is a new procedure _____ revised procedure ✓ outdated procedure (archive) _____

- Procedure Code: IP481B SOP Section #: 1.3.2.4 Revision #: 13

SOP Title: gc/ms Analysis of Low Concentration Volatiles in Soil/Sediment/Sludge Samples by SW-846 Method 8260B

Effective date: (QA fills in) 4/8/11

- Procedure prepared by: [signature] Date: 4-7-11
- Procedure approved by: (If the manager prepared the SOP, a qualified second party should sign) [signature] Date: 4-8-11
- Reason for change: Addition of DoD parameters and protocols, addition of LIMS information
- This procedure meets the requirements of the following approved method references: SW-846, 3rd Edition, Update III, 12/96, Method 8260B; Method 5035A; DoD-QSM, Version 4.2, 10/25/2010

Procedure approved by a QA Representative (unless QA Representative signed above):

_____ Date: _____

On an annual basis: Lab managers are required to review lab practices and revise the SOP if necessary. If no revision is necessary, indicate by your signature that the SOP has been reviewed.

Annual Review—Signature: [signature] NA [signature] 4/8/11 Date: ~~4-7-11~~ NA [signature] 4/8/11

Annual Review—Signature: [signature] Date: 6-20-11

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Instrument Procedure 481B: GC/MS Analysis of Low Concentration Volatiles in Soil/Sediment/Sludge Samples by SW-846 Method 8260B

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Instrument Procedure 481B: GC/MS Analysis of Low Concentration Volatiles in Soil/Sediment/Sludge Samples by SW-846 Method 8260B

1.0 Scope and Application

This Standard Operating Procedure (SOP) describes the procedure for the purge and trap GC/MS analysis of solid (soil, sediment and sludge) samples following Method 8260B and incorporating Method 5035A. The method is applicable to a wide range of organic compounds. Target compounds that may be analyzed by this method are listed in Attachment 1, along with their associated internal standards and quantitation ions. Note, however, that many of these compounds are not routinely analyzed.

The reporting limit is the low-level calibration standard concentration. Reporting limits for this method are shown in Attachment 3.

Staff members performing the procedures described in this SOP are responsible for reading, understanding, and complying with the SOP requirements. Supervisors are responsible for directing the analyst to the controlled SOP, and providing adequate explanation of the material contained therein.

This procedure is restricted to use by or under the supervision of analysts experienced in the instrumentation or preparative methods and who have demonstrated the ability to generate acceptable results through QC samples and analyst capability studies.

2.0 Summary of Method

Low concentration level volatiles samples are analyzed using a closed system purge and trap technique (Method 5035A). Field samples may be collected in vials containing a preservative solution (sodium bisulfate), immediately sealed and shipped to the laboratory at 4 °C ± 2 °C. Normally, an EnCore sampling device (or equivalent) is used to obtain a 5g sample that does not contain headspace. When the EnCore device is used, it is sent refrigerated to the laboratory and, within 48 hours of sampling, the contents of the Encore device must be transferred to a closed-system purge and trap **vial** and placed in a freezer at – 10 to – 20 °C.

A special autosampler is used for the analysis. This device allows the sample vial to remain closed while reagent water and a solution containing internal standards and surrogates are injected by a double-walled needle through the septum. The needle used to pierce the septum to deliver the water, internal standards, and surrogates is then the source of an inert gas which allows adequate mixing through the bottom of the needle. The same needle has entrance holes located above the sample/water level to collect and

transfer the headspace onto a sorbent column, where the purgeables are trapped. The autosampler also provides for heating the sample vial to 40 °C while the contents are being mixed and the sample constituents purged and trapped. After purging is completed, the sorbent column is heated and backflushed with the inert gas to desorb the purgeables onto a gas chromatograph (GC) wide-bore capillary column. The GC is temperature-programmed to separate the purgeables that are then detected with a mass spectrometer (MS).

3.0 Definitions

3.1 Method detection limit (MDL) – The minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte (40 CFR, Part 136, Appendix B.) **A minimum of seven sample replicates is required to calculate a statistical MDL. The MDL is an approximation of the DL. Any analyte concentration result at or above the MDL must also meet all qualitative identification criteria required by the test method in order to be reported as present.**

3.2 Detection Limit (DL) - The DL is the smallest analyte that can be demonstrated to be different from zero or a blank concentration at the 99 % level of confidence. The false positive rate at the DL is 1% and the false negative rate is 50%. Any analyte concentration result at or above the DL must also meet all qualitative identification criteria required by the test method in order to be reported as present.

3.3 Limit of Detection (LOD) – The LOD is the smallest concentration of an analyte that must be present in a sample in order to be detected at a 99% confidence level. The false negative rate at the LOD is 1 %. For DoD-QSM, non-detect sample results are reported as < LOD. Numeric values of measurements between the DL and the LOQ are reported as estimates. The DL < LOD ≤ LOQ.

3.4 Limit of Quantitation (LOQ) – The Limit of Quantitation is the lowest concentration of a substance that produces a quantitative result within specified limits of precision and bias. The LOQ must be within the calibration range.

3.5 Reporting Limit (RL) –

3.5.1 For Non-DoD work, the laboratory reporting limit is based on the lowest multipoint calibration standard concentration. For organic

methods, values detected below the reporting limit and above the MDL may be reported and qualified as an estimated concentration.

3.5.2 The DoD-QSM defines the reporting limit as being the lowest concentration value specified by the client that meets project requirements for reporting data with known precision and bias for a specific analyte in a specific matrix. The LOQ cannot be greater than the RL. Data reported below the RL must be flagged as estimated values if they are also less than the LOQ.

3.6 Reporting Units – µg/kg

3.7 A Sample Delivery Group (SDG) is defined by the following, whichever is more frequent:

- each 20 field samples received within a case, or
- each 7 calendar day period during which field samples in a case are received (14 calendar days if requested by the client) beginning with the receipt of the first sample.

NOTE: The **DoD**-QSM and SC DHEC do not accept the SDG approach, unless the samples are prepared in a single batch. When a group of up to 20 field samples of a similar matrix are prepared as one batch, method-specified QC samples such as a method blank, laboratory control sample, matrix spike, matrix spike duplicate, and matrix duplicate must also be prepared together. If samples are batched together from different sites, project-specific QC must be processed.

3.8 SC DHEC – South Carolina Department of Health and Environmental Control

3.9 **DoD**-QSM – Department of Defense Quality Systems Manual

3.10 Marginal Exceedance – Beyond the LCS control limit but within the marginal exceedance limits (set at 4 standard deviations around the mean). This outside boundary prevents a grossly out-of-control LCS from passing.

3.11 Batch – a group of up to 20 field samples of a similar matrix, method-specified QC samples such as a method blank, laboratory control sample, matrix spike, matrix spike duplicate, and matrix duplicate prepared together at the same time.

3.12 LIMS – Laboratory Information Management System

4.0 Interferences

4.1 Impurities in the purge gas or methanol, organic compounds out-gassing from the plumbing ahead of the trap, and solvent vapors in the laboratory account for the majority of contamination problems. Gas lines from the gas tanks to the instrument must be either stainless steel or copper tubing. Non-polytetrafluoroethylene (PTFE) thread sealants, or flow controllers with rubber components are not to be used. When potential interfering peaks are noted in laboratory method blanks, one or more of the following corrective actions may be necessary to reduce solvent contamination: purging the methanol used to prepare standard solutions, purging the DI water with helium or nitrogen, changing the purge gas source, and regenerating the molecular sieve purge gas filter.

4.2 Samples can be contaminated by diffusion of purgeable organics (particularly methylene chloride, fluorocarbons, and other common laboratory solvents) through the septum seal into the sample during storage and handling. Therefore, these samples are stored in the GC/MS VOA laboratory freezer; separate from laboratory standards, and they must be analyzed in a room in which the atmosphere is demonstrated to be free of all potential contaminants that will interfere with the analysis. Because methylene chloride will permeate PTFE tubing, all GC carrier gas lines and purge gas plumbing are to be constructed from stainless steel or copper tubing.

4.3 Contamination by carryover can occur whenever a sample is analyzed after a sample that contains high levels of organic compounds. Whenever an unusually concentrated sample is encountered, it must either be followed by analysis of an instrument blank or the next sample must be closely monitored to check for cross-contamination. For samples containing large amounts of water soluble materials, high boiling compounds, or high purgeable levels, it may be necessary to clean the purge and trap apparatus by purging a 10-20% methanol solution, followed by baking the purge and trap apparatus and the analysis of an instrument blank to confirm that the system is free from contamination. The trap and other parts of the system are also subject to contamination; therefore, frequent bakeout and purging of the entire system may be required.

5.0 Safety

5.1 The toxicity and carcinogenicity of many chemicals used in this method have not been precisely determined: each chemical should be treated as a potential health hazard. Exposure to these chemicals should be minimized. Preparation of calibration standards, blanks, and samples is performed in a fume hood to minimize risk.

5.2 The following method analytes have been tentatively classified as known or suspected human or mammalian carcinogens: benzene, carbon tetrachloride, 1,2- dichloroethane, 1,1,2,2-tetrachloroethane, 1,1,2- trichloroethane, chloroform, 1,2-dibromoethane, trichloroethene, and vinyl chloride.

5.3 Appropriate protective equipment and clothing must be used under the assumption that all samples are potentially hazardous. During sample preparation, safety glasses, gloves and lab coats are a minimum requirement. The persistent presence of noxious odors may be indicative of failure of the laboratory ventilation system and must be reported to a supervisor or manager.

5.4 Laboratory staff members are required to review the Chemical Hygiene Plan for general safety policies, and Material Safety Data Sheets (MSDS) for solvents and reagents used in the laboratory. The MSDS are located in the Quality Assurance department.

6.0 Equipment and Supplies

6.1 5, 10, and 25 mL Gastight Syringes with Luerlock tips

6.2 1 and 10 µL Hamilton syringes

6.3 Assorted volumetric flasks ranging from 50 mL to 1000 mL

6.4 1 mL mininert vials

6.5 40 mL screw-top, PTFE-lined, septum-sealed vials

6.6 Magnetic stirring bars

6.7 Analytical Column

6.7.1 Supelco SPB-624 60-m, 0.32mm ID with 1.8 um film thickness

6.7.2 Descriptions of alternative capillary columns are presented in EPA Contract Laboratory Program (CLP) Statement of Work (SOW)

documents. Columns other than those listed may be used if equivalency is demonstrated. Specifications for equivalency are also presented in the SOW documents. The equivalency documentation must be maintained and made available during on-site audits

6.8 Purge and Trap Autosampler System

6.8.1 Tekmar LSC

6.8.1.1 Tekmar, LSC 3000, LCS 3100 and Velocity XPT with glass frit bottom liquid sample purging vessel and Luerlock valve

6.8.1.2 The absorption trap must be at least 25 cm long and have an internal diameter of at least 0.105 inches (0.2667 cm).

6.8.1.3 The Supelco K (VOCARB 3000) trap consists of the following:

- Carbopack B, 10 cm
- Carboxen-1000, 6 cm
- Carboxen-1001, 1 cm

6.8.1.4 Alternate sorbent traps may be used if they meet the QC acceptance criteria. Performance documentation must be maintained and made available during an on-site audit.

6.8.2 Archon ALS

6.8.2.1 The Archon Model 5100, 4552 Purge and trap autosampler, interfaces directly to a Tekmar Purge and Trap Concentrators.

6.8.2.2 The autosampler is designed for soil samples and utilizes 40 mL VOA vials with low bleed Teflon septa. All samples, water and soil, are purged in situ in the VOA vials.

6.8.2.3 The Archon ALS has the capacity of up to 51 vials.

6.9 GCMS

6.9.1 Hewlett Packard 5890 Series

6.9.2 Hewlett Packard 6890 Series

6.9.3 Agilent 6890N Series

6.9.4 Hewlett Packard 5972 Mass Selective Detector (MSD)

6.9.5 Hewlett Packard 5973 MSD

6.9.6 Hewlett Packard 6890MSD

6.9.7 Agilent Technologies 5975 MSD

6.9.8 Interface (GC to mass spectrometer)

6.9.8.1 Direct capillary interface at 225 °C is used for Hewlett Packard MSDs.

6.10 Data system

6.10.1 The Hewlett Packard GC/MS systems utilize ChemServer software, for data acquisition.

6.10.2 For data processing, CompuChem uses the Hewlett Packard HP 9000 series 735 Unix Workstation employing Target3 and Envision software by Thru-Put Systems.

6.10.3 The reference library used is the NIST Library (NIST2005), purchased from ThermoFisher Scientific, plus updates and revisions.

6.11 Data storage

Data are stored on the Target3 Unix Workstation. The Workstation is backed up incrementally on a daily basis.

6.12 Element DataSystem® LIMS computer software by Promium is used for sample management and report generation.

7.0 <u>Reagents and Standards</u>

Note: Detailed standard preparation information may be found in the Standard Preparation Logbook 11D(4), "GCMS VOA Standard Preparation Logbook", located in the Volatile Laboratory or in LIMS.

All standards are prepared in the Volatile Organic Laboratory. Stock Standards are stored separately from samples in Teflon®- sealed screw-cap bottles with zero headspace at -10 to -20 ^{o}C in the freezer units in the instrument laboratory when not in use. Protect the standards from light. Standards for gases usually need to be replaced after one week or as recommended by the manufacturer, unless the acceptability of the standard can be documented. Standards for the non-gases must be monitored and fresh standards prepared if a 20% drift is experienced. These standards need to be replaced after six months or as recommended by the manufacturer, unless the acceptability of the standard can be documented. 2-chloroethyl vinyl ether (CEVE) and styrene may have to be prepared more frequently. Secondary dilutions of Stock Standards must be checked frequently for signs of degradation or evaporation, especially just prior to their use in preparing the working calibration standards. Working standards must be prepared just prior to analysis unless they are to be purged by an autosampler. When an autosampler is used, the standards may be kept up to 12 hours in purge vessels connected via the autosampler to the purge and trap device.

Note: All spiking standard information is entered into the LIMS. To obtain information on any standard, access Element, click on "Laboratory," and scroll down and access "Standards." Standards can be sorted by Department. Select the standard you would like to access. The view will show lot number, prepared dates, solvent, vendor, composition, and concentration.

Note: **All reagents and standards must be ACS (American Chemical Society) grade or equivalent, unless otherwise denoted.** All standards and reagents are subject to change in vendor and in concentration. The Reporting Limits are also subject to change, but must remain at or above the lowest point in the calibration.

7.1 Reagent Water-All water used in this procedure must be equivalent to ASTM Type II water (as it relates to specific conductance and specific resistance) which is subsequently purged with an inert gas and demonstrated to meet the blank contamination acceptance criteria contained in this Standard Operating Procedure (SOP). It is referred to throughout the remainder of this SOP as DI water.

7.2 Methanol (B&J Scientific, purge and trap grade)

7.3 Sodium bisulfate, $NaHSO_4$ - ACS reagent grade or equivalent

7.4 Tuning Standard

7.4.1 Bromofluorobenzene - Standard ID# 7008 at 25 µg/mL. Two µL, yielding 50 **η**g on column, are injected onto the column every 12 hours.

7.4.1.1 Prepare the standard by adding 50 µL Restek VOA Tuning Mix 5000 µg/mL) to an amount of purge and trap grade methanol in a 10 mL volumetric flask and bring to volume.

7.4.1.2 Prepare this standard monthly.

7.5 Calibration Standards

7.5.1 For the initial calibration, the internal standard solution is added automatically by the Archon Purge and Trap Autosampler. For all subsequent analyses, both the internal standard and the surrogate solutions are added automatically by the Archon autosampler.

Standard Preparation

Std. ID TCL4-High	**005 µg/kg**	**010 µg/kg**	**020 µg/kg**	**050* µg/kg**	**100 µg/kg**	**200 µg/kg**
8260 S.S.	10.0 µL	20.0 µL	50.0 µL	100.0 µL	200.0 µL	400.0 µL
TCL4-1&2	1.0 µL	2.0 µL	4.0 µL	10.0 µL	20.0 µL	40.0 µL
TCL4-gases	1.0 µL	2.0 µL	4.0 µL	10.0 µL	20.0 µL	40.0 µL
TCL4-ketones	1.0 µL	2.0 µL	4.0 µL	10.0 µL	20.0 µL	40.0 µL
TCL4-AppIX	1.0 µL	2.0 µL	4.0 µL	10.0 µL	20.0 µL	40.0 µL

*Continuing Calibration level

7.5.1.1 To prepare the standards at the concentrations shown in the column headers of the preceding table above, add the µL amount of standard shown to a 100 mL volumetric flask containing DI water, then bring up to volume.

Alternatively, the standards may be prepared at the above concentrations by diluting the 200 µg/kg standard directly into the purge and trap impingers. Dilute as follows:

- For a 100 µg/kg standard, add 2.5 mL to 5 mL DI water;
- For a 50 µg/kg standard, add 1.25 mL to 5 mL DI water;
- For a 20 µg/kg standard, add 0.50 mL to 5 mL DI water;

- For a 10 µg/kg standard, add 0.25 mL to 5 mL DI water;
- For a 5 µg/kg standard, add 0.125 mL to 5 ml DI water.

7.5.1.2 The concentrations of the compounds in the TCL4-1&2 High standard are 500 µg/mL. See Attachment 5 for the composition of this standard.

7.5.1.2.1 Prepare the standard by adding 1.25mL Restek 502.2 VOA 2000 MegaMix (2000 µg/mL) and 1.25 mL of Restek Custom 502.2 Additions Mix (2000 µg/mL) to an amount of purge and trap grade methanol in a 5 mL volumetric flask and bring to volume.

7.5.1.2.2 Prepare this standard every three months.

7.5.1.3 The concentrations of the compounds in the TCL4-gases High standard are 500 µg/mL. See Attachment 5 for the composition of this standard.

7.5.1.3.1 Prepare each standard by adding 1.25mL Restek 502.2 Calibration Mix #1 (2000 µg/mL) to an amount of purge and trap grade methanol in a 5 mL volumetric flask and bring to volume.

7.5.1.3.2 The method states that this standard usually needs to be replaced weekly, unless the standard manufacturer recommends otherwise, or unless the acceptability of the standard can be documented. This standard has generally proven to be more stable in the laboratory. The gas standard can be used for longer than a week if the gases in the continuing calibration (CCV) standard meet the CCV requirements when compared to the initial calibration standards that contain a gas standard that has been prepared within a one-week holding time. Prepare this standard monthly, or more frequently as need dictates, or when degradation is evident rendering the standard unacceptable.

7.5.1.4 The concentrations of the compounds in the TCL4-ketones standard are 500 µg/mL, 1250 µg/mL, or 5000 µg/mL. See Attachment 5 for the composition of this standard.

7.5.1.4.1 Prepare the standard by transferring AccuStandard custom VOA Mix #2 to a mininert vial.

7.5.1.4.2 Replenish this standard as needed and replace every three months.

7.5.1.5 The concentrations of the compounds in the TCL4-AppIX standard are 500 µg/mL, 5000 µg/mL, or 25000 µg/mL. See Attachment 5 for the composition of this standard.

7.5.1.5.1 Prepare the standard by transferring AccuStandard custom VOA Mix #1 to a mininert vial.

7.5.1.5.2 Replenish this standard as needed and replace every three months.

7.6 Initial Calibration Verification Standard (also the Full Spike LCS, MS, and MSD Stock Standard)

7.6.1 The ICV contains the full list of target analytes at the same concentration as the continuing calibration verification (CCV) standard. See Attachment 7.

7.6.2 The initial calibration curve must be verified using a standard from a second source. The laboratory purchases the initial calibration verification (ICV) standards from a different vendor than the ones used for the calibration standards. This is prepared in the same manner as described above. See Section 7.5 or Standard Preparation Logbook 11D(4). Also See Attachment 7.

7.6.2.1 The concentrations of the compounds in Second source TCL4-1 & 2 High standard are 500 µg/mL.

7.6.2.1.1 Prepare the standard by adding 1.25 mL of AccuStandard M-502A-R-10X and 1.25 mL of AccuStandard S-13035 to an amount of purge and trap grade methanol in a 5 mL volumetric flask and bring to volume with purge and trap grade methanol.

7.6.2.2 Prepare this standard every three months or when degradation is evident rendering the standard unacceptable.

7.6.2.3 The concentrations of the compounds in the second source TCL4-gases standard are 500 µg/mL. See Attachment 7.

7.6.2.3.1 Prepare each standard by adding 1.25 mL of AccuStandard M-502B-10X to an amount of purge and trap grade methanol in a 5 mL volumetric flask and bring to volume.

7.6.2.3.2 The method states that this standard usually needs to be replaced weekly, unless the standard manufacturer recommends otherwise, or unless the acceptability of the standard can be documented. This standard has generally proven to be more stable in the laboratory. The gas standard can be used for longer than a week if the gases in the continuing calibration (CCV) standard meet the CCV requirements when compared to the initial calibration standards that contain a gas standard that has been prepared within a one week holding time. Prepare this standard monthly, or more frequently as need dictates, or when degradation is evident rendering the standard unacceptable.

7.6.3 The concentrations of the compounds in the second source TCL4-ketones standard are 500 µg/mL, 1250 µg/mL, or 5000 µg/mL. See Attachment 7.

7.6.3.1 Prepare each standard by adding 800µL of NSI custom Acrolein standard Q-6087-0, 800µL of Restek Custom Vinyl Acetate standard 560347, and 800µL of Restek Custom Ketone Plus to clean dry 2.5 mL-miniert and invert to mix.

7.6.3.2 Prepare this standard every three months or when degradation is evident rendering the standard unacceptable.

7.6.4 The concentrations of the compounds in the second source TCL4-AppIX standard are 500 µg/mL, 5000 µg/mL, or 25000 µg/mL. See Attachment 7.

7.6.4.1 Prepare the standard by transferring Restek custom VOA Standard #1 to a mininert vial.

7.6.4.2 Replenish this standard as needed and replace every three months or when degradation is evident rendering the standard unacceptable.

7.7 Internal Standards

Compounds in 8260 I.S. (Internal standard) at a concentration of 50 µg/mL (250 µg/mL for the Archon)

- fluorobenzene
- D5-chlorobenzene
- D4-1,4-dichlorobenzene

7.7.1 Prepare the internal standard spiking solution by adding 0.2 mL Restek 8260A ampulated internal standard mix (2500 µg/mL) to an amount of purge and trap grade methanol in a 10 mL volumetric flask and bring to volume.

7.7.2 Prepare this standard every three months.

7.8 Surrogate Standard

Compounds in 8260 S.S. (Surrogate Standard) at a concentration of 50 µg/mL (250 µg/mL for the Archon)

- dibromofluoromethane
- D4-1,2-dichloroethane
- D8-toluene
- 4-bromofluorobenzene

7.8.1 Prepare the surrogate spiking solution by adding 0.2 mL Restek 8260A ampulated surrogate mix (2500 µg/mL) to an amount of purge and trap grade methanol in a 10 mL volumetric flask and bring to volume.

7.8.2 Prepare this standard every three months.

7.9 Short List Spike Standard

Compounds in 8260 Spiking Mixture (1001C) at a concentration of 25 µg/mL:

- 1,1-dichloroethene
- trichloroethene

- benzene
- toluene
- chlorobenzene

Note: The spiking cocktail is project dependent. This spiking mixture can also be used as a Laboratory Control Sample (LCS) spike. Some projects may require full analyte spike, and in that case, the standard used for the full analyte spike LCS is the ICV. For some programs, the CCV may be used in the place of the LCS.

7.9.1 Prepare this standard by adding 100 µ**L** Restek VOA Matrix Spike Mix to an amount of purge and trap grade methanol in a 10 mL volumetric flask and bring to volume.

7.9.2 Prepare this standard every six months.

8.0 Sample Preservation and Storage

8.1 Samples are preserved, and stored according to the tables in Sample Control SOPs 4.1, "Receiving Samples" and 4.6, "Storing Samples." Sample holding times are also listed.

8.2 All samples must be analyzed within 14 days of collection.

8.3 Prior to analysis, all samples must be stored in the freezer unit in the laboratory at a temperature of -10 to -20 °C. After analysis, samples are returned to Sample Control for long-term storage and disposal.

9.0 Quality Control

9.1 Surrogates

9.1.1 Surrogate compounds are added to all field and QC samples prior to analysis. Surrogates are used to assess the efficiency of the analytical system.

9.1.2 Surrogate compounds must meet recovery criteria as shown below:

Surrogate Compound	**Soil % Recovery Range**
Dibromofluoromethane	71-141
D4-1,2-dichloroethane	70-139
D8-toluene	72-123

4-bromofluorobenzene	63-131

9.1.2.1 The same surrogates and recovery criteria are to be used for samples submitted to meet the regulatory requirements of the State of South Carolina.

9.1.2.2 The following table contains the surrogate recovery limits required by the DOD-QSM.

Surrogate Compound	**Soil % Recovery Range**
Dibromofluoromethane	N/A
D4-1,2-dichloroethane	N/A
D8-toluene	85-115
4-bromofluorobenzene	85-120

9.1.3 Samples with surrogate recovery failures must be re-extracted to confirm a matrix effect. Surrogate recovery failures in method blanks and LCS require re-extraction of the entire batch. Similar surrogate failures in the MS/MSD and original sample confirm a matrix effect and do not require re-extraction.

9.2 Internal Standards

9.2.1 The integrated areas of the quantitation ions of the internal standards are monitored in continuing calibration verification checks, samples, and QC for a change in retention time and response or sensitivity. These should remain reasonably constant over time.

Internal standard retention time and area responses must be assessed in each continuing calibration verification standard by comparison to the corresponding internal standard in the most recent initial calibration mid-point standard. Internal standard responses in samples and QC are compared to the most recent continuing calibration verification.

9.2.2 The area responses of the internal standards must be within 50-200% difference of the area responses compared to.

9.2.3 The retention time for the internal standards must be less than 30 seconds.

9.2.4 If any of these criteria cannot be met, the analytical system must be checked for malfunctions and corrections made. Re-analysis of any affected sample is required.

9.3 Method/Instrument Blanks

9.3.1 Before any samples are analyzed, it must be demonstrated that a laboratory reagent blank is free from contamination that would prevent the determination of any analyte of concern. Sources of background contamination are glassware, purge gas, sorbents, and equipment. Background contamination must be reduced to an acceptable level before proceeding with the next analysis.

9.3.2 All blanks must be analyzed on a GC/MS system meeting the BFB, initial calibration, and continuing calibration verification acceptance criteria.

9.3.3 A method blank is analyzed with each batch of up to 20 samples processed as a group within a 12-hour tune. If more than 20 samples are analyzed in a tune batch, a second method blank is required. Method blanks must be analyzed immediately following a valid continuing calibration verification analysis.

9.3.4 The concentration of the target compounds in the blank must be less than the reporting limit for each target compound, with the exception of the common laboratory contaminants acetone, 2-butanone, and methylene chloride, which must be <2X the reporting limit.

9.3.4.1 The DOD-QSM requires that the target compounds in the blank must be at a concentration of <½ the reporting limit and < the reporting limit for lab contaminants.

9.3.4.2 The SC DHEC requires that all compounds in the blank be less that the reporting limits except for the **common laboratory contaminants**, which must be <2X the reporting limit.

9.3.5 All samples processed within the same 12-hour tune associated with a method blank that does not meet the blank technical acceptance criteria must be reanalyzed.

9.3.6 Method interferences caused by contaminants in solvents, reagents, glassware, laboratory air, and other sample storage and processing hardware that lead to discrete artifacts and/or elevated baselines in gas chromatograms must be eliminated. The chromatographic system must be inspected for malfunctions, and corrections must be made as required

before more samples are analyzed. An instrument blank is analyzed after a high concentration sample in order to eliminate carryover.

9.4 Laboratory Control Sample

9.4.1 A laboratory control sample (LCS) is prepared and analyzed with each tune batch of up to 20 samples. The LCS and matrix spikes are spiked with the same target analytes. The LCS is spiked at the same concentration as the matrix spike. The LCS is spiked with all compounds of interest in the project.

9.4.2 The percent recovery criteria, developed from in-house statistical data, for the analytes in the full LCS are listed in Attachment 2.

9.4.2.1 The LCS control limits required by the DOD-QSM are listed in Attachment 6 along with the marginal exceedances.

9.4.2.2 The following table presents the DOD-QSM and 2003 NELAC Standards allowed number of marginal exceedances governed by the number of compounds spiked into the LCS.

Number of analytes in the LCS	Allowed number of Marginal Exceedances
> 90	5
71-90	4
51-70	3
31-50	2
11-30	1
< 11	0

The LCS fails if the more than the allowed number of marginal exceedances occur or if a spike recovery is outside of the marginal exceedance limits.

9.4.3 Gases and known poor purging compounds

- gases: bromomethane
  chloromethane
  chloroethane
  vinyl chloride
  dichlorodifluoromethane
  trichlorofluoromethane)
- acetone

- 2-butanone
- carbon disulfide
- crotonaldehyde
- 1,2-dibromo-3-chloropropane
- 1,4-dioxane
- isobutyl alcohol
- 2-hexanone
- 4-methyl-2-pentanone
- vinyl acetate
- 2-chloroethyl vinyl ether

9.4.4 For SC DHEC, an expanded subset of analytes, representative of the compounds being reported, is employed and all analytes must have recovery limits within 70 - 130%. The analytes are:

- vinyl chloride
- 1,1-dichloroethene
- methylene chloride
- 1,1-dichloroethane
- cis-1,2-dichloroethene
- 2-butanone
- carbon tetrachloride
- benzene
- trichloroethene
- 1,2-dichloropropane
- bromodichloromethane
- tetrachloroethene
- chlorobenzene
- ethylbenzene
- styrene
- bromoform
- 1,4-dichlorobenzene

9.4.5 When the LCS fails to meet the acceptance criteria, the entire batch associated with it must be re-prepared and reanalyzed.

9.5 Matrix Spikes

9.5.1 A matrix spike and matrix spike duplicate (MS/MSD) are prepared and analyzed with every SDG. The MS/MSD and LCS are spiked with the same analytes.

9.5.2 For the MS/MSD, in addition to spiking internal standard solution and surrogate solution, also add 5.0 µL of 8260 spike solution. For a full LCS requirement, use the ICV standard. The same ICV standard can be used for projects submitted to meet the regulatory requirements of the State of South Carolina, but only the 17 analytes presented in Section 9.4.4 are assessed. The spiking solutions are added by piercing the septum with the syringe needle.

9.5.3 Matrix spikes have the following advisory recovery criteria:

Spike Compound	% Recovery Range
1,1-dichloroethene	59-172
Trichloroethene	62-137
Benzene	66-142
Toluene	59-139
Chlorobenzene	78-122
All others	50-150

9.5.4 Matrix spikes have the following advisory RPD criteria:

Spike Compound	% RPD
1,1-dichloroethene	22
Trichloroethene	24
Benzene	21
Toluene	21
Chlorobenzene	21
All others	25

Note: This table is subject to change without notice.

9.5.5 Most spike compounds should meet these criteria. If the criteria are not met in the MS/MSD but are met in the LCS, the results may be reported with the failures attributed to the matrix of the sample. If the LCS does not meet criteria, then all will have to be repeated as discussed above.

9.5.6 To meet the requirements of the **DoD**-QSM, the duplicate matrix spikes should meet the LCS control limits listed in Attachment 6. The RPD between the duplicate matrix spikes should be ≤ 30%.

9.5.6.1 If the duplicate matrix spikes fail **DoD**-QSM acceptance criteria, notify the project manager. The project manager will contact the client for guidance.

9.5.6.2 If the original sample results are associated with failing duplicate matrix spikes, qualify the results in the narrative as estimated concentrations. Refer to the **DoD**-QSM "J" flag.

9.6 Initial Calibration Verification

9.6.1 A second source initial calibration verification (ICV) standard is run after the initial calibration standards have met criteria.

9.6.2 The ICV must be within 20% of its expected value for each target analyte and surrogate or within 40% for the poor purgers and the gases. Sporadic failure of up to three target compounds is allowed but they must not exceed 40% of their expected value. Gases and poor purgers are listed above.

9.6.2.1 To meet the requirements for the **DoD**-QSM, the ICV must be ± 25% of its expected value for each target analyte.

9.6.3 If the ICV fails to meet the criteria in **Sections** 9.6.2 or 9.6.2.1, take corrective action and reanalyze the standard. If the ICV fails again, repeat the initial calibration.

9.7 MDL Studies

9.7.1 On an annual basis and after major maintenance, a method detection limit (MDL) study is performed on at least one instrument per method and matrix. When multiple instruments are used, individual instrument MDL studies may be replaced by the analysis of an MDL check sample. The MDL check sample must be analyzed on all instruments, to demonstrate equivalent sensitivity.

9.7.1.1 The **DoD**-QSM requires that the MDL check sample be prepared at approximately 2x the MDL and is analyzed on a quarterly basis for each matrix. A response must be detected in the 2x MDL

check sample. Additionally, qualifying ions of 50% or higher must also be present. For more information on MDL studies, refer to QC SOP 13.11, "Performing Annual Method Detection Limit (MDL) Studies."

9.8 Corrective action: Instrument Problems/Preventative Maintenance

9.8.1 If a low response is observed for the early eluting compounds such as the gases, replacement of the trap or septum may be necessary. In addition, adjustments to the purge flow may be necessary to achieve a desired response for these compounds. If such adjustments do not help, it may be necessary to check the fittings on the purge and trap device and on the column for leaks. This is done with a helium leak detector and software utility programs.

9.8.2 Column maintenance or replacement may be necessary if peak tailing or broad chromatographic peaks are observed.

9.9 Contingency

9.9.1 If due to a lab accident or to QC failures, a re-preparation and analysis are required for the sample and insufficient sample volume remains, the Project Manager must be alerted and will contact the client for direction on how to proceed.

9.9.2 If persistent contamination occurs in the laboratory, analysis must be halted until the source of the contamination can be identified and isolated. When the contamination issue is resolved, samples analysis may proceed.

9.9.3 Refer to the corresponding Data Review SOP (number will vary among sections) for information on how to handle reporting of data that are unacceptable or out-of-control.

9.9.4 Any other issues that potentially effect data quality must be addressed with the Project Manager.

10.0 <u>Calibration and Standardization</u>

Note: The laboratory reporting limit is at or above the lowest initial calibration standard concentration.

10.1 BFB Tuning

10.1.1 The analysis of the instrument performance check solution is performed by injecting 50 ηg of BFB (2 µL STD ID#7008) into the GC using a 10 µL Hamilton syringe. BFB may be analyzed simultaneously with a continuing calibration verification standard as long as all QC criteria are met.

10.1.2 The peak selection criteria for BFB analysis are as follows (in order of performance):

10.1.2.1 Average one scan prior to the apex of the BFB peak to one scan after the apex, subtracting a single background scan prior to the peak, but no more than 20 scans prior to the elution of BFB. Also, do not subtract part of the BFB peak.

10.1.2.2 Choose the apex of the BFB peak only and include background subtraction.

Note: Background subtraction is performed to eliminate interference and when performed, the subtracted scan must be no more than 20 scans prior to the elution of the BFB and no scans within the BFB peak may be subtracted.

10.1.2.3 Choose a single scan or a range of scans within the BFB peak and include background subtraction.

10.1.3 The analysis of the instrument performance check solution must meet the ion abundance criteria given in the following table.

BFB Key Ions and Ion Abundance Criteria

Mass	Ion Abundance Criteria
50	15-40% of m/z 95
75	30-60% of m/z 95
95	Base Peak; 100% relative abundance
96	5-9% of m/z 95
173	<2% of m/z 174
174	>50% of m/z 95

Mass	Ion Abundance Criteria
175	5-9% of m/z 174
176	>95% but less than 101% of m/z 174
177	5-9% of m/z 176

10.1.4 BFB technical acceptance criteria must be met before any standards, samples, or required blanks are analyzed. GC/MS tuning and Mass Calibration forms must be printed and attached to the instrument run log page for each tune. The relative abundance for each ion is calculated to two decimal places.

10.1.5 If BFB technical acceptance criteria are not met, retune the GC/MS system. It may also be necessary to clean the ion source, clean the quadrupole rods, if serviceable, or take other corrective action to achieve the technical acceptance criteria.

10.2 Initial Calibration

10.2.1 Prior to the analysis of samples and required blanks, and after the instrument performance check solution (BFB) criteria have been met, each GC/MS system must be calibrated at six concentrations to demonstrate instrument sensitivity and the linearity of responses for the purgeable target compounds.

10.2.2 Prepare standards according to the Initial Calibration Standard Preparation Table in Section 7.5. The purge and trap volume is 5 mL. All initial calibration standards must be analyzed at the concentration levels and frequency described in this SOP on a GC/MS system meeting the BFB technical acceptance criteria. The analysis of the six calibration standards determines the linearity of the six-point initial calibration curve.

10.2.3 The area response of the characteristic ions in the extracted ion current profile (EICP) is tabulated against the concentration for each compound and internal standard. Relative response factors (RRF) are calculated for each compound.

10.2.4 Minimum relative response factors for the System Performance Check Compounds (SPCC) must be met and are listed in the following table.

Relative Response Factor Criteria for SPCCs:

Volatile Compound	**Minimum RRF**
Chloromethane	0.10
1,1-dichloroethane	0.10
Chlorobenzene	0.30
Bromoform	0.10
1,1,2,2-tetrachloroethane	0.30

10.2.5 The following Calibration Check Compounds (CCC) have maximum % RSD criteria of ≤ 30%:

- 1,1-dichloroethene
- chloroform
- 1,2-dichloropropane
- toluene
- ethylbenzene
- vinyl chloride

10.2.5.1 The remaining compounds must have an RSD of ≤ 15%. If the % RSD is 15% or less, the average relative response factor may be used for quantitation. If the % RSD is greater than 15% then an alternate method for quantitation, such as a linear calibration using least squares regression or quadratic fit, may be used. When one of these options is used, the line must not be forced through the origin.

If the linear or quadratic regression fit is used, the correlation coefficient must be ≥ 0.990. These alternate methods of quantitation are available in the ThruPut system.

Note: The **DoD**-QSM requires that the linear least squares regression correlation coefficient must be ≥ 0.995 and does not allow the used of quadratic fit.

10.2.5.2 If the initial calibration does not meet the criteria above, corrective action is necessary.

- Check the instrument operating conditions and perform maintenance as necessary. It may be necessary to clean the ion source, perform column maintenance, change the column, service the purge and trap device, or take other

corrective action to achieve the technical acceptance criteria.

- Compare responses for the analyte in each of the standard levels to verify that a single standard analysis is not presenting results significantly higher or lower then the other standard analyses, as this would indicate that the standard solution was prepared in error. If that is the case, re-prepare and reanalyze the standard.

10.2.7 The initial calibration verification must be analyzed after each initial calibration and must meet the acceptance criteria. If the ICV fails, then a new initial calibration curve must be generated.

10.3 Continuing Calibration Verification

10.3.1 Before the analysis of samples and blanks, but after BFB and initial calibration acceptance criteria have been met, each GC/MS system must be routinely checked by analyzing a continuing calibration verification standard. This standard contains all purgeable target analytes and surrogate compounds. It is used to ensure that the instrument meets the sensitivity and linearity requirements of the method throughout the analytical sequence.

10.3.2 A check of the calibration curve must be performed once every 12 hours, beginning with the injection of BFB. A percent difference of the response for each compound compared to the mean relative response factor from the initial calibration is calculated when performing the average response factor model.

10.3.3 The calculated percent difference must be less than or equal to 20% for the CCCs listed above in Section 10.2.5. Minimum response factor criteria for the continuing calibration verification standard (SPCCs) are also shown in Section 10.2.4.

10.3.3.1 If a regression fit model was used for analytes in the initial calibration, the continuing calibration verification is performed using percent drift (difference) for the CCCs.

10.3.4 As indicated for the initial calibration acceptance criteria, for the continuing calibration verification, the remaining target analytes (non-CCC compounds) do not have defined % difference criteria. We have

established a warning limit of 50%D and an action limit of 90%D. These values have been inserted as defaults into the data reduction software program. This is based strictly on established U.S. EPA data validation guidelines where values greater than 90% RSD results in rejection of data.

10.3.4.1 For samples submitted to meet the regulatory requirements of the State of South Carolina, all non-CCC target analytes must be within 30% acceptance criteria, with the exception of the poor purgers listed in Section 9.4.3. The poor purgers should fall with 40% acceptance criteria.

10.3.5 If continuing calibration verification acceptance criteria cannot be met after inspection and normal maintenance, a new initial calibration will have to be performed.

Note: Method 8260B indicates that if the CCCs are not required analytes, then all required analytes, must meet the 20% difference/drift criterion. Our typical analysis includes all of the CCCs.

11.0 Procedure

Documentation must follow the requirements in QC SOP 13.6: "Proper Documentation Procedures". All injections must be recorded on the instrument runlog (Attachment 4) along with the date, time (use a 24 hour clock), the volume injected, operator ID, and any comments relevant to the injection. Circle the Method used to perform the analysis. Condition codes, abbreviations defined in Attachment 8, are used to document failed and qualified injections. Preventive maintenance such as clipping the front-end of the column must be recorded in the logbook. Any major maintenance, i.e., changing the source or column, must be recorded in the instrument maintenance logbook.

All samples must be analyzed on a GC/MS system meeting the BFB, initial calibration, continuing calibration verification, and instrument blank criteria.

11.1 Instrument Software Conventions

11.1.1 Quantitation method: Average of the whole

11.1.2 File naming convention: XX123456X78

where: XX = Analysis type
123456 = Date/Lab ID with first digit dropped
Y = shift
78 = instrument #

11.1.3 Analysis type prefixes

11.1.3.1 Standard: CS, CT, CU, CV, CW, CX

11.1.3.2 Initial Sample Injection:

- SDG-Sample Number-Shift-Instrument, e.g., Q1636-1A52

11.1.3.3 Sample reinjection:

- SDG-Sample Number-J-Shift-Instrument, e.g., Q1636-1JA52

11.1.3.4 Sample re-extraction:

- SDG-Sample Number-R-Shift-Instrument, e.g., Q1636-1RA52

11.1.3.5 Sample dilution:

- SDG-Sample Number-D-Shift-Instrument, e.g., Q1636-1DA60

11.1.3.6 Additional repeats:

- SDG-Sample Number-(J2, R2, D2)-Shift-Instrument, e.g., Q1636-1J2A52

11.2 Analytical Sequence

11.2.1 Order of analysis for the instrument calibration:

- BFB (tune)
- initial calibration
- initial calibration verification

11.2.2 Order of analysis for the twelve-hour tune:

- BFB
- continuing calibration verification
- instrument blank
- laboratory control sample-LCS
- samples

11.2.3 All samples must be analyzed on a GC/MS system meeting the BFB, initial calibration, continuing calibration verification, and instrument blank criteria.

11.2.3.1 If tune time remains after the initial calibration standards have been run, samples may be analyzed as long as they are preceded by a valid instrument blank.

11.3 Preparations

11.3.1 Standards

11.3.1.1 The analysis of the instrument performance check solution is performed by injecting 50 ng of BFB (2 µL Standard ID#7008) into the GC using a 10 µL Hamilton syringe.

11.3.1.2 Calibration standards are prepared by spiking the appropriate volume of each standard solution into 5 mL of sparged DI water contained in a 5 mL syringe. This is then added to a 40 mL vial which is immediately capped with a PTFE-lined, septum-sealed cap and loaded into the Archon autosampler.

Initiate the Archon autosampler which will provide mixing, the addition of 5 mL of water containing 1 µL of internal standards and 1 µL of surrogate (5 µL of 50 µg/mL solutions if spiked by the chemist and not the Archon), heating at 40 °C, and purging for 11 minutes. The system will then transfer the constituents in the headspace to the Tekmar 3000 purge and trap concentrator and will then desorb all target analytes for 4 minutes before analysis. The analyses of the six calibration standards determine the linearity of the six-point initial calibration curve.

11.3.2 Instrument Blank and Method Blank

11.3.2.1 An instrument blank is prepared by filling a 40 mL VOA vial with 5 mL of purged DI water and sealing with a screw-top, PFTE-faced, septum-sealed cap. This is placed into the Archon autosampler where DI water, 1 µL of internal standards, and 1 µL of surrogates are added automatically to the blank (5 µL of 50 µg/mL solutions if spiked by the chemist and not the Archon). It is analyzed by a closed system heated purge and trap analysis.

11.3.2.2 A Method Blank is similar to an Instrument Blank in composition but it is prepared at the same time samples are prepared and is stored in the refrigerator. If samples are received from the field already in vials with sodium bisulfate preservative solution, only an Instrument Blank is required.

11.3.3 Laboratory Control Sample

11.3.3.1 A laboratory control sample (LCS) is prepared by filling a 40 mL VOA vial with 5 mL of purged DI water. To this 10 µL of the spiking standard is added before sealing with a screw-top, PFTE-faced, septum-sealed cap. This is placed into the Archon autosampler where DI water, 1 µL of internal standards, and 1 µL of surrogates are added automatically (5 µL of 50 µg/mL solutions if spiked by the chemist and not the Archon). It is analyzed by a closed system heated purge and trap analysis.

11.3.3.2 For certain projects and programs, a full list spike is required.

11.3.4 Samples

11.3.4.1 Solid samples are prepared by Method 5035. For details see Sample Preparation Procedure –238: "**Preparation of Soil / Sediment / Sludge / Non-aqueous Waste Samples for the Analysis of Volatile Organic Compounds by Closed-System Purge and Trap by SW-846 Methods 5035A and 3585, and EPA CLP SOW OLM04.3**."

11.3.4.2 The choice of whether a 5 g or medium level sample is analyzed is generally based on a screen analysis.

11.3.4.3 Samples are stored in a rack located in the volatile GC/MS freezer at -10 to -20 °C. Samples are allowed to come to room temperature and, 5 mL of DI water added by piercing the septum, then loaded into the Archon autosampler carousel shaking each vial gently so that the contents move freely.

11.3.4.4 In some case, samples are preserved with 5 mL of a solution of sodium bisulfate. In those cases, the vials are removed from a refrigerator, maintained at 2-6 °C, allowed to come to room temperature and loaded into the Archon autosampler, shaking

each vial gently so that the contents move freely and the stirring bar will be able to spin.

11.3.5 Matrix Spikes

11.3.5.1 For sample spikes, the Archon will spike 1 µL of internal standard solution and 1 µL of surrogate solution (5 µL of 50 µg/mL solutions is spiked by the chemist and not the Archon), also add 10.0 µL of 8260B spike solution.

11.3.5.2 For certain projects, full target list matrix spikes are required.

11.4 Analysis

11.4.1 When the Archon autosampler is initiated, the system will add 5 mL of purged DI water, containing 5 µL of internal standards and 5 µL of surrogates, by piercing the septum.

11.4.2 Prior to purging, the sample is heated to 40 °C. The sample is purged for 11 minutes, while mixing. For soil samples preserved with a sodium bisulfate solution, the stirring bar is turned on.

11.4.3 The same needle that is used to add the DI water is the source for the inert gas used for purging. The needle also contains slots above the sample/water level which provide a path for the headspace to be directed to the Tekmar 3000 purge and trap concentrator. This contains the trap that is then thermally desorbed into the GC/MS instrument.

11.4.4 After purging, the Purge and Trap Concentrator apparatus will desorb onto the GC column by elevating the trap temperature to 260 °C and back-flushing the trap with helium for 4 minutes at 20 to 60 mL/minute.

11.4.5 After desorbing, the trap is reconditioned by baking at 260 °C for at least 7 minutes. When the trap has finished baking and is cool, it is ready for the next sample to be purged.

11.4.6 In each analytical run, all analytes must fall below the maximum calibration range established by the highest standard in the initial calibration. If an analyte is present at a concentration higher than the highest initial calibration standard, it must be reanalyzed at a lesser amount or dilution. A valid dilution is one in which the compound in

question falls above the mid-point calibration standard concentration. The dilution is considered valid if the analyte concentration is above 50 µg/kg.

11.5 Target Compound Identification

11.5.1 Target compounds are identified in the samples by analyzing standards under the same conditions used for samples. The resulting mass spectra are compared to established library spectra and GC retention times to retention times from the latest continuing calibration standard. The mass spectrum of the sample compound and a laboratory library-generated spectrum must match according to the following criteria:

11.5.1.1 All ions present in the library mass spectrum at a relative intensity >10% must be present in the sample spectrum.

11.5.1.2 The relative intensities of ions specified above must agree within ± 20% between the library and sample spectra.

11.5.1.3 Ions >10% in the sample spectrum but not present in the library spectrum must be considered and accounted for. (These ions may be a result of co-eluting/closely-eluting compounds.)

11.5.2 If a compound analyzed by GC/MS techniques cannot be verified by all of the criteria listed above, but in the technical judgment of the mass spectral interpretation specialist the identification is correct, then the laboratory will report that identification.

11.5.3 If any of the internal standards, surrogates, or spike compounds are missing or failing, check the peak integration in "Target Review". Changes can be made in Target Review and EICPs can be generated. Any compound for which manual peak integration has been performed will have an "M" flag displayed on the quantitation report. All manual integration must follow the procedures documented in SOP 13.18, "Manual Chromatographic Peak Integration Procedures." These entries must be assigned a numerical code and the analyst's initials and the date must appear on each quantitation report page containing an "M" flag. For multiple "M" flags appearing on a quantitation report page, a bracket encompassing the flags can be used, with a single entry of the initials and date. The department supervisor or a representative of the QA department must approve of all manual integrations performed on all initial and continuing calibration standards. This is documented by initialing and dating each page of the quantitation report of the raw data containing such

manual integrations. See Attachment 9 for definitions of manual integration codes.

11.5.4 Non-target compounds are identified by comparing the resultant mass spectra from the non-target compounds to mass spectra contained in the National Institute of Standards and Technology (NIST) Mass Spectral Library. See Section 11.6.

11.6 Qualitative Analysis of Non-Target Compounds

11.6.1 Tentatively identify all compounds in the sample that have not already been identified as target compounds, or that are not surrogates, internal standards or semivolatile target compounds, by performing a computer-generated library search using the NIST 129K.1 mass spectral library (See Section 6.10.3). The library search must not be normalized.

11.6.2 Up to 30 tentatively identified compounds (TICs), including alkanes, of the greatest concentration are reported for each sample. The number of TICs required may vary, depending on project requirements.

11.6.3 Rules for making tentative identification:

11.6.3.1 TICs receiving a library search match of 85% or higher are considered a "probable match". Report the compound identified.

11.6.3.2 For TICs receiving more than one library search match of 85% or higher, report the compound with the highest percent match.

11.6.3.3 For TICs receiving two or more library search matches of 85% or higher with the same percent match, report the first compound.

11.6.3.4 For TICs that are isomers receiving library search matches of 85% or higher, report the compound with the highest percent match.

Note: If in the opinion the experienced analyst/data reviewer there is sound technical evidence not to identify the compound as specified in Sections 11.6.3.1 to 11.6.3.4 the justification must be documented in the narrative.

11.6.3.5 TICs receiving a library search match of < 85% are given a tentative identification by the analyst/data reviewer, if possible. If no identification can be made the TIC is reported as "unknown". If possible the unknown is further identified as part of a class of compounds (for example "unknown aromatic").

11.7 Quantitation

11.7.1 The mean relative response factor (RRF) from the initial calibration standard is used to calculate the concentration in the sample. For NYSASP, the RRF from the continuing calibration standard is used to calculate concentrations.

Note: Alternatively, the calibration curve(s) generated from the initial calibration may be used for the determination of analyte(s) concentration(s). This option is discussed above.

11.7.2 All samples require a search of all extraneous peaks >10% of the height of the nearest internal standard, up to 10 searches, i.e**,**. 10 most intense extraneous peaks. The number of searches may be more, depending on client requirements.

11.7.3 In each analytical run, all analytes must fall below the method's maximum analytical range, i.e. the highest calibration standard.

11.7.3.1 If an analyte is present at a concentration higher than the maximum analytical range in a 5g analysis, the medium level sample must be analyzed.

11.7.4 When a sample is analyzed that has saturated ions from a compound, this analysis must be followed by the analysis of an instrument blank or the following sample must be monitored for contamination and interference from carryover. If the blank or sample is not free from interferences, the system must be decontaminated. Sample analysis may not resume until a blank or sample has been analyzed which is free from interferences. Being free from interferences means that whatever compound was present above the initial calibration range in a sample, cannot be present in an instrument blank or the sample analyzed immediately following, at a level above the reporting limit for that compound.

11.7.5 Secondary ion quantitation is allowed only when there are sample matrix interferences with the primary ion. If secondary ion quantitation is performed, document the reasons in the SDG narrative.

11.7.6 Non-target compounds are quantified by comparing the MS response from the reconstructed ion chromatogram (RIC) for the non-target compound peaks to the MS response for a peak produced by the nearest internal standard compound. A response factor of 1 is assumed.

12.0 Data Analysis and Calculations

Calculations must be consistent with the Quality Control SOP 13.4, "Numerical Data Reduction".

12.1 Calculation of the mean or average of a set of values:

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

where: n = total number of values
x_i = each individual value used to calculate the mean
x = the mean of n

12.2 Calculation of the standard deviation of a set of values:

$$\text{Standard deviation} = \sqrt{\frac{\sum_{i=1}^{n}\left(X_n - \overline{X}\right)^2}{n-1}}$$

12.3 Calculation of percent recovery:

12.3.1 LCS and surrogates:

$$\%R = \frac{Amount\ found}{Amount\ spiked}\ x\ 100$$

12.3.2 Matrix spikes:

$$\%\,R = \frac{Amount\ in\ spiked\ sample - Amount\ in\ unspiked\ (native)\ sample}{Amount\ spiked}\ x\ 100$$

12.4 Calculation of %RSD

$$\%RSD = \left(\frac{Standard\ deviation}{\overline{X}}\right) \times 100$$

12.5 Calculation of RPD

$$RPD = \frac{|Value\ 1\ -\ Value\ 2|}{(Value\ 1\ +\ Value\ 2)/2}\ x100$$

12.6 Calculation of %Difference (%D)

$$\%Diff = \frac{Value\ -\ \overline{Reference\ \ value}}{\overline{Reference\ \ value}}\ x\ 100$$

12.7 Relative Response Factor

$$RRF = \frac{Ax\ x\ C(is)}{A(is)\ x\ Cx}$$

where: Ax = Area of the characteristic ion (EICP) for the compound to be measured
A(is) = Area of the characteristic ion (EICP) for the specific internal standard
C(is) = Concentration of the internal standard (in µg/**L**)
Cx = Concentration of the compound to be measured

12.8 Linear Calibration using Least Squares Regression

General linear equation: $y = ax + b$

where: y = Instrument response (peak area)
a = Slope of the line (coefficient of x)
x = Mass of the analyte in the calibration standard aliquot injected
b = y-intercept

Linear Regression by Least Squares:

$$y_1^{'} = ax_i + b$$

Where: b = intercept
x_i = Mass of the analyte in the ith calibration standard aliquot injected
$y_1^{'}$ = calculated response for the ith calibration standard

The sum of the squares of the differences is minimized to obtain a and b:

12.9 Correlation Coefficient r:

$$r = \frac{N\left[\sum_{i=1}^{N}(x_i y_i)\right] - \left[\sum_{i=1}^{N}(x_i)\right]\left[\sum_{i=1}^{N}(y_i)\right]}{\sqrt{N\left[\sum_{i=1}^{N}(x_i^2)\right] - \left[\sum_{i=1}^{N}(x_i)\right]^2} * \sqrt{N\left[\sum_{i=1}^{N}(y_i^2)\right] - \left[\sum_{i=1}^{N}(y_i)\right]^2}}$$

Where:
r = Correlation Coefficient
N = number of data points (equals 5 in a 5 point curve)
y = response
i = index variable (first data point i = 1)
x = Mass of the analyte in the calibration standard aliquot injected

12.10 Quadratic Calibration (second order: $y = ax^2 + bx + c$) fit in Target

$$y = [n]\left[b + m^1\ (Rsp) + m^2\ (Rsp\text{^}2)\right]$$

where: b = constant
m^1 = multiplier for the unsquared term
m^2 = multiplier for the squared term
x = area of analyte/area of Internal Standard
n = amount of Internal Standard
y = amount in ng on column
Rsp = area of analyte/area of Internal Standard

12.11 Concentration

12.11.1 The area response of the characteristic ions in the extracted ion current profile (EICP) is tabulated against the concentration for each compound and internal standard.

12.11.2 Concentration of soil samples (dry weight basis) by GC/MS analysis using relative response factor:

$$ug/kg = \frac{(As)(Cis)}{(Ais)(\overline{RF})(Ws)(D)}$$

where: As = Area of the peak for the analyte in the sample
Ais = Area of the peak for the internal standard
Cis = Concentration of the internal standard in the volume purged, in µg/L
$\overline{RF}$ = Mean response factor from the initial calibration

$$\overline{RF} = \frac{\sum_{i=1}^{n} RFi}{n}$$

Ws = weight of sample purged, in grams

$$D\ (dry\ weight) = \frac{100 - \%\ moisture}{100}$$

12.11.3 Concentration of soil samples (dry weight basis) by GC/MS using quadratic (second order) fit in Target:

$$y = [n]\left[b + m^1\ (Rsp) + m^2\ (Rsp\text{^}2)\right]$$

where:b = constant
m^1 = multiplier for the unsquared term
m^2 = multiplier for the squared term
n = amount of Internal Standard
y = concentration in ng on column
Rsp = area of analyte/area of Internal Standard

Example:Area of acetone = 35659
Area of IS = 613275
b = -0.0909161

$m^1 = 9.605304$
$m_2 = 7.132688$
ng of IS = 250
response = 35659/613275 = 0.058145

Amount in ng on column =

$$(250ng)[-0.0909161 + 9.605304 \ x \ 0.058145 + 7.132688 \ x \ 0.058145^2] = 122.9ng$$

$$Concentration \ \mu g / Kg = \frac{122.9ng}{(Ws)(D)}$$

12.11.4 Concentration of soil samples (dry weight basis) by GC/MS using linear regression analysis:

$$\frac{A_s C_{is}}{A_{is}} = aC_s + b$$

$$C_s = \frac{\left[\frac{A_s C_{is}}{A_{is}} - b\right]}{a}$$

where: As = Area of the target analyte peak in the sample
Ais = Area of the internal standard peak
Cs = Concentration of the target analyte in the calibration standard
Cis = Concentration of the internal standard
a = Slope of the line (coefficient of Cs)
b = The intercept

$$Concentration \ \mu g / Kg = \frac{(Cs)}{(\mathrm{Ws})(D)}$$

12.11.5 Tentatively Identified Compound (TIC) Estimation

$$TIC \ Amount = \frac{(Area \ TIC) \ x \ Amount(Std)}{(Area \ IS) \ x \ 1(RF)(Ws)(D)}$$

where: Area (TIC) = area response from RIC for non-target compound
Amount(Std) = amount of internal standard added to the sample, in µg/L.

Area (IS)	=	area response of the nearest internal standard in the reconstructed ion chromatogram
1(RF)	=	assumed response factor of 1

12.12 Calculating Dilutions

12.12.1 If a sample concentration exceeds the high level standard a dilution must be performed. Determine a level of dilution that will result in a value within the upper half of the calibration range. This is an acceptable dilution.

12.12.2 Adjust the amount of sample purged with 1 gram being the lowest acceptable weight for a low level analysis. If the analyte still exceeds the analytical range in the medium level analysis, perform a methanol extraction following Sample Preparation Procedure –238, "**Preparation of Soil/Sediment/Sludge/Non-aqueous Waste Samples for the Analysis of Volatile Organic Compounds by Closed-System Purge and Trap by SW-846 Methods 5035A and 3585, and EPA CLP SOW OLM04.3**".

13.0 Method Performance

This method was validated through in-house laboratory studies of method detection limits and precision and accuracy for single analyst. The data are retained by the QA department.

14.0 Pollution Prevention

The solvents used in this procedure pose little threat to the environment when recycled and managed properly. Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The EPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency recommends recycling as the next best thing. See SOP 12.1, "Hazardous Waste Disposal", regarding laboratory procedures for recycling solvent waste streams.

15.0 Waste Management

It is the laboratory's responsibility to comply with all federal, state, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions, and to protect the air, water, and land by minimizing and controlling all releases from fume hoods and bench operations. Compliance with all sewage discharge permits and regulations is also required.

Samples preserved with HCl, HNO_3, or H_2SO_4 to pH <2 are hazardous and must be neutralized before being disposed, or must be handled as hazardous waste.

Refer to the Hazardous Waste Management and Safety SOPs located in the lab.

16.0 References

16.1 Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. U.S. EPA SW846 3rd Edition, Update 3, 12/96, Methods 8000C, 8260B and 5035A

16.2 Standard Methods for the Examination of Water and Wastewater, 20th Edition (1998), Method 1080

16.3 Code of Federal Register, 40 CFR, Part 136, "Guidelines for Establishing Test Procedures for Priority Pollutants"

16.4 QC SOP 13.6: "Proper Documentation Procedures"

16.5 QC SOP 13.4: "Numerical Data Reduction"

16.6 NELAC Standards, effective July 2003, plus revisions

16.7 QA/G6: Guidance for Preparing Standard Operating Procedures (SOPs) EPA/600/B-07/027, April 2007.

16.8 Department of Defense Quality Systems Manual for Environmental Laboratories, Version 4.2, **10/25/2010**

16.9 CompuChem Quality Manual, Revision ~~13, November 17, 2009,~~ 14, January 25, 2011 plus revisions

16.10 Sample Control SOP 4.1, "Receiving Samples"

16.11 Sample Control SOP 4.6, "Storing Samples"

16.12 QC SOP 13.11, "Performing Annual Method Detection Limit (MDL) Studies"

16.13 Sample Preparation Procedure –238, "**Preparation of Soil / Sediment / Sludge / Non-aqueous Waste Samples for the Analysis of Volatile Organic Compounds by Closed-System Purge and Trap by SW-846 Methods 5035A and 3585, and EPA CLP SOW OLM04.3**"

17.0 Attachments as Tables, Diagrams, and Flowcharts

17.1 Attachment 1 – Target Analyte List

17.2 Attachment 2 – In-house Statistical Control Limits

17.3 Attachment 3 – Target Analyte Reporting Limits

17.4 Attachment 4 – **Example** Instrument Run Log

17.5 Attachment 5 – Initial Calibration Standard Mixes

17.6 Attachment 6 – **DoD**-QSM LCS Control Limits

17.7 Attachment 7 – Second Source Initial Calibration Verification Standard Mixes

17.8 Attachment 8 – Definitions of Condition Codes

17.9 Attachment 9 – Definitions of Manual Integration Codes

Attachment 1

Volatile Target Compounds

Compounds	Internal Standard	Primary Quantitation Ion	Secondary Quantitation Ion(s)
dichlorodifluoromethane	1	85	87
chloromethane	1	50	52
vinyl chloride	1	62	64
bromomethane	1	94	96
chloroethane	1	64	66
trichlorofluoromethane	1	101	103
1,1-dichloroethene	1	96	61, 98
methylene chloride	1	84	49, 86
trans-1,2-dichloroethene	1	96	61, 98
1,1-dichloroethane	1	63	65, 83
2,2-dichloropropane	1	77	97
cis-1,2-dichloroethene	1	96	61, 98
bromochloromethane	1	128	49, 130
chloroform	1	83	85
1,1,1-trichloroethane	1	97	99, 61
carbon tetrachloride	1	117	119, 121
1,1-dichloropropene	1	75	110, 77
benzene	1	78	77, 51
1,2-dichloroethane	1	62	98
trichloroethene	1	130	95, 97
1,2-dichloropropane	1	63	112
dibromomethane	1	174	93, 95
bromodichloromethane	1	83	85, 127
2-chloroethyl vinyl ether	1	63	65, 106
cis-1,3-dichloropropene	1	75	77
acrolein	1	56	55, 58
iodomethane	1	142	127, 141
1,1,1-trichloro-2,2,2,-trifluoroethane	1	117	151, 153
1,1,2-trichloro-1,2,2,-trifluoroethane	1	85	101, 151
carbon disulfide	1	76	78
acetone	1	43	58
3-chloropropene	1	76	41, 78
acetonitrile	1	41	40, 39

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Attachment 1 (continued)

Volatile Target Compounds

Compounds	Internal Standard	Primary Quantitation Ion	Secondary Quantitation Ion(s)
Acrylonitrile	1	53	52, 51
Methyl-tert-butyl ether	1	73	41, 43
Vinyl acetate	1	43	86
2-Butanone	1	72	43, 57
Propionitrile	1	54	55, 52
Methacrylonitrile	1	41	39, 67
1-Chlorobutane	1	56	49
1,4-Dioxane	1	88	58
Methylmethacrylate	1	69	100, 41
Dibromofluoromethane: Surrogate #1	1	113	111, 192
1,2-Dichloroethane-d_4: Surrogate #2	1	65	102, 67
4-Methyl-2-pentanone	2	43	85, 100
Toluene	2	92	91
trans-1,3-Dichloropropene	2	75	77
1,1,2-Trichloroethane	2	97	83, 85
Ethylmethacrylate	2	69	41, 99
Tetrachloroethene	2	164	168, 129
1,3-Dichloropropane	2	76	78
2-Hexanone	2	43	58, 57
Dibromochloromethane	2	129	127, 48
1,2-Dibromoethane	2	107	109, 188
Chlorobenzene	2	112	114, 77
1,1,1,2-Tetrachloroethane	2	131	119, 133
Ethylbenzene	2	106	91
m,p-Xylene	2	106	91
o-Xylene	2	106	91
Styrene	2	104	91, 78
Bromoform	2	173	175, 254
Isopropyl benzene	2	105	120
Bromobenzene	2	156	77,158
1,1,2,2-Tetrachloroethane	2	83	85, 131

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Attachment 1 (continued)

Volatile Target Compounds

Compounds	Internal Standard	Primary Quantitation Ion	Secondary Quantitation Ion(s)
1,2,3-Trichloropropane	2	110	75, 112
trans-1,4-Dichloro-2-butene	2	53	88, 75
Toluene-d_8: Surrogate #3	2	98	70, 100
n-Propyl benzene	3	91	120
2-Chlorotoluene	3	126	91
4-Chlorotoluene	3	91	126
1,2,4-Trimethyl benzene	3	105	120
1,3,5-Trimethyl benzene	3	105	120
Pentachloroethane	3	167	130, 165
sec-Butyl benzene	3	105	134
1,2-Dichlorobenzene	3	146	111, 148
1,3-Dichlorobenzene	3	146	111, 148
1,4-Dichlorobenzene	3	146	111, 148
n-Butyl benzene	3	91	92, 134
tert-Butyl benzene	3	119	91, 134
p-Isopropyl toluene	3	119	134, 91
1,2-Dibromo-3-chloropropane	3	75	155, 157
1,2,4-Trichlorobenzene	3	180	182, 145
Hexachlorobutadiene	3	225	223, 227
Naphthalene	3	128	64, 51
1,2,3-Trichlorobenzene	3	180	182, 145
4-Bromofluorobenzene: Surrogate #4	3	95	174, 176
Fluorobenzene: Internal Standard #1	NA	96	70
Chlorobenzene-d_5: Internal Standard #2	NA	117	82, 119
1,4-Dichlorobenzene-d_4:Internal Standard #3	NA	152	150

[1] Based on laboratory tests, 2-chloroethyl vinyl ether is not analyzable from the sodium bisulfate solution associated with Method 5035.

Attachment 2

Statistical Control Limits for the LCS

Compound	Percent Recovery Range 5 gram soil
Dichlorodifluoromethane	50-142
Chloromethane	52-150
Vinyl chloride [2]	58-148
Bromomethane	50-150
Chloroethane	52-150
Trichlorofluoromethane	54-144
Acrolein	50-150
1,1-Dichloroethene [1, 2]	51-146
Iodomethane	50-150
1,1,1-Trichloro-2,2,2,-trifluoroethane	58-148
Carbon disulfide	56-140
1,1,2-Trichloro-1,2,2,-trifluoroethane	50-149
Acetone	50-147
3-Chloropropene	50-150
Acetonitrile	68-126
Methyl acetate	50-150
Methylene chloride [2]	50-137
trans-1,2-dichloroethene	65-122
Acrylonitrile	50-136
Methyl-tert-butyl ether	70-133
Tert butyl alcohol	60-148
n-Hexane	50-143
1,1-Dichloroethane [2]	66-123
Chloroprene	50-150
Vinyl acetate	50-150
Isopropyl ether	81-114
2,2-Dichloropropane	64-141
cis-1,2-Dichloroethene [2]	69-127
2-Butanone [2]	66-132
Propionitrile	50-150
Bromochloromethane	73-126
Methyl acrylate	50-133
Methacrylonitrile	51-127
Tetrahydrofuran	50-150

Attachment 2 (continued)

Statistical Control Limits for the LCS

Compound	Percent Recovery Range 5 gram soil
Chloroform	75-128
1,1,1-trichloroethane	71-127
Cyclohexane	65-126
Carbon tetrachloride [2]	67-132
1,1-Dichloropropene	72-132
Benzene [1, 2]	67-126
1,2-Dichloroethane	56-141
Isobutyl alcohol	50-150
Trichloroethene [1, 2]	69-130
Methylcyclohexane	80-119
1,2-Dichloropropane [2]	73-121
Dibromomethane	64-131
1,4-Dioxane	50-150
Methylmethacrylate	60-127
Bromodichloromethane [2]	75-133
2-Chloroethyl vinyl ether	50-150
cis-1,3-Dichloropropene	87-127
4-Methyl-2-pentanone	67-125
Toluene [1]	73-121
trans-1,3-Dichloropropene	64-131
1,1,2-Trichloroethane	67-123
Ethylmethacrylate	67-124
Tetrachloroethene [2]	72-130
1,3-Dichloropropane	75-130
2-Hexanone	51-128
Dibromochloromethane	68-127
1,2-Dibromoethane	69-127
Chlorobenzene [1, 2]	71-120
1-Chlorohexane	80-113
1,1,1,2-Tetrachloroethane	82-120
Ethylbenzene [2]	76-121
m,p-Xylene	76-130

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Attachment 2 (continued)

Statistical Control Limits for the LCS

Compounds	Percent Recovery Range 5 gram soil
o-Xylene	76-130
Styrene [2]	68-126
Bromoform [2]	64-134
Isopropyl benzene	68-126
Bromobenzene	67-140
1,2,3-Trichloropropane	58-137
1,1,2,2-Tetrachloroethane	66-128
trans-1,4-Dichloro-2-butene	50-150
n-Propylbenzene	71-136
2-Chlorotoluene	78-124
4-Chlorotoluene	74-131
1,3,5-Trimethyl benzene	72-129
Pentachloroethane	64-150
tert-Butyl benzene	67-140
1,2,4-Trimethyl benzene	70-133
sec-Butyl benzene	67-141
1,3-Dichlorobenzene	74-119
1,4-Dichlorobenzene [2]	72-115
p-Isopropyl toluene	74-132
1,2-Dichlorobenzene	67-126
n-Butyl benzene	63-137
1,2-Diethylbenzene	75-117
1,2-Dibromo-3-chloropropane	72-127
1,2,4-Trichlorobenzene	57-133
Hexachlorobutadiene	68-129
Naphthalene	50-139
1,2,3-Trichlorobenzene	63-129
Xylene (total)	76-130

Table displays statistical control limits calculated in 2002.

[1] Denotes component of minimum LCS spike
[2] Denotes component of LCS spike for SC DHEC. Each of these analytes must be recovered within 70 - 130%.

Attachment 3

8260B Compounds and Reporting Limits

CAS#	Compound	5 grams (µg/Kg)
630-20-6	1,1,1,2-Tetrachloroethane	5
354-58-5	1,1,1-Trichloro-2,2,2-trifluoroethane	5
71-55-6	1,1,1,-Trichloroethane	5
79-34-5	1,1,2,2-Tetrachloroethane	5
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane	5
79-00-5	1,1,2-Trichloroethane	5
75-34-3	1,1-Dichloroethane	5
75-35-4	1,1-Dichloroethene	5
563-58-6	1,1-Dichloropropene	5
544-10-5	1-Chlorobenzene	5
87-61-6	1,2,3-Trichlorobenzene	5
96-18-4	1,2,3-Trichloropropane	5
120-82-1	1,2,4-Trichlorobenzene	5
95-63-6	1,2,4-Trimethylbenzene	5
96-12-8	1,2-Dibromo-3-Chloropropane	5
106-93-4	1,2-Dibromoethane	5
95-50-1	1,2-Dichlorobenzene	5
107-06-2	1,2-Dichloroethane	5
78-87-5	1,2-Dichloropropane	5
108-67-8	1,3,5-Trimethylbenzene	5
541-73-1	1,3-Dichlorobenzene	5
142-28-9	1,3-Dichloropropane	5
106-46-7	1,4-Dichlorobenzene	5
123-91-1	1,4-Dioxane	250
594-20-7	2,2-Dichloropropane	5
78-93-3	2-Butanone	12.5
110-75-8	2-Chloroethyl vinyl ether	5
95-49-8	2-Chlorotoluene	5
591-78-6	2-Hexanone	12.5
107-05-1	3-Chloropropene	5
106-43-4	4-Chlorotoluene	5
108-10-1	4-Methyl-2-pentanone	12.5
67-64-1	Acetone	12.5
75-05-8	Acetonitrile	5
107-02-8	Acrolein	50

Attachment 3 (continued)

8260B Compounds and Reporting Limits

CAS#	Compound	5 grams µg/Kg
107-13-1	Acrylonitrile	50
71-43-2	Benzene	5
108-86-1	Bromobenzene	5
74-97-5	Bromochloromethane	5
75-27-4	Bromodichloromethane	5
75-25-2	Bromoform	5
74-83-9	Bromomethane	5
75-15-0	Carbon disulfide	5
56-23-5	Carbon Tetrachloride	5
108-90-7	Chlorobenzene	5
75-00-3	Chloroethane	5
67-66-3	Chloroform	5
74-87-3	Chloromethane	5
126-99-8	Chloroprene	5
156-59-2	cis-1,2-Dichloroethene	5
10061-01-5	cis-1,3-Dichloropropene	5
110-82-7	Cyclohexane	5
124-48-1	Dibromochloromethane	5
74-95-3	Dibromomethane	5
75-71-8	Dichlorodifluoromethane	5
100-41-4	Ethylbenzene	5
97-63-2	Ethylmethacrylate	50
87-68-3	Hexachlorobutadiene	5
74-88-4	Iodomethane	5
78-83-1	Isobutyl alcohol	250
89-82-8	Isopropyl Benzene	5
108-20-3	Isopropyl ether	5
108-38-3	m,p-Xylene	10
126-89-7	Methacrylonitrile	50
79-20-9	Methyl acetate	5
108-87-2	Methylcyclohexane	5
75-09-2	Methylene Chloride	5
80-62-6	Methylmethacrylate	50
1634-04-4	Methyl-tert-butyl ether	5
91-20-3	Naphthalene	5
104-51-8	n-Butyl benzene	5
110-54-3	n-Hexane	5

ORIGINAL MASTER COPY CONTROLLED COPY
If words above are not highlighted, this is an uncontrolled copy of this document.

Attachment 3 (continued)

8260B Compounds and Reporting Limits

CAS#	Compound	5 grams µg/Kg
103-65-1	n-Propyl benzene	5
95-47-6	o-Xylene	5
76-01-7	Pentachloroethane	5
99-87-6	p-Isopropyl Toluene	5
107-12-0	Propionitrile	250
135-98-8	sec-Butyl benzene	5
100-42-5	Styrene	5
75-65-0	Tert-Butyl alcohol	5
98-06-6	tert-Butyl benzene	5
127-18-4	Tetrachloroethene	5
109-99-9	Tetrahydrofuran	20
108-88-3	Toluene	5
156-60-5	trans-1,2-Dichloroethene	5
10061-02-6	trans-1,3-Dichloropropene	5
110-57-6	trans-1,4-Dichloro-2-butene	20
79-01-6	Trichloroethene	5
75-69-4	Trichlorofluoromethane	5
108-05-4	Vinyl acetate	5
75-01-4	Vinyl Chloride	5
1330-20-7	Xylene (total)	15

Attachment 4

COMPUCHEM a Division of Liberty Analytical Corp DATE ___/___/___ INITIAL TIME OF TUNE_____ SHIFT/S(A)_____(B)_____(C)____
GC/MS VOLATILE RUN LOG TIME TUNE EXPIRES_____ LINKER /METHOD_____
COMPUCHEM LOGBOOK 11 NNN 29 (5972hp59) METHOD: 8260B SOM01.2 (Circle one) or Other: _____
MAINTENANCE_____

	REJECTED	FILE NAME	REPORTED	pH	Vial	DATE	TIME	Client ID	SDG#	INJ. VOL.*	DF+	CHEMIST	COMMENTS (ETC.)/ DISPOSITION
1						/ /							
2						/ /							
3						/ /							
4						/ /							
5						/ /							
6						/ /							
7						/ /							
8						/ /							
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20						/ /							
21						/ /							
22						/ /							
23						/ /							
24						/ /							

*On-column sample aliquot +Not applicable to soil matrix

The presence of the Chemist's/Analyst's employee ID number, or signature, on this run log attests that strict compliance with the method's SOP has occurred. Any SOP deviations require documentation by the responsible chemist/analyst together with the chemist's/analyst's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation

Tune (ID #7008) Lot No.: _____ Calibration Group Code / Lot No.: _____
Internal Standard Lot No.: _____ Surrogate Lot No.: _____

REVIEWED BY: _____ Date_____

4/05/10: jad

Note: This page subject to change without notice.

Attachment 5

TCL4 1&2 HIGH

RESTEK

CERTIFICATE OF ANALYSIS

110 Benner Circle
Bellefonte, PA 16823-8812
Tel.: (800)356-1688
Fax: (814)353-1309

FOR LABORATORY USE ONLY–READ MSDS PRIOR TO USE.

Cat. No.: 30431 Lot No.: A027506
Description: 502.2 CAL 2000 Mega-Mix
Expiration Date[1]: August 2005 Storage: Freezer

Compound	CAS#	Percent Purity[3]	Concentration (weight/volume)[4]	Percent Uncertainty[5]
1,1-dichloroethane	75-34-3	99%	2,000 µg/ml	+/- .04%
1,1-dichloroethene	75-35-4	99%	2,000 µg/ml	+/- .04%
1,1-dichloropropene	563-58-6	99%	2,000 µg/ml	+/- .04%
1,1,1-trichloroethane	71-55-6	99%	2,000 µg/ml	+/- .04%
1,1,1,2-tetrachloroethane	630-20-6	99%	2,000 µg/ml	+/- .04%
1,1,2-trichloroethane	79-00-5	99%	2,000 µg/ml	+/- .04%
1,1,2,2-tetrachloroethane	79-34-5	99%	2,000 µg/ml	+/- .04%
1,2-dibromo-3-chloropropane	96-12-8	97%	2,000 µg/ml	+/- .04%
1,2-dibromoethane	106-93-4	99%	2,000 µg/ml	+/- .04%
1,2-dichlorobenzene	95-50-1	99%	2,000 µg/ml	+/- .04%
1,2-dichloroethane	107-06-2	99%	2,000 µg/ml	+/- .04%
1,2-dichloropropane	78-87-5	99%	2,000 µg/ml	+/- .04%
1,2,3-trichlorobenzene	87-61-6	99%	2,000 µg/ml	+/- .04%
1,2,3-trichloropropane	96-18-4	99%	2,000 µg/ml	+/- .04%
1,2,4-trichlorobenzene	120-82-1	99%	2,000 µg/ml	+/- .04%
1,2,4-trimethylbenzene	95-63-6	99%	2,000 µg/ml	+/- .04%
1,3-dichlorobenzene	541-73-1	99%	2,000 µg/ml	+/- .04%
1,3-dichloropropane	142-28-9	99%	2,000 µg/ml	+/- .04%
1,3,5-trimethylbenzene	108-67-8	99%	2,000 µg/ml	+/- .04%
1,4-dichlorobenzene	106-46-7	99%	2,000 µg/ml	+/- .04%
2-chlorotoluene	95-49-8	99%	2,000 µg/ml	+/- .04%
2,2-dichloropropane	594-20-7	99%	2,000 µg/ml	+/- .04%
4-chlorotoluene	106-43-4	99%	2,000 µg/ml	+/- .04%
p-isopropyltoluene	99-87-6	99%	2,000 µg/ml	+/- .04%
benzene	71-43-2	99%	2,000 µg/ml	+/- .04%
bromobenzene	108-86-1	99%	2,000 µg/ml	+/- .04%
bromochloromethane	74-97-5	99%	2,000 µg/ml	+/- .04%

[1]Expiration date of the unopened ampul stored at recommended temperature.
[2]Listed in alphabetical order.
[3]Purity was determined by one or more of the following techniques: GC/FID, HPLC, GC/ECD, GC/MS. Value rounded to the nearest LOWER whole percentage. In addition to detectors listed above, chemical identity and purity are confirmed using 1 or more of the following: MS, DSC, solid probe MS, GC/FPD, GC/NPD, GC/TC, FTIR, melting point, refractive index, and Karl Fisher. See data pack or contact Restek for further details.
[4]Based upon gravimetric preparation with balance calibration verified using NIST traceable weights (seven mass levels).
[5]Percent uncertainty based upon balance AND ASTM Class A volumetric glassware accuracy.

ISO 9001 REGISTERED RESTEK QUALITY SEPARATES US FROM THE REST

MANUFACTURED UNDER RESTEK'S ISO 9001 REGISTERED QUALITY SYSTEM: Certificate #97-HOU-AQ-8550 Issued by DNV Certification, Inc.

Attachment 5 (continued)

TCL4 1 & 2 HIGH

RESTEK

CERTIFICATE OF ANALYSIS (cont.)

FOR LABORATORY USE ONLY–READ MSDS PRIOR TO USE.

PAGE 2

Cat. No.: 30431 Lot No.: A027506

Description: 502.2 CAL 2000 Mega-Mix

Compound	CAS#	Percent Purity[3]	Concentration (weight/volume)[4]	Percent Uncertainty[5]
bromodichloromethane	75-27-4	99%	2,000 µg/ml	+/- .04%
bromoform	75-25-2	99%	2,000 µg/ml	+/- .04%
carbon tetrachloride	56-23-5	99%	2,000 µg/ml	+/- .04%
chlorobenzene	108-90-7	99%	2,000 µg/ml	+/- .04%
chloroform	67-66-3	99%	2,000 µg/ml	+/- .04%
cis-1,2-dichloroethene	156-59-2	99%	2,000 µg/ml	+/- .04%
cis-1,3-dichloropropene	10061-01-5	99%	2,000 µg/ml	+/- .04%
dibromochloromethane	124-48-1	99%	2,000 µg/ml	+/- .04%
dibromomethane	74-95-3	99%	2,000 µg/ml	+/- .04%
ethylbenzene	100-41-4	99%	2,000 µg/ml	+/- .04%
hexachlorobutadiene	87-68-3	99%	2,000 µg/ml	+/- .04%
isopropylbenzene	98-82-8	99%	2,000 µg/ml	+/- .04%
methylene chloride	75-09-2	99%	2,000 µg/ml	+/- .04%
m-xylene	108-38-3	99%	2,000 µg/ml	+/- .04%
naphthalene	91-20-3	99%	2,000 µg/ml	+/- .04%
n-butylbenzene	104-51-8	99%	2,000 µg/ml	+/- .04%
n-propylbenzene	103-65-1	99%	2,000 µg/ml	+/- .04%
o-xylene	95-47-6	99%	2,000 µg/ml	+/- .04%
p-xylene	106-42-3	99%	2,000 µg/ml	+/- .04%
sec-butylbenzene	135-98-8	99%	2,000 µg/ml	+/- .04%
styrene	100-42-5	99%	2,000 µg/ml	+/- .04%
tetrachloroethene	127-18-4	99%	2,000 µg/ml	+/- .04%
tert-butylbenzene	98-06-6	99%	2,000 µg/ml	+/- .04%
toluene	108-88-3	99%	2,000 µg/ml	+/- .04%
trans-1,2-dichloroethene	156-60-5	99%	2,000 µg/ml	+/- .04%
trans-1,3-dichloropropene	10061-02-6	97%	2,000 µg/ml	+/- .04%
trichloroethene	79-01-6	99%	2,000 µg/ml	+/- .04%
Solvent: purge & trap methanol	67-56-1	99%		

[1]*Expiration date of the unopened ampul stored at recommended temperature.*

[2]*Listed in alphabetical order.*

[3]*Purity was determined by one or more of the following techniques: GC/FID, HPLC, GC/ECD, GC/MS. Value rounded to the nearest LOWER whole percentage. In addition to detectors listed above, chemical identity and purity are confirmed using 1 or more of the following: MS, DSC, solid probe MS, GC/FPD, GC/NPD, GC/TC, FTIR, melting point, refractive index, and Karl Fisher. See data pack or contact Restek for further details.*

[4]*Based upon gravimetric preparation with balance calibration verified using NIST traceable weights (seven mass levels).*

Attachment 5 (continued)

TCL4 - GASES HIGH

RESTEK

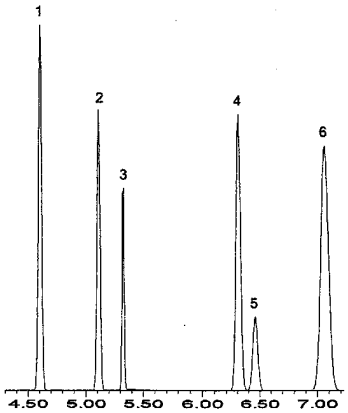
CERTIFICATE OF ANALYSIS

110 Benner Circle
Bellefonte, PA 16823-8812
Tel.: (800)356-1688
Fax: (814)353-1309

FOR LABORATORY USE ONLY--READ MSDS PRIOR TO USE.

Cat. No.: 30042 Lot No.: A028050
Description: 502.2 Calibration Mix #1
Expiration Date[1]: March 2010 Storage: Freezer

Elution Order	Compound	CAS#	Percent Purity[3]	Concentration (weight/volume)[4]	Percent Uncertainty[5]
1	Dichlorodifluoromethane	75-71-8	99%	1,997 µg/ml	± 1.9%
2	Chloromethane	74-87-3	99%	2,003 µg/ml	± 1.3%
3	Vinyl chloride	75-01-4	99%	2,003 µg/ml	± 1.4%
4	Bromomethane	74-83-9	99%	1,997 µg/ml	± 1.3%
5	Chloroethane	75-00-3	99%	2,003 µg/ml	± 1.5%
6	Trichlorofluoromethane	75-69-4	99%	2,000 µg/ml	± 0.3%
Solvent:	Purge and trap Methanol	67-56-1	99%		



Column: 105m .32mm 1.8µm
Rtx-502.2 (cat.#10921)
Carrier gas: helium @ 2.2 ml/min.
Temp. program: 50°C (hold 12 min.)
Isothermal
Inj. temp.: 240°C
Det. temp.: 240°C
Detector type: MSD

John Lidgett
John Lidgett—QA Analyst

[1]Expiration date of the unopened ampul stored at recommended temperature.
[2]Listed in alphabetical order.
[3]Purity was determined by one or more of the following techniques: GC/FID, HPLC, GC/ECD, GC/MS. Value rounded to the nearest LOWER whole percentage. In addition to detectors listed above, chemical identity and purity are confirmed using 1 or more of the following: MS, DSC, solid probe MS, GC/FPD, GC/NPD, GC/TC, FTIR, melting point, refractive index, and Karl Fisher. See data pack or contact Restek for further details.
[4]Based upon gravimetric preparation with balance calibration verified using NIST traceable weights (seven mass levels).
[5]Percent uncertainty based upon balance AND ASTM Class A volumetric glassware accuracy.

ISO 9001 REGISTERED RESTEK QUALITY SEPARATES US FROM THE REST

MANUFACTURED UNDER RESTEK'S ISO 9001 REGISTERED QUALITY SYSTEM: Certificate #97-HOU-AQ-8550 issued by DNV Certification, Inc.

Attachment 5 (continued)

.TCL4 - KETONES

125 Market Street
New Haven, CT 06513
USA

AccuStandard, Inc.

Tel (203)786-5290
Fax (203)786-5287
Website AccuStandard.com

CERTIFICATE OF ANALYSIS

CATALOG NO: S-9863-R3
DESCRIPTION: Custom VOA Std #2
LOT: 209051016
SOLVENT: Methanol

EXPIRATION: Sep 6, 2009

See reverse for additional certification information.

This product is guaranteed accurate to ± 0.5% of the Certified Analyte concentration through the Expiration Date on the Label.

Component	CAS #	Purity % (GC/FID)	Prepared Concentration[1] (µg/mL)	Certified Analyte Concentration[2] (µg/mL)
Acetone	67-64-1	100	1252	1252
Methyl ethyl ketone	78-93-3	99.9	1252	1251
4-methyl-2-pentanone	108-10-1	100	1252	1252
2-hexanone	591-78-6	99.4	1252	1244
Vinyl acetate	108-05-4	99.9	500.3	499.8
2-Chloroethylvinyl ether	110-75-8	99.5	500.0	497.5

6 Components

AccuStandard

1. All weights are traceable through NIST, Test No. 822/272103-05

2. Certified Analyte Concentration = Purity x Prepared Concentration. The Uncertainty calculated for this product is ±4% which is the Combined Uncertainty uc(y). It represents an estimated standard deviation equal to the positive square root of the total variance of the uncertainty of components. The Expanded Uncertainty is U which is Uc(y) *K where K is the coverage factor at the 95% confidence level (K=2).

3. A product with a suffix (-1A, -2B, etc.) on its lot# has had its expiration date extended and is identical to the same lot# without the suffix.

Certified by: R. Cooper

AccuStandard is accredited to ISO/IEC 17025:2005 and certified to ISO 9001:2000

OR-ORG/INO-001
Rev. 9/08

Attachment 5 (continued)

TCL4 – APPIX

125 Market Street
New Haven, CT 06513
USA

AccuStandard, Inc.

Tel (203)786-5290
Fax (203)786-5287
Website AccuStandard.com

CERTIFICATE OF ANALYSIS

CATALOG NO: S-9862-R2
DESCRIPTION: Custom VOA Std #1
LOT: B9020309
SOLVENT: Methanol

EXPIRATION: Jul 4, 2009

See reverse for additional certification information.

This product is guaranteed accurate to ± 0.5% of the Certified Analyte concentration through the Expiration Date on the Label.

Component	CAS #	Purity % (GC/FID)	Prepared Concentration[1] (mg/mL)	Certified Analyte Concentration[2] (mg/mL)
Acetonitrile	75-05-8	99.9	0.504	.503
Allyl chloride	107-05-1	99.1	0.505	.500
1-Chlorohexane	544-10-5	99.0	0.505	.500
Chloroprene	126-99-8	97.0	0.520 *	.504
trans-1,4-Dichloro-2-butene	110-57-6	100	2.002	2.002
p-Dioxane	123-91-1	99.7	25.004	24.929
Ethyl methacrylate	97-63-2	99.5	5.002	[illegible]
Isobutyl alcohol	78-83-1	100	25.008	25.[illegible]
Methacrylonitrile	126-98-7	100	5.003	5.00[illegible]
Methyl iodide	74-88-4	99.5	0.504	.50[illegible]
Methyl methacrylate	80-62-6	99.8	5.002	[illegible]
Pentachloroethane	76-01-7	95.4	0.528 *	.504
Propionitrile	107-12-0	98.9	25.[illegible]	24.733
Acrolein	107-02-8	90.0	[illegible]	5.015
Acrylonitrile	107-13-1	99.8	[illegible]	4.991

15 Components

1. All weights are traceable through NIST, Test No. 822/272103-05
2. Certified Analyte Concentration = Purity x Prepared Concentration. The Uncertainty calculated for this product is ±4% which is the Combined Uncertainty uc(y). It represents an estimated standard deviation equal to the positive square root of the total variance of the uncertainty of components. The Expanded Uncertainty is U which is Uc(y) *K where K is the coverage factor at the 95% confidence level (K=2).
3. A product with a suffix (-1A, -2B, etc.) on its lot# has had its expiration date extended and identical to the same lot# without the suffix.

* Weight compensated to 100% purity

Certified by: R. Cooper

AccuStandard is accredited to ISO/IEC 17025:2005 and certified to ISO 9001:2000

OR-ORG/INO-001
Rev. 9/08

AccuStandard

Attachment 5 (continued)

TCL4 1&2 Additions
received 10 vials 12-19-08

RESTEK

Certificate of Composition

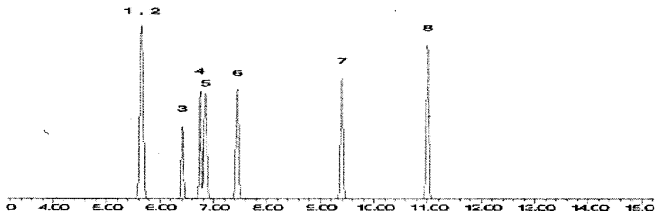
110 Benner Circle
Bellefonte, PA 16823-8812
Tel: (800)356-1688
Fax: (814)353-1309

FOR LABORATORY USE ONLY-READ MSDS PRIOR TO USE.

Catalog No. : 557093 **Lot No.:** A064665
Description : Custom 502.2 Additions Mix
Expiration Date[1]: December 2009 **Storage:** Freezer

Elution Order	Compound	CAS #	Percent Purity [2]	Concentration [3] (weight/volume)	Percent Uncertainty [4]
1	1,1,2-Trichlorotrifluoroethane	76-13-1	97%	2,000.140 ug/ml	+/-0.08 %
2	1,1,1-Trichlorotrifluoroethane	354-58-5	98%	2,000.180 ug/ml	+/-0.08 %
3	Methyl acetate	79-20-9	99%	2,000.000 ug/ml	+/-0.08 %
4	Carbon disulfide	75-15-0	99%	2,000.000 ug/ml	+/-0.08 %
5	Methyl-tert-butyl ether (MTBE)	1634-04-4	99%	2,000.000 ug/ml	+/-0.08 %
6	Diisopropyl ether (DIPE)	108-20-3	99%	2,000.000 ug/ml	+/-0.08 %
7	Cyclohexane	110-82-7	99%	2,000.000 ug/ml	+/-0.08 %
8	Methylcyclohexane	108-87-2	99%	2,000.000 ug/ml	+/-0.08 %
Solvent:	P&T Methanol	67-56-1	99%		

Column: 105m x .32mm x 1.8um Rtx-502.2 (cat.#10921)
Carrier Gas: helium @ 2.2 ml/min.
Temp. Program: 40°C (hold 2 min.) to 240°C @ 8°C/min.
Inj. Temp: 200°C
Det. Temp: 250°C
Det. Type: MSD



Adam K Clark

Balance: 1125113331

Manufactured under Restek's ISO 9001:2000 Registered Quality System Certificate #FM80397

1 Expiration date of the unopened ampul stored at recommended temperature.
2 Purity was determined by one or more of the following techniques: GC/FID, HPLC, GC/ECD, GC/MS. Value rounded to the nearest LOWER whole percentage. In addition to detectors listed above, chemical identity and purity are confirmed using 1 or more of the following: MS, DSC, solid probe MS, GC/FPD, GC/NPD, GC/TC, FTIR, melting point, refractive index, and Karl Fisher. See data pack or contact Restek for further details.
3 Based upon gravimetric preperation with balance calibration verified using NIST traceable weights (seven mass levels).
4 Percent Uncertainty based upon balance AND ASTM Class A volumetric glassware accuracy.

Attachment 6
DoD-QSM LCS Control Limits and Marginal Exceedances

CAS#	Volatile Compound	Soil CL	Soil ME
630-20-6	1,1,1,2-Tetrachloroethane	75-125	65-135
71-55-6	1,1,1,-Trichloroethane	70-135	55-145
79-34-5	1,1,2,2-Tetrachloroethane	55-130	40-145
79-00-5	1,1,2-Trichloroethane	60-125	50-140
75-34-3	1,1-Dichloroethane	75-125	65-135
75-35-4	1,1-Dichloroethene	65-135	55-150
563-58-6	1,1-Dichloropropene	70-135	60-145
87-61-6	1,2,3-Trichlorobenzene	60-135	50-145
96-18-4	1,2,3-Trichloropropane	65-130	50-140
120-82-1	1,2,4-Trichlorobenzene	65-130	55-140
95-63-6	1,2,4-Trimethylbenzene	65-135	55-145
96-12-8	1,2-Dibromo-3-Chloropropane	40-135	25-150
106-93-4	1,2-Dibromoethane	70-125	60-135
95-50-1	1,2-Dichlorobenzene	75-120	65-125
107-06-2	1,2-Dichloroethane	70-135	60-145
78-87-5	1,2-Dichloropropane	70-120	65-125
108-67-8	1,3,5-Trimethylbenzene	65-135	55-145
541-73-1	1,3-Dichlorobenzene	70-125	65-135
142-28-9	1,3-Dichloropropane	75-125	70-130
106-46-7	1,4-Dichlorobenzene	70-125	65-135
594-20-7	2,2-Dichloropropane	65-135	55-145
78-93-3	2-Butanone	30-160	10-180
95-49-8	2-Chlorotoluene	70-130	60-140
591-78-6	2-Hexanone	45-145	30-160
106-43-4	4-Chlorotoluene	75-125	65-135
108-10-1	4-Methyl-2-pentanone	45-145	30-165
67-64-1	Acetone	20-160	10-180
71-43-2	Benzene	75-125	65-135
108-86-1	Bromobenzene	65-120	55-130
74-97-5	Bromochloromethane	70-125	60-135
75-27-4	Bromodichloromethane	70-130	60-135
75-25-2	Bromoform	55-135	45-150
74-83-9	Bromomethane	30-160	10-180
75-15-0	Carbon Disulfide	45-160	30-180
56-23-5	Carbon Tetrachloride	65-135	55-145
108-90-7	Chlorobenzene	75-125	65-130
75-00-3	Chloroethane	40-155	20-175
67-66-3	Chloroform	70-125	65-135
74-87-3	Chloromethane	50-130	40-140
156-59-2	cis-1,2-Dichloroethane	65-125	55-135
10061-01-5	cis-1,3-Dichloropropene	70-125	65-135
124-48-1	Dibromochloromethane	65-130	55-140
74-95-3	Dibromomethane	75-130	65-135
75-71-8	Dichlorodifluoromethane	35-135	15-155

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Attachment 6 (continued)
DoD-QSM LCS Control Limits and Marginal Exceedances

CAS#	Volatile Compound	Soil CL	Soil ME
100-41-4	Ethylbenzene	75-125	65-135
87-68-3	Hexachlorobutadiene	55-140	40-155
89-82-8	Isoproplybenzene	75-130	70-140
108-38-3	m, p-Xylene	80-125	70-135
75-09-2	Methylene Chloride	55/140	40-155
1634-04-4	Methyl-tert-butyl ether	40-125	25-140
91-20-3	Naphthalene	40-125	25-140
104-51-8	n-Butylbenzene	65-140	50-140
103-65-1	n-Propylbenzene	65-135	50-145
95-47-6	o-Xylene	75-125	70-135
99-87-6	p-Isopropyltoluene	75-135	65-140
135-98-8	sec-Butylbenzene	65-130	50-150
100-42-5	Styrene	75-125	65-135
98-06-6	Tert-Butylbenzene	65-130	55-145
127-18-4	Tetrachloroethene	65-140	55-140
108-88-3	Toluene	70-125	60-135
156-60-5	Trans-1, 2-Dichloroethene	65-135	55-145
10061-02-6	Trans-1,3-Dichloropropene	65-125	55-140
79-01-6	Trichloroethene	75-125	70-130
75-65-4	Trichlorofluoromethane	25-185	10-215
75-01-4	Vinyl Chloride	60-125	45-140

Attachment 7

5 vials - received 3-26-09 Red Source TCL4 1&2

125 Market Street
New Haven, CT 06513
USA

AccuStandard, Inc.

Tel (203)786-5290
Fax (203)786-5287
Website AccuStandard.com

CERTIFICATE OF ANALYSIS

CATALOG NO: M-502A-R-10X **EXPIRATION:** Oct 21, 2011
DESCRIPTION: Volatile Organic Compounds - Liquids
LOT: B8100189 **See reverse for additional certification information.**
SOLVENT: MeOH

This product is guaranteed accurate to ±0.5% of the Certified Analyte concentration through the Expiration Date on the Label.

Component	CAS #	Purity % (GC/FID)	Prepared Concentration[1] (µg/mL)	Certified Analyte Concentration[2] (µg/mL)
Benzene	71-43-2	99.5	2000	1990
Bromobenzene	108-86-1	99.5	2001	1991
Bromochloromethane	74-97-5	99.1	2003	1985
Bromodichloromethane	75-27-4	98.7	2001	1975
Bromoform	75-25-2	99.2	2001	1985
n-Butylbenzene	104-51-8	99	2001	1981
sec-Butylbenzene	135-98-8	100	2001	2001
tert-Butylbenzene	98-06-6	99.6	2000	1992
Carbon tetrachloride	56-23-5	100	2001	2001
Chlorobenzene	108-90-7	100	2000	2000
Chloroform	67-66-3	99.8	2001	1997
2-Chlorotoluene	95-49-8	98.9	2001	1979
4-Chlorotoluene	106-43-4	98.5	2000	1970
Dibromochloromethane	124-48-1	99.1	2001	1983
1,2-Dibromo-3-chloropropane	96-12-8	100	2000	2000
1,2-Dibromoethane	106-93-4	99.9	2007	2005
Dibromomethane	74-95-3	98.6	2001	1973
1,2-Dichlorobenzene	95-50-1	98.2	2000	1964
1,3-Dichlorobenzene	541-73-1	99.8	2000	1996
1,4-Dichlorobenzene	106-46-7	99.9	2000	1998
1,1-Dichloroethane	75-34-3	99.6	2001	1993
1,2-Dichloroethane	107-06-2	100	2000	2000
1,1-Dichloroethene	75-35-4	99.0	2000	1980
cis-1,2-Dichloroethene	156-59-2	99.9	2000	1998
trans-1,2-Dichloroethene	156-60-5	96.0	2085 *	2002
1,2-Dichloropropane	78-87-5	100	2001	2001
1,3-Dichloropropane	142-28-9	99.9	2000	1998
2,2-Dichloropropane	594-20-7	100	2000	2000
1,1-Dichloropropene	563-58-6	99.1	2000	1982
cis-1,3-Dichloropropene	10061-01-5	97.7	2150 *	2101
trans-1,3-Dichloropropene	10061-02-6	97.7	1945 *	1900
Ethylbenzene	100-41-4	99.2	2000	1984
Hexachlorobutadiene	87-68-3	98.0	2001	1961
Isopropylbenzene	98-82-8	100	2000	2000
p-Isopropyltoluene	99-87-6	99.4	2001	1989
Dichloromethane	75-09-2	99.9	2003	2001

1. All weights are traceable through NIST, Test No. 822/272103-05
2. Certified Analyte Concentration = Purity x Prepared Concentration. The Uncertainty calculated for this product is ±4% which is the Combined Uncertainty uc(y). It represents an estimated standard deviation equal to the positive square root of the total variance of the uncertainty of components. The Expanded Uncertainty is U which is Uc(y) *K where K is the coverage factor at the 95% confidence level (K=2).
3. A product with a suffix (-1A, -2B, etc.) on its lot# has had its expiration date extended and is identical to the same lot# without the suffix.

* Weight compensated to 100% purity

Page 1 of 2 Certified by: R. Cooper

AccuStandard is accredited to ISO/IEC 17025:2005 and certified to ISO 9001:2000

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Rev. 9/08

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Attachment 7 (Continued)

125 Market Street
New Haven, CT 06513
USA

AccuStandard, Inc.

Tel (203)786-5290
Fax (203)786-5287
Website AccuStandard.com

CERTIFICATE OF ANALYSIS

CATALOG NO: M-502A-R-10X **EXPIRATION:** Oct 21, 2011
DESCRIPTION: Volatile Organic Compounds - Liquids
LOT: B8100189 **See reverse for additional certification information.**
SOLVENT: MeOH

This product is guaranteed accurate to ±0.5% of the Certified Analyte concentration through the Expiration Date on the Label.

Component	CAS #	Purity % (GC/FID)	Prepared Concentration[1] (µg/mL)	Certified Analyte Concentration[2] (µg/mL)
Naphthalene	91-20-3	99.8	2000	1996
n-Propylbenzene	103-65-1	100	2000	2000
Styrene	100-42-5	99.7	2001	1995
1,1,1,2-Tetrachloroethane	630-20-6	98.6	2000	1972
1,1,2,2-Tetrachloroethane	79-34-5	98.6	2001	1973
Tetrachloroethene	127-18-4	100	2002	2002
Toluene	108-88-3	99.9	2001	1999
1,2,3-Trichlorobenzene	87-61-6	100	2001	2001
1,2,4-Trichlorobenzene	120-82-1	99.3	2001	1987
1,1,1-Trichloroethane	71-55-6	100	2000	2000
1,1,2-Trichloroethane	79-00-5	98.3	2000	1966
Trichloroethene	79-01-6	100	2001	2001
1,2,3-Trichloropropane	96-18-4	98.5	2001	1971
1,2,4-Trimethylbenzene	95-63-6	98.2	2000	1964
1,3,5-Trimethylbenzene	108-67-8	98.8	2000	1976
o-Xylene	95-47-6	99.0	2000	1980
m-Xylene	108-38-3	99.9	2001	1999
p-Xylene	106-42-3	99.9	2000	1998

54 Components

AccuStandard

1. All weights are traceable through NIST, Test No. 822/272103-05
2. Certified Analyte Concentration = Purity x Prepared Concentration. The Uncertainty calculated for this product is ±4% which is the Combined Uncertainty uc(y). It represents an estimated standard deviation equal to the positive square root of the total variance of the uncertainty of components. The Expanded Uncertainty is U which is Uc(y) *K where K is the coverage factor at the 95% confidence level (K=2).
3. A product with a suffix (-1A, -2B, etc.) on its lot# has had its expiration date extended and is identical to the same lot# without the suffix.

* Weight compensated to 100% purity

Page 2 of 2 Certified by: R. Cooper

AccuStandard is accredited to ISO/IEC 17025:2005 and certified to ISO 9001:2000

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Rev. 9/08

Attachment 7 (Continued)

~~15~~ 10 vials received 6-20-08 2nd Source Gas

125 Market Street
New Haven, CT 06513 USA

AccuStandard, Inc.

Tel (203)786-5290 Fax (203)786-5287
Web AccuStandard.com

CERTIFICATE OF ANALYSIS

CATALOG NO: M-502B-10X
DESCRIPTION: Volatile Organic Cmpds - Gases
LOT: B8020151
SOLVENT: MeOH

EXPIRATION: Feb 21, 2011

See reverse for additional certification information.

This product is guaranteed accurate to ± 0.5% of the Certified Analyte concentration through the Expiration Date on the Label

Component	CAS #	Purity % (GC/FID)	Prepared Concentration[1] (µg/mL)	Certified Analyte Concentration[2] (µg/mL)
Bromomethane	74-83-9	99.0	2000	1980
Chloroethane	75-00-3	99.7	2000	1994
Chloromethane	74-87-3	99.5	2010	2000
Dichlorodifluoromethane	75-71-8	98	2008	1968
Trichlorofluoromethane	75-69-4	99.0	2001	1981
Vinyl chloride	75-01-4	99.5	2010	2000

6 Components

1. All weights are traceable through NIST, Test No. 822/272103-05
2. Certified Analyte Concentration = Purity x Prepared Concentration. The Uncertainty calculated for this product is ±4% which is the Combined Uncertainty uc(y). It represents an estimated standard deviation equal to the positive square root of the total variance of the uncertainty of components. The Expanded Uncertainty is U which is Uc(y) *K where K is the coverage factor at the 95% confidence level (K=2).
3. A product with a suffix (-1A, -2B, etc.) on its lot# has had its expiration date extended and identical to the same lot# without the suffix.

Certified by R. Cooper

AccuStandard is accredited to ISO/IEC 17025:2005

OR-ORG/INO-001
Rev. 7/07

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Attachment 7 (Continued)

Received 2 ampules 2-6-09

Certificate of Analysis

NSI Solutions, Inc. * 7517 Precision Drive, Suite 101 * Raleigh, NC 27617 * 1-800-234-7837

Compound Name: Acrolein
Part Number: Q-6087-O
Lot Number: 020509-01

Expiration Date: 05/09
Solvent: P&T MeOH
(FLAMMABLE, IRRITANT)

COMPOUND NUMBER	ANALYTE	CHROMATOGRAPHIC Purity	GRAVIMETRIC CONCENTRATION (ug/mL)
W-02-06	Acrolein	99.2%	15017

PREPARATION: Reported concentration value has been corrected for purity. Concentration is calculated from wt/vol or vol/vol measurements using microbalances calibrated with NIST traceable weights to 0.0001 g and or ASTM Class A volumetric glassware or calibrated equivalent labware.

STORAGE & HANDLING: Store at ≤ 5° C. Allow to equilibrate to room temperature before use.

Kristi Bright

Kristi Bright, Organic Chemist

Attachment 7 (Continued)

Received 2 vials 5-10-09

RESTEK

Certificate of Composition

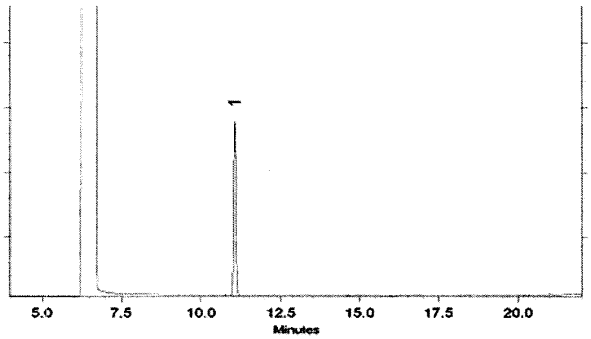
110 Benner Circle
Bellefonte, PA 16823-8812
Tel: (800)356-1688
Fax: (814)353-1309

FOR LABORATORY USE ONLY-READ MSDS PRIOR TO USE.

Catalog No. : 560347 **Lot No.:** A065489
Description : Custom Vinyl Acetate Standard
Expiration Date[1]**:** January 2011 **Storage:** Freezer

Elution Order	Compound	CAS #	Percent Purity [2]	Concentration [3] (weight/volume)	Percent Uncertainty [4]
1	Vinyl acetate	108-05-4	98%	1,501.360 ug/ml	+/-0.12 %
Solvent:	P&T Methanol	67-56-1	99%		

Column: 105m x .53mm x 3.0um Rtx-502.2 (cat.#10910)
Carrier Gas: hydrogen @ 40 cm/sec.
Temp. Program: 40°C (hold 2 min.) to 240°C @ 8°C/min.
Inj. Temp: 200°C
Det. Temp: 250°C
Det. Type: FID



Diane Shaffer
Diane Shaffer - QA Analyst **Date Passed:** 01/27/2009 **Balance:** 1128353505 REVIEWED

Manufactured under Restek's ISO 9001-2000 Registered Quality System Certificate #FMB0397

1 Expiration date of the unopened ampule stored at recommended temperature.
2 Purity was determined by one or more of the following techniques: GC/FID, HPLC, GC/ECD, GC/MS. Value rounded to the nearest LOWER whole percentage. In addition to detectors listed above, chemical identity and purity are confirmed using one or more of the following: MS, DSC, solid probe MS, GC/FPD, GC/NPD, GC/TC, FTIR, melting point, refractive index, and Karl Fisher. See data pack or contact Restek for further details.
3 Based upon gravimetric preparation with balance calibration verified using NIST traceable weights (seven mass levels).
4 Percent uncertainty based upon balance AND ASTM Class A volumetric glassware accuracy.

Tech Tip:

Vinyl acetate is a volatile organic ester included in the target lists of several US EPA and other methods. Under acidic conditions, esters react with alcohols to form r esters (transesterification). Methanol-based mixes containing halogenated compounds are slightly acidic, so it is important to minimize exposure of vinyl acetate to n of halogenated compounds in methanol. For this reason, we offer vinyl acetate in individual solution, and suggest that it be introduced into the working level calibrati solution immediately before use. This will minimize problems and ensure more consistent results.

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Attachment 7 (Continued)

Received (2 vials) 3-10-09

RESTEK

Certificate of Composition

110 Benner Circle
Bellefonte, PA 16823-8812
Tel: (800)356-1688
Fax: (814)353-1309

FOR LABORATORY USE ONLY-READ MSDS PRIOR TO USE.

Catalog No. : 560345 **Lot No.:** A065532
Description : Custom Ketones Plus Standard
Expiration Date[1]: July 2010 **Storage:** Freezer

Elution Order	Compound	CAS #	Percent Purity [2]	Concentration [3] (weight/volume)	Percent Uncertainty [4]
1	Acetone	67-64-1	99%	3,750.000 ug/ml	+/-0.10 %
2	Acrylonitrile	107-13-1	99%	15,000.000 ug/ml	+/-0.10 %
3	2-Butanone (MEK)	78-93-3	99%	3,750.000 ug/ml	+/-0.10 %
4	2-Chloroethyl vinyl ether	110-75-8	98%	1,499.400 ug/ml	+/-0.10 %
5	4-Methyl-2-pentanone (MIBK)	108-10-1	99%	3,750.000 ug/ml	+/-0.10 %
6	2-Hexanone	591-78-6	99%	3,750.000 ug/ml	+/-0.10 %
Solvent:	P&T Methanol/Water (90:10)	67-56-1/7732-18-5	99%		

Column:
60m x .25mm x 1.4um
Rtx-502.2 (cat.#10916)

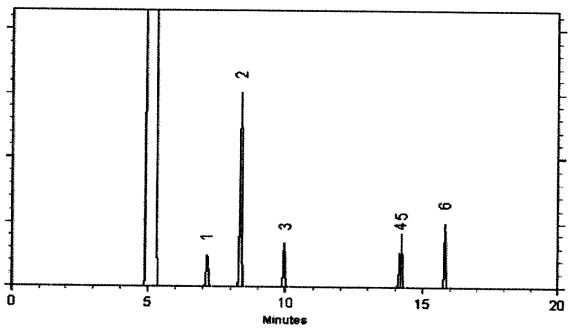
Carrier Gas:
helium @ 2.2 ml/min.

Temp. Program:
40°C (hold 2 min.) to 240°C
@ 8°C/min. (hold 10 min.)

Inj. Temp:
200°C

Det. Temp:
250°C

Det. Type:
MSD



Sara Eyster
Sara Eyster QA Analyst

Date Passed: 01/29/2009 **Balance:** 1121472889

REVIEWED

Manufactured under Restek's ISO 9001-2000 Registered Quality System Certificate #FMB0397

1 Expiration date of the unopened ampule stored at recommended temperature.
2 Purity was determined by one or more of the following techniques: GC/FID, HPLC, GC/ECD, GC/MS. Value rounded to the nearest LOWER whole percentage. In addition to detectors listed above, chemical identity and purity are confirmed using one or more of the following: MS, DSC, solid probe MS, GC/FPD, GC/NPD, GC/TC, FTIR, melting point, refractive index, and Karl Fisher. See data pack or contact Restek for further details.
3 Based upon gravimetric preparation with balance calibration verified using NIST traceable weights (seven mass levels).
4 Percent uncertainty based upon balance AND ASTM Class A volumetric glassware accuracy.

Tech Tip:

Degradation of tetrachloroethylene to pentachloroethane may occur if solutions containing 2-chloroethyl vinyl ether are combined with solutions that contain tetrachloroethylene.

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Attachment 7 (Continued)

10 vials received 6-20-08 2nd Source TCL4 1#2. Additions

125 Market Street
New Haven, CT 06513 USA

AccuStandard, Inc.

Tel (203)786-5290 Fax (203)786-5287
Web AccuStandard.com

CERTIFICATE OF ANALYSIS

CATALOG NO: S-13035
DESCRIPTION: Custom Standard Mix
LOT: B8060071
SOLVENT: Methanol

EXPIRATION: Jun 9, 2010

See reverse for additional certification information.

This product is guaranteed accurate to ± 0.5% of the Certified Analyte concentration through the Expiration Date on the Label

Component	CAS #	Purity % (GC/FID)	Prepared Concentration[1] (µg/mL)	Certified Analyte Concentration[2] (µg/mL)
1,1,1-Trichlorotrifluoroethane	354-58-5	99	2005	1985
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	99.2	2001	1985
Carbon disulfide	75-15-0	99.9	2002	2000
MtBE	1634-04-4	99.9	2000	1998
Isopropyl ether	108-20-3	99.6	2005	1997
Cyclohexane	110-82-7	99.9	2001	1999
Methylcyclohexane	108-87-2	100	2001	2001
Methyl acetate	79-20-9	99.7	2014	2008

8 Components

1. All weights are traceable through NIST, Test No. 822/272103-05
2. Certified Analyte Concentration = Purity x Prepared Concentration. The Uncertainty calculated for this product is ±4% which is the Combined Uncertainty uc(y). It represents an estimated standard deviation equal to the positive square root of the total variance of the uncertainty of components. The Expanded Uncertainty is U which is Uc(y) *K where K is the coverage factor at the 95% confidence level (K=2).
3. A product with a suffix (1A, 2B, etc.) on its lot# has had its expiration date extended and identical to the same lot# without the suffix.

Certified by: R. Cooper

AccuStandard is accredited to ISO/IEC 17025:2005

OR-ORG/NO-001
Rev. 7/07

AccuStandard

Attachment 7 (Continued)

2nd Source
A [illegible]

Received 6-20-08

RESTEK

Certificate of Composition

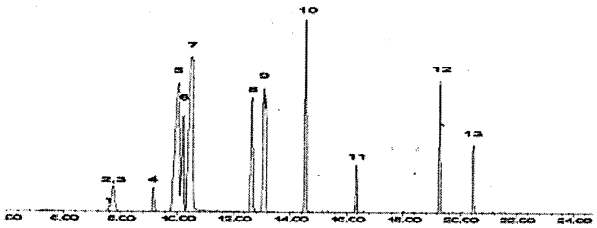
110 Benner Circle
Bellefonte, PA 16823-8812
Tel: (800)356-1688
Fax: (814)353-1309

FOR LABORATORY USE ONLY-READ MSDS PRIOR TO USE.

Catalog No. : 563125 **Lot No.:** A060833
Description : Custom VOA Standard #1
Expiration Date[1]**:** June 2009 **Storage:** Freezer

Elution Order	Compound	CAS #	Percent Purity [2]	Concentration [3] (weight/volume)	Percent Uncertainty [4]
1	Acetonitrile	75-05-8	99%	500.000 ug/ml	+/-0.05 %
2	Allyl chloride (3-chloropropene)	107-05-1	98%	499.800 ug/ml	+/-0.05 %
3	Iodomethane (methyl iodide)	74-88-4	99%	500.000 ug/ml	+/-0.05 %
4	Chloroprene (2-chloro-1,3-butadiene)	126-99-8	99%	485.770 ug/ml	+/-5.04 %
5	Methacrylonitrile	126-98-7	99%	5,000.000 ug/ml	+/-0.05 %
6	Propionitrile	107-12-0	99%	25,000.000 ug/ml	+/-0.05 %
7	Isobutanol (2-Methyl-1-propanol)	78-83-1	99%	25,000.000 ug/ml	+/-0.05 %
8	Methyl methacrylate	80-62-6	99%	5,000.000 ug/ml	+/-0.05 %
9	1,4-Dioxane	123-91-1	----%	25,000.000 ug/ml	+/-0.05 %
10	Ethyl methacrylate	97-63-2	99%	5,000.000 ug/ml	+/-0.05 %
11	1-Chlorohexane	544-10-5	99%	500.000 ug/ml	+/-0.05 %
12	trans-1,4-dichloro-2-butene	110-57-6	98%	2,000.180 ug/ml	+/-0.05 %
13	Pentachloroethane	76-01-7	98%	499.800 ug/ml	+/-0.05 %
Solvent:	P&T Methanol	67-56-1	99%		

Column: 60m x .25mm x 1.4um
Rtx-502.2 (cat.#10916)
Carrier Gas: helium @ 2 ml/min.
Temp. Program: 40°C (hold 2 min.) to 240°C
@ 8°C/min. (hold 10 min.)
Inj. Temp: 200°C
Det. Temp: 250°C
Det. Type: MSD



Sara Eyster
Sara Eyster / QA Analyst

Balance 1121472889

1 Expiration date of the unopened ampul stored at recommended temperature.
2 Purity was determined by one or more of the following techniques: GC/FID, HPLC, GC/ECD, GC/MS. Value rounded to the nearest LOWER whole percentage. In addition to detectors listed above, chemical identity and purity are confirmed using 1 or more of the following: MS, DSC, solid probe MS, GC/FPD, GC/NPD, GC/TC, FTIR, melting point, refractive index, and Karl Fisher. See data pack or contact Restek for further details.
3 Based upon gravimetric preparation with balance calibration verified using NIST traceable weights (seven mass levels).
4 Percent Uncertainty based upon balance AND ASTM Class A volumetric glassware accuracy.

ISO 9001 REGISTERED

Manufactured under Restek's ISO 9001 Registered Quality System
Certificate #FM80397

Attachment 8

Condition Codes Used for Documentation in Logbooks

Condition Code	Definition
CS	Contamination Suspected
CT	Contamination Verified
DA	Dilution Acceptable
DI	Requires Dilution
DW	Dilution Wrong
ES	Extraction Same
EF2JS	Ending Standard Failed Second Tune Injection Same
JS	Injection Same
IH	Internals High
IL	Internals Low
IM	Internals Missing
LA	Lab Accident (Must Explain)
OT	Other (Must Explain)
OQ	Original Run Qualified
OW	Original Wrong for QC Sample
RP	Reportable Prior Run
RT	Retention Time Shift
RU	Run Unnecessarily
SF	Spike Recoveries Failed
SH	Surrogate Recoveries Failed High
SI	Spiked Inadvertently
SL	Surrogate Recoveries Failed Low
SM	Surrogate or Spike Missing
IF	Instrument Failure (Must Explain)
US	Unacceptable Standard (Must Explain)
VR	Verify Results (Must Explain)
NM	Did Not Match Prior Run or Duplicate
RN	Reanalyze Neat
PC	Poor Chromatography
WS	Wrong Standard

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Attachment 9

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Notification Regarding Manual Editing/Integration Flags

In some instances, manual adjustments to the software output are necessary to provide accurate data. These manual integrations are performed by the data reviewers, GC/MS operators, or GC/HPLC chemists. An Extracted Ion Current Profile (EICP) or a GC/HPLC chromatographic peak has been provided for the manual integration performed on each compound to demonstrate the accuracy of that process. The manual integrations are flagged on the quantitation report in the far right column beyond the FINAL concentration for GC/MS analysis, and in the "Flags" column for GC/HPLC analysis. The manual editing/integration flags are:

M **- Denotes that a manual integration has been performed for this compound. The manual integration was performed in order to provide the most accurate area count possible for the peak. The most common reasons for performing manual integrations/editing are: the compound was not found by the automatic integration routine, the compound was incorrectly integrated by the automatic integration routine, and the co-eluting compounds were incorrectly integrated by the automatic integration routine.**

H **- Denotes that the data reviewer, GC/MS operator, or GC/HPLC Chemist has chosen an alternate peak within the retention time window from that chosen by the software for that compound. No manual integration is performed in choosing an alternate peak. The software still performs the integration.**

MH **- Denotes that an alternate peak has been chosen within the retention time window from that chosen by the software for that compound and also a manual integration of the chosen peak has been performed. The manual integration was performed in order to provide the most accurate area count possible for the peak.**

L **- Denotes that a data reviewer or GC/MS operator has selected an alternate library search. This is typically done when an additional tentatively identified compound (TIC) has been added to the number of peaks searched. No manual integration is performed in choosing an alternate peak. The software still performs the integration.**

ML **- Denotes that an alternate GC/MS library search has been selected and a manual integration has also been performed. This is typically done when an additional TIC has been added and the TIC peak also required a manual integration.**

These codes will appear in the GC/MS and GC/HPLC raw data.

Revision 8 (01/29/2011)

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NELAP accredited

SOP DOCUMENTATION FORM

This form must accompany all new and revised Standard Operating Procedures (SOPs) when you turn them in to Quality Assurance for review. Please fill out the entire block below (except effective date).

This is a new procedure _____ revised procedure ✓ outdated procedure (archive) _____

- Procedure Code: IP 192 SOP Section #: 2.2.4.10 Revision #: 9

SOP Title: GC/ECD Analysis of Organochlorine Pesticides in Water and Soil Extracts by SW-846 Method 8081B

Effective date: (QA fills in) 4/11/11

- Procedure prepared by: Teresa Amentt Jennings Date: 4/11/11
- Procedure approved by: (If the manager prepared the SOP, a qualified second party should sign) Date: 4/11/11
- Reason for change: Removal of Method 8081A
- This procedure meets the requirements of the following approved method references: SW-846, 3RD Edition, Update IV Method 8081B, 2/07; Dept. of Defense Quality Systems Manual for Environmental Laboratories, Version 4.2, 10/25/2010

Procedure approved by a QA Representative (unless QA Representative signed above):

_____ Date: _____

On an annual basis: Lab managers are required to review lab practices and revise the SOP if necessary. If no revision is necessary, indicate by your signature that the SOP has been reviewed.

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Instrument Procedure 192: GC/ECD Analysis of Organochlorine Pesticides in Water and Soil Extracts by SW-846 Method 8081B

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Instrument Procedure 192: GC/ECD Analysis of Organochlorine Pesticides in Water and Soil Extracts by SW-846 Method 8081B

1.0 Scope and Application

The Standard Operation Procedure describes the procedures used to determine the concentration of various organochlorine pesticides in extracts of solid and liquid sample matrices. Open-tubular, capillary columns are employed with electron capture detectors (ECD). Compound identification is based on dual column confirmation, with the second column being of a dissimilar nature. See Attachment 1 for a list of the analytes determined using this SOP and their reporting limits.

Staff members performing the procedures described in this SOP are responsible for reading, understanding, and complying with the SOP requirements. Supervisors are responsible for directing the analyst to the controlled SOP, and providing adequate explanation of the material contained therein.

This procedure is restricted to use by or under the supervision of analysts experienced in the instrumentation or preparative methods and who have demonstrated the ability to generate acceptable results through QC samples and analyst capability studies.

This SOP is NOT for use with Ohio VAP projects. Please see Ohio VAP specific SOP.

2.0 Summary of Method

2.1 A measured volume of sample (1 L for liquids, 2 to 30 grams for solids) is extracted using a separatory funnel for water and either an automated Soxhlet or Ultrasonic Extraction method, for soils. A variety of cleanup steps may be used, including Gel Permeation Chromatography (GPC). After cleanup, the extract is analyzed by injecting 2-µL (1-µL per column) into a GC with dual wide-bore, fused silica, capillary columns with dual electron capture detectors (GC/ECD). The instrument hardware is configured to allow two analytical columns joined to a single injection port for simultaneous dual column analysis.

Samples are prepared following the procedures in Sample Preparation Procedure -069," Sample Preparation for Pesticides/PCBs in Water by SW 846" or Sample Preparation Procedure –733, "Low Level Preparation for Analysis of Pesticides/PCBs in Soil/Sediment/Sludge by SW-846."

3.0 Definitions

3.1 Method Detection Limit (MDL) - The MDL is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from the analysis of a sample in a given matrix containing the analyte **(40 CFR, Part 136, Appendix B*)***. A minimum of seven sample replicates is required to calculate a statistical MDL. The MDL is an approximation of the DL. Any analyte concentration result at or above the MDL must also meet all qualitative identification criteria required by the test method in order to be reported as present.

3.2 Detection Limit (DL) - The DL is the smallest analyte that can be demonstrated to be different from zero or a blank concentration at the 99 % level of confidence. The false positive rate at the DL is 1% and the false negative rate is 50%. Any analyte concentration result at or above the DL must also meet all qualitative identification criteria required by the test method in order to be reported as present.

3.3 Limit of Detection (LOD) – The LOD is the smallest concentration of an analyte that must be present in a sample in order to be detected at a 99% confidence level. The false negative rate at the LOD is 1 %. For DoD-QSM, non-detect sample results are reported as < LOD. Numeric values of measurements between the DL and the LOQ are reported as estimates. The DL $<$ LOD $\leq$ LOQ.

3.4 Limit of Quantitation (LOQ) – The Limit of Quantitation is the lowest concentration of a substance that produces a quantitative result within specified limits of precision and bias. The LOQ must be within the calibration range.

3.5 Reporting Limit (RL) –

3.5.1 For Non-DoD work, the laboratory reporting limit is based on the lowest multipoint calibration standard concentration. For organic methods, values detected below the reporting limit and above the MDL may be reported and qualified as an estimated concentration.

3.5.2 The DoD-QSM defines the reporting limit as being the lowest concentration value specified by the client that meets project requirements for reporting data with known precision and bias for a specific analyte in a specific matrix. The LOQ cannot be greater than the RL. Data reported below the RL must be flagged as estimated values if they are also less than the LOQ.

3.6 Reporting Units – µg/L and µg/Kg

3.7 A Sample Delivery Group (SDG) is defined by the following, whichever is more frequent:

- each 20 field samples received within a case, or
- each 7 calendar day period during which field samples in a case are received (14 calendar days if requested by the client) beginning with the receipt of the first sample.

NOTE: The DoD-QSM and South Carolina Department of Health and Environmental Control (SC DHEC) do not accept the SDG approach, unless the samples are prepared in a single extraction batch. When a group of up to 20 field samples of a similar matrix are prepared as one batch, method-specified QC samples such as a method blank, laboratory control sample, matrix spike, matrix spike duplicate, and matrix duplicate must also be prepared together. If samples are batched together from different sites, project-specific QC must be processed.

3.8 Extraction Batch – a group of to 20 field samples of a similar matrix, method-specified QC samples such as a method blank, laboratory control sample, matrix spike, matrix spike duplicate, and matrix duplicate prepared together at the same time.

3.9 SC DHEC – South Carolina Department of Health and Environmental Control

3.10 DoD-QSM – Department of Defense Quality Systems Manual

3.11 Ohio VAP – Ohio Environmental Protection Agency Voluntary Action Program

3.12 Marginal Exceedance – Value outside the LCS control limit but within the marginal exceedance limits (4 standard deviations around the mean). This outside boundary prevents a grossly out-of-control LCS from passing. (See Attachment #4)

3.13 LIMS – Laboratory Information Management System

4.0 Interferences

4.1 Interference in this method can be grouped into three broad categories: contaminated solvents, reagents, or glassware; contaminated GC carrier gas, parts, column surfaces, detector surfaces; and the presence of co-eluting compounds in the sample matrix that also are detected by the ECD. Specific cleanups may be necessary for samples, depending on the compounds of interest.

4.2 Interferences by phthalate esters introduced during the sample preparation procedures can be a major problem including, but not limited to: common flexible plastics found in certain gloves and other objects containing varying amounts of phthalates that may be introduced during lab operations; and cross-contamination of clean glassware routinely occurring, when plastics are handled during extraction steps, especially when solvent wetted surfaces are handled. These interferences can be minimized by cleanup of solvents, reagents, and glassware.

4.3 Glassware must be scrupulously cleaned as soon as possible after use by rinsing with the last solvent used. This should be followed by detergent washing with hot water, and rinses with tap water and organic-free reagent water. Drain the glassware and dry in an oven at 130° C for several hours or rinse with methanol and drain.

4.4 The presence of elemental sulfur will result in broad peaks that interfere with early eluting pesticides, and can be removed by cleaning the extract with TBA clean up.

4.5 Waxes, lipids, and other high molecular weight compounds are also removed using GPC.

4.6 Technical **Chlordane** and Toxaphene are multi-component analytes. When samples contain more than one multi-component analyte, a more experienced analyst may be required to process/assess the data. Similar conditions exist when multi-component analytes have been subjected to environmental degradation.

5.0 Safety

Appropriate protective equipment and clothing must be used under the assumption that all samples are potentially hazardous. During sample preparation, safety glasses, gloves and lab coats are a minimum requirement. The persistent presence of noxious odors may be indicative of failure of the laboratory ventilation system and must be reported to a supervisor or manager.

Laboratory staff must review the Chemical Hygiene Plan for general safety policies, and Material Safety Data Sheets (MSDS) for solvents and reagents used in the laboratory. The MSDS are located in the Quality Assurance department.

6.0 Equipment and Supplies

6.1 Gas chromatograph: Agilent Technologies 6890N and Thermoquest Trace GC 2000 gas chromatographs suitable for on-column and splitless injection with all required accessories, including syringes, analytical columns, gases, ECDs, and or data system.

6.2 The following wide-bore columns or equivalent are used in the analysis:

6.2.1 Column 1 – 30 m x 0.32 mm ID fused silica capillary column bonded with 35% phenyl methylpolysiloxane (clpest), 0.50 µm film thickness.

6.2.2 Column 2 – 30 m x 0.32 mm ID fused silica capillary column chemically bonded with 50% phenyl methylpolysiloxane (clpest2), 0.42 µm film thickness.

6.2.3 Wide-bore columns are installed in a 1/4 inch injectors, with deactivated liners designed specifically for use with mega-bore columns.

6.3 Restek Y-shaped fused silica connector.

6.4 Data system: Standards and samples are processed using the EZ Chrom® Elite data acquisition system, Target® Quick Forms report generation software from ThruPut Systems, and Element **DataSystem**® LIMS **by Promium**, plus revisions.

7.0 Reagents and Standards

Details for the standard preparation are contained in the Standards Preparation Logbook (22F) or Promium Element LIMS.

All standards are prepared in the Organic Standards Laboratory. Standards are stored separately from samples at 2-6 ^{o}C in the reach-in cold storage units in the preparation and organic standards laboratories when not in use. All stock standard**s from the manufacturer** must be replaced after one year or sooner if routine QC indicates a problem. All other standard solutions must be replaced after six months or sooner if QC indicates a problem.

Note**:** All spiking standard information is entered into the LIMS. To obtain information on any standard, access Element, click on "Laboratory," and scroll down and access "Standards." Standards can be sorted by Department. Select the standard you would like to access. The view will show lot number, prepared dates, solvent, vendor, composition, and concentration.

Note: All reagents and standards must be ACS (American Chemical Society) grade or equivalent**, unless otherwise denoted**. All standards and reagents are subject to change in vendor and in concentration. The Reporting Limits are also subject to change, but must remain at or above the lowest point in the calibration.

7.1 Reagent water – All water used in this procedure must be equivalent to ASTM Type II water (as it relates to specific conductance and specific resistance) which is demonstrated to meet the blank contamination acceptance criteria contained in this SOP. It is referred to throughout the remainder of this SOP as reagent water.

7.2 Reagent or pesticide grade chemicals must be used for all tests.

7.3 Working Standards

7.3.1 Commercially available standards are purchased from Restek and are received with manufacturer's certificates of analysis. The certificate documentation is retained for reference purposes. Working standards are prepared from the commercial standards in the organic standards preparation lab.

Note: The concentration and composition of standards used during the sample preparation and cleanup are provided in the sample preparation SOPs. Standards must equilibrate to room temperature before use.

7.3.**2** Performance Evaluation Mixture (PEM)

7.3.2.1 Prepare in hexane every six months, or sooner, if the solution has degraded or concentrated.

Compounds	Concentration (ng/mL)
4,4′-DDT	3
Endrin	3
Tetrachloro-m-xylene	20

Compounds	Concentration (ng/mL)
Decachlorobiphenyl	40

7.3.**3** Individual Standard Mixture C (INDC)

7.3.3.1 Prepare in hexane every six months or sooner, if the solution has degraded or concentrated.

7.3.3.2 The low calibration standard concentration corresponds to the RL, the midpoint concentration must be 4x the low point concentration and the high point concentration must be at least 16x the low point concentration. The standard is prepared every six months, or sooner if the solutions have degraded or concentrated.

INDC (ηg/mL)					
Compound	**CS1**	**CS2**	**CS3**	**CS4**	**CS5**
alpha-BHC	5.0	10	20	40	80
Heptachlor	5.0	10	20	40	80
gamma-BHC	5.0	10	20	40	80
Endosulfan I	5.0	10	20	40	80
Dieldrin	10	20	40	80	160
Endrin	10	20	40	80	160
4,4'-DDD	10	20	40	80	160
4,4'-DDT	10	20	40	80	160
Methoxychlor	50	100	200	400	800
beta-BHC	5.0	10	20	40	80
delta-BHC	5.0	10	20	40	80
Aldrin	5.0	10	20	40	80
Heptachlor Epoxide	5.0	10	20	40	80
alpha-Chlordane	5.0	10	20	40	80
gamma-Chlordane	5.0	10	20	40	80
4,4'-DDE	10	20	40	80	160
Endosulfan Sulfate	10	20	40	80	160
Endrin Aldehyde	10	20	40	80	160
Endrin ketone	10	20	40	80	160
Endosulfan II	10	20	40	80	160
Tetrachloro-m-xylene	5.0	10	20	40	80
Decachlorobiphenyl	10	20	40	80	160

NOTE: Only the exo-epoxy isomer (isomer B) of Heptachlor Epoxide is used as an analytical standard.

INDC – Individual Standard Mixture C
CS – Calibration Standard

7.3.5 Toxaphene and Technical Chlordane

Multicomponent Analytes (ηg/mL)

Analyte	Low	Med1	Med2	Med3	High
Toxaphene	500	1000	2000	4000	8000
Tech. Chlordane	160	200	400	800	1600
Tetrachloro-m-xylene	5	10	20	40	80
Decachlorobi-phenyl	10	20	40	80	160

7.3.6 Separate calibration standards are used for Toxaphene and Technical **Chlordane** (if required). Alpha and gamma chlordane are included in the single component standard solutions.

7.4 A standard prepared from a source separate from that used to prepare the calibration standard is analyzed after each initial calibration for verification. This standard is referred to as the initial calibration verification (ICV) standard.

7.4.1 An ICV must be analyzed for every target compound within a five-point calibration curve.

7.5 Surrogate standards are added to all samples, method blanks, matrix spikes, laboratory control samples, and calibration standards.

7.5.1 Decachlorobiphenyl (DCB) at 1.2 µg/mL and Tetrachloro-m-xylene (TCX) at 0.6 µg/mL are the surrogates used. Corrective action is taken when both surrogates are recovered outside of acceptance criteria on both columns.

7.5.2 For surrogate standard preparation details, refer to Sample Preparation Procedure -069, "Sample Preparation for Pesticides/PCBs in Water by SW-846".

7.6 All standard solutions are stored separately from samples at 2-6 ^{o}C in Teflon®-sealed containers in the dark. All stock standard solutions must be replaced after one year or sooner if routine QC indicates a problem. All other standard solutions must be replaced after six months or sooner if QC indicates a problem.

8.0 Sample Preservation and Storage

8.1 Samples are preserved and stored according to the tables in Sample Control SOP 4.1, "Receiving Samples" and 4.6, "Storing Samples." Sample holding times are also listed.

8.2 All extracts must be analyzed within 40 days of extraction.

8.3 All sample extracts are stored in the refrigerator in the laboratory at 2 – 6 ^{o}C prior to analysis. After analysis, extracts are returned to Sample Control for long-term storage and disposal.

9.0 Quality Control

9.1 Breakdown

9.1.1 The breakdown standard (PEM) must be analyzed initially with the calibration curve and at least every 12 hours within the analytical sequence.

9.1.2 Degradation of Endrin and DDT is indicated by the presence of 4,4'-DDE, 4,4'-DDD, Endrin aldehyde, or Endrin ketone and is caused by the injector port becoming contaminated with high boiling residue from sample injection.

9.1.2 Degradation of either Endrin or 4,4'-DDT must not exceed 15%. (See **Sections** 12.13 and 12.14 for calculations)

9.1.2.1 If either the degradation of either Endrin or 4,4'-DDT exceed 15%, replace the liner and clean the injection port.

9.2 Surrogates

9.2.1 Statistical control limits for surrogates are shown in the following table. Surrogate recoveries must be met for all samples, blanks, laboratory control samples, matrix spikes, and matrix spike duplicates.

Surrogate	Aqueous % Recovery	Soil % Recovery
Decachlorobiphenyl	43-144	43-144
Tetrachloro-m-xylene	43-135	43-135

9.2.1.1 The surrogate control limits required by the DoD-QSM are presented in the following table:

Surrogate	Aqueous % Recovery	Soil % Recovery
Decachlorobiphenyl	30-135	55-130
Tetrachloro-m-xylene	25-140	70-125

9.2.1.2 Field and QC samples reported with failing surrogates are qualified in the narrative, referencing the applicable DoD-QSM "Q" data flag.

9.2.2 If both surrogates are outside the control range on both columns, the sample must be re-extracted and re-analyzed unless interfering peaks are the reason for the failure. Carefully examine all chromatograms to make certain the out of control surrogate recoveries are not caused by interference or a partial injection before re-extracting the sample. **Only one surrogate out of the four is required to pass.**

9.2.2.1 Partial injections should be re-injected and can be diagnosed by comparing the solvent peak of the sample to the solvent peak of the standard. They should be similar in size.

9.3 Method Blanks (B**LK**)

9.3.1 Method blanks are prepared and analyzed with each extraction batch of up to 20 samples.

9.3.2 No target analyte may be present above the reporting limit and all surrogate criteria stated above must be met.

9.3.2.1 The DoD-QSM requires that no target analyte be present in the method blank > ½ the reporting limit.

9.3.3 If the method blank exceeds acceptance criteria, the source of the problem(s) must be investigated and appropriate corrective action taken. All samples processed with a method blank that does not meet acceptance criteria must be re-extracted and reanalyzed.

9.3.4 Analyte concentration reported for all field and quality control samples that do not meet surrogate acceptance criteria must be qualified as estimates in the SDG narrative. Refer to the DOD-QSM "J" and "Q" flags.

9.4 Laboratory Control Sample (LCS)

9.4.1 A LCS is reagent water or furnaced Ottawa sand or sodium sulfate for solid matrices fortified with the target analyte compounds and surrogates.

9.4.2 The LCS is prepared with each extraction batch of up to 20 samples.

9.4.3 The LCS must meet the control limits of 50 to 150% recovery for the analytes listed in Attachment 4. SC DHEC requires control limits of 70 – 130% recovery. If the client requests Toxaphene or Technical **C**hlordane spike, the acceptance criteria are 50-150% recovery, except SC DHEC which requires 70 – 130% recovery for all analytes.

9.4.3.1 An LCS, analyzed in compliance with the DoD-QSM, must be spiked with all of the analytes of interest in the project. The LCS must meet the control limits presented in Attachment 4, with the allowance that one analyte may fail within the marginal exceedance limit.

9.4.3.2 If the LCS does not meet the acceptance criteria, re-extract and reanalyze the associated samples (if sufficient sample volume is available).

9.4.3.2.1 If corrective actions fail, identify the specific analytes in the associated samples in the SDG narrative.

9.4.3.2.2 To meet the requirements of the DoD-QSM, refer to the "Q" flag.

9.4.3.3 SC DHEC does not accept the use of marginal exceedances, all target analytes must be spiked and must pass all acceptance criteria.

9.5 Matrix Spike/Matrix Spike Duplicate **(MS/MSD)**

9.5.1 A matrix spike and matrix spike duplicate must be performed for each batch of up to 20 samples.

9.5.2 The percent recovery must be within the control limits of 50 to 150. The % RPD of matrix spike duplicates must be ≤ 40. If the client requests Toxaphene or Technical **Chlordane** spike, the acceptance criteria are the same.

9.5.2.1 The objective for the MS/MSD test is for the majority of the spiked compounds to meet recovery and RPD criteria. However, the recoverability of spiked analytes in environmental samples is very much influenced by the particular matrix and, therefore, these objectives may not be able to be met. When recoveries do not meet the acceptance criteria or interference preclude proper assessment of the data, results of a LCS are evaluated to verify that the analytical systems are under control.

9.5.2.2 SC DEHC requires that all target analytes be spiked.

9.5.2.3 SC DEHC requires limits of 70 – 130% recovery for all analytes.

9.5.2.4 If the original sample used for the MS/MSD test does not meet surrogate acceptance criteria, it should be reanalyzed or re-extracted/reanalyzed if the MS/MSD surrogate recoveries are within limits. If the original sample and the MS/MSD test yield the same unacceptable surrogate recoveries, then the sample does not require re-extraction/ reanalysis since matrix interferences is confirmed.

9.6 Duplicate matrix spikes analyzed in compliance with the DoD-QSM must meet the control limits presented for the LCS in Attachment 4. The RPD between the duplicate matrix spikes must be ≤ 30%.

9.6.**1** Results for the specific analytes in the original sample associated with failing matrix spike must be identified in the narrative as estimated values. Refer to the DoD-QSM "J" flag.

9.7 Instrument Maintenance and Trouble Shooting

9.7.1 When linearity is difficult to achieve, verify that the appropriate length of column is inserted in the detector. Examine all column ends and determine if the ends of the columns need to be trimmed.

9.7.2 When the instrument blanks fail, examine the chromatography to determine if there is contamination in the column that is causing the failure. If so, bake the column for 1 hour or less to see if this can be corrected. If the contamination is such that baking for 1 hour does not improve the baseline, it may be necessary to change the liner.

9.7.3 When CCV standards fail recovery low, verify that the correct peaks are being named. Also verify that the syringe is not plugged and change the septa. If the CCV standard fails again, examine the chromatography to determine if there is a problem with the baseline that is causing the failure. If so, bake the column for 1 hour or less and run 1-2 hexane blanks to see if this can be corrected. Also, if the CCV standard is failing on only one column, the y-splitter may be plugged. If the calibration verification continues to fail, the instrument will need a new calibration curve.

9.7.4 When CCV standards fail recovery high, verify that the correct peaks are being named. Examine the chromatography to determine if there is contamination on the column that is causing the failure. If so, bake the column for 1 hour or less and run solvents to see if this can be corrected. If the CCV standard fails again, the instrument will need a new calibration curve.

9.7.5 When the CCV standard fails due to drift, change the septum and verify that all the column fittings are secure. Also, determine if there is contamination on the column that is causing the failure. If so, bake the column for 1 hour or less to see if this can be corrected. If the CCV standard still fails, it is permissible to update retention times once per 24 hours period. Record in the instrument run log when the retention times are updated.

9.7.6 All preventive and routine maintenance as mentioned above is recorded in the instrument run log (Attachment 2). Major maintenance is recorded in the maintenance log (Attachment 3).

9.7.7 If the dual capillary columns used in this method are connected by press-fit Y-shaped glass splitters, the splitter should be replaced along with the insert (uniliner) when DDT and/or Endrin degradation is a problem or when CCV standards fail. Along with this, remove the first few inches of the injector port side of the column and pre-column. If this fails to correct the degradation problems, it may be necessary to deactivate the injector port or replace the columns.

9.7.8 Other corrective actions include removal of 0.5 meters of the detector end of the columns when linearity is difficult to achieve.

9.7.9 To silanize the injector when DDT and Endrin degradation is a problem, the following steps should be taken. Remove the analytical columns after cooling the GC oven. Remove the glass insert (uniliner). Lower the injector port temperature to room temperature. Remove any foreign materials observed while inspecting the injector port. Prepare a solution of deactivating agent (Sylon-CT) following the manufacturer's instructions. Place a beaker under the injector port inside the oven, and rinse the inside of the injector port with acetone and then toluene, catching the rinsate in the beaker. Coat the inside of the injector port with the solution thoroughly and allow it to dry. Finally, rinse the injector with toluene, methanol, acetone, and then hexane, in that order. Reassemble the injector and replace the columns.

9.7.10 Because of the relatively low concentration of pesticide standards injected on the GC/ECD, column adsorption may be a problem if the GC has been unused for several days. Deactivation (priming) can be achieved by injecting a standard at least 20 times more concentrated than the mid-level standard before beginning the initial calibration or continuing calibration verification. Run an instrument blank after system priming because analytes may carry over.

9.8 Contingency

9.8.1 If due to a lab accident or to QC failures, a re-preparation and analysis are required for the sample and insufficient sample volume remains, the Project Manager must be alerted and will contact the client for direction on how to proceed.

9.8.2 If persistent contamination occurs in the laboratory, analysis must be halted until the source of the contamination can be identified and isolated. When the contamination issue is resolved, samples analysis may proceed.

9.8.3 Any other issues that potentially effect data quality should also be addressed with the Project Manager.

10.0 Calibration and Standardization – **all calibration criteria apply to both columns**

10.1 Initial Calibration

10.1.1 The initial calibration consists of a five point curve. The percent Relative Standard Deviation (% RSD) of the calibration factors for the initial calibration must be less than or equal to 20% for all analytes.

10.1.1.**1** Least squares linear regression may be used when the RSDs exceed 20%. When this option is used, the line must not be forced through the origin. The correlation coefficient for the linear fit must be ≥ 0.990 (≥ 0.995 to meet the requirements of the DoD-QSM).

10.2 Initial Calibration Verification

10.2.1 The initial calibration verification (ICV) must be analyzed after each new initial or additional calibration for every target compound within a five-point calibration.

10.2.2 Acceptance criteria for the ICV is ± 20% of the true value.

10.**3** Continuing Calibration **Verification (CCV)**

10.3.1 The calibration factors in all continuing calibration verification (CCV) standards must be within ± 20% difference (% D) when compared to the mean calibration factors from the initial calibration on both analytical columns.

10.3.2 If the % D exceeds ± 20%, then corrective action must be taken and new initial calibration must be analyzed.

10.3.3 If any of the continuing calibration components fall outside their retention time windows, which can be updated every 24 hours as needed, the system is out of control and corrective action must be taken to correct the problem. If, after re-injection of the standard following corrective action, the retention times are still outside the windows, a new initial calibration must be analyzed.

10.3.4 All samples must be bracketed by passing CCVs.

10.3.4.1 If a "closing" standard, which is injected after a group of samples, contains target analyte responses that are 20% D for 8081B different, when compared to the mean calibration factor from the initial calibration, and the analyte was not detected in that group of samples, the samples do not require re-injection. However, if the standard is more than 20% D for 8081B below the mean calibration factor from the initial calibration, then re-injection is required.

10.4 Toxaphene

10.4.1 Unless specified for a particular project/program, a single calibration standard of Toxaphene is analyzed to provide pattern recognition information. The mid-point standard (level 4) is used. Additionally, a 5-point calibration can be performed for Toxaphene detected in samples.

10.5 PCBs

When Method 8082A for PCBs is being used in conjunction with Method 8081B, a five-point calibration has to be performed for Aroclor-1660 followed by individual mid-level standards for the remaining Aroclors. See Instrument Procedure 194, "**GC/ECD Analysis of Polychlorinated Biphenyls (PCBs) as Aroclors in Water and Soil Extracts by SW-846 Method 8082A**" for standards and concentrations.

10.5.1 When Method 8082**A** is employed for PCBs a verification standard of AR1660 must be analyzed **at the frequency of the INDC CCV**. The Aroclor standard can be injected after the **INDC** mix.

10.**6** For **continuing** calibration verification, all target analytes must be injected (INDC) with the exception of Toxaphene and Technical Chlordane.

10.**7** If Toxaphene and/or Technical Chlordane are detected in any samples, the mid-concentration level of those standards must be injected. Samples may be required to be re-injected against those mid-concentration standards.

10.**8** The Endrin and DDT breakdown (PEM) standard is included with each **CCV**. PEM is analyzed after the INDC standard.

11.0 Procedure

Documentation must follow the requirements in Quality Control SOP 13.6, "Proper Documentation Procedures". The analyst must complete the instrument run log. (See Attachment 2) Condition codes are used to document failed and qualified injections. (See Attachment 5)

11.1 Samples are first extracted using Sample Preparation Procedure –069, "Sample Preparation for Pesticides/PCBs in Water by SW-846" or Sample Preparation Procedure –733, "Sample Preparation for Pesticides/PCBs in Soil/Sediment/Sludge by SW-846."

11.2 GC Conditions

11.2.1 Dual Column Analysis

11.2.1.1 The dual column/dual detector approach involves the use of two 30 m x 0.**32** mm ID fused silica open-tubular columns of different polarities, thus having different selectivities towards the target compounds. The columns are connected to a "Y-splitter" and ECD detectors.

11.2.1.2 Column 1:

- Type: clpest
- Dimensions: 30 m x 0.32 mm ID
- Film Thickness: 0.50 µm

11.2.1.3 Column 2

- Type: clpest2
- Dimensions: 30 m x 0.32 mm ID
- Film Thickness: 0.42 µm

11.2.1.4 Carrier gas

- flow rate – 6 mL/minute, helium

11.2.1.5 Makeup gas

- flow rate – 20 mL/minute, argon/methane

11.2.1.6 Temperatures

- Temperature program – 150 °C (0.5 minute hold) to 275 °C (10 minute hold) at 7 degrees/minute
- Injector temperature – 200 °C
- Detector temperature – 300 °C

11.2.1.7 Injection volume – **2** µL (**1** µL per column)

11.2.1.8 Solvent – Hexane

11.2.1.9 Detector – Dual ECD's

11.2.1.10 Range – 10

11.3 GC analysis

11.3.1 The GC is set up according to the conditions above. An initial oven temperature at or below 150 ^{o}C is required to resolve the BHC's. A final temperature of 240 – 275 ^{o}C is necessary to elute Decachlorobiphenyl.

11.3.2 The initial calibration is performed according to the conditions discussed above and criteria must be met for both columns.

11.3.3 The calibration is verified, with an independent second source ICV standard after each multipoint.

11.3.4 **A CCV standard is run during each 12 hour shift (after every 10 samples for DoD-QSM requirements) using a mid-level calibration standard. Within the 12-hour period, and based on current GC run conditions, approximately 10 samples will be analyzed. Since an**

analytical sequence may continue as long as instrumental QC criteria are met, the end of one 12-hour sequence is considered to be the beginning of the next 12-hour sequence. The calibration factor must meet acceptance criteria when compared to the initial calibration curve. When this criterion is exceeded, corrective action is required as described in Section 9.7 and may include re-injection of the calibration verification standard or analysis of a new initial calibration.

11.3.5 Each sample analysis must be bracketed with acceptable initial or continuing calibration verification standards.

11.4 Retention time windows

11.4.1 Retention time windows are established for each analyte. The width of the retention time windows should be based on actual retention times of standards, assessed over 72 hours. The windows are defined as ± three times the standard deviation of the absolute retention times of each standard. Analyst experience is critical in the interpretations of chromatograms.

11.4.2 Absolute retention time windows are established for each analyte, including five component peaks for multi-component analytes. For each analyte, the absolute retention time from each standard injected at the beginning of a 24-hour period is used as the midpoint of the window ± three times the standard deviation as determined from above.

11.5 Analyte Identification

If any of the surrogates or spike compounds are missing or failing, check the peak integration in "Target Review". Changes can be made in Target Review and manual peak integration chromatograms can be generated. Any compound for which manual peak integration has been performed will have an "M" flag displayed on the quantitation report. All manual integration must follow the procedures documented in SOP 13.18, "Manual Chromatographic Peak Integration Procedures."

Analyst's initials and the date must appear on each quantitation report page containing an "M" flag. For multiple "M" flags appearing on a quantitation report page, a bracket encompassing the flags can be used, with a single entry of the initials and date. The department supervisor or a representative

of the QA department must approve of all manual integrations performed on all initial and continuing calibration standards. This is documented by initialing and dating each page of the quantitation report of the raw data containing such manual integrations. See Attachment 6 for definitions of manual integration codes

11.5.1 Tentative identification of an analyte occurs when a peak from a sample extract falls within the estimated retention time window on both analytical columns. The **lower** concentration of the two columns is reported provided there is no interference from overlapping peaks.

11.5.2 Identification of multi-component analytes is based on the characteristic pattern and retention times of the indicator peaks.

11.6 Analyte quantitation

11.6.1 The external calibration procedure is used and establishes mean calibration factors for each analyte from the initial calibration. Peaks falling within an analyte's retention time window are used to calculate the quantity present. The concentration reported is the higher of the two values obtained from the dual column analysis. If one result is > 40% different, verify that there are not overlapping peaks causing this to occur. Also examine the baseline to verify that the baseline parameters are set properly. Flag the data with a "P" and document results in the narrative. Refer to the "J" flag for results reported in compliance with the DoD-QSM.

11.6.2 If the response of an analyte exceeds the on column amount of the high level standard, dilute and re-analyze. This can be done by comparing a component peak area to the corresponding analyte in the high level standard. Within the Target data system the "**E**" flag is used on the quantitation report to indicate that an analyte is outside the upper initial calibration range. **This criteria applies independently to both columns, even if the reporting column is not above the calibration range.**

11.6.3 Quantitation of multi-component analytes

11.6.3.1 Toxaphene and **Technical Chlordane** are quantitated using response factors of five major peaks (minimum of three required) of the sample pattern compared to the response factors of five peaks in the standard.

11.6.3.2 Quantitation is based on the area under the characteristic Toxaphene and Technical Chlordane peaks as compared to the area under the corresponding calibration peaks at the same retention times using the external calibration method.

11.6.3.3 Quantify Aroclors analyzed together with pesticides using the approach stated in sections 11.6.3.1 and 11.6.3.2.

11.6.4 A normal initial calibration sequence only contains a mid-concentration level of Toxaphene and Technical Chlordane. On a project-specific basis, five levels of Technical Chlordane and Toxaphene may be required.

12.0 Data Analysis and Calculations

Calculations must be consistent with the Quality Control SOP 13.4, "Numerical Data Reduction".

12.1 Calculation of the mean or average of a set of values:

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

where: n = total number of values
x_i = each individual value used to calculate the mean
x = the mean of n

12.2 Calculation of the standard deviation of a set of values:

$$\text{Standard deviation} = \sqrt{\frac{\sum_{i=1}^{n}\left(X_n - \overline{X}\right)^2}{n-1}}$$

12.3 Calculation of percent recovery:

12.3.1 LCS and surrogates:

$$\%R = \frac{Amount\ found}{Amount\ spiked}\ x\ 100$$

12.3.2 Matrix spikes:

$$\% R = \frac{Amount\ in\ spiked\ sample - Amount\ in\ unspiked\ (native)\ sample}{Amount\ spiked} \times 100$$

12.4 Calculation of % RSD

$$\%RSD = \left(\frac{Standard\ deviation}{\overline{X}}\right) \times 100$$

12.5 Calculation of RPD

$$RPD = \frac{|Value\ 1 - Value\ 2|}{(Value\ 1 + Value\ 2)/2} \times 100$$

12.6 Calculation of %Difference (%D)

$$\%Diff = \frac{Value - \overline{Reference\ value}}{\overline{Reference\ value}} \times 100$$

12.7 Calibration factors for GC analysis are calculated by dividing the total peak area for each chosen compound in the standard by the total mass injected (in nanograms).

$$Calibration\ Factor\ (CF) = \frac{Peak\ area}{Total\ mass\ injected}$$

12.8 Linear Calibration using Least Squares Regression

General linear equation: $y = ax + b$

where:
y = Instrument response (peak area)
a = Slope of the line (coefficient of x)
x = Mass of the analyte in the calibration standard aliquot injected
b = y-intercept

Linear Regression by Least Squares:

$$y_1' = ax_i + b$$

Where: b = intercept
x_i = Mass of the analyte in the ith calibration standard aliquot injected
$y_1^{'}$ = calculated response for the ith calibration standard

The sum of the squares of the differences is minimized to obtain a and b:

$$\sum_{i=1}^{N}(y_i - y_1^{'})^2$$

12.9 Correlation Coefficient r:

$$r = \frac{N\left[\sum_{i=1}^{N}(x_i y_i)\right] - \left[\sum_{i=1}^{N}(x_i)\right]\left[\sum_{i=1}^{N}(y_i)\right]}{\sqrt{N\left[\sum_{i=1}^{N}(x_i^2)\right] - \left[\sum_{i=1}^{N}(x_i)\right]^2} * \sqrt{N\left[\sum_{i=1}^{N}(y_i^2)\right] - \left[\sum_{i=1}^{N}(y_i)\right]^2}}$$

Where: r = Correlation Coefficient
N = number of data points (equals 5 in a 5 point curve)
y = response
i = index variable (first data point i = 1)
x = Mass of the analyte in the calibration standard aliquot injected

12.10 Calculation of % Difference (% D)

$$\%Diff = \frac{Value - \overline{Reference\ \ value}}{\overline{Reference\ \ value}} \ x\ 100$$

12.11 Calibration factors for GC analysis are calculated by dividing the total peak area for each chosen component in the standard by the total mass injected (in nanograms).

$$Calibration\ Factor\ (CF) = \frac{Peak\ area}{Total\ mass\ injected}$$

12.12 Concentration

12.12.1 Concentration of aqueous samples for GC analysis

$$\mu g / L = \frac{(Ax)(Vt)(Df)}{(\overline{CF})(Vi)(Vs)}$$

where: Ax = area response for the analyte
Vt = volume of the concentrated extract (**µL**)
Df = dilution factor. If no dilution, Df = 1.0
$\overline{CF}$ = mean calibration factor from the initial calibration
Vo = volume of water sample extracted (mL)
Vi = volume of extract injected (**µL**)

12.12.2 Concentration of soil samples (dry weight basis) for GC analysis

$$\mu g / kg = \frac{(Ax)(Vt)(Df)}{(\overline{CF})(Vi)(Ws)(D)}$$

where: Ws = weight of sample extracted, in grams

$$D \text{ (dry weight)} = \frac{100 - \%\text{ moisture}}{100}$$

Ax, Vt, Df, $\overline{CF}$, Vi have the same definitions as for water.

12.12.3 Concentration of aqueous samples for GC analysis using linear regression:

$$ug / L = \frac{(a(Ax) + b)(Vt)(Df)}{(Vi)(Vo)}$$

where: Ax = area response for the analyte
Vt = volume of the concentrated extract (**µL**)
Df = dilution factor. If no dilution, Df = 1.0
a = slope
b = y-intercept
Vo = volume of water sample extracted (**mL**)
Vi = volume of extract injected (**µL**)

12.12.4 Concentration of soil samples for GC analysis using linear regression:

$$ug/kg = \frac{(a(Ax)+b)(Vt)(Df)}{(Vi)(Ws)(D)}$$

where: Ws = weight of sample extracted, in grams
D (dry weight)= 100 - % moisture/100
Ax = area response for the analyte
Vt = volume of the concentrated extract (**µL**)
Df = dilution factor. If no dilution, Df = 1.0
a = slope
b = y-intercept
Vo = volume of water sample extracted (**mL**)
Vi = volume of extract injected (**µL**)

12.13 Endrin Breakdown:

$$\%\text{ breakdown of Endrin } = \frac{\text{sum of degradation peak areas (Endrin aldehyde + Endrin ketone)}}{\text{sum of all peak areas (Endrin + Endrin aldehyde + Endrin ketone)}} \times 100$$

12.14 DDT Breakdown:

$$\%\text{ breakdown of DDT } = \frac{\text{sum of degradation peak areas (DDD + DDE)}}{\text{sum of all peak areas (DDT + DDD + DDE)}} \times 100$$

12.15 Calculating Dilutions

If a sample concentration exceeds the high level standard a dilution must be performed. **This criteria applies independently to both columns, even if the reporting column is not above the calibration range.** Determine a level of dilution that will result in a value within the upper half of the calibration range. This is an acceptable dilution. A 10x dilution is performed using 1 mL sample plus 9 mL diluent for a total volume of 10 mL. It should be recorded on the run log as "10x **(1 mL in 10 mL)**."

13.0 Method Performance

This method was validated through in-house laboratory studies of method detection limits and precision and accuracy for single analyst. The data are retained by the QA department.

14.0 Pollution Prevention

The solvents used in this procedure pose little threat to the environment when recycled and managed properly. Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The EPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency recommends recycling as the next best thing. See SOP 12.1, "Hazardous Waste Disposal", regarding laboratory procedures for recycling solvent waste streams.

15.0 Waste Management

It is the laboratory's responsibility to comply with all federal, state, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions, and to protect the air, water, and land by minimizing and controlling all releases from fume hoods and bench operations. Compliance with all sewage discharge permits and regulations is also required.

Samples preserved with HCl, HNO_3, or H_2SO_4 are hazardous and must be handled as hazardous waste.

16.0 References

16.1 Standard Methods for the Examination of Water and Wastewater, 20th Edition (1998), Method 1080

16.2 Code of Federal Register, 40 CFR, Part 136, "Guidelines for Establishing Test Procedures for Priority Pollutants"

16.3 Quality Control SOP 13.6, "Proper Documentation Procedures"

16.4 Quality Control SOP 13.4, "Numerical Data Reduction"

16.5 NELAC Standards, effective July 2003, plus revisions

16.6 EPA QA-G6: Guidance for the Preparing Standard Operating Procedures (SOPs) EPA/600/B-07/001, April 2007.

16.7 CompuChem Quality Manual, Revision 13, November 17, 2009, plus revisions

16.8 Sample Control SOP 4.6, "Storing Samples"

16.9 Department of Defense Quality Systems Manual for Environmental Laboratories, Version 4.**2**, **10**/**25**/**10**

16.10 "Test Methods for Evaluating Solid Wastes: Physical/Chemical Methods", SW-846, 3rd Edition, Update IV, Method 8081B, February 2007

17.0 Attachments as Tables, Diagrams and Flowcharts

17.1 Attachment 1 – Analyte List and Reporting Limits

17.2 Attachment 2 – Example of a GC Extractables Run Log

17.3 Attachment 3 – Example of a GC Extractables Instrument Maintenance Log

17.4 Attachment 4 – LCS Control Limits Required by the DoD-QSM and Marginal Exceedences

17.5 Attachment 5 – Condition Codes

17.6 Attachment 6 – Manual Integration Codes

Attachment 1

		Reporting Limits	
Compound Name	**CAS Registry No.**	**µg/L**	**µg/Kg**
Aldrin	309-00-2	0.025	0.83
alpha-BHC	319-84-6	0.025	0.83
beta-BHC	319-85-7	0.025	0.83
delta-BHC	319-86-8	0.025	0.83
gamma-BHC (Lindane)	58-89-9	0.025	0.83
alpha-Chlordane	5103-71-9	0.025	0.83
gamma-Chlordane	5103-74-2	0.025	0.83
4,4'-DDD	72-54-8	0.050	1.67
4,4'-DDE	72-55-9	0.050	1.67
4,4'-DDT	50-29-3	0.050	1.67
Dieldrin	60-57-1	0.050	1.67
Endosulfan I	959-98-8	0.025	0.83
Endosulfan II	33213-65-9	0.050	1.67
Endosulfan sulfate	1031-07-8	0.050	1.67
Endrin	72-20-8	0.050	1.67
Endrin aldehyde	7421-93-4	0.050	1.67
Endrin ketone	53494-70-5	0.050	1.67
Heptachlor	76-44-8	0.025	0.83
Heptachlor epoxide	1024-57-3	0.025	0.83
Methoxychlor	72-43-5	0.250	16.7
Technical **Chlordane**	12789-03-06	0.8	26.7
Toxaphene	8001-35-2	2.5	83.3

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Attachment 2

COMPUCHEM a Division of Liberty Analytical Corporation Instrument ID: 86 File Path: _____ DATE ___/___/___
GC EXTRACTABLES RUN LOG Amt. Inj. 2 µL (1 µL per column)
LOGBOOK 4N(5) 23 Method: 8081B 8082A 8151A SOM01.2 (Circle one) Other _____

☐Changed septum ☐Changed liner ☐Baked column ☐Trimmed column ☐ Other: _____

	REJECTED	FILE NUMBER	REPORTED	DATE	COMPUCHEM #	CASE/SDG#	STANDARD ID	CHEMIST	COMMENTS
1				/ /					
2				/ /					
3				/ /					
4				/ /					
5				/ /					
6				/ /					
7				/ /					
8				/ /					
9				/ /					
10				/ /					
11				/ /					
12				/ /					
13				/ /					
14				/ /					
15				/ /					
16				/ /					
17				/ /					
18				/ /					
19				/ /					
20				/ /					

The presence of the Chemist's/Analyst's employee ID number, or signature, on this run log attests that strict compliance with the method's SOP has occurred. Any SOP deviations require documentation by the responsible chemist/analyst together with the chemist's/analyst's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation.

Calibration ID: _____ Sequence ID: _____ Hexane Lot No_____

REVIEWED BY: _____ DATE _____

5/19/10: jad

4201

Note: This page subject to change without notice.

Attachment 3

CompuChem a division of Liberty Analytical Corp. Logbook 4 K(4) 1

GC Extractables Instrument Maintenance Log: 80/81

Date: _____ Time: _____

System: _____

Problem: _____

_____

_____

_____

_____

Action Taken: _____

_____

_____

_____

_____

_____

Parts used:

Part Number	Description	Quantity

File Name Indicating Instrument In Control: _____

Performed By: _____ Date: _____

Reviewed By: _____ Date: _____

2/11/00:mlj

Attachment 4

DoD-QSM Aqueous and Solid LCS Control Limits and Marginal Exceedance Limits

Analyte	Aqueous % Recovery	Aqueous Marginal Exceedance	Solid % Recovery	Solid Marginal Exceedance
4,4'-DDD	25-150	10-170	30-135	10-155
4,4'-DDE	35-140	15-160	70-125	60-135
4,4'-DDT	45-140	30-155	45-140	30-155
Aldrin	25-140	10-155	45-140	30-155
alpha-BHC	60-130	50-140	60-125	50-135
alpha-Chlordane	65-125	55-135	65-120	55-130
beta-BHC	65-125	55-135	60-125	50-135
delta-BHC	45-135	30-150	55-130	45-145
Dieldrin	60-130	50-140	65-125	55-135
Endosulfan I	50-110	40-120	15-135	10-155
Endosulfan II	30-130	10-150	35-140	20-160
Endosulfan sulfate	55-135	40-150	60-135	50-145
Endrin	55-135	45-145	60-135	50-145
Endrin aldehyde	55-135	40-150	35-145	20-165
Endrin ketone	75-125	70-135	65-135	55-145
gamma-BHC	25-135	10-155	60-125	50-135
gamma-Chlordane	60-125	50-135	65-125	55-135
Heptachlor	40-130	30-145	50-140	35-155
Heptachlor Epoxide	60-130	50-140	65-130	55-140
Methoxychlor	55-150	40-165	55-145	45-155

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Attachment 5

Code	Explaination
CS	Carry over Suspected from prior analysis
CT	Contamination verified
DI	Requires Dilution
DW	Diluition Wrong
JS	Reinjection same as prior run
LA	Lab Accident (explain in comments)
OT	Other (explain in coments)
OW	Original wrong for QC sample
RP	Reportable prior run
RT	Retention time shift
RU	Repeated Unnecessarily
SF	Spike recoveries failed (high or low)
SI	Spiked inadvertently
SH	Surrogate recoveries high
SL	Surrogate recoveries low
SM	Surrogate or spike missing
IF	Instrument failure
US	Unacceptable Standard (explain in comments)
VR	Verify results
NM	Did not match prior run or duplicate
RN	Reanalyze neat, was run at a dilution
PC	Poor chromatography
SC	Sulfur clean up required
WS	Wrong standard (SOM PCBs)
MI	Misinjection (bad injection)

Code	Explaination
%R	%RSD failed (Ical)
%B	Breakdown failed
%D	%D (CCV)
RT	Retention time shift
RU	Repeated Unnecessarily
IF	Instrument failure
US	Unacceptable Standard (explain in comments)
PC	Poor chromatography
SC	Sulfur clean up required
LA	Lab Accident (explain in comments)
OT	Other (explain in coments)

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Attachment 6

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Notification Regarding Manual Editing/Integration Flags

In some instances, manual adjustments to the software output are necessary to provide accurate data. These manual integrations are performed by the data reviewers, GC/MS operators, or GC/HPLC chemists. An Extracted Ion Current Profile (EICP) or a GC/HPLC chromatographic peak has been provided for the manual integration performed on each compound to demonstrate the accuracy of that process. The manual integrations are flagged on the quantitation report in the far right column beyond the FINAL concentration for GC/MS analysis, and in the "Flags" column for GC/HPLC analysis. The manual editing/integration flags are:

M - **Denotes that a manual integration has been performed for this compound. The manual integration was performed in order to provide the most accurate area count possible for the peak. The most common reasons for performing manual integrations/editing are: the compound was not found by the automatic integration routine, the compound was incorrectly integrated by the automatic integration routine, and the co-eluting compounds were incorrectly integrated by the automatic integration routine.**

H - **Denotes that the data reviewer, GC/MS operator, or GC/HPLC Chemist has chosen an alternate peak within the retention time window from that chosen by the software for that compound. No manual integration is performed in choosing an alternate peak. The software still performs the integration.**

MH - **Denotes that an alternate peak has been chosen within the retention time window from that chosen by the software for that compound and also a manual integration of the chosen peak has been performed. The manual integration was performed in order to provide the most accurate area count possible for the peak.**

L - **Denotes that a data reviewer or GC/MS operator has selected an alternate library search. This is typically done when an additional tentatively identified compound (TIC) has been added to the number of peaks searched. No manual integration is performed in choosing an alternate peak. The software still performs the integration.**

ML - **Denotes that an alternate GC/MS library search has been selected and a manual integration has also been performed. This is typically done when an additional TIC has been added and the TIC peak also required a manual integration.**

These codes will appear in the GC/MS and GC/HPLC raw data.

Revision 8 (01/29/2011)

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SOP DOCUMENTATION FORM

This form must accompany all new and revised Standard Operating Procedures (SOPs) when you turn them in to Quality Assurance for review. Please fill out the entire block below (except effective date).

This is a new procedure _____ revised procedure ✓ outdated procedure (archive) _____

- Procedure Code: IP 1404 SOP Section #: 2.4.4.5 Revision #: 3

SOP Title: GC/MS Selected Ion Monitoring (SIM) Semivolatile Analyses of Aqueous and Soil Samples Using SW-846

Effective date: (QA fills in) 05-18-11

- Procedure prepared by: [signature] Date: 4/25/11
- Procedure approved by: (If the manager prepared the SOP, a qualified second party should sign) Bob McEiver Date: 05-18-2011
- Reason for change: Annual Review and response to LA-B audit
- This procedure meets the requirements of the following approved method references: SW-846, 3rd Ed, Update III, Method 8270C, 12/96 and Update IV Method 8270D 1/08; DoD QSM Version 4.2 10/25/2010, plus revisions

Procedure approved by a QA Representative (unless QA Representative signed above):

_____ Date: _____

On an annual basis: Lab managers are required to review lab practices and revise the SOP if necessary. If no revision is necessary, indicate by your signature that the SOP has been reviewed.

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Instrument Procedure 1404: GC/MS Selected Ion Monitoring (SIM) Semivolatile Analyses of Aqueous and Soil Samples Using SW-846

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Instrument Procedure 1404: GC/MS Selected Ion Monitoring (SIM) Semivolatile Analyses of Aqueous and Soil Samples Using SW-846

1.0 Scope and Application

This procedure is used for the determination and quantitation of low concentrations of semi-volatile compounds in extracts of aqueous and solid samples. Attachment 1 presents the compounds currently analyzed by these methodologies. Additional compounds may be analyzed per client request.

Staff members performing the procedures described in this SOP are responsible for reading, understanding, and complying with the SOP requirements. Supervisors are responsible for directing the analyst to the controlled SOP, and providing adequate explanation of the material contained therein.

This procedure is restricted to use by or under the supervision of analysts experienced in the instrumentation or preparative methods and who have demonstrated the ability to generate acceptable results through QC samples and analyst capability studies.

2.0 Summary

This procedure provides for the gas chromatograph mass spectrometer (GC/MS) analysis of aqueous and solid samples using the SW-846, Update III, Method 8270C SIM and Update IV, Method 8270D SIM. Aqueous samples are extracted prior to analysis using the SW-846 separatory funnel extraction, Method 3510C or continuous liquid-liquid extraction, and concentrated to a final volume of 1.0 mL. Soil samples are extracted by the ultrasonic extraction, Method 3550B/C, and concentrated to a final volume of 1.0 mL. Each extract is injected into a GC equipped with a fused silica capillary column, where it is chromatographically separated from other extractable organic compounds. A mass spectrometer detector operating in the selected ion monitoring (SIM) mode analyzes the eluents. SIM analysis is performed on extracts that were prepared for scan analysis, as well as those prepared for SIM analysis only.

3.0 Definitions

3.1 Method detection limit (MDL) – The minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte (40 CFR, Part 136, Appendix B). A minimum of seven sample replicates is required to calculate a statistical MDL. The MDL is an approximation of the DL. Any analyte concentration result at or above the MDL

must also meet all qualitative identification criteria required by the test method in order to be reported as present.

3.2 Detection Limit (DL) – The DL is the smallest analyte concentration that can be demonstrated to be different from zero or a blank concentration at the 99% level of confidence. The false positive rate at the DL is 1% and the false negative rate is 50%. Any analyte concentration result at or above the DL must also meet all qualitative identification criteria required by the test method in order to be reported as present.

3.3 Limit of Detection (LOD) – The LOD is smallest concentration of an analyte that must be present in a sample in order to be detected at 99% confidence level. The false negative rate at the LOD is 1%. For DoD-QSM, non-detect sample results are reported as < LOD. Numeric values of the measurements between the DL and the LOQ are reported as estimates. The DL < LOD ≤ LOQ.

3.4 Limit of Quantitation (LOQ) – The Limit of Quantitation is the lowest concentration of a substance that produces a quantitative result within specified limits of precision and bias. The LOQ must be within the calibration range.

3.5 Reporting Limit (RL) –

3.5.1 For Non-DoD work, the laboratory reporting limit is based on the lowest multipoint calibration standard concentration. For organic methods, values detected below the reporting limit and above the MDL may be reported as qualified as an estimated concentration.

3.5.2 The DoD-QSM defines the reporting limit as being the lowest concentration value specified by the client that meets project requirements for reporting data with known precision and bias for specific analyte in a specific matrix. The LOQ cannot be greater than the RL. Data reported below the RL must be flagged as estimated values if they are also less than the LOQ.

3.6 Reporting Units – µg/L for water and µg/Kg for soil

3.7 A Sample Delivery Group (SDG) is defined by the following, whichever is more frequent:

- each 20 field samples received within a case, or

- each 7 calendar day period during which field samples in a case are received (14 calendar days if requested by the client) beginning with the receipt of the first sample.

NOTE: The DoD-QSM and SC DHEC do not accept the SDG approach, unless the samples are prepared in a single batch. When a group of up to 20 field samples of a similar matrix is prepared as one batch, method-specified QC samples such as a method blank, laboratory control sample, matrix spike, matrix spike duplicate, and matrix duplicate must also be prepared together. If samples are batched together from different sites, project-specific QC must be processed.

3.8 Extraction Batch – a group of up to 20 field samples of a similar matrix, method specified QC samples such as a method blank, laboratory control sample, matrix spike, matrix spike duplicate prepared together at the same time.

3.9 CCC – Calibration Check Compounds

3.10 SPCC – System Performance Check Compounds

3.11 AMU – atomic mass unit

3.12 FC-43 – Perfluorotributylamine

3.13 DoD QSM Department of Defense Quality Systems Manual

3.14 SC DHEC – South Carolina Department of Health and Environmental Control

3.15 LIMS – Laboratory Information Management System

3.16 For the purposes of this SOP, DFTPP refers to an instrument check solution containing Pentachlorophenol, Benzidine, and 4,4'-DDT.

4.0 Interferences

4.1 This method is applicable to the analysis of aqueous and solid samples containing low total concentrations of extractable organic compounds. If interferences are detected from other sample constituents, the GC conditions may be adjusted to reduce or eliminate the interference. Extract clean-up by gel permeation chromatography (GPC) may be attempted following Sample Preparation Procedure –939, "Gel Permeation Chromatography (GPC) Cleanup of Semivolatile (SV) Soil Sample Extracts by CLP, SW-846".

4.2 The client must be aware that in some cases analysis for low concentrations of semi-volatile compounds will not be possible because of matrix interferences.

5.0 Safety

5.1 The analysts and laboratory management must be aware of the proper techniques used to handle hazardous chemicals and samples.

5.2 Appropriate protective equipment and clothing must be used under the assumption that all samples are potentially hazardous. During sample preparation, glasses, gloves and lab coats are a minimum requirement. The persistent presence of noxious odors may be indicative of failure of the laboratory ventilation system and must be reported to a supervisor or manager.

5.3 Laboratory staff are required to review the Chemical Hygiene Plan for general safety policies, and Material Safety Data Sheets (MSDS) for solvents and reagents used in the laboratory. The MSDS are located in the Quality Assurance department.

6.0 Equipment and Supplies

6.1 Mass spectrometer

6.1.1 Hewlett Packard 5972A mass selective detector (MSD)

6.1.2 Agilent 5973N mass selective detector (MSD)

6.2 Gas Chromatograph

6.2.1 Hewlett Packard 5890 Series II gas chromatograph (GC) with electronic pressure control (EPC)

6.2.2 Agilent Technologies 6890N series with EPC.

6.3 Analytical Column

6.3.1 Fused silica 30 m (length) Restek RTX-5MS, 0.25 mm (ID), 0.25 µM (film thickness) or RTX-5 Sil ms

6.3.2 Fused silica 30 m (length) Restek RTX-5MS, 0.32 mm (ID), 0.25 µM (film thickness) or RTX-5 Sil ms

6.4 Autosampler

6.4.1 Hewlett Packard 7673 Automated Liquid Sampler

6.4.2 Agilent 7873B Automated Liquid Sampler

6.5 Data System

6.5.1 A computer is interfaced to the mass spectrometer to allow the continuous acquisition and storage on machine-readable media of all mass spectra obtained throughout the duration of the chromatographic program.

6.5.2 The data processing computer has software that searches any GC/MS data file for ions of a specified mass and plots ion abundances versus time or scan number. This type of plot is defined as an Extracted Ion Current Profile (EICP). The software integrates the abundance of any EICP between specified time or scan number limits.

6.5.2.1 For data processing, the laboratory uses the Hewlett Packard HP 9000 series 735 Unix Workstation.

6.5.2.2 Standards and samples are processed using the EZ Chrom® Elite data acquisition system, Target® Quick Forms report generation software from ThruPut Systems, and Promium Element® LIMS.

6.6 Syringes - 10 µL Hamilton syringe

7.0 <u>Reagents and Standards</u>

All standards are prepared by the Organic Standards Laboratory. Details for the standard preparation are contained in the Standards Preparation Logbook (22F) or Promium Element® LIMS. Standards are stored separately from samples at 2 – 4 ^{o}C in the laboratory when not in use. Stock solutions must be prepared every three to six months or sooner, if comparisons with quality control check samples indicate degradation or concentration of solution compounds.

Note: All spiking standard information is entered into the LIMS. To obtain information on any standard, access Element, click on "Laboratory," and scroll down and access "Standards." Standards can be sorted by Department. Select the standard you would like to access. The view will show lot number, prepared dates, solvent, vendor, composition, and concentration.

Note: All standards and reagents are subject to change in vendor and in concentration. The Reporting Limits are also subject to change, but must remain at or above the lowest point in the calibration. Standards may be purchased as certified neat materials or concentrated solutions. Commercially-prepared stock standard solutions should be obtained whenever possible in order to avoid the hazard of handling neat explosive material. All reagents and standards must be ACS (American Chemical Society) grade or equivalent, unless otherwise denoted.

7.1 Reagent water – All water used in this procedure must be equivalent to ASTM Type I with regard to resistivity of > 10 megohm-cm (19th and 20th Editions of Standard Methods, Method 1080), which is demonstrated to meet the blank contamination acceptance criteria contained in this Standard Operating Procedure (SOP). It is referred to throughout the remainder of this SOP as DI water.

7.2 Methylene Chloride

7.3 Standards

7.3.1 Calibration standard solutions are prepared at 0.2, 0.6, 1.5, 2.5, 5.0 µg/mL for the majority of compounds. See Attachment 4 for details on the standard concentrations.

7.3.2 Internal standard solution is prepared at 40 µg/mL.

7.3.3 Standards are prepared every six months or sooner if degradation or evaporation occurs.

8.0 <u>Sample Preservation and Storage</u>

8.1 Samples are preserved and stored according to the tables in Sample Control SOP 4.1, "Receiving Samples" and 4.6, "Storing Samples." Sample holding times are also listed.

8.2 All extracts must be analyzed within 40 days of extraction.

8.3 Prior to analysis, all extracts must be stored under refrigeration at 2 – 4 ^{o}C in the reach-in storage unit in the laboratory. After analysis, extracts are returned to Sample Control for long-term storage and disposal.

9.0 Quality Control

9.1 Surrogates

9.1.1 Surrogates are added to each sample prior to extraction.

9.1.2 Samples requiring scan analysis prior to SIM analysis have surrogates added at the scan concentration and the recoveries are assessed in the scan analysis.

9.1.3 Samples requiring SIM analysis only have surrogates added at the SIM concentration and recoveries are assessed in the SIM analysis.

9.1.4 The recovery of each surrogate is monitored. Surrogate recovery criteria must be met or the affected sample must be re-extracted and reanalyzed. If surrogate recovery is not met in the method blank or LCS, the entire batch must be re-extracted and re-analyzed. Surrogate recovery limits are presented in the following table for SW-846 analyses.

Compound	Aqueous Acceptance Limits	Soil Acceptance Limits
Nitrobenzene-d_5	34-114	25-136
2-Fluorobiphenyl	55-110	29-131
Terphenyl-d_{14}	53-110	34-149
2, 4, 6-Tribromophenol	25-120	22-143

9.1.5 Surrogate control limits required by the DoD-QSM are listed in the following table.

Compound	Aqueous Acceptance Limits	Soil Acceptance Limits
Nitrobenzene-d_5	40-110	35-100
2-Fluorobiphenyl	50-110	45-105
Terphenyl-d_{14}	50-135	30-125
2, 4, 6-Tribromophenol	40-125	35-125

9.2 Internal Standards

9.2.1 In each method blank, laboratory control sample (LCS), matrix spike, and sample run immediately after the initial calibration, the internal standard area responses must be greater than 50% and less than 200% of the area of the internal standard in the mid level initial calibration standard.

9.2.2 For each method blank, LCS, matrix spike, and sample run after a continuing calibration verification standard, the internal standard area responses must be greater than 50% and less than 200% of the area of the internal standard in the continuing calibration verification standard.

9.2.3 The retention time of each internal standard in each method blank, LCS, matrix spike, and sample must be within ± 0.5 minutes (30 seconds) of its corresponding internal standard in the calibration standard.

9.2.4 If the internal standard criteria are not met, the extract must be re-injected. When the internal standard fails in the same way in the re-injection of a sample, a matrix effect is confirmed.

9.3 Method Blank

9.3.1 A method blank is prepared with each extraction batch of samples. The concentrations of target compounds (see Attachment 1) in the method blank prepared for SIM analysis only must be less than the RL for SW-846 analyses.

9.3.1.1 Blanks that were originally prepared for scan analysis may contain target compounds at concentrations above the RL or CRQL.

9.3.1.2 To meet the requirements of the DoD-QSM, all target analytes must be at concentrations less than half the reporting limit.

9.3.2 Internal standard responses must be within acceptance windows.

9.3.3 If the method blank prepared for SIM analysis fails acceptance criteria for surrogate recovery or contamination, the analytical system is considered to be out of control. The source of the contamination must be investigated and appropriate corrective measures taken and documented before samples are analyzed. All samples processed with a method blank that is

out of control must be re-extracted and reanalyzed, unless the method blank meets acceptance criteria upon re-injection.

9.4 Laboratory Control Sample

9.4.1 A laboratory control sample (LCS) is extracted with each SW-846 batch of samples. An LCS is spiked with a subset of the compounds listed in the Table from Section 9.4.2.1, unless otherwise specified by the project.

9.4.2 The recovery of each spike analyte is monitored.

9.4.2.1 If the LCS fails, all samples analyzed in the batch must be re-extracted and reanalyzed. LCS recovery limits are presented in the following table.

Compound	Aqueous Acceptance Limits	Soil Acceptance Limits
Naphthalene	61-107	36-149
2-Methylnaphthalene	58-100	31-150
1-Methylnaphthalene	60-109	33-134
Acenaphthylene	62-112	35-148
Acenaphthene	65-111	34-147
Fluorene	70-116	34-150
Phenanthrene	71-119	37-144
Anthracene	67-112	38-146
Fluoranthene	63-109	33-150
Pyrene	64-108	35-144
Benzo(a)anthracene	66-114	36-145
Chrysene	67-111	40-140
Benzo(b)fluoranthene	53-148	32-149
Benzo(k)fluoranthene	51-111	30-150
Benzo(a)pyrene	62-129	35-143
Indeno(1,2,3-c,d)pyrene	77-125	25-112
Dibenzo(a,h)anthracene	67-131	34-146
Benzo(g,h,i)perylene	61-119	34-139
4-Nitrophenol	10-150	10-150
Pentachlorophenol	32-150	23-150
Hexachlorobutadiene	29-107	11-137
Hexachlorobenzene	27-101	15-148

9.4.2.2 DoD LCS recovery limits are presented in the following table.

Compound	Aqueous Acceptance Limits	Soil Acceptance Limits
Naphthalene	40-100	40-105
2-Methylnaphthalene	45-105	45-105
1-Methylnaphthalene	N/A	N/A
Acenaphthylene	50-105	45-105
Acenaphthene	45-110	45-110
Fluorene	50-110	50-110
Phenanthrene	50-115	50-110
Anthracene	55-100	55-105
Fluoranthene	55-115	55-115
Pyrene	50-130	45-125
Benzo(a)anthracene	55-110	50-110
Chrysene	55-110	55-110
Benzo(b)fluoranthene	45-120	45-115
Benzo(k)fluoranthene	45-125	45-125
Benzo(a)pyrene	55-110	50-110
Indeno(1,2,3-c,d)pyrene	45-125	40-120
Dibenzo(a,h)anthracene	40-125	40-125
Benzo(g,h,i)perylene	40-125	40-125
4-Nitrophenol	0-125*	15-140
Pentachlorophenol	40-115	25-120
Hexachlorobutadiene	25-105	40-115
Hexachlorobenzene	50-110	45-120

* Batch acceptance should not be evaluated using these limits.

9.5 Matrix Spike/Matrix Spike Duplicate

9.5.1 If requested by the client a matrix spike and matrix spike duplicate (MS/MSD) are extracted and analyzed with a SDG.

9.5.2 The percent recovery limits for spiked compounds are the same as those for the LCS.

9.5.3 The relative percent difference between the MS and the MSD should be less than or equal to 50.

9.5.4 The objective for the MS/MSD test is for the majority of the spiked compounds to meet recovery and RPD criteria. However, the recoverability of spiked analytes in environmental samples is very much influenced by the particular matrix and, therefore, these objectives may

not be able to be met. When recoveries do not meet the acceptance criteria or interference preclude proper assessment of the data, results of a LCS are evaluated to verify that the analytical systems are under control.

If the original sample used for the MS/MSD test does not meet surrogate acceptance criteria, it should be reanalyzed or re-extracted/reanalyzed if the MS/MSD surrogate recoveries are within limits. If the original sample and the MS/MSD test yield the same unacceptable surrogate recoveries, then the sample does not require re-extraction/ reanalysis since matrix interferences is confirmed.

9.6 Contingency

9.6.1 If due to a lab accident or to QC failures, a re-preparation and analysis are required for the sample and insufficient sample volume remains, the Project Manager must be alerted and will contact the client for direction on how to proceed.

9.6.2 If persistent contamination occurs in the laboratory, analysis must be halted until the source of the contamination can be identified and isolated. When the contamination issue is resolved, samples analysis may proceed.

9.6.3 Refer to the corresponding Data Review SOP (number will vary among sections) for information on how to handle reporting of data that are unacceptable or out-of-control.

9.6.4 Any other issues that potentially effect data quality should also be addressed with the Project Manager.

10.0 <u>Calibration and Standardization</u>

10.1 Instrument Tuning

10.1.1 Tuning is done for the purpose of demonstrating proper mass axis alignment. The instrument must be tuned to meet the manufacturer's specifications through mass assignment of the three key ions of the tuning compound. The mass drift from the true values of the major ions of FC-43 must be no more than 0.10 AMU. The peak width should be ± 0.2 of 0.50.

10.1.2 A twelve-hour tune window is observed starting from the time of injection of the DFTPP solution. See Sections 10.1.3 and 10.1.4 **for DoD analyses or for the generation of the FC-43 report for non-DoD analyses.**

10.1.3 The DoD-QSM requires evaluation of a solution containing benzidine, pentachlorophenol and 4,4'-DDT to assess the condition of the column and injection port. This is accomplished by injecting the DFTPP solution that contains the three (3) compounds.

10.1.3.1 Benzidine, pentachlorophenol, and 4,4´-DDT are used as evaluation aids to indicate injector port and GC column efficiencies.

10.1.3.2 Excessive 4,4´-DDT breakdown and poor peak shape and response for benzidine and pentachlorophenol indicate maintenance is required for the injector port or GC column.

10.1.4 The following breakdown and tailing factor criteria must be met for the analysis to be acceptable.

10.1.4.1 The % breakdown for DDT into DDE and DDD must not exceed 20%.

10.1.4.2 Acceptance Criteria for the tailing factor for benzidine

10.1.4.2.1 The tailing factor for benzidine must not exceed 2.0 for all DoD analyses.

10.1.4.3 Acceptance Criteria for the tailing factor for pentachlorophenol.

10.1.4.3.1 The tailing factor for pentachlorophenol must not exceed 2.0 for all DoD analyses.

Note: When the breakdown or tailing factor criteria are not met it is indicative that instrument maintenance is necessary for the column and/or the injector port.

10.1.5 After Section 10.1.4 criteria are met, generate a printout demonstrating FC-43 criteria are met.

10.2 Initial Calibration

10.2.1 Prior to sample analysis, an initial calibration curve consisting of **five** levels of standards for SW-846 must be analyzed. The calibration curve consists of the following concentrations: 0.4, 1.2, 3.0, 5.0, and 10.0 nanograms (ηg) on column.

10.2.2 Initial calibration acceptance criteria for SW-846 SIM

10.2.2.1 For SW-846, the %RSD for the RRFs in the initial calibration must be < 15% for 8270C and < 20% for 8270D, in order for the average relative response factor to be used for quantitation. For DoD, the %RSD must be < 15%.

10.2.2.1.1 If the % RSD is > 15% for 8270C and > 20% for 8270D (> 15% for DoD), then an alternate method for quantitation, such as a linear calibration using least squares regression or a non-linear calibration method, such as quadratic fit, may be used. When one of these options is used, the line must not be forced through the origin**,** and the correlation coefficient of the equation must be 0.99 or greater (0.995 or greater for the DoD-QSM) for a valid calibration. If a quadratic equation is used, six levels of standards must be used. These alternate methods of quantitation are available in the ThruPut system.

10.2.2.2 Minimum response factor requirements for the typical analytes of this analysis are given in the following table.

Minimum Response Factor in Initial Calibaration

	8270C	DOD-QSM	8270D
Naphthalene	0.01	0.01	0.7
Hexachlorobutadiene	0.01	0.01	0.01
2-Methylnaphthalene	0.01	0.01	0.4
1-Methylnaphthalene	0.01	0.01	0.01
Acenaphthalene	0.01	0.01	0.9
Acenaphthene	0.01	0.01	0.9
4-Nitrophenol	0.05	0.05	0.01
Fluorene	0.01	0.01	0.9
Hexachlorobenzene	0.01	0.01	0.1
Pentachlorophenol	0.01	0.01	0.05
Phenanthrene	0.01	0.01	0.7
Anthracene	0.01	0.01	0.7
Fluroanthene	0.01	0.01	0.6
Pyrene	0.01	0.01	0.6
Benzo(a)anthracene	0.01	0.01	0.8
Chrysene	0.01	0.01	0.7
Benzo(b)fluroanthene	0.01	0.01	0.7
Benzo(k)fluoranthene	0.01	0.01	0.7
Benzo(a)pyrene	0.01	0.01	0.7
Indeno(1,2,3-cd)pyrene	0.01	0.01	0.5
Dibenzo(a,h)anthracene	0.01	0.01	0.4
Benzo(g,h,i)perylene	0.01	0.01	0.5

Note: The minimum response factor must be met at all calibration levels for Method 8270D.
For 8270C and DOD-QSM the minimum average response for 4-Nitrophenol must be 0.05 or greater if it is being analyzed. The remaining criteria are Compuchem in house criteria.

10.2.3 **Method 8270D cites the EPA CLP Organics SOW as a source of guidance in performing SIM analyses. Based on the acceptance criteria of the current CLP Organics SOW (SOM01.2), up to two**

target compounds and surrogates may fail to meet the minimum RRF criteria, as long as they still meet a minim RRF of 0.010.

10.2.4 If initial calibration criteria are not met, instrument maintenance may be required prior to recalibration.

10.3 Continuing Calibration

10.3.1 Samples may be analyzed immediately after a valid initial calibration if there is sufficient tune time remaining. Otherwise, a continuing calibration verification standard must be run to demonstrate that the instrument is in control.

10.3.2 Before running the continuing calibration verification (CCV) standard, follow the instrument tuning Section 10.1.

10.3.3 The continuing calibration verification standard is the 3.0 ηg level.

10.3.4 Continuing calibration verification acceptance criteria.

10.3.4.1 For SW-846, the percent difference (%D) for the continuing calibration for all compounds must be ≤ 20%.

10.3.4.2 The minimum RRF for all compounds is the same as in the initial calibration**, with up to two compounds allowed out for Method 8270D, as described in Section 10.2.3.**.

11.0 Procedure

11.1 Documentation must follow the requirements in Quality Control SOP 13.6 "Proper Documentation Procedures". Complete the instrument run log (Attachment 3) with the information for the tune sequence.

11.2 Define the retention time (RT) windows needed for SIM analysis, by analyzing a calibration standard in the scan mode first. Switch the MS to SIM mode. Using the compound RTs from the scan analysis, edit the RT windows in the GC/MS SIM analysis method.

11.3 Optimize GC conditions so that chromatographic peaks are as sharp and symmetrical as possible.

11.4 Prior to the analysis of any calibration standards, method blanks, matrix spikes, or samples, the GC/MS system must be tuned by the acquisition of FC-43. This

marks the beginning of the twelve-hour analysis period. Print a hard copy of the FC-43 scan.

11.4.1 For the DoD-QSM, inject a solution containing benzidine, pentachlorophenol, and 4,4'-DDT and evaluate as indicated in Section 10.1.3.

11.5 After the acquisition of FC-43, analyze the initial calibration.

11.5.1 Allow standard solutions to equilibrate to room temperature. Aliquot each calibration standard, 0.2, 0.6, 1.5, 2.5, and 5.0 µg/mL, in an autosampler vial containing a conical insert. The injection volume is 2.0 µL. This will yield a ηg on column amount of 0.4, 1.2, 3.0, 5.0 and 10.0 respectively, for each analyte.

11.5.2 Process and review each standard analysis using the Target3 data system insuring that each surrogate and target compound is present in each standard.

Note: Attachment 1 contains all of the target compounds for which the laboratory analyzes for by SIM. However, only a subset of this list may be analyzed for at one time.

11.5.3 Check that the initial calibration met acceptance criteria by reviewing the initial calibration summary form on the Target3 data system.

11.5.4 If time remains in the twelve-hour period after the initial calibration has been analyzed, samples may be analyzed without the analysis of an continuing calibration standard.

11.5.5 If no samples are analyzed, complete the GC/MS run log. (Attachment 3). "Z" out any unused portion of the run log and have a supervisor or designee review and sign it. Make a photocopy of the run log and attach it to the hard copy data for the tune.

11.6 After the analysis and acceptance of the initial calibration, analyze the continuing calibration.

11.6.1 Process and review the continuing calibration standard using Target3 processing software insuring that each target compound is present in the analysis.

11.6.2 Check that the continuing calibration standard met acceptance criteria, by reviewing the continuing calibration summary form on the Target3 data system.

11.7 After the analysis and acceptance of the initial and continuing calibrations, analyze the method blanks (LCSs, if required), matrix spikes, and samples. Allow all extracts to equilibrate to room temperature prior to analysis.

11.7.1 To prepare a method blank, LCS, matrix spike or sample extract for SW-846 analysis, add 100 µL of the sample extract and 2.5 µL of internal standard solution. All injections must be made using the cold needle injection technique. The injection volume is 2.0 µL and this will yield 2 ηg on column of each of the internal standards.

11.7.2 Place each auto sampler vial on the tray on top of the GC/MS for analysis. Set up the analytical sequence by entering lab identifications for each calibration standard, method blank, matrix spike, and sample in to the ChemStation data system.

11.7.3 Review each blank analysis, ensuring that it meets all surrogate, internal standard and blank contamination criteria.

11.7.4 Review each LCS and matrix spike analysis, ensuring that it meets surrogate, internal standard, and spike recovery criteria.

11.7.5 Review each sample analysis, ensuring that it meets surrogate, internal standard, and dilution criteria.

11.7.6 At the end of the twelve-hour analysis period, complete the instrument run log (Attachment 3). "Z" out any unused portion of the run log and have the supervisor or designee review and sign it. Photocopy the run log and attach it to the hard copy data for the tune and calibration.

12.0 Data Analysis and Calculations

Calculations must be consistent with the Quality Control SOP 13.4, "Numerical Data Reduction".

12.1 Calculation of the mean or average of a set of values:

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

where: n = total number of values
x_i = each individual value used to calculate the mean
x = the mean of n

12.2 Calculation of the standard deviation of a set of values:

$$\text{Standard deviation} = \sqrt{\frac{\sum_{i=1}^{n}\left(X_n - \overline{X}\right)^2}{n-1}}$$

12.3 Calculation of percent recovery:

12.3.1 LCS and surrogates:

$$\%R = \frac{Amount\ found}{Amount\ spiked}\ x\ 100$$

12.3.2 Matrix spikes:

$$\%\ \mathrm{R} = \frac{Amount\ in\ spiked\ sample\ -\ Amount\ in\ unspiked\ (native)\ sample}{Amount\ spiked}\ x\ 100$$

12.4 Calculation of % RSD

$$\%\mathrm{RSD} = \left(\frac{Standard\ deviation}{\overline{\mathrm{X}}}\right) \times 100$$

12.5 Calculation of RPD

$$RPD = \frac{|Value\ 1\ -\ Value\ 2|}{\left(Value\ 1\ +\ Value\ 2\right)/2}\ x100$$

12.6 Calculation of %Difference (%D)

$$\%Diff = \frac{Value - \overline{Reference\ \ value}}{\overline{Reference\ \ value}} \times 100$$

12.7 Relative Response Factor

$$RRF = \frac{Ax \times C(is)}{A(is) \times Cx}$$

where: Ax = Area of the characteristic ion (EICP) for the compound to be measured
A(is) = Area of the characteristic ion (EICP) for the specific internal standard
C(is) = Concentration of the internal standard (in µg/L)
Cx = Concentration of the compound to be measured

12.8 Linear Calibration using Least Squares Regression

$$y = ax + b$$

where: y = Instrument response (peak area)
a = Slope of the line (coefficient of x)
x = Concentration of the calibration standard
b = The intercept

12.7 Concentration

12.7.1 Concentration of aqueous samples by GC/MS analysis

$$\mu g / L = \frac{(Ax)(Is)(Vt)(Df)}{(Ais)(\overline{RRF})(Vo)(Vi)}$$

where: Ax = area of the characteristic ion from the EICP for the compound to be measured
Ais = area of the characteristic ion for the EICP for the internal standard
Is = amount of internal standard injected (**η**g)
$\overline{RRF}$ = mean relative response factor from initial calibration standards
Vo = volume of water extracted (mL)
Vi = volume of extract injected (µL)
Vt = volume of the concentrated extract (µL)
Df = dilution factor. If no dilution, Df = 1.0

12.7.2 Concentration of soil samples (dry weight basis) by GC/MS

$$\mu g / kg = \frac{(Ax)(Is)(Vt)(Df)(2.0)}{(Ais)(\overline{RRF})(Vi)(Ws)(D)}$$

where: Ax, Ais, Is, Vt, Vi, RRF, and Df are the same as given for water
2.0 = GPC factor (if used)
Ws = weight of sample extracted, in grams

$$D \text{ (dry weight)} = \frac{100 - \%\text{ moisture}}{100}$$

12.7.3 Concentration of water and soil samples (dry weight basis) by GC/MS using quadratic (second order) fit in Target:

$$y = [n]\left[b + m^1\ (Rsp) + m^2\ (Rsp\text{^}2)\right]$$

where:
b = constant
m^1 = multiplier for the unsquared term
m^2 = multiplier for the squared term
x = area of analyte/area of Internal Standard
n = amount of Internal Standard
y = concentration amount in ηg on column
Rsp = area of analyte/area of Internal Standard

Example:
Area of acenapthene = 35659
Area of IS = 613275
b = -0.0909161
m^1 = 9.605304
m^2 = 7.132688
ηg of IS = 250
response = 35659/613275 = 0.058145

Amount in ηg on column =

$$(250\eta g)\left[-0.0909161 + 9.605304\ x\ 0.058145 + 7.132688\ x\ 0.058145\text{^}2\right] = 122.9\eta g$$

$$Concentration\ (water)\mu g / L = \frac{(y)(Df)(Vt)}{(Vo)(Vi)}$$

$$Concentration\ (soil)\mu g / Kg = \frac{(y)(Df)(Uf)(Vt)}{(Vi)(Ws)(D)}$$

where: Uf = unit of correction for GPC, if used

12.7.4 Concentration of soil samples (dry weight basis) by GC/MS using linear regression analysis:

$$\frac{A_s C_{is}}{A_{is}} = aC_s + b$$

$$C_s = \frac{\left[\frac{A_s C_{is}}{A_{is}} - b\right]}{a}$$

where:
As = Area of the target analyte peak in the sample
Ais = Area of the internal standard peak
Cs = Concentration of the target analyte in on column the calibration standard
Cis = Concentration of the internal standard
a = Slope of the line (coefficient of Cs)
b = The intercept

$$Concentration\ (\text{water})\mu g / L = \frac{(Cs)(Df)(Vt)}{(Vo)(Vi)}$$

$$Concentration\ (\text{soil})\ \mu g / Kg = \frac{(Cs)(Df)(Uf)(Vt)}{(Vi)(Ws)(D)}$$

12.8 Calculating Dilutions

If a sample concentration exceeds the high level standard a dilution must be performed. Determine a level of dilution that will result in a value within the upper half of the calibration range. This is an acceptable dilution. A 10x dilution is performed by adding 100 µL of sample extract to 900 µL of methylene chloride for a total volume of 1000 µL. It should be recorded on the run log as "10x (1 in 10)."

13.0 <u>Method Performance</u>

This method was validated through in-house laboratory studies of method detection limits and precision and accuracy for a single analyst. The data are retained by the QA department.

14.0 Pollution Prevention

The solvents used in this procedure pose little threat to the environment when recycled and managed properly. Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The EPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency recommends recycling as the next best thing. See SOP 12.1, Hazardous Waste Disposal, regarding laboratory procedures for recycling solvent waste streams.

15.0 Waste Management

It is the laboratory's responsibility to comply with all federal, state, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions, and to protect the air, water, and land by minimizing and controlling all releases from fume hoods and bench operations. Compliance with all sewage discharge permits and regulations is also required.

Samples preserved with HCl, HNO_3, or H_2SO_4 are hazardous and must be handled as hazardous waste.

Refer to the Hazardous Waste Management and Safety SOPs located in the lab.

16.0 References

16.1 "Test Methods for Evaluating Solid Wastes: Physical/Chemical Methods", SW-846, 3rd Edition, Update III, 12/96, Method 8270C, Update IV, 1/08, Method 8270D

16.2 Quality Control SOP 13.6, "Proper Documentation Procedures"

16.3 Quality Control SOP 13.4, "Numerical Data Reduction"

16.4 EPA QA-G6: Guidance for the Preparing Standard Operating Procedures (SOPs), EPA/600/B-07/001, April 2007

16.5 Standard Methods for the Examination of Water and Wastewater, 20th (1998) Edition, Method 1080

16.6 Code of Federal Regulations, 40 CFR, Part 136, "Guidelines for Establishing Test Procedures for Priority Pollutants"

16.7 NELAC Standards, effective July 2003, plus revisions

16.8 CompuChem Quality Manual, Revision 13, November 17, 2009, plus revisions

16.9 Department of Defense Quality Systems Manual for Environmental Laboratories, Version 4.2, October 25, 2010, plus revisions

17.0 Attachments as Tables, Diagrams, Flowcharts and Validation Data

17.1 Attachment 1 – List of **Analytes**, CAS numbers and key ions

17.2 Attachment 2 – Method Reporting Limits

17.3 Attachment 3 – Example Instrument Run Log

17.4 Attachment 4 – SIM Standards Concentration

Attachment 1

Analyte List with CAS Numbers and Key Ions

Compound	CAS#	Primary Ion	Secondary Ions
Naphthalene	91-20-3	128	129, 127
1-Methylnaphthalene	90-12-0	142	141, 115
2-Methylnaphthalene	91-57-6	142	141, 115
Acenaphthylene	208-96-8	152	151, 153
Acenaphthene	83-32-9	153	154, 152
Fluorene	86-73-7	166	165, 167
Hexachlorobenzene	118-74-1	284	142, 249
Pentachlorophenol	87-86-5	266	264, 268
Phenanthrene	208-96-8	152	151, 153
Anthracene	83-32-9	153	154, 152
Fluoranthene	86-73-7	166	165, 167
Pyrene	129-00-0	202	200, 203
Benzo(a)anthracene	56-55-3	228	226, 229
Chrysene	218-01-9	228	226, 229
Benzo(b)fluoranthene	205-99-2	252	126, 125
Benzo(k)fluoranthene	207-08-9	252	126, 125
Benzo(a)pyrene	50-32-8	252	126, 125
Indeno(1,2,3-cd)pyrene	193-39-5	276	138, 227
Dibenzo(a,h)anthracene	53-70-3	278	139, 279
Benzo(g,h,i)perylene	191-24-2	276	138, 277
4-Nitrophenol	100-02-7	109	65, 139
Hexachlorobutadiene	87-68-3	225	227, 223
1,4-Dichlorobenzene-d4*	2199-69-1	152	115
Naphthalene-d_8 *	1146-65-2	136	68
Acenaphthene-d_{10} *	15067-26-2	164	162, 160
Phenanthrene-d_{10} *	1517-22-2	188	94, 80
Chrysene-d_{12} *	1719-03-5	240	120, 236
Perylene-d_{12} *	1520-96-3	264	260, 265
Nitrobenzene-d_5 $	4165-60-0	82	128, 54
2-Fluorobiphenyl $	321-60-8	172	171, 174
Terphenyl-d_{14} $	98904-43-9	244	122, 212
2,4,6-Tribromophenol $	118-79-6	330	141, 332

* = Internal Standards $ = Surrogate

NOTE: For SIM analyses only one secondary ion is used for identification.

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Attachment 2

Compound	Aqueous Reporting Limit µg/L	Soil Reporting Limit µg/Kg
1-Methylnaphthalene	0.20	8.3
2-Methylnaphthalene	0.20	8.3
4-Nitrophenol	1.9	64
Acenaphthene	0.20	8.3
Acenaphthylene	0.20	8.3
Anthracene	0.20	8.3
Benzo(a)anthracene	0.20	8.3
Benzo(a)pyrene	0.20	8.3
Benzo(b)fluoranthene	0.20	8.3
Benzo(g,h,i)perylene	0.20	8.3
Benzo(k)fluoranthene	0.20	8.3
Chrysene	0.20	8.3
Dibenzo(a,h)anthracene	0.20	8.3
Fluoranthene	0.20	8.3
Fluorene	0.20	8.3
Hexachlorobenzene	0.64	21.3
Hexachlorobutadiene	0.20	8.3
Indeno(1,2,3-cd)pyrene	0.20	8.3
Naphthalene	0.20	8.3
Pentachlorophenol	0.64	21.3
Phenanthrene	0.20	8.3
Pyrene	0.20	8.3

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Attachment 3

COMPUCHEM a Division of Liberty Analytical Corp
GC/MS SEMIVOLATILE RUN LOG
LOGBOOK 4U(4) 23 (5972hp70)

DATE ___/___/___ INITIAL TIME OF TUNE _____ SHIFT/S (A) ____(B)_____(C)____
TIME TUNE EXPIRES_____
METHOD: 8270C 8270D SOM01.2 (Circle One) or Other: _____SIM: (Y/N)

PREVENTIVE MAINTENANCE_____

	SEQUENCE#	REJECTED	FILENAME	REPORTED	DATE	TIME	CLIENT ID	SDG#	AMOUNT INJECTED	CHEMIST	COMMENTS
1					/ /						
2					/ /						
3					/ /						
4					/ /						
5					/ /						
6					/ /						
7					/ /						
8					/ /						
9					/ /						
10					/ /						
11					/ /						
12					/ /						
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21					/ /						
22					/ /						
23					/ /						
24					/ /						

DFTPP Lot #/Exp. Date: _____ Calibration STD Lot#/Exp. Date: _____ Internal STD Lot#/Exp. Date: _____ Methylene Chloride Lot#/Exp. Date: _____ Column Type: _____

The presence of the Chemist's/Analyst's employee ID number, or signature, on this run log attests that strict compliance with the method's SOP has occurred. Any SOP deviations require documentation by the responsible chemist/analyst together with the chemist's/analyst's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation.

REVIEWED BY: _____ DATE _____

7/9/10:jad

3301

Note: This page subject to change without notice.

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Attachment 4

SIM standards concentration (µg/mL)

Compound/ Compound Group	Level 1	Level 2	Level 3	Level **4**	Level **5**
PAHs	0.2	0.6	1.5	2.5	5.0
Hexachlorobutadiene	0.2	0.6	1.5	2.5	5.0
B/N Surrogates	0.2	0.6	1.5	2.5	5.0
Acid Surrogate	0.4	1.2	3.0	5.0	10.0
4-Nitrophenol	1.0	2.0	4.0	8.0	10.0
Pentachlorophenol	1.0	2.0	4.0	8.0	10.0
Hexachlorobenzene	1.0	2.0	4.0	8.0	10.0

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SOP DOCUMENTATION FORM

This form must accompany all new and revised Standard Operating Procedures (SOPs) when you turn them in to Quality Assurance for review. Please fill out the entire block below (except effective date).

This is a new procedure _____ revised procedure ✓ outdated procedure (archive) _____

- Procedure Code: IP477 SOP Section #: 2.5.2.7 Revision #: 15

SOP Title: gc/mS Analysis of extractable Semivolatiles in Aqueous and Solid Sample Extracts by SW-846

Effective date: (QA fills in) 3/4/11

- Procedure prepared by: [signature] Date: 3/4/11
- Procedure approved by: (If the manager prepared the SOP, a qualified second party should sign) Bob Meyers Date: 03-04-2011
- Reason for change: modify in response to L-A-B DoD Audit comments
- This procedure meets the requirements of the following approved method references: SW-846, 3rd Edition, Update III, Method 8270C, 12/96; Update IV Method 8270D 2/07; Department of Defense Quality Systems Manual for Environmental Laboratories Version 4.2, 10/25/2010, plus revisions

Procedure approved by a QA Representative (unless QA Representative signed above):

_____ Date: _____

On an annual basis: Lab managers are required to review lab practices and revise the SOP if necessary. If no revision is necessary, indicate by your signature that the SOP has been reviewed.

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Instrument Procedure 477: GC/MS Analysis of Extractable Semivolatiles in Aqueous and Solid Sample Extracts by SW-846

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Instrument Procedure 477: GC/MS Analysis of Extractable Semivolatiles in Aqueous and Solid Sample Extracts by SW-846

1.0 Scope and Application

This method covers the determination of a variety of semivolatile compounds in aqueous and solid samples. These compounds are partitioned into an organic solvent and are amenable to analysis by gas chromatograph/mass spectrometer (GC/MS) instrumentation. The method involves solvent extraction of the matrix, and GC/MS analysis to determine the semivolatile compounds present in the sample. Target compounds for this method are listed in Attachment 1, along with associated internal standards, surrogates and quantitation ions. Reporting limit are included in Attachment 3.

Staff members performing the procedures described in this SOP are responsible for reading, understanding, and complying with the SOP requirements. Supervisors are responsible for directing the analyst to the controlled SOP, and providing adequate explanation of the material contained therein.

This procedure is restricted to use by or under the supervision of analysts experienced in the instrumentation or preparative methods and who have demonstrated the ability to generate acceptable results through QC samples and analyst capability studies.

2.0 Summary of Method

Water samples are extracted prior to analysis following Sample Preparation Procedure – 079**A**, "Preparation of Water Samples for the Analysis of Semivolatile**s by** SW-846 **Method 3510C**." Soil samples are extracted using Sample Preparation Procedure –176, "Preparation of Soil/Sediment/Sludge Samples **by SW-846 Method 3550B and Method 3550C** for the Analysis of Low-Level Semivolatiles"**;** Sample Preparation Procedure – 236, "Soxhlet Extraction of S**oil**/S**ediment**/S**ludge and Wipe** Samples by SW-846"**;** Sample Preparation Procedure –183, "Medium Level Preparation Procedure for Semivolatile Organics in Soil Samples by SW-846"**;** or Sample Preparation Procedure – 247, "Automated Soxhlet Extraction of **Solid Samples (including** Wipe**s)** by SW-846 **Method 3541**"**.** This procedure encompasses both EPA 8270C and EPA 8270D. All samples for SC DHEC must be analyzed by EPA 8270D. This SOP is NOT for use with Ohio VAP projects. Please see Ohio VAP specific SOP.

Sample extracts are injected into a GC/MS system equipped with a narrow bore, fused silica capillary column. The GC is temperature programmed in order to separate the analytes for detection by the MS. Target compounds are identified in the samples by analyzing standards under the same conditions used for samples, comparing mass spectra with established library spectra, and comparing GC retention times with retention times

from the latest continuing calibration verification standard. Internal standards and surrogate compounds are added to all field and QC samples. An average relative response factor is established for each target and surrogate compound during the initial calibration procedures and this average response factor is used to calculate the analyte concentrations.

3.0 Definitions

3.1 Method detection limit (MDL) – The minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte (40 CFR, Part 136, Appendix B.) **A minimum of seven sample replicates is required to calculate a statistical MDL. The MDL is an approximation of the DL. Any analyte concentration result at or above the MDL must also meet all qualitative identification criteria required by the test method in order to be reported as present.**

3.2 Detection Limit (DL) - The DL is the smallest analyte concentration that can be demonstrated to be different from zero or a blank concentration at the 99 % level of confidence. The false positive rate at the DL is 1% and the false negative rate is 50%. Any analyte concentration result at or above the DL must also meet all qualitative identification criteria required by the test method in order to be reported as present.

3.3 Limit of Detection (LOD) – The LOD is the smallest concentration of an analyte that must be present in a sample in order to be detected at a 99% confidence level. The false negative rate at the LOD is 1 %. For DoD-QSM, non-detect sample results are reported as < LOD. Numeric values of measurements between the DL and the LOQ are reported as estimates. The DL < LOD ≤ LOQ.

3.4 Limit of Quantitation (LOQ) – The Limit of Quantitation is the lowest concentration of a substance that produces a quantitative result within specified limits of precision and bias. The LOQ must be within the calibration range.

3.5 Reporting Limit (RL) –

3.5.1 For Non-DoD work, the laboratory reporting limit is based on the lowest multipoint calibration standard concentration. For organic methods, values detected below the reporting limit and above the MDL may be reported and qualified as an estimated concentration.

3.5.2 The DoD-QSM defines the reporting limit as being the lowest concentration value specified by the client that meets project requirements for reporting data with known precision and bias for a specific analyte in a specific matrix. The LOQ cannot be greater than the RL. Data reported below the RL must be flagged as estimated values if they are also less than the LOQ.

3.6 Reporting Units – µg/L for water, µg/Kg for soil, and ug/wipe for wipe samples

3.7 A Sample Delivery Group (SDG) is defined by the following, whichever is more frequent:

- each 20 field samples received within a case, or
- each 7 calendar day period during which field samples in a case are received (14 calendar days per client request) beginning with the receipt of the first sample.

NOTE: The **DoD**-QSM and SC DHEC do not accept the SDG approach, unless the samples are prepared in a single batch. When a group of up to 20 field samples of a similar matrix are prepared as one batch, method-specified QC samples such as a method blank, laboratory control sample, matrix spike, and matrix spike duplicate must also be prepared together. If samples are batched together from different sites, project-specific QC must be processed.

3.8 Extraction Batch – a group of to 20 field samples of a similar matrix, method-specified QC samples such as a method blank, laboratory control sample, matrix spike, matrix spike duplicate, and matrix duplicate prepared together at the same time.

3.9 **DoD**-QSM – Department of Defense-Quality Systems Manual

3.10 SC DHEC – South Carolina Department of Health and Environmental Control

3.11 Ohio VAP – Ohio Environmental Protection Agency Voluntary Action Program

3.12 LIMS – Laboratory Information Management System

4.0 Interferences

4.1 Contamination by carryover can occur whenever high concentration and low concentration samples are sequentially analyzed. To reduce carryover, the sample

syringe must be rinsed with solvent between sample injections. Whenever an unusually concentrated sample is encountered, the following sample must be evaluated for carryover.

4.2 If any contamination is present in blanks, samples or QC, the source must be identified and re-extraction of part or the entire analytical batch may be required.

5.0 Safety

5.1 Appropriate protective equipment and clothing must be used under the assumption that all samples are potentially hazardous. During sample preparation, i.e., extraction, safety glasses, gloves and lab coats are a minimum requirement. Sample extracts must be prepared under a hood. The persistent presence of noxious odors may be indicative of failure of the laboratory ventilation system and must be reported to a supervisor or manager.

5.2 Laboratory staff members are required to review the Chemical Hygiene Plan for general safety policies and Material Safety Data Sheets (MSDS) for solvents and reagents used in the laboratory. The MSDS are located in the Quality Assurance department.

6.0 Equipment and Supplies

6.1 Analytical Columns

6.1.1 RTX-5MS and RTX-5SilMS, 0.32 mm ID, 0.25 µm film thickness

6.2 GC

6.2.1 Hewlett Packard (HP) 5890 Series with Electronic Pressure Control (EPC)

6.2.2 Hewlett Packard (HP) 6890N Series with Electronic Pressure Control (EPC)

6.3 MS

6.3.1 HP 5972A Mass Selective Detector (MSD)

6.3.2 HP 5973N Mass Selective Detector (MSD)

6.4 AutoSampler

6.4.1 Hewlett Packard 7673 Automated Liquid Sampler

6.4.2 Hewlett Packard 7873B Automated Liquid Sampler

6.5 Data System

6.5.1 A computer is interfaced to the mass spectrometer to allow the continuous acquisition and storage on machine-readable media of all mass spectra obtained throughout the duration of the chromatographic program.

Standards and samples are processed using the EZ Chrom® data acquisition system, Target® Quick Forms report generation software from ThruPut Systems, and Promium Element® LIMS.

6.5.2 The data processing computer has software that searches any GC/MS data file for ions of a specified mass and plots ion abundances versus time or scan number. This type of plot is defined as an Extracted Ion Current Profile (EICP). Also, for the non-target compounds, the software compares sample spectra against reference library spectra. The reference library used is the NIST Mass Spectral library (NBS129K.1).

6.6 Syringes

6.6.1 10 µL Hamilton syringe

7.0 Reagents and Standards

Refer to the Standards Preparation Logbook 22 F **or Promium Element LIMS** and applicable standard preparation SOPs for details on preparation of standards used in this procedure. All standards used in this procedure are prepared in optima grade methylene chloride.

Note: All reagents and standards must be ACS (American Chemical Society) grade or equivalent, unless otherwise denoted. All standards and reagents are subject to change in vendor and in concentration. The Reporting Limits are also subject to change, but must remain at or above the lowest point in the calibration.

7.1 Reagent water – All water used in this procedure must be reagent-grade Type I with regard to resistivity of > 10 megohm-cm (19th and 20th Editions of Standard Methods, Method 1080), and is demonstrated to meet the blank criteria contained in this Standard Operating Procedure (SOP). It is referred throughout this SOP as reagent water.

7.2 Methylene Chloride – analytical grade

7.3 Reference Standards

7.3.1 Stock standards

7.3.1.1 Stock standards are prepared from certified, pure standard materials or purchased as certified solutions.

7.3.1.2 Stock standards are stored as recommended by the manufacturer (4 ± 2° C) in the Organic Standards Preparation laboratory.

7.3.1.3 Stock standards are replaced after 1 year or sooner, if problems occur.

7.3.1.4 Please refer to the Promium Element LIMS for standard preparation.

7.3.2 Working Standards

Working standards are stored in the analysis laboratory at 4 ± 2° C separate from sample extracts, when not in use. Working standards are prepared every six months or sooner.

7.3.2.1 Internal standard solution is prepared at a concentration of 800 µg/mL.

7.3.2.2 Initial calibration standard solutions are prepared at concentrations of 5, 10, 25, 40, 60 and 80 µg/mL for the majority of analytes. The 40 **µ**g/mL standard also serves as the Continuing Calibration Verification (CCV) standard.

7.3.2.2.1 Attachment 1 lists the entire common target analytes included in the 8270 analysis code, in the Promium LIMS, calibration.

7.3.2.2.2 Attachment 2 lists the entire common target analytes included in the 8270 Appendix IX analysis code, in the Promium LIMS, calibration.

7.3.2.3 The Initial Calibration Verification (ICV) standard is at a concentration of 40 **µ**g/mL and is prepared from a second source.

7.3.2.4 Please refer to the Promium Element® LIMS for standard preparation.

8.0 Sample Preservation and Storage

8.1 Samples are preserved and stored according to the tables in Sample Control SOPs 4.1, "Receiving Samples" and 4.6, "Storing Samples." Sample holding times are also listed.

8.2 All extracts must be analyzed within 40 days of extraction.

8.3 All sample extracts are stored in the refrigerator in the laboratory at 2 - 6° C prior to analysis except for samples to be analyzed under **DoD**-QSM or Ohio VAP requirements which must be stored in the freezer at -10° C. After analysis, extracts are returned to Sample Control for long-term storage and disposal.

9.0 Quality Control

9.1 Surrogates

9.1.1 Surrogates are added to all field and QC samples and are used to measure the efficiency and accuracy of the analytical system. For surrogate standard preparation please refer to the appropriate sample preparation procedure or the Promium Element LIMS. Statistical control limits for surrogates are listed in the following table.

Compound	Aqueous (% Recovery)	Soil (% Recovery)
Nitrobenzene-d_5	35-110	28-110
2-fluorobiphenyl	45-110	39-112
Terphenyl-d_{14}	49-120	51-119
Phenol-d_5	10-110	38-110
2-fluorophenol	11-110	33-110
2,4,6-tribromophenol	44-131	34-150

9.1.1.1 If the surrogate recoveries are outside the control limits in **Section** 9.1.1, re-analyze the sample neat (undiluted). Do not dilute unless it is necessary to bring target analytes into the calibration range. If the surrogate recoveries are still outside of control limits, re-extract and reanalyze the sample.

9.1.1.2 If insufficient sample volume remains for re-extraction or the holding time has been exceeded, report results and document the failing surrogate results in the narrative.

9.1.2 The surrogate control limits required by the **DoD**-QSM are listed in the following table and in attachment 6.

Compound	Aqueous (% Recovery)	Soil (% Recovery)
Phenol-d_5	N/A	40-100
2-Fluorobiphenyl	50-110	45-105
Terphenyl-d_{14}	50-135	30-125
2,4,6-Tribromophenol	40-125	35-125
2-Fluorophenol	20-110	35-105
Nitrobenzene-d_5	40-110	35-100

9.1.2.1 If the surrogate recoveries are outside the control limits in **Section** 9.1.2, re-analyze the sample. If the surrogate recoveries are still outside of control limits, re-extract and reanalyze the sample, if sufficient sample volume is available.

9.1.2.2 If field sample results are reported with failing surrogate recoveries, qualify the results as estimated concentrations in the narrative. Refer to the **DoD**-QSM "J" flag.

9.1.2.3 If QC samples results are reported with failing surrogate recoveries, qualify the results as estimated concentrations in the narrative. Refer to the **DoD**-QSM "Q" flag.

9.2 Internal Standards

9.2.1 Internal standards are added to an aliquot of the extract just prior to analysis in the instrumentation laboratory and are used in the quantitation of target analytes and surrogates.

9.2.2 The internal standard retention times in the continuing calibration standard must not differ more than ± 30 seconds from those in the mid point standard (80 ηg) in the most recent initial calibration. Additionally, the area response of the internal standards in the continuing calibration verification standard must be within -50% and +100% of those in the mid point standard of the most recent initial calibration.

9.2.3 If a sample fails internal standard acceptance criteria, reanalyze neat. Do not dilute unless it is necessary to bring target analytes into the calibration range or there is obvious matrix interference.

9.3 Method Blanks

9.3.1 A method blank is prepared with every analytical batch of up to 20 samples. It is used to indicate extraction efficiency and contamination control within the analytical system. The method blank must be analyzed on each GC/MS system used to analyze the associated samples.

9.3.2 Any target analyte detected in the method blank must be less than the reporting limit. Surrogate and internal standard responses must be within acceptance windows

9.3.2.1 To meet the requirements of the **DoD**-QSM, all target analytes in the method blank must be at concentrations < half the reporting limit.

9.3.3 If the method blank fails acceptance criteria for surrogate recovery or contamination, the analytical system is considered to be out of control. The source of the contamination must be investigated and appropriate corrective measures taken and documented before more samples are analyzed. All samples processed with a method blank that is out of control must be re-extracted and reanalyzed, unless the method blank meets acceptance criteria upon re-injection.

9.4 Laboratory Control Sample (LCS)

9.4.1 An LCS for an aqueous matrix is reagent water and for a solid matrix is furnaced Ottawa sand, or an additional portion of furnaced sodium sulfate, which has been fortified with target compounds and surrogate standards. The LCS is prepared with each extraction batch of up to 20 samples. The LCS should be analyzed after any method blank associated with the group of samples. The LCS data are used to ensure that any failing spiked target compound in the matrix spike and matrix spike duplicate is due to interference and not representative of an analytical system that is out of control. All surrogates in an LCS must pass. If any fail the LCS is re-analyzed (neat). Instrument maintenance may be needed (see **Section** 9.7) If reanalysis fails the entire batch must be re-extracted. New surrogate standard preparation may be necessary.

9.4.2 An acceptable LCS will contain all project compounds within the in-house control limits listed in Attachments 5. A certain number of recoveries may be outside of the control limits but within the marginal exceedances listed in Attachment 5 depending on the number of compounds spiked. See the following table.

Number of analytes in the LCS	Allowed number of Marginal Exceedances
>90	5
71-90	4
51-70	3
31-50	2
11-30	1
<11	0

Note: SC DHEC does not allow for marginal exceedance failures in the LCS. All project analytes must pass in the LCS.

9.4.3 To meet the requirements of the **DoD**-QSM, the LCS must meet the control limits listed in Attachment 6 with allowance for a number of marginal exceedances based on the number of compounds spiked (see table in **Section** 9.4.2). All target compounds must be spiked. **Marginal exceedences are not allowed for project analytes in the DoD-QSM**

9.4.3.1 If the LCS fails acceptance criteria, re-extract and reanalyze all associated samples (if sufficient sample volume remains).

9.4.3.2 Sample results associated with a failing LCS must be qualified in the narrative. Refer to the DoD-QSM "Q" flag.

9.5 Matrix Spike and Matrix Spike Duplicate

9.5.1 A matrix spike and matrix spike duplicate (MS/MSD) are prepared with each SDG.

9.5.2 The majority of the acid spiked compound recoveries and relative percent differences (RPDs) and the majority of the base/neutral spiked compound recoveries and RPDs should be within the control limits listed in Attachment 5 and the RPD limits listed in Attachment 7. A subset of analytes may be reported depending on specific project requirements.

9.5.2.1 To meet the requirements of the **DoD**-QSM, the LCS control limits must be applied to the duplicate matrix spikes. The RPD between the duplicate matrix spikes must be ≤ 30%,

9.5.2.2 If the duplicate matrix spikes do not meet **DoD**-QSM criteria, contact the client for guidance. Results for specific compounds in the original sample associated with failing matrix spikes must be qualified in the narrative as estimated values. Refer to the **DoD**-QSM "J" flag.

9.5.3 If the sample and its associated MS/MSD show the same recovery trend, then re-extraction is not required. If the original associated with the MS/MSD does not meet QC criteria, it must be reanalyzed neat or re-extracted then reanalyzed, if the MS/MSD surrogate recoveries are within limits. Do not dilute unless dilution is necessary to bring target analytes into the calibration range or there is obvious matrix interference

9.5.4 If the LCS results are acceptable, and the MS/MSD results are consistent with the original, unspiked sample, it can be assumed that the poor recovery is matrix related.

9.6 Contingency

9.6.1 If due to a lab accident or to QC failures, a re-preparation and analysis are required for the sample and insufficient sample volume remains, the Project Manager must be alerted and will contact the client for direction on how to proceed.

9.6.2 If persistent contamination occurs in the laboratory, analysis must be halted until the source of the contamination can be identified and isolated. When the contamination issue is resolved, samples analysis may proceed.

9.6.3 Any other issues that potentially effect data quality should also be addressed with the Project Manager.

9.7 Corrective Actions

9.7.1 Instrument related corrective actions include, but are not limited to changing the liner, septum, cutting or replacing the column, replacing the source, cleaning the injection port and replacing the inlet base seal.

9.7.1.1 If the column or the source is replaced a new initial calibration must be performed.

9.7.2 Standard related corrective action includes preparing new standards from existing stock solutions and preparing new stock solutions.

9.7.2.1 If surrogate or spiking solutions are suspected of needing to be replaced notify the preparation laboratory supervisor as soon as possible.

9.7.2.2 Request an aliquot of the solution and analyze. Report results to the preparation laboratory supervisor.

10.0 Calibration and Standardization

10.1 Tuning the GC/MS

10.1.1 Prior to analysis of any samples, blanks, or calibration standards, the laboratory must establish that the GC/MS system meets the mass spectral ion abundance criteria for a tuning standard performance check solution containing Decafluorotriphenylphosphine (DFTPP).

10.1.1.1 At the time of tuning the instrument, the laboratory clock and instrument system clock must be verified to be in agreement for both time and date. Document that the lab's clock and date (LCD) are the same as the instrument's system clock and date (SCD) by writing "LCD=SCD" in the instrument's run log.

10.1.2 The instrument is standardized (tuned) by analyzing the DFTPP tuning solution every 12 hours. Two µL of the 25 **η**g/µL DFTPP solution (50 **η**g) are injected into the GC/MS.

10.1.3 The peak selection criteria for DFTPP analysis are as follows.

10.1.3.1 Acquire and average the apex of the DFTPP peak and one scan immediately before and after the apex. Subtract a single background scan prior to the peak, but no more than 20 scans prior to the elution of DFTPP. Also, do not subtract part of the DFTPP peak. The DFTPP acceptance criteria are listed in the following table.

Mass	Ion Abundance Criteria
51	30.0-80.0% of mass 198
68	< 2.0% of mass 69
69	present
70	< 2.0% of mass 69
127	25.0-75.0% of mass 198
197	<1.0% of mass 198
198	Base peak, 100% relative abundance(see note)
199	5.0-9.0% of mass 198
275	10.0-30.0% of mass 198
365	Greater than 0.75% of mass 198
441	Present but < mass 443
442	40.0-110.0% of mass 198
443	15.0-24.0% of mass 442

Note: All ion abundances are normalized to m/z 198, the normal base peak.

10.1.4 The DFTPP solution also contains benzidine, pentachlorophenol, and 4,4'-DDT to assess the condition of the column and injection port.

10.1.4.1 Benzidine, pentachlorophenol, and 4,4´-DDT are added as evaluation aids to indicate injector port and GC column efficiencies.

10.1.4.2 4,4´-DDT is used to assess the instrument condition prior to GC/MS confirmations of pesticide analytes.

10.1.4.3 Excessive 4,4´-DDT breakdown and poor peak shape and response for benzidine and pentachlorophenol indicate maintenance is required for the injector port or GC column.

10.1.5 The following breakdown and tailing factor criteria must be met for the DFTPP analysis to be acceptable. (See attachment 4).

10.1.5.1 The % breakdown for DDT into DDE and DDD must not exceed 20%.

10.1.5.2 Acceptance Criteria for the tailing factor for benzidine

10.1.5.2.1 The tailing factor for benzidine must not exceed 3.0 for 8270C **(2.0 for DoD-QSM)**.

10.1.5.2.2 The tailing factor for benzidine must not exceed **2**.0 for 8270D.

10.1.5.3 Acceptance Criteria for the tailing factor for pentachlorophenol.

10.1.5.3.1 The tailing factor for pentachlorophenol must not exceed 5.0 for 8270C **(2.0 for DoD-QSM)**.

10.1.5.3.2 The tailing factor for pentachlorophenol must not exceed 2.0 for 8270D.

Note: When the breakdown or tailing factor criteria are not met it is indicative that instrument maintenance is necessary for the column and/or the injector port.

10.1.6 All valid injections must be made within the 12-hour calibration period that begins with the time of the injection of the DFTPP. Each injection thereafter must be recorded on the instrument run log (Attachment 3).

10.2 Initial Calibration

10.2.1 An initial six-point calibration ("multipoint") must be performed if a valid multipoint for the method has not already been analyzed on the instrument or if the continuing calibration standard (12-hour continuing calibration standard) does not meet all acceptance criteria.

10.2.2 The initial calibration standards are at six concentration levels (the majority of the analytes are at 10, 20, 50, 80, 120, and 160 total **η**g per 2 µL). The low standard must be at or below the reporting limit. Each calibration standard contains each target compound of interest, internal standards, and each surrogate. Please refer to the Promium Element® LIMS for information on preparation of standards.

10.2.3 Allow the calibration standard solutions to equilibrate to room temperature. Place an aliquot of each calibration standard solution in an amber 2 mL autosampler vial and place the vials on the instrument's autosampler.

Note: All injection volumes are 2 µL and are performed with a using cold needle.

10.2.4 Structural isomers must be identified as individual isomers if sufficient resolution can be achieved. Sufficient resolution is defined as having the height of the valley between two peaks less than 50 % of the average of the height of both peaks. Benzo(b) fluoranthene and Benzo(k) fluoranthene are examples of structural isomers that can be resolved. The resolution of such pairs must be verified on the mid-point of the initial calibration and on all subsequent calibration verifications.

10.2.5 Initial Calibration Acceptance Criteria for 8270C

10.2.5.1 The System Performance Check Compounds (SPCCs) N-Nitroso-di-n-propylamine, 2,4-Dinitrophenol, Hexachloro-cyclopentadiene, and 4-Nitrophenol must have an average response factor of ≥ 0.050.

10.2.5.2 The Calibration Check Compounds (CCCs) Phenol, 1,4-Dichlorobenzene, 2-Nitrophenol, Hexachlorobutadiene, 4-Chloro-3-methylphenol, 2,4-Dichlorophenol, Acenaphthene, Pentachlorophenol, Diphenylamine, 2,4,6-Trichlorophenol, Fluoranthene, Di-n-octylphthalate and Benzo(a)pyrene must have a maximum RSD of 30%.

10.2.5.3 Each of the remaining compounds must have an average RSD of ≤ 15% for the initial calibration to be acceptable.

10.2.5.4 If a short list of compounds is prepared and/or analyzed for the initial calibration, each compound must have an RSD ≤15% or have a linear regression correlation coefficient of ≥ 0.990 (≥ 0.995 for **DoD**-QSM). The Grand Mean cannot be used for a short list of compounds or **DoD** -QSM.

10.2.6 Alternate Initial Calibration Acceptance Criteria for 8270C

If the initial calibration criteria in **Section** 10.2.5 are not met, the calibration options in **Sections** 10.2.6.1 or 10.2.6.2 are used.

10.2.6.1 A linear or quadratic regression is used. Quadratic calibration may only be used for analytes which historically exhibit a non-linear response. It is not to be used to extend the calibration range. The correlation coefficient must be

≥ 0.99 for the calibration curve to be acceptable. To meet the requirements of the **DoD**-QSM the linear regression correlation coefficient must be ≥ 0.995.

Note: **DoD**-QSM does not accept the use of quadratic regression.

10.2.6.2 The "grand mean" is used. The mean of the RSD for all of the compounds present in the calibration standard is calculated and must be ≤ 15%. The client must be provided with a list of the individual compounds that did not meet the ≤ 15% RSD criteria.

Note: Calibration using the "grand mean" is not allowed by the **DoD**-QSM.

10.2.7 Initial Calibration Acceptance Criteria for 8270D

10.2.7.1 Each of the compounds must have an RSD of ≤ 20% **(< 15% for DoD)** or have a linear regression correlation coefficient of ≥ 0.990 (≥ 0.995 for **DoD**-QSM) for the initial calibration for that compound to be acceptable.

10.2.7.1.1 Average response factor must not be used for compounds that have an RSD > 20% unless the concentration is reported as estimated.

10.2.7.1.2 If linear regression is used to calibrate a compound, the viability of the quantitation limit should be checked. Requantitate the low point of the calibration curve as an unknown. The concentration must be ± 30% of the true value. Any compound which fails this criterion must only be reported as an estimated value.

10.2.7.1.3 An acceptable initial calibration will contain all project compounds at a minimum response factor, at each level of the calibration curve, listed in Attachment 8.

Note: Any compounds which fail to meet acceptance criteria may only be used as qualified data and reported as estimated or for screening purposes. In order to report

non-detects, adequate sensitivity must be demonstrated at the quantitation limit. Corrective action must be initiated if more than 10 % of the compounds included in the initial calibration fail.

10.2.8 Corrective Actions for the Initial Calibration

10.2.8.1 Check the instrument operating conditions and perform maintenance as necessary. It may be necessary to clean the ion source, perform column maintenance, change the column, or take other corrective action to achieve the technical acceptance criteria.

10.2.8.2 Compare responses for the analytes in each of the standard levels to verify that a single standard analysis is not presenting results significantly higher or lower then the other standard analyses. If that is the case, the wrong standard may have been injected. Or the standard prepared incorrectly. Reanalyze the standard and calculate the response factors and % RSD.

10.2.8.3 The calibration range may be narrowed to determine if linearity can be achieved. The highest or lowest calibration standard may be replaced with a lower or higher concentration. This may cause more dilution re-analyses, if the high level standard is replaced or change the reporting limit if the lower standard is replaced.

10.2.8.4 If neither of the corrective actions in **S**ection**s** 10.2.8.2 or 10.2.8.3 produces an acceptable calibration, perform instrument maintenance and analyze a new initial calibration.

10.3 Initial Calibration Verification (ICV)

10.3.1 Inject 2 µL of a second source ICV standard immediately after the initial calibration has been completed. The concentration of the standard must be at or near the mid-point of the calibration curve. Multiple ICV standards containing different analytes may be necessary to avoid interactions between certain analytes. For example, nitrosamine compounds should be segregated from other compounds.

10.3.2 All analytes must be in the range of ± 30% of the expected value.

10.3.2.1 For 8270C an allowance is made that 10% of the analytes can be within 40% of the expected value.

10.3.2.2 Quantitative sample analysis for 8270D must not proceed for analytes which exceed ± 30% of the expected value or do not meet the minimum response factors listed in **Attachment** 8.

10.3.2.3 To meet the requirements of the **DoD**-QSM, all analyte recoveries in the ICV must be within ± 25% of the expected value.

10.3.3 If criteria in **Section** 10.3.2 are not met, reanalyze the ICV standard. If the ICV criteria are still not met, investigate and correct the problem. A freshly prepared ICV standard may be needed. If instrument maintenance is performed analyze a new initial calibration.

10.4 Continuing Calibration Verification (CCV)

10.4.1 Inject 2 µL of the CCV standard at the beginning of the 12-hour period, after the DFTPP acceptance criteria have been met. The CCV standard is the mid-level initial calibration standard level (40 µg/mL).

10.4.2 CCV Acceptance Criteria for 8270C and Corrective Action

10.4.2.1 The internal standard retention times for the CCV standard must not differ from the corresponding internal standards in the mid-point standard (80 ηg) in the most recent initial calibration by more that ± 0.5 minutes (30 seconds).

10.4.2.2 The internal standard area responses for the CCV standard must be within ± 50 % of the corresponding internal standard area responses in the mid-point standard of the most recent initial calibration.

10.4.2.3 The SPCCs (see 10.2.4.1) must have a minimum response factor of ≥ 0.050.

10.4.2.4 The CCCs (see 10.2.4.2) must have a percent drift/difference of ≤ 20%.

10.4.2.5 The remaining target compounds do not have defined % difference/drift criteria. The lab has established a warning limit of 50% and an action limit of 90% D. These criteria are based

strictly on established U.S. EPA data validation guidelines where values greater than 90% result in rejection of data.

Note: For samples submitted to meet the regulatory requirements of the SC DHEC, the non-CCC have a warning limit of 40% D and an action limit of 50%D.

10.4.2.6 If a short list of compounds is prepared and/or analyzed for the CCV, each compound must have a % D ≤ 20%. No failures are allowed.

10.4.2.7 If the Continuing Calibration Verification (CCV) fails acceptance criteria verify the instrument is performing properly.

10.4.2.7.1 Check gas flow

10.4.2.7.2 Check syringe

10.4.2.7.3 See section 9.7 for possible corrective action.

10.4.2.8 If continuing calibration acceptance criteria cannot be met after inspection and normal maintenance, a new initial calibration is performed.

10.4.3 CCV Acceptance Criteria for 8270D and Corrective Action

10.4.3.1 Each project compound must have a % D ≤ 20% and meet the minimum response factor listed in Attachment 8.

10.4.3.2 If the decision is made to continue a sequence which have project analytes in the CCV with a % D >20% or do not meet the minimum response factor, a calibration verification standard at or below the reporting limit (i.e. the low point of the calibration) must be run prior the analysis of any samples.

Note: Any compounds which fail to meet acceptance criteria may only be used as qualified data and reported as estimated or for screening purposes. In order to report non-detects, adequate sensitivity must be demonstrated at the quantitation limit. This is demonstrated by running a calibration verification standard at or below the reporting limit (i.e. the low point of the calibration). If more than 20 % of the compounds included in the initial calibration

fail corrective action must be initiated prior to the analysis of samples.

10.4.3.3 If the Continuing Calibration Verification (CCV) fails acceptance criteria verify the instrument is performing properly.

10.4.3.3.1 Check gas flow

10.4.3.3.2 Check syringe

10.4.3.3.3 See Section 9.7 for possible corrective action.

10.4. Corrective action for CCV:

10.4.1 If continuing calibration acceptance criteria cannot be met after inspection and normal maintenance, a new initial calibration is performed. New standard preparation may be necessary.

11.0 Procedure

Documentation must follow the requirements in Quality Control SOP 13.6, "Proper Documentation Procedures". The run log (Attachment 3) must contain the date and time of the injection, the volume of the extract injected, standard identification numbers, sample identification numbers, Case/SDG numbers, any comment relevant to the injection, and any preventive maintenance performed. Condition codes, abbreviations defined in attachment 9, are used to document failed and qualified injections. Preventive maintenance includes clipping the front-end of the column, changing liners and septum. Any major maintenance, i.e., changing the source or column, is recorded in the instrument maintenance logbook.

11.1 Calibrate the GC/MS as outlined in **Section** 10.0

11.2 Instrument settings

11.2.1 GC Conditions

- Injector — Split/Splitless
- Carrier Gas — Helium
- Injection Port Temp (°C) — 280 – 320
- Sweep Flow (ml/min) — 100
- Column Flow (ml/min) — 1.5 – 2.7
- Initial Temp (°C) — 40
- Hold (min) — 2

- Ramp Rate (°C/min) 15 – 25
- Final Temp (°C) 305 – 315
- Hold (min) 2 – 7
- Transfer Line Temp (°C) 280 – 310

Note: GC conditions may vary with regular instrument maintenance.

11.2.2 Mass Spectrometer Scanning parameters

- Low Mass: 35 amu
- High Mass: 500 amu
- Threshold: 150 amu
- Scan time: ≤ 1 second
- Electron energy: 70 volts (nominal)

11.3 Sample Analysis

11.3.1 Allow the sample extracts to equilibrate to room temperature. Aliquot 100 µL of the sample extract and 2.5 µL of internal standard solution (800 **η**g/µL) into an autosampler vial. Close each vial with a crimp-top cap containing a Teflon® septa. Transfer vials to the instrument's autosampler for analysis. All injections are made using the cold needle injection technique. The injection volume is 2.0 µL and this will yield 40 **η**g per 2 µL on column of each of the internal standards.

11.3.2 Type the sample information into the autosampler sequence in HP ChemServer and start the analyses. All valid injections must be made within the 12-hour calibration period that begins at the moment of injection of the DFTPP. The DFTPP and each injection thereafter must be recorded on the instrument run log (Attachment 3).

11.4 Sample Processing

11.4.1 Process each sample by entering the sample preparation information from the extraction worksheet into the corresponding field on the Target3 (Einstein) data system.

11.4.2 If any of the internal standards, surrogates, or spike compounds are missing or failing, check the peak integration in "Target Review". Changes can be made in Target Review and EICPs can be generated. Any compound for which manual peak integration has been performed will have an "M" flag displayed on the quantitation report. These entries must be assigned a numerical code and the analyst's initials and the date must

appear on each quantitation report page containing an "M" flag. For multiple "M" flags appearing on a quantitation report page, a bracket encompassing the flags can be used, with a single entry of the initials and date. The department supervisor or a representative of the QA department must approve of all manual integrations performed on all initial and continuing calibration standards. This is documented by initialing and dating each page of the quantitation report of the raw data containing such manual integrations. See Attachment 10 for definitions of manual integration codes.

11.4.3 The GC/MS analyst has the initial review responsibility. The analyst must ensure that the internal standard, surrogate recovery, and spike recovery acceptance criteria are met for each field and QC sample and that all target analyte concentrations are within the calibration range.

11.4.4 If internal standards do not meet acceptance criteria in Section 9.0, the sample must be re-injected to confirm a matrix effect or discount a miss-injection.

11.4.5 If surrogates do not meet acceptance criteria in Section 9.0 and there are no problems with the surrogate or internal standard solutions, the sample must be reinjected or scheduled for re-extraction and reanalysis. Re-extraction is not needed, if the sample was used as the original for duplicate matrix spikes and those analyses produced similar surrogate recoveries.

11.4.6 If the on-column amount of any target analyte exceeds the initial calibration range, the extract must be diluted, internal standard added, and the sample reinjected.

11.5. Target Compound Identification

11.5.1 The mass spectrum of the sample compound and a laboratory library-generated spectrum must match according to the following criteria.

- All ions present in the library mass spectrum at a relative intensity >10% must be present in the sample spectrum.
- The relative intensities of ions specified above must agree within ± 20% between the library and sample spectra.
- Ions >10% in the sample spectrum but not present in the library spectrum must be considered and accounted for. (These ions may be a result of co-eluting/closely-eluting compounds.)

- The RRT (relative retention time) of the sample component must be within ± 0.06 RRT units of the RRT of the standard component.

$$RRT = \frac{\text{Retention time of the analyte}}{\text{Retention time of the internal standard}}$$

11.5.2 If a compound analyzed by GC/MS techniques cannot be verified by all of the criteria listed above, but in the technical judgment of the mass spectral interpretation specialist the identification is correct, then the laboratory will report that identification.

11.6 Qualitative Analysis of Non-Target Compounds

11.6.1 Tentatively identify all compounds in the sample that have not already been identified as target compounds, or that are not surrogates, internal standards or volatile target compounds, by performing a computer-generated library search using the NIST 129K.1 mass spectral library (See Section 6.5.2). The library search must not be normalized.

11.6.2 Up to 30 tentatively identified compounds (TICs), including alkanes, of the greatest concentration are reported for each sample. The number of TICs required may vary, depending on project requirements.

11.6.3 Rules for making tentative identification:

11.6.3.1 TICs receiving a library search match of 85% or higher are considered a "probable match". Report the compound identified.

11.6.3.2 For TICs receiving more than one library search match of 85% or higher, report the compound with the highest percent match.

11.6.3.3 For TICs receiving two or more library search matches of 85% or higher with the same percent match, report the first compound.

11.6.3.4 For TICs that are isomers receiving library search matches of 85% or higher, report the compound with the highest percent match.

Note: If in the opinion of the experienced analyst/data reviewer there is sound technical evidence not to identify the

compound as specified in sections 11.6.3.1 to 11.6.3.4 the justification must be documented in the narrative.

11.6.3.5 TICs receiving a library search match of < 85% are given a tentative identification by the analyst/data reviewer, if possible. If no identification can be made the TIC is reported as "unknown". If possible the unknown is further identified as part of a class of compounds (for example "unknown aromatic").

12.0 Data Analysis and Calculations

Calculations must be consistent with the Quality Control SOP 13.4, "Numerical Data Reduction".

12.1 Calculation of the mean or average of a set of values:

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

where: n = total number of values
x_i = each individual value used to calculate the mean
$\overline{x}$ = the mean of n

12.2 Calculation of the standard deviation of a set of values:

$$\text{Standard deviation} = \sqrt{\frac{\sum_{i=1}^{n}\left(X_n - \overline{X}\right)^2}{n-1}}$$

12.3 Calculation of percent recovery:

12.3.1 LCS and surrogates:

$$\%R = \frac{Amount\ found}{Amount\ spiked}\ x\ 100$$

12.3.2 Matrix spikes:

$$\%\,\mathrm{R} = \frac{Amount\ in\ spiked\ sample\ -\ Amount\ in\ unspiked\ (native)\ sample}{Amount\ spiked}\ x\ 100$$

12.4 Calculation of % RSD

$$\%RSD = \left(\frac{Standard\ deviation}{\overline{X}}\right) \times 100$$

12.5 Calculation of RPD

$$RPD = \frac{|Value\ 1 - Value\ 2|}{(Value\ 1 + Value\ 2)/2} x100$$

12.6 Calculation of %Difference (%D)

$$\%Diff = \frac{Value - Reference\ value}{Reference\ value} x\ 100$$

12.7 Relative Response Factor

$$RRF = \frac{Ax\ x\ C(is)}{A(is)\ x\ Cx}$$

where: Ax = Area of the characteristic ion (EICP) for the compound to be measured
A(is) = Area of the characteristic ion (EICP) for the specific internal standard
C(is) = Concentration of the internal standard (in µg/**L**)
Cx = Concentration of the compound to be measured

12.8 Linear Calibration using Least Squares Regression

General linear equation: $y = ax + b$

where: y = Instrument response (peak area)
a = Slope of the line (coefficient of x)
x = Mass of the analyte in the calibration standard aliquot injected
b = y-intercept

Linear Regression by Least Squares:

$$y_1' = ax_i + b$$

where: b = intercept
x_i = Mass of the analyte in the ith calibration standard aliquot injected
y_1' = calculated response for the ith calibration standard

The sum of the squares of the differences is minimized to obtain a and b:

$$\sum_{i=1}^{N}(y_i - y_1^{'})^2$$

12.9 Correlation Coefficient r:

$$r = \frac{N\left[\sum_{i=1}^{N}(x_i y_i)\right] - \left[\sum_{i=1}^{N}(x_i)\right]\left[\sum_{i=1}^{N}(y_i)\right]}{\sqrt{N\left[\sum_{i=1}^{N}(x_i^2)\right] - \left[\sum_{i=1}^{N}(x_i)\right]^2} * \sqrt{N\left[\sum_{i=1}^{N}(y_i^2)\right] - \left[\sum_{i=1}^{N}(y_i)\right]^2}}$$

Where: r = Correlation Coefficient
N = number of data points (equals 5 in a 5 point curve)
y = response
i = index variable (first data point i = 1)
x = Mass of the analyte in the calibration standard aliquot injected

12.10 Quadratic Calibration (second order: $y = ax^2 + bx + c$) fit in Target

$$y = [n]\left[b + m^1\ (Rsp) + m^2\ (Rsp\text{^}2)\right]$$

where: b = constant
m^1 = multiplier for the unsquared term
m^2 = multiplier for the squared term
x = area of analyte/area of Internal Standard
n = amount of Internal Standard
y = amount in ng on column
Rsp = area of analyte/area of Internal Standard

12.11 Concentration

1211.1 Concentration of aqueous samples by GC/MS analysis

$$\mu g / L = \frac{(Ax)(Is)(Vt)(Df)}{(Ais)(\overline{RRF})(Vo)(Vi)}$$

where: Ax = area of the characteristic ion from the EICP for the compound to be measured

Ais = area of the characteristic ion for the EICP for the internal standard
Is = amount of internal standard injected (ηg)
$\overline{RRF}$ = mean relative response factor from initial calibration standards
Vo = volume of water extracted (mL)
Vi = volume of extract injected (µL)
Vt = volume of the concentrated extract (µL)
Df = dilution factor. If no dilution, Df = 1.0

12.11.2 Concentration of soil samples (dry weight basis) by GC/MS

$$\mu g / kg = \frac{(Ax)(Is)(Vt)(Df)(2.0)}{(Ais)(\overline{RRF})(Vi)(Ws)(D)}$$

where: Ax, Ais, Is, Vt, Vi, $\overline{RRF}$, and Df are the same as given for water
2.0 = GPC factor (if used)
Ws = weight of sample extracted, in grams
D (dry weight)= $\frac{100 - \%\ moisture}{100}$

12.11.3 Concentration of water and soil samples (dry weight basis) by GC/MS using quadratic (second order) fit in Target:

$$y = [n]\left[b + m^1\ (Rsp) + m^2\ (Rsp\text{^}2)\right]$$

where:
b = constant
m^1 = multiplier for the unsquared term
m^2 = multiplier for the squared term
x = area of analyte/area of Internal Standard
n = amount of Internal Standard
y = amount in ng on column
Rsp = area of analyte/area of Internal Standard

Example:
Area of acenapthene = 35659
Area of IS = 613275
b = -0.0909161
m^1 = 9.605304
m^2 = 7.132688
ηg of IS = 250
response = 35659/613275 = 0.058145

Amount in ηg on column =

$$(250\eta g)\left[-0.0909161+9.605304x\,0.058145+7.132688x\,0.058145^2\right]=1229\eta g$$

$$Concentration\ (water)\mu g/L=\frac{(y)(Df)(Vt)}{(Vo)(Vi)}$$

$$Concentration\ (soil)\mu g/Kg=\frac{(y)(Df)(Uf)(Vt)}{(Vi)(Ws)(D)}$$

where:

Uf = unit of correction for GPC, if used

12.11.4 Concentration of soil samples (dry weight basis) by GC/MS using linear regression analysis:

$$\frac{A_sC_{is}}{A_{is}}=aC_s+b$$

$$C_s=\frac{\left[\frac{A_sC_{is}}{A_{is}}-b\right]}{a}$$

where:
As = Area of the target analyte peak in the sample
Ais = Area of the internal standard peak
Cs = Concentration of the target analyte on column
Cis = Concentration of the internal standard
a = Slope of the line (coefficient of Cs)
b = The intercept

$$Concentration\ (\text{water})\mu g/L=\frac{(Cs)(Df)(Vt)}{(Vo)(Vi)}$$

$$Concentration\ (\text{soil})\ \mu g/Kg=\frac{(Cs)(Df)(Uf)(Vt)}{(Vi)(Ws)(D)}$$

12.11.5 Concentration of TICs

$$TIC\ Amount\ (\text{water})\ \mu\text{g/L}=\frac{(Area\,TIC)\ x\ Amount(Std)(Df)(Vt)}{(Area\ IS)\ x\ 1(RF)(Vo)(Vi)}$$

$$TIC\ Amount\ (\text{soil})\ \mu\text{g/Kg} = \frac{(Area\,TIC)\ x\ Amount(Std)(Df)(Uf)(Vt)}{(Area\ IS)\ x\ 1(RF)(Vi)(Ws)(D)}$$

where:	Area (TIC)	=	area response from RIC for non-target compound
	Amount (Std)	=	amount of internal standard added to the sample, in µg/L
	Area (IS)	=	area response of the nearest internal standard in the reconstructed ion chromatogram
	1(RF)	=	assumed response factor of 1

12.12 Calculating Dilutions

If a sample concentration exceeds the high level standard a dilution must be performed. Determine a level of dilution that will result in a value within the upper half of the calibration range. This is an acceptable dilution. A 10x dilution is generally performed using 100 µL sample plus 900 µL diluent for a total volume of 1.0 mL. It should be recorded on the run log as "10x (100 **µ**L in 1000 **µ**L)."

12.13 Percent Breakdown of DDT in DFTPP Solution

$$\%\ DDT = \frac{DDD + DDE\ (Summation\ of\ \ degradation\ \ peak\ areas)}{DDT + DDD + DDE\ (Summation\ of\ \ all\ \ peak\ areas)}\ x\ 100$$

12.14 Tailing Factor for Benzidine and Pentachlorophenol

12.14.1 See the diagram, Attachment 4.

13.0 Method Performance

This method was validated through in-house laboratory studies of method detection limits and precision and accuracy for single analyst. The data are retained by the QA department.

14.0 Pollution Prevention

The solvents used in this procedure pose little threat to the environment when recycled and managed properly. Pollution prevention encompasses any technique that reduces or

eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The EPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency recommends recycling as the next best thing. See SOP 12.1, Hazardous Waste Disposal, regarding laboratory procedures for recycling solvent waste streams.

15.0 Waste Management

It is the laboratory's responsibility to comply with all federal, state, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions, and to protect the air, water, and land by minimizing and controlling all releases from fume hoods and bench operations. Compliance with all sewage discharge permits and regulations is also required. See SOP 12.1, Hazardous Waste Disposal, regarding laboratory procedures for recycling solvent waste streams.

Samples preserved with HCl, HNO_3, or H_2SO_4 to pH <2 are hazardous and must be handled as hazardous waste.

Refer to the Hazardous Waste Management and Safety SOPs located in the lab.

16.0 References

16.1 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods. SW-846, 3rd Edition, Update 3, December, 1996, Method 8270C

16.2 Standard Methods for the Examination of Water and Wastewater, 20th (1998) Edition, Method 1080

16.3 Code of Federal Register, 40 CFR, Part 136, "Guidelines for Establishing Test Procedures for Priority Pollutants"

16.4 Quality Control SOP 13.6, "Proper Documentation Procedures"

16.5 Quality Control SOP 13.4, "Numerical Data Reduction"

16.6 NELAC Standards, effective July 2003, plus revisions

16.7 QA/G6: Guidance for Preparing Standard Operating Procedures (SOPs) EPA/600/B-07/001, April, 2007.

16.8 CompuChem Quality Manual, Revision 13, November 17, 2009, plus revisions

16.9 Sample Control SOP 4.6, "Storing Samples"

16.10 Department of Defense Quality Systems Manual for Environmental Laboratories, Version 4.**2**, **October 25, 2010, plus revisions**

16.11 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods. SW-846 3rd Edition, Update 4, February, 2007, Method 8270D

17.0 Attachments as Tables, Diagrams, Flowcharts

17.1 Attachment 1 – Target Compounds, Corresponding Internal Standards, and Quantitation Ions

17.2 Attachment 2 – Additional Appendix IX Analytes

17.3 Attachment 3 – **Example** Semivolatile Instrument Run Log

17.4 Attachment 4 - Peak Tailing Factor Demonstration

17.5 Attachment 5 - In-house LCS Control Limits

17.6 Attachment 6 – **DoD**-QSM LCS **and Surrogate** Control Limits

17.8 Attachment 7 - Matrix Spike Relative Percent Differences

17.9 Attachment 8 - Minimum Response Factors for 8270D

17.10 Attachment 9 - Condition Codes

17.11 Attachment 10 - Definitions of Manual Integration Codes

Attachment 1
8270 Compounds

Compounds	Internal Standard	Primary Quantitation Ion	Secondary Quantitation Ion(s)
1,4-dichlorobenzene-d_4 *	1	152	150, 115
2-Fluorophenol $	1	112	64, 92
Phenol-d_5 $	1	99	71, 42
N-Nitrosodimethylamine	1	42	74, 43
Pyridine	1	79	52, 78
Benzaldehyde	1	77	105,106
Phenol	1	94	66, 65
bis(2-Chloroethyl)ether	1	93	95, 63
2-Chlorophenol	1	128	130, 64
1,3-Dichlorobenzene	1	146	148, 111
1,4-Dichlorobenzene	1	146	148, 111
Benzyl alcohol	1	108	77, 79
1,2-Dichlorobenzene	1	146	148, 111
2-Methylphenol	1	107	108, 77
2,2'-oxybis[1-chloropropane]	1	45	121, 77
Acetophenone	2	105	77, 51
3/4-Methylphenol	1	107	108, 77
N-Nitroso-di-n-propylamine	1	70	130, 42
Hexachloroethane	1	117	201, 199
Naphthalene-d_8 *	2	136	68, 137
Nitrobenzene-d_5 $	2	82	128, 54
Nitrobenzene	2	77	123, 65
Vernolate	2	128	86, 146
Isophorone	2	82	138, 95
2,4-Dimethylphenol	2	122	107, 121
2-Nitrophenol	2	139	109, 65
2,4-Dimethylphenol	2	122	107, 121
bis(2-Chloroethoxy)methane	2	93	95, 123
2,4-Dichlorophenol	2	162	164, 98
1,2,4-Trichlorobenzene	2	180	182, 145
Naphthalene	2	128	129, 127
4-Chloroanaline	2	127	129, 65
Hexachlorobutadiene	2	225	227, 223
Caprolactam	2	113	55, 56
4-Chloro-3-methylphenol	2	107	144, 142
2-Methylnaphthalene	2	141	142, 115
1-Methylnaphthalene	2	142	141, 115
Acenaphthene-d_{10} *	3	164	162, 181
2-Fluorobiphenyl $	3	172	171, 174

Attachment 1 (continued)
8270 Compounds

Compounds	Internal Standard	Primary Quantitation Ion	Secondary Quantitation Ion(s)
2,4,6-Tribromophenol $	3	330	332, 141
Hexachlorocyclopentadiene	3	237	272, 235
2,4,6-Trichlorophenol	3	196	198, 200
2,4,5-Trichlorophenol	3	196	198, 200
1,1-Biphenyl	3	154	153, 76
2-Chloronaphthalene	3	162	164, 127
Phenyl Ether	3	170	141, 77
2-Nitroaniline	3	65	138, 92
Dimethyl phthalate	3	163	194, 164
2,6-Dinitrotoluene	3	165	63, 89
Acenaphthylene	3	152	151, 153
3-Nitroaniline	3	138	92, 108
Acenaphthene	3	154	153, 152
2,4-Dinitrophenol	3	184	154,63
4-Nitrophenol	3	139	109, 65
2,4-Dinitrotoluene	3	165	89, 63
Dibenzofuran	3	168	139, 169
Diethyl phthalate	3	149	177, 150
4-Chlorophenyl phenyl ether	3	204	206, 141
Fluorene	3	166	165, 167
4-Nitroaniline	3	138	108, 65
Phenanthrene-d_{10} *	4	188	94, 80
4,6-Dinitro-2-methylphenol	4	198	51, 105
N-Nitrosodiphenylamine[1]	4	169	168, 167
1,2-Diphenylhydrazine[2]	4	77	182, 105
4-Bromophenyl phenyl ether	4	248	250, 141
Hexachlorobenzene	4	284	249, 142
Atrazine	4	200	173, 215
Pentachlorophenol	4	266	268, 264
Phenanthrene	4	178	176, 89
Anthracene	4	178	176, 89
Carbazole	4	167	166, 139
Di-n-butyl phthalate	4	149	150, 104
Fluoranthene	4	202	101, 203
Chrysene-d_{12} *	5	240	120, 236
Benzidine	5	184	185, 92
Pyrene	5	202	200,203

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Attachment 1 (continued)
8270 Compounds

Compounds	Internal Standard	Primary Quantitation Ion	Secondary Quantitation Ion(s)
Butylbenzyl phthalate	5	149	206, 91
3,3'-Dichlorobenzidine	5	252	254, 126
Bis(2-ethylhexyl) phthalate	5	149	167, 279
Benzo(a)anthracene	5	228	226, 229
Chrysene	5	228	226, 229
Perylene-d_{12} *	6	264	260, 265
Terphenyl-d_{14} $	5	244	122, 212
Di-n-octyl phthalate	6	149	167, 4
Benzo(b)fluoranthene	6	252	253, 125
Benzo(k)fluoranthene	6	252	253, 125
Benzo(a)pyrene	6	252	253, 125
Indeno(1,2,3-c,d)pyrene	6	276	138, 277
Dibenzo(a,h)anthracene	6	278	139, 279
Benzo(g,h,i)perylene	6	276	138, 277

$ Surrogate
* Internal Standard
[1] N-nitrosodiphenylamine decomposes diphenylamine
[2] 1,2-diphenylhydrazine decomposes to azobenzene

Attachment 2
Appendix IX Compounds (includes additional non-routine/project-specific analytes)

Compounds	Internal Standard	Primary Quantitation Ion	Secondary Quantitation Ion(s)
1,4-dichlorobenzene-d_4 *	1	152	150, 115
2-Fluorophenol $	1	112	64, 92
Phenol-d_5 $	1	99	71, 42
N-Nitrosodimethylamine	1	42	74, 43
Pyridine	1	79	52, 78
Ethylmethacrylate	1	69	99, 114
2-Picoline	1	93	66, 92
N-Nitrosomethylethylamine	1	88	56, 71
Methyl Methanesulfonate	1	80	79, 65
N-Nitrosodiethylamine	1	102	56, 42
Ethyl Methanesulfonate	1	79	109, 97
Phenol	1	94	66, 65
Aniline	1	93	66, 65
Pentachloroethane	1	167	165, 117
Bis(2-Chloroethyl)ether	1	93	95, 63
2-Chlorophenol	1	128	130, 64
1,3-Dichlorobenzene	1	146	148, 111
1,4-Dichlorobenzene	1	146	148, 111
Benzyl alcohol	1	108	77, 79
1,2-Dichlorobenzene	1	146	148, 111
2-Methylphenol	1	108	107, 77
2,2'-oxybis[1-chloropropane]	1	45	121, 77
N-Nitrosopyrrolidine	1	100	41, 68
3/4-Methylphenol	1	107	108, 77
Acetophenone	2	105	77, 51
N-Nitroso-di-n-propylamine	1	70	130, 42
o-Toluidine	1	106	107, 77
Hexachloroethane	1	117	201, 199
Naphthalene-d_8 *	2	136	68, 137
Nitrobenzene-d_5 $	2	82	128, 54
Nitrobenzene	2	77	123, 65
N-Nitrosopiperidine	2	114	55, 42
Isophorone	2	82	138, 95
2-Nitrophenol	2	139	109, 65
2,4-Dimethylphenol	2	122	107, 121
Benzoic Acid	2	122	105, 77
Bis(2-chloroethoxy)methane	2	93	95, 123
2,4-Dichlorophenol	2	162	164, 98
1,2,4-Trichlorobenzene	2	180	182, 145
Naphthalene	2	128	129, 127

Attachment 2 (continued)
Appendix IX Compounds (includes additional non-routine/project-specific analytes)

Compounds	Internal Standard	Primary Quantitation Ion	Secondary Quantitation Ion(s)
4-Chloroanaline	2	127	129, 65
2,6-Dichlorophenol	2	162	164, 126
Hexachloropropene	2	213	215, 211
Hexachlorobutadiene	2	225	227, 223
N-Nitroso-di-n-butylamine	2	84	57, 41
p-Phenylenediamine	2	108	80, 54
4-Chloro-3-methylphenol	2	107	144, 142
Safrole	2	162	104, 77
2-Methylnaphthalene	2	141	142, 115
1-Methylnaphthalene	2	142	141, 115
Acenaphthene-d_{10} *	3	164	162, 181
2-Fluorobiphenyl $	3	172	171, 174
2,4,6-Tribromophenol $	3	330	332, 141
Hexachlorocyclopentadiene	3	237	272, 235
2,4,6-Trichlorophenol	3	196	198, 200
2,4,5-Trichlorophenol	3	196	198, 200
Isosafrole	3	162	104, 131
2-Chloronaphthalene	3	162	164, 127
2-Nitroaniline	3	65	138, 92
1,4-Naphthoquinone	3	158	102, 104
Dimethylphthalate	3	163	194, 164
1,3-Dinitrobenzene	3	168	76, 50
2,6-Dinitrotoluene	3	165	63, 89
Acenaphthylene	3	152	151, 153
3-Nitroaniline	3	138	92, 108
Acenaphthene	3	154	153, 152
2,4-Dinitrophenol	3	184	154,63
4-Nitrophenol	3	139	109, 65
Pentachlorobenzene	3	250	252, 108
2,4-Dinitrotoluene	3	165	89, 63
Dibenzofuran	3	168	139, 169
1-Naphthylamine	3	143	115, 89
2,3,4,6-Tetrachlorophenol	3	232	166, 230
2-Naphthylamine	3	143	115, 116
Diethyl phthalate	3	149	177, 150
Zinophos	3	97	143, 77
4-Chlorophenyl-phenyl ether	3	204	206, 141
5-Nitro-o-toluidine	3	152	77, 79
Fluorene	3	166	165, 167
4-Nitroaniline	3	138	108, 65
Phenanthrene-d_{10} *	4	188	94, 80
4,6-Dinitro-2-methylphenol	4	198	51, 105
N-Nitrosodiphenylamine[1]	4	169	168, 167

Attachment 2 (continued)
Appendix IX Compounds (includes additional non-routine/project-specific analytes)

Compounds	Internal Standard	Primary Quantitation Ion	Secondary Quantitation Ion(s)
1,2-Diphenylhydrazine[2]	4	77	182, 105
Sulfotep	4	322	202, 75
1,3,5-Trinitrobenzene	4	75	213, 74
Diallate (trans)	4	86	234, 43
Phoroate	4	75	121, 97
Phenacetin	4	108	180, 179
Diallate (cis)	4	86	234, 43
4-Bromophenyl- phenyl ether	4	248	250, 141
Hexachlorobenzene	4	284	249, 142
Dimethoate	4	87	125, 93
4-Aminobiphenyl	4	169	168, 170
Pentachlorophenol	4	266	268, 264
Pentachloronitrobenzene	4	237	214, 142
Pronamide	4	173	175, 145
Disulfoton	4	88	97, 89
Phenanthrene	4	178	176, 89
Anthracene	4	178	176, 89
Carbazole	4	167	166, 139
Methyl parathion	4	109	125, 263
Di-n-butyl phthalate	4	149	150, 104
Parathion	4	109	97, 291
4-Nitroquinoline-1-oxide	4	174	101, 128
Methapyrilene	4	97	191, 50
Isodrin	4	193	66, 195
Fluoranthene	4	202	101, 203
Chrysene-d_{12} *	5	240	120, 236
Benzidine	5	184	185, 92
Pyrene	5	202	200,203
p-Dimethylaminoazobenzene	5	225	120, 77
Chlorobenzilate	5	251	139, 253
Kepone	5	272	274, 237
Famfur	5	237	218, 93
Butylbenzyl phthalate	5	149	206, 91
3,3'-Dimethylbenzidine	5	212	106, 196
2-Acetylaminofluorene	5	181	180, 223
3,3'-Dichlorobenzidine	5	252	254, 126
Bis(2-ethylhexyl) phthalate	5	149	167, 279
Benzo(a)anthracene	5	228	226, 229
Chrysene	5	228	226, 229
Perylene-d_{12} *	6	264	260, 265
Terphenyl-d_{14} $	5	244	122, 212
Di-n-octyl phthalate	6	149	167, 4
Benzo(b)fluoranthene	6	252	253, 125

Attachment 2 (continued)
Appendix IX Compounds (includes additional non-routine/project-specific analytes)

Compounds	Internal Standard	Primary Quantitation Ion	Secondary Quantitation Ion(s)
Benzo(k)fluoranthene	6	252	253, 125
Benzo(a)pyrene	6	252	253, 125
Indeno(1,2,3-c,d)pyrene	6	276	138, 277
Dibenzo(a,h)anthracene	6	278	139, 279
Benzo(g,h,i)perylene	6	276	138, 277

$ Surrogate
* Internal Standard
[1] N-nitrosodiphenylamine decomposes diphenylamine
[2] 1,2-diphenylhydrazine decomposes to azobenzene

Attachment 3

COMPUCHEM a Division of Liberty Analytical Corp
GC/MS SEMIVOLATILE RUN LOG
LOGBOOK 4X(4) 23(5972hp66)

DATE ___/___/___ INITIAL TIME OF TUNE _____ SHIFT/S (A) ____(B)_____(C)____
TIME TUNE EXPIRES_____
METHOD: 8270C 8270D SOM01.2 (Circle One) or Other: _____SIM: (Y/N)
PREVENTIVE MAINTENANCE_____

	SEQUENCE#	REJECTED	FILENAME	REPORTED	DATE	TIME	CLIENT ID	SDG#	AMOUNT INJECTED	CHEMIST	COMMENTS
1					/ /						
2					/ /						
3					/ /						
4					/ /						
5					/ /						
6					/ /						
7					/ /						
8					/ /						
9					/ /						
10					/ /						
11					/ /						
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21					/ /						
22					/ /						
23					/ /						
24					/ /						

DFTPP Lot #/Exp. Date: _____ Calibration STD Lot#/Exp. Date: _____ Internal STD Lot#/Exp. Date: _____ Methylene Chloride Lot#/Exp. Date: _____ Column Type: _____

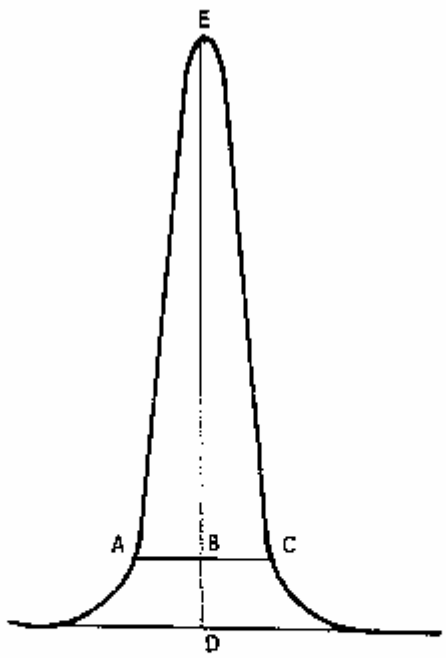
The presence of the Chemist's/Analyst's employee ID number, or signature, on this run log attests that strict compliance with the method's SOP has occurred. Any SOP deviations require documentation by the responsible chemist/analyst together with the chemist's/analyst's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation.

REVIEWED BY: _____ DATE _____
6/24/10:jad

3301

Note: This page subject to change without notice.

Attachment 4



TAILING FACTOR= $\frac{BC}{AB}$

Example calculation: Peak Height = DE = 100 mm
10% Peak Height = BD = 10 mm
Peak Width at 10% Peak Height = AC = 23 mm
AB = 11 mm
BC = 12 mm

Therefore: Tailing Factor = $\frac{12}{11}$ = 1.1

Tailing factor calculation.

Attachment 5

In-House LCS Recovery Limits

Semivolatile Compound	Soil (% Recovery)	Marginal Exceedance (% Recovery)
N-Nitrosodimethylamine	20-118	10-135
Pyridine	20-100	10-160
Benzaldehyde	20-100	10-160
Phenol	38-112	26-123
bis (2-Chloroethyl)ether	30-112	16-125
2-Chlorophenol	30-100	10-160
1,3-Dichlorobenzene	21-104	10-118
1,4-Dichlorobenzene	21-104	10-118
Benzyl alcohol	40-107	29-118
1,2-Dichlorobenzene	24-108	10-122
2-Methylphenol	42-110	30-121
2,2'-Oxybis (1-chloropropane)	24-107	10-121
Acetophenone	32-105	20-117
3/4-Methylphenol	38-114	26-127
n-Nitroso-di-n-propylamine	23-130	10-147
Hexachloroethane	20-105	10-120
Nitrobenzene	20-135	10-156
Isophorone	39-114	27-126
2-Nitrophenol	33-119	19-133
2,4-Dimethylphenol	43-117	31-130
bis (2-Chloroethoxy)methane	39-107	24-118
2,4-Dichlorophenol	42-119	29-132
1,2,4-Trichlorobenzene	32-112	19-126
Naphthalene	38-118	24-132
4-Chloroaniline	26-129	10-146
Hexachlorobutadiene	31-118	16-132
Caprolactam	45-122	32-134
4-Chloro-3-methylphenol	46-120	34-132
2-Methylnaphthalene	39-111	27-123
1-Methylnaphthalene	39-112	27-124
Hexachlorocyclopentadiene	20-134	10-160
2,4,6-Trichlorophenol	46-127	33-141
2,4,5-Trichlorophenol	52-122	40-134
1,1'-Biphenyl	42-116	30-126
2-Chloronaphthalene	11-112	33-123
2-Nitroaniline	50-109	40-118

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Attachment 5 (continued)

In-House LCS Recovery Limits

Semivolatile Compound	Soil (% Recovery)	Marginal Exceedance (% Recovery)
Dimethylphthalate	50-120	39-132
2,6-Dinitrotoluene	47-119	35-131
Acenaphthylene	50-125	38-137
3-Nitroaniline	43-100	34-160
Acenaphthene	50-126	37-138
2,4-Dinitrophenol	20-121	10-140
4-Nitrophenol	26-145	10-160
2,4-Dinitrotoluene	50-125	37-137
Dibenzofuran	47-116	36-127
Diethylphthalate	51-123	39-135
4-Chlorophenyl-phenylether	52-123	40-135
Fluorene	52-128	40-141
4-Nitroaniline	42-100	32-160
4,6-Dinitro-2-methylphenol	32-127	16-143
n-Nitrosodiphenylamine	46-125	33-125
1,2-Diphenylhydrazine	48-110	38-110
4-Bromophenyl-phenylether	53-122	42-134
Hexachlorobenzene	49-126	36-139
Atrazine	22-100	10-160
Pentachlorophenol	35-132	19-148
Phenanthrene	51-129	38-143
Carbazole	45-135	30-150
Anthracene	53-136	40-149
di-n-Butylphthalate	49-121	37-133
Fluoranthene	56-134	43-147
Benzidine	20-150	10-160
Pyrene	48-136	34-151
Butylbenzylphthalate	42-137	36-153

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Attachment 5 (continued)

In-House LCS Recovery Limits

Semivolatile Compound	Soil (% Recovery)	Marginal Exceedance (% Recovery)
3,3'-Dichlorobenzidine	21-100	10-160
Bis (2-Ethylhexyl) phthalate	37-133	21-149
Benzo(a)anthracene	57-134	44-147
Chrysene	53-135	39-148
Di-n-Octylphthalate	43-138	26-154
Benzo(b)fluoranthene	48-130	35-143
Benzo(k)fluoranthene	61-141	47-155
Benzo(a)pyrene	60-131	48-142
Indeno(1,2,3-cd)pyrene	47-137	32-152
Dibenz(a,h)anthracene	51-127	38-139
Benzo(g,h,i)perylene	43-129	29-142

Note: LCS recovery limits are based on in-house performance statistics. A subset of analytes may be reported, depending on project requirements. While the limits were statistically derived, from actual laboratory data, it is expected that a minimum of 40% recovery is achieved for the vast majority of analytes.

Attachment 5 (continued)

Semivolatile Compound	Aqueous (% Recovery)	Marginal Exceedance (% Recovery)
N-Nitrosodiphenylamine	20-100	10-120
Pyridine	20-100	10-120
Benzaldehyde	20-100	10-117
Phenol	20-100	10-120
bis (2-Chloroethyl)ether	31-100	20-120
2-Chlorophenol	23-100	15-120
1,3-Dichlorobenzene	24-100	13-120
1,4-Dichlorobenzene	25-100	15-120
Benzyl alcohol	29-100	19-120
1,2-Dichlorobenzene	27-100	16-101
2-Methylphenol	25-100	13-120
2,2'-Oxybis (1-chloropropane)	24-100	13-120
Acetophenone	39-100	29-105
3/4-Methylphenol	24-100	15-120
N-Nitroso-di-n-propylamine	34-101	23-112
Hexachloroethane	28-100	18-120
Nitrobenzene	20-131	10-150
Isophorone	43-105	32-115
2-Nitrophenol	39-103	28-113
2,4-Dimethylphenol	19-109	10-120
bis (2-Chloroethoxy)methane	35-110	25-106
2,4-Dichlorophenol	39-103	28-113
1,2,4-Trichlorobenzene	36-101	25-111
Naphthalene	40-104	29-114
4-Chloroaniline	25-115	10-130
Hexachlorobutadiene	29-103	17-115
Caprolactam	20-100	10-120
4-Chloro-3-methylphenol	41-103	30-113
2-Methylnaphthalene	40-100	30-110
1-Methylnaphthalene	39-100	29-109
Hexachlorocyclopentadiene	20-123	10-143
2,4,6-Trichlorophenol	46-113	35-124
2,4,5-Trichlorophenol	41-119	29-132
1,1'-Biphenyl	49-109	36-119
2-Chloronaphthalene	46-105	36-115
2-Nitroaniline	34-107	22-119

Attachment 5 (continued)

Semivolatile Compound	Aqueous (% Recovery)	Marginal Exceedance (% Recovery)
Dimethylphthalate	53-116	43-127
2,6-Dinitrotoluene	51-115	40-126
Acenaphthylene	50-115	39-126
3-Nitroaniline	20-110	10-125
Acenaphthene	53-118	43-128
2,4-Dinitrophenol	20-102	10-118
4-Nitrophenol	10-100	10-120
2,4-Dinitrotoluene	52-119	41-131
Dibenzofuran	50-107	41-129
Diethylphthalate	52-118	45-111
4-Chlorophenyl-phenylether	51-117	40-128
Fluorene	53-121	41-132
4-Nitroaniline	20-110	10-129
4,6-Dinitro-2-methylphenol	38-116	25-129
N-Nitrosodiphenylamine	52-117	41-127
1,2-Diphenylhydrazine	38-105	27-117
4-Bromophenyl-phenylether	51-115	41-125
Hexachlorobenzene	52-116	41-126
Atrazine	20-100	10-120
Pentachlorophenol	20-100	10-150
Phenanthrene	56-121	45-131
Carbazole	39-115	27-127
Anthracene	55-127	43-139
Di-n-butylphthalate	51-114	41-124
Fluoranthene	58-124	47-134
Benzidine	20-150	10-160
Pyrene	48-131	34-145
Butylbenzylphthalate	41-118	28-131

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Attachment 5 (Continued)

Semivolatile Compound	Aqueous (% Recovery)	Marginal Exceedance (% Recovery)
3,3'-Dichlorobenzidine	20-100	10-120
Bis (2-Ethylhexyl) phthalate	47-121	35-133
Benzo(a)anthracene	53-128	41-140
Chrysene	50-130	36-143
Di-n-octylphthalate	30-148	10-160
Benzo(b)fluoranthene	41-130	26-145
Benzo(k)fluoranthene	39-150	19-160
Benzo(a)pyrene	46-135	31-150
Indeno(1,2,3-cd)pyrene	47-138	32-154
Dibenz(a,h)anthracene	47-134	32-148
Benzo(g,h,i)perylene	42-132	27-147

Attachment 6

LCS Control Limits for 8270 required by the DoD-QSM

Compound	Aqueous Recovery Limits	Solid Recovery Limits
n-Nitrosodiphenylamine	50-110	50-115
Phenol	0-155*	40-100
Bis(2-chloroethyl] ether	35-110	40-105
2-Chlorophenol	35-105	45-105
1,3-Dichlorobenzene	30-100	40-100
1,4-Dichlorobenzene	30-100	35-105
Benzyl alcohol	30-110	20-125
1,2-Dichlorobenzene	35-100	45-100
2-Methylphenol	40-110	40-105
2,2'-oxybis[1-chloropropane]	25-130	20-115
3/4-Methylphenol	30-110	40-105
n-Nitroso-di-n-propylamine	35-130	40-115
Hexachloroethane	30-100	35-110
Nitrobenzene	45-110	40-115
Isophorone	50-110	45-110
2-Nitrophenol	40-115	40-110
2,4-Dimethylphenol	30-110	30-105
Bis[2-chloroethoxy]methane	45-105	45-110
2,4-Dichlorophenol	50-105	45-110
1,2,4-Trichlorobenzene	35-105	45-110
Naphthalene	40-100	40-105
4-Chloroaniline	15-110	10-100*
Hexachlorobutadiene	25-105	40-115
4-Chloro-3-methylphenol	45-110	45-115
2-Methylnaphthalene	45-105	45-105
2,4,6-Trichlorophenol	50-115	45-110
2,4,5-Trichlorophenol	50-110	50-110
2-Chloronaphthalene	50-105	45-105
2-Nitroaniline	50-115	45-120
Dimethylphthalate	25-125	50-110
2,6-Dinitrotoluene	50-115	50-110
Acenaphthylene	50-105	45-105
3-Nitroaniline	20-125	25-110
Acenaphthene	45-110	45-110
2,4-Dinitrophenol	15-140	15-130
4-Nitrophenol	0-125*	15-140
2,4-Dinitrotoluene	50-120	50-115
Dibenzofuran	55-105	50-105
Diethyl phthalate	40-120	50-115

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Attachment 6 (continued)

Compound	Aqueous Recovery Limits	Solid Recovery Limits
4-Chlorophenyl-phenylether	50-110	45-110
Fluorene	50-110	50-110
4-Nitroaniline	35-120	35-115
4,6-Dinitro-2-methylphenol	40-130	30-135
1,2-Diphenylhydrazine	55-115	N/A
4-Bromophenyl-phenyl ether	50-115	45-115
Hexachlorobenzene	50-110	45-120
Pentachlorophenol	40-115	25-120
Phenanthrene	50-115	50-110
Carbazole	50-115	45-115
Anthracene	55-110	55-105
Di-n-butyl phthalate	55-115	55-110
Fluoranthene	55-115	55-115
Pyrene	50-130	45-125
Butyl benzyl phthalate	45-115	50-125
3,3'-Dichlorobenzidine	20-110	10-130*
Bis[2-ethylhexyl] phthalate	40-125	45-125
Benzo[a]anthracene	55-110	50-110
Chrysene	55-110	55-110
Di-n-octyl phthalate	35-135	40-130
Benzo[b]fluoranthene	45-120	45-115
Benzo[k]fluoranthene	45-125	45-125
Benzo[a]pyrene	55-110	50-110
Indeno[1,2,3-cd]pyrene	45-125	40-120
Dibenz[a,h]anthracene	40-125	40-125
Benzo [g,h,i]perylene	40-125	40-125
n-Nitrosodimethylamine	25-110	20-115

Surrogate recovery limits for 8270 required by the DoD-QSM

Compound	Aqueous (% Recovery)	Soil (% Recovery)
Nitrobenzene-d_5	40-110	35-100
2-fluorobiphenyl	50-110	45-105
Terphenyl-d_{14}	50-135	30-125
Phenol-d_5	10-115*	40-100
2-fluorophenol	20-110	35-105
2,4,6-tribromophenol	40-125	35-125

*** For the preceding 3 tables, batch acceptance should not be evaluated using the limits for these analytes.**

Attachment 7

Matrix Spike Relative Percent Differences

Semivolatile Compound	Aqueous	Solid
N-Nitrosodiphenylamine	50	50
Pyridine	50	50
Benzaldehyde	50	42
Phenol	46	39
bis (2-Chloroethyl)ether	46	39
2-Chlorophenol	42	37
1,3-Dichlorobenzene	50	47
1,4-Dichlorobenzene	50	46
Benzyl alcohol	41	36
1,2-Dichlorobenzene	50	42
2-Methylphenol	50	32
2,2'-Oxybis (1-chloropropane)	48	40
Acetophenone	47	41
3/4-Methylphenol	50	40
N-Nitroso-di-n-propylamine	50	42
Hexachloroethane	50	43
Nitrobenzene	44	37
Isophorone	50	40
2-Nitrophenol	47	39
2,4-Dimethylphenol	50	31
2,4-Dinitrophenol	50	46
4-Nitrophenol	50	35
2,4-Dinitrotoluene	44	34
Dibenzofuran	45	33
Diethylphthalate	45	31
4-Chlorophenyl-phenylether	47	33
Fluorene	49	32
4-Nitroaniline	50	42
4,6-Dinitro-2-methylphenol	50	38
N-Nitrosodiphenylamine	50	31
1,2-Diphenylhyhydrazine	50	28
4-Bromophenyl-phenylether	47	37
Hexachlorobenzene	42	32
Atrazine	50	31
Pentachlorophenol	50	48
Phenanthrene	50	33

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Attachment 7 (continued)

Matrix Spike Relative Percent Differences

Semivolatile Compound	Aqueous	Solid
Anthracene	50	31
Carbazole	50	32
Di-n-butylphthalate	40	29
Fluoranthene	50	36
Benzidine	50	50
Pyrene	50	31
Butyl benzylphthalate	48	27
3,3'-Dichlorobenzidine	50	50
Bis (2-ethylhexyl)phthalate	49	44
Benzo(a)anthracene	50	35
Chrysene	50	35
Di-n-octylphthalate	50	33
Benzo(b)fluoranthene	50	39
Benzo(k)fluoranthene	50	40
Benzo(a)pyrene	50	29
Indeno(1,2,3-cd)pyrene	50	29
Dibenzo(a,h)anthracene	50	31
Benzo(g,h,i)perylene	50	31

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Attachment 8

Minimum Response Factors for 8270D

Semivolatile Compound	Minimum Response Factor
Benzaldehyde	0.010
Phenol	0.800
bis (2-Chloroethyl)ether	0.700
2-Chlorophenol	0.800
2-Methylphenol	0.700
2,2'-Oxybis (1-chloropropane)	0.010
Acetophenone	0.010
4-Methylphenol	0.600
N-Nitroso-di-n-propylamine	0.500
Hexachloroethane	0.300
Nitrobenzene	0.200
Isophorone	0.400
2-Nitrophenol	0.100
2,4-Dimethylphenol	0.200
bis (2-Chloroethoxy)methane	0.300
2,4-Dichlorophenol	0.200
Naphthalene	0.700
4-Chloroaniline	0.010
Hexachlorobutadiene	0.010
Caprolactam	0.010
4-Chloro-3-methylphenol	0.200
2-Methylnaphthalene	0.400
Hexachlorocyclopentadiene	0.050
2,4,6-Trichlorophenol	0.200
2,4,5-Trichlorophenol	0.200
1,1'-Biphenyl	0.010
2-Chloronaphthalene	0.800
2-Nitroaniline	0.010
Dimethylphthalate	0.010
2,6-Dinitrotoluene	0.200
Acenaphthylene	0.900
3-Nitroaniline	0.010
Acenaphthene	0.900
2,4-Dinitrophenol	0.010
4-Nitrophenol	0.010
Dibenzofuran	0.800
2,4-Dinitrotoluene	0.200
Diethylphthalate	0.010
1,2,4,5-Tetrachlorobenzene	0.010
4-Chlorophenyl-phenylether	0.400

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Attachment 8(continued)

Minimum Response Factors for 8270D

Semivolatile Compound	Minimum Response Factor
Fluorene	0.900
4-Nitroaniline	0.010
4,6-Dinitro-2-methylphenol	0.010
4-Bromophenyl-phenylether	0.100
N-Nitrosodiphenylamine	0.010
Hexachlorobenzene	0.100
Atrazine	0.010
Pentachlorophenol	0.050
Phenanthrene	0.700
Anthracene	0.700
Carbazole	0.010
Di-n-butylphthalate	0.010
Fluoranthene	0.600
Pyrene	0.600
Butyl benzylphthalate	0.010
3,3'-Dichlorobenzidine	0.010
Benzo(a)anthracene	0.800
Chrysene	0.700
Bis (2-ethylhexyl)phthalate	0.010
Di-n-octylphthalate	0.010
Benzo(b)fluoranthene	0.700
Benzo(k)fluoranthene	0.700
Benzo(a)pyrene	0.700
Indeno(1,2,3-cd)pyrene	0.500
Dibenzo(a,h)anthracene	0.400
Benzo(g,h,i)perylene	0.500
2,3,4,6-Tetrachlorophenol	0.010

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Attachment 9

Condition Codes Used for Documentation in Logbooks

Condition Code	Definition
CS	Contamination Suspected
CT	Contamination Verified
DA	Dilution Acceptable
DI	Requires Dilution
DW	Dilution Wrong
ES	Extraction Same
EF2JS	Ending Standard Failed Second Tune Injection Same
JS	Injection Same
IH	Internals High
IL	Internals Low
IM	Internals Missing
LA	Lab Accident (Must Explain)
OT	Other (Must Explain)
OQ	Original Run Qualified
OW	Original Wrong for QC Sample
RP	Reportable Prior Run
RT	Retention Time Shift
RU	Run Unnecessarily
SF	Spike Recoveries Failed
SH	Surrogate Recoveries Failed High
SI	Spiked Inadvertently
SL	Surrogate Recoveries Failed Low
SM	Surrogate or Spike Missing
IF	Instrument Failure (Must Explain)
US	Unacceptable Standard (Must Explain)
VR	Verify Results (Must Explain)
NM	Did Not Match Prior Run or Duplicate
RN	Reanalyze Neat
PC	Poor Chromatography
WS	Wrong Standard

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Attachment 10

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Notification Regarding Manual Editing/Integration Flags

In some instances, manual adjustments to the software output are necessary to provide accurate data. These manual integrations are performed by the data reviewers, GC/MS operators, or GC/HPLC chemists. An Extracted Ion Current Profile (EICP) or a GC/HPLC chromatographic peak has been provided for the manual integration performed on each compound to demonstrate the accuracy of that process. The manual integrations are flagged on the quantitation report in the far right column beyond the FINAL concentration for GC/MS analysis, and in the "Flags" column for GC/HPLC analysis. The manual editing/integration flags are:

M - **Denotes that a manual integration has been performed for this compound. The manual integration was performed in order to provide the most accurate area count possible for the peak. The most common reasons for performing manual integrations/editing are: the compound was not found by the automatic integration routine, the compound was incorrectly integrated by the automatic integration routine, and the co-eluting compounds were incorrectly integrated by the automatic integration routine.**

H - **Denotes that the data reviewer, GC/MS operator, or GC/HPLC Chemist has chosen an alternate peak within the retention time window from that chosen by the software for that compound. No manual integration is performed in choosing an alternate peak. The software still performs the integration.**

MH - **Denotes that an alternate peak has been chosen within the retention time window from that chosen by the software for that compound and also a manual integration of the chosen peak has been performed. The manual integration was performed in order to provide the most accurate area count possible for the peak.**

L - **Denotes that a data reviewer or GC/MS operator has selected an alternate library search. This is typically done when an additional tentatively identified compound (TIC) has been added to the number of peaks searched. No manual integration is performed in choosing an alternate peak. The software still performs the integration.**

ML - **Denotes that an alternate GC/MS library search has been selected and a manual integration has also been performed. This is typically done when an additional TIC has been added and the TIC peak also required a manual integration.**

These codes will appear in the GC/MS and GC/HPLC raw data.

Revision 8 (01/29/2011)

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SOP DOCUMENTATION FORM

This form must accompany all new and revised Standard Operating Procedures (SOPs) when you turn them in to Quality Assurance for review. Please fill out the entire block below (except effective date).

This is a new procedure _____ revised procedure ✓ outdated procedure (archive) _____

- Procedure Code: IP309 SOP Section #: 3.2.1.6 Revision #: 18

SOP Title: Inductively Coupled Plasma Atomic Emission Spectroscopy by SW-846 Methods 6010B and 6010C

Effective date: (QA fills in) 07-07-2010

- Procedure prepared by: Bob Meneza Date: 07-06-2010

- Procedure approved by: (If the manager prepared the SOP, a qualified second party should sign) _____ Date: 07.07.10

- Reason for change: Addition of DoD-QSM Protocols

- This procedure meets the requirements of the following approved method references: SW-846, 3RD Edition, Update III, 12/96, Method 6010B and Update IV, 2/2007, Method 6010C, ~~Rev~~ Revision 3; DoD Quality Systems ~~for~~ Manual for Environmental Laboratories, Version 4.1 4/22/2009

Procedure approved by a QA Representative (unless QA Representative signed above):

_____ Date: _____

On an annual basis: Lab managers are required to review lab practices and revise the SOP if necessary. If no revision is necessary, indicate by your signature that the SOP has been reviewed.

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Instrument Procedure 309: Inductively Coupled Plasma Atomic Emission Spectroscopy by SW-846 Methods 6010B and 6010C

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Instrument Procedure 309: Inductively Coupled Plasma Atomic Emission Spectroscopy by SW-846 Methods 6010B and 6010C

1.0 Scope and Application

This Standard Operating Procedure (SOP) describes the determination of elements in solution including metals by Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP/AES). This SOP is applicable to a large number of metals and wastes. All matrices, including groundwater, aqueous samples, EP extracts, industrial wastes, soils, sludges, sediments, TCLP leachates, and other solid wastes, require digestion prior to analysis.

Methods 6010B and 6010C are applicable to the elements listed in Attachment 5. The elements determined for TCLP analysis are listed in Section 3.6. Detection limits, sensitivity, and optimum ranges of the metals will vary with the matrices and model of spectrometer. The data shown in these attachments are provided from clean aqueous samples.

Staff members performing the procedures described in this SOP are responsible for reading, understanding, and complying with the SOP requirements. Supervisors are responsible for directing the analyst to the controlled SOP, and providing adequate explanation of the material contained therein.

This procedure is restricted to use by or under the supervision of analysts experienced in the instrumentation or preparative methods and who have demonstrated the ability to generate acceptable results through QC samples and analyst capability studies. Use of this method is restricted to spectroscopists who are knowledgeable in the correction of spectral, chemical, and physical interferences.

2.0 Summary of Method

Prior to analysis, samples must be solubilized or digested following Sample Preparation Procedure –1080, "Digestion Block Preparation of Aqueous Samples for the ICP Determination of Total or Dissolved Metals by SW-846, MCAWW, and Standard Methods" or Sample Preparation Procedure –240, "Digestion Block Preparation of Solid Samples for ICP Determination of Total Metals by SW-846 Method 3050" TCLP samples must be leached following Sample Preparation Procedure –814, "Toxicity Characteristic Leaching Procedure (TCLP)" after which the leachates are digested as liquid samples using the TCLP spiking levels.

Methods 6010B and 6010C are executed by the laboratory using the simultaneous, multielemental determination of elements by ICP. The method measures element-

emitted light by optical spectrometry. Samples are nebulized and the resulting aerosol is transported to the plasma torch. Element-specific atomic-line emission spectra are produced by a radio-frequency inductively coupled plasma. The spectra are dispersed by a grating spectrometer, and the intensities of the lines are monitored by photomultiplier tubes. Background correction is required for trace element determination. Background must be measured adjacent to analyte lines on samples during analysis. The position selected for the background-intensity measurement, on either or both sides of the analytical line, will be determined by the complexity of the spectrum adjacent to the analyte line. The position used must be free of spectral interference and reflect the same change in background intensity as occurs at the analyte wavelength measured. Background correction is not required in cases of line broadening where a background correction measurement would actually degrade the analytical result. The possibility of additional interferences should also be recognized and appropriate corrections made. Three exposures are averaged to obtain a final result.

3.0 Definitions

3.1 Method detection limit (MDL) – The minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte**. A minimum of seven sample replicates is required to calculate a statistical MDL. The MDL is an approximation of the DL. Any analyte concentration result at or above the MDL must also meet all qualitative identification criteria required by the test method in order to be reported as present.**

3.2 Detection Limit (DL) - The DL is the smallest analyte that can be demonstrated to be different from zero or a blank concentration at the 99 % level of confidence. The false positive rate at the DL is 1% and the false negative rate is 50%. Any analyte concentration result at or above the DL must also meet all qualitative identification criteria required by the test method in order to be reported as present.

3.3 Limit of Detection (LOD) – The LOD is the smallest concentration of an analyte that must be present in a sample in order to be detected at a 99% confidence level. The false negative rate at the LOD is 1 %. For DoD-QSM, non-detect sample results are reported as < LOD. Numeric values of measurements between the DL and the LOQ are reported as estimates. The DL < LOD ≤ LOQ.

3.4 Limit of Quantitation (LOQ) – The Limit of Quantitation is the lowest concentration of a substance that produces a quantitative result within

specified limits of precision and bias. The LOQ must be within the calibration range.

3.5 Reporting Limit (RL) –

3.5.1 The DoD-QSM defines the reporting limit as being the lowest concentration value specified by the client that meets project requirements for reporting data with known precision and bias for a specific analyte in a specific matrix. The LOQ cannot be greater than the RL. Data reported between the DL and the LOQ must be flagged as estimated values.

3.**6** Instrument Detection Limits (IDLs) – IDLs are helpful to evaluate the instrument noise level and response changes over time for each analyte. They aren't to be confused with the lower limit of quantitation and should not be used in establishing that limit.

3.**8** Reporting Units – µg/L for water and mg/Kg for soil

3.**9** A Sample Delivery Group (SDG) is defined by the following, whichever is more frequent:

- each 20 field samples received within a case, or
- each 7 calendar day period during which field samples in a case are received (14 calendar days if requested by the client) beginning with the receipt of the first sample.

NOTE: The DOD-QSM and SC DHEC do not accept the SDG approach, unless the samples are prepared in a single batch. When a group of up to 20 field samples of a similar matrix are prepared as one batch, method-specified QC samples such as a method blank, laboratory control sample, matrix spike, matrix spike duplicate, and matrix duplicate must also be prepared together. If samples are batched together from different sites, project-specific QC must be processed.

3.10 Toxicity characteristics constituents and regulatory levels for TCLP

Constituent (mg/L)	**Chronic toxicity reference level (mg/L)**	**Regulatory level (mg/L)**
Arsenic	0.05	5.0
Barium	1.0	100.0
Cadmium	0.01	1.0
Chromium	0.05	5.0
Lead	0.05	5.0
Mercury	0.002	0.2
Selenium	0.01	1.0
Silver	0.05	5.0

3.**11** SC DHEC – South Carolina Department of Health and Environmental Control

Note: For samples submitted to meet the regulatory requirements of the SC DHEC, analyses have to be performed using Method 6010C.

3.8 DOD-QSM – Department of Defense Quality Systems Manual

4.0 <u>Interferences</u>

4.1 Spectral Interferences are caused by: (1) overlap of a spectral line from another element; (2) unresolved overlap of molecular band spectra; (3) background contribution from continuous or recombination phenomena; and (4) stray light from the line emission of high-concentration elements. Spectral overlap can be compensated for by computerized correction of the raw data after monitoring and measuring the interfering element. Unresolved overlap requires selection of an alternate wavelength. Background contribution and stray light can usually be compensated for by a background correction adjacent to the analyte line.

Users of simultaneous multi-element instruments must verify the absence of spectral interference from an element in a sample for which there is no instrument detection channel. Potential spectral interferences for the recommended wavelengths are given in the table in Attachment 1. The data are intended as rudimentary guides for indicating potential interferences; for this purpose, linear relations between concentration and intensity for the analytes and the interferences can be assumed.

4.1.1 The interference is expressed as analyte concentration equivalents (i.e., false analyte concentrations) arising from 100-mg/L of determined As (at 193,696 **η**m) in a sample containing approximately 10-mg/L of Al. According to Attachment 1, 100-mg/L of Al would yield a false signal for As equivalent to approximately 1.3-mg/L. Therefore, the presence of 10-mg/L of A1 would result in a false signal for As equivalent to approximately 0.13-mg/L. The user is cautioned that other instruments may exhibit somewhat different effects and must be evaluated individually since the intensities will vary with operating conditions, power, viewing height, argon flow rate, etc.

4.1.2 The dashes in Attachment 1 indicate that no measurable interferences were observed even at higher interference concentrations. Generally, interferences were discernible if they produced peaks, or background shifts, corresponding to 2 to 5% of the peaks generated by the analyte concentrations.

4.1.3 At present, information on the listed silver and potassium wavelengths is not available, but it has been reported that second-order energy from the magnesium 393.231 **η**m wavelength interferes with the listed potassium line at 766.491 **η**m.

4.2 Physical Interferences are effects associated with the sample nebulization and transport processes. Changes in viscosity and surface tension can cause significant inaccuracies, especially in samples containing high dissolved solids or high acid concentrations. If physical interferences are present, they must be reduced by diluting the sample, by using a peristaltic pump or by using the standard additions method. Another problem that can occur with high dissolved solids is salt buildup at the tip of the nebulizer, which affects aerosol flow rate and causes instrumental drift. The problem can be controlled by wetting the argon using a tip washer prior to nebulization or by diluting the sample. Also, it has been reported that better control of the argon flow rate improves instrument performance; this is accomplished with the use of mass flow controllers.

4.3 Chemical Interferences include molecular compound formation, ionization effects, and solute vaporization effects. Normally, these effects are not significant with the ICP technique. If observed, they can be minimized by careful selection of operating conditions (incident power, observation position, and so forth), by buffering of the sample, by matrix matching, and by standard addition procedures. Chemical interferences are highly dependent on matrix type and the specific analyte element.

4.4 The Thermo Jarrell Ash ICAP Trace Analyzer uses yttrium as an internal standard and takes into account any interference by ratioing the elements detected against the yttrium detected. All standards, blanks, and samples are spiked with yttrium.

5.0 Safety

5.1 Appropriate protective equipment and clothing must be used under the assumption that all samples are potentially hazardous. During sample preparation, safety glasses, gloves and lab coats are a minimum requirement. The persistent presence of noxious odors may be indicative of failure of the laboratory ventilation system and must be reported to a supervisor or manager.

5.2 Laboratory staff must review the Chemical Hygiene Plan for general safety policies and Material Safety Data Sheets (MSDS) for solvents and reagents used in the laboratory. The Chemical Hygiene Plan and MSDS are located in the Quality Assurance department.

6.0 Equipment and Supplies

6.1 Inductively coupled argon plasma emission spectrometer

6.1.1 Computer-controlled emission spectrometer with background correction

6.1.2 Radio frequency generator

6.1.3 Argon gas supply: Welding grade or better

6.2 Disposable sample tubes,

6.3 Automated pipette

6.4 Plastic screw-top bottles, various sizes

7.0 Reagents and Standards

Note: All standards and reagents are subject to change in vendor and in concentration. The Reporting Limits are also subject to change, but must remain at or above the Low Range Standard (LRS)/low-level continuing calibration verification (LLCCV), at the PQL.

Refer to the Standards/QC Preparation Log for Trace ICP (Attachment 2) for details of all standard preparations. Label each standard bottle with the lot number as described in the log.

7.1 Reagent Water-All water used during preparation should be reagent-grade Type I with regard to resistivity of > 10 megohm-cm (20th Edition of Standard Methods, Method 1080), and referred throughout this SOP as reagent water.

7.2 Concentrated acids – ultra high-purity grade

7.2.1 Hydrochloric acid (HCl), Caledon, Trace Metal Grade

7.2.2 Nitric acid (HNO_3), J.T. Baker, Instra-Analyzed® Reagent, or equipment

7.2.3 The same grade/purity of acids is to be used for all sample preparation, calibration standards, blanks, and QC samples.

7.3 Stock standard solutions – commercially available

7.3.1 The following table contains the stock standards used for ICP-AES analysis. Stock standard expiration dates are provided by the manufacturer.

Manufacturer	Standard
High Purity	SM-770-027 multi-element standard mix (RSTD-1)
High Purity	SM-770-028 part A multi-element standard mix (RSTD-2A)
High Purity	SM-770-028 part B multi-element standard mix (RSTD-2B)
High Purity	SM-770-029 part A multi-element standard mix (RSTD-3A)
High Purity	SM-770-029 part B multi-element standard mix (RSTD-3B)
High Purity	SM-770-030 multi-element standard mix (RSTD-4)
High Purity	SPEX-R multi-element standard mix
High Purity	ICP-AES-CRQL-R multi-element standard mix
EPA	ICV1 multi-element standard mix
EPA	ICSA multi-element standard mix
EPA	ICSB multi-element standard mix
High Purity	SM-770-031 multi-element standard mix (PDS-R)
High Purity	IRON (Fe) 10,000 PPM single-element standard
High Purity	CHROMIUM (Cr) 1,000 PPM single-element standard
High Purity	LEAD (Pb) 1,000 PPM single-element standard
High Purity	ARSENIC (As) 1,000 PPM single-element standard
High Purity	ZINC (Zn) 1,000 PPM single-element standard
High Purity	Internal Mix
High Purity**	XCL LCS 10XR multi-element mix
High Purity**	XCL 20R multi-element mix

7.4 Intermediate and working standards are prepared at the bench by the analyst as needed. Intermediate and stock standard expiration dates do not exceed the expiration date of the stock standards used.

7.5 Calibration standards are prepared as needed as described on the Standards/QC Preparation Log for Trace ICP.

8.0 Sample Preservation and Storage

8.1 Samples are preserved and stored according to the tables in Sample Control SOP 4.1, "Receiving Samples" and 4.6, "Storing Samples." Sample holding times are also listed.

8.2 All samples must be preserved to a pH <2 with HNO_3.

8.3 Samples must be digested and analyzed within 180 days of collection.

8.4 Soil samples must be stored under refrigeration at 4 ^{o}C ± 2 ^{o}C. Aqueous samples may be stored at ambient temperature.

8.5 After analysis residual digestate is maintained in the ICP room for three months then returned to the Custodian for storage until disposal into the acid waste stream.

9.0 Quality Control

9.1 Instrument Detection Limit (IDL)

9.1.1 IDLs are determined quarterly for each wavelength used for sample analyses.

9.1.2 Calculate the IDL for each analyte by multiplying by three, the average of the standard deviations calculated from the analysis of seven consecutive standard solutions (containing each analyte in reagent water) on three non-consecutive days (e.g., Monday, Wednesday, and Friday). The concentration of the standard analyzed should be at three to five times the most recently determined IDL values.

9.1.3 The IDL for each analyte must be less than the analyte reporting limit.

9.1.3.1 To meet the requirements of the DOD-QSM, the IDL must be less than or equal to the **LOD** for each analyte.

9.2 Linear Dynamic Range

9.2.1 The upper limit of the linear dynamic range for each ICP-AES instrument needs to be established for each wavelength used, by determining the signal response from a minimum of three, preferably five, different concentration standards across the range and must be verified every six months.

9.2.2 Analyze a high concentration standard, linear range standard (LRS), during a routine analytical sequence. This concentration is the upper limit of the ICP-AES linear range.

9.2.3 The recovery of the LRS must be within ± 10% of the expected value.

9.2.4 Samples with concentrations exceeding the linear range must be diluted.

9.2.5 For DOD-QSM and North Carolina compliance reporting, the linear range is defined by the highest calibration standard.

9.2.5.1 A high calibration standard that encompasses the concentration of the samples may be used to bracket the sample analyses. This high standard must meet the acceptance criteria in **Sections** 9.2.3 or 9.2.5.

9.3 Method Blank

9.3.1 A method blank is prepared in every batch of up to 20 samples and is carried through the entire sample preparation and analytical process. This blank is used to ascertain whether sample concentrations reflect contamination.

9.3.2 The method blank must contain absolute values of analyte concentrations below the reporting limit (PQL) or below the applicable action level. If the method blank concentrations exceed the reporting limit, the entire sample batch must be re-prepared along with a new method blank.

9.3.3 To meet the requirements of the DOD-QSM, the concentration of the target analytes in the method blank must be ≤ ½ the reporting limit.

9.3.4 For samples submitted for North Carolina compliance reporting, the concentrations of target analytes detected are reported between the MDL

and PQL with a "J" flag. Any analytes detected in preparation blanks cannot be > ½ the PQL.

9.4 Matrix Spike

9.4.1 One matrix spike/matrix spike duplicate (MS/MSD) pair or matrix spike/sample duplicate (depending on project requirements) must be prepared with each batch of up 20 samples.

9.4.2 If the sample spikes do not meet the acceptance criteria of 75-125% recovery, the corresponding element is flagged with an "N" on the Form 1 to indicate that the element did not recover in the matrix spike acceptably. A post-digestion spike is performed for those elements that fall outside the limit.

9.4.2.1 To meet the requirements of the DOD-QSM, the recoveries of the matrix spike should meet the LCS control limits of 80 – 120%.

9.4.3 The Relative Percent Difference (RPD) between the MS/MSD or sample and sample duplicate must be ≤ 20%. If the criteria is not met, the affected element is flagged with an "*" to indicate poor duplication of results.

9.4.3.1 To meet the requirements of the DOD-QSM, report the specific analytes in the original sample as estimated values if the matrix spike and duplicate sample criteria are not met.

9.5 Post Digestion Spike (PDS)

9.5.2.1 Prepare and analyze a PDS, if matrix spike recovery criteria are not met. The spike addition should result in a value that is 2x the **RL**.

9.5.2.2 The PDS results should be within 75% to 125% for Method 6010B and within 80% to 120% for Method 6010C. If not, the data are reported and discussed in the SDG narrative.

9.6 Laboratory Control Sample

9.6.1 A Laboratory Control Sample (LCS) is prepared with every digestion batch of up to 20 samples.

9.6.2 The manufacturer supplies the certified acceptance limits for the solid LCS. A recovery limit of 80 – 120% is required for the aqueous LCS. If the LCS falls outside these control limits, the analysis must be terminated, the problem corrected, and the samples associated with that LCS re-digested and reanalyzed.

9.6.2.1 To meet the requirements of the DOD-QSM, the LCS recoveries must be within 80 – 120% of the expected result.

9.7 Serial Dilution

9.7.1 One serial dilution must be performed for each batch.

9.7.2 Prepare a 5x dilution on a sample with an analyte concentration ≥ 50x of the instrument detection limit in the original sample. The results of the dilution must then agree within ± 10% of the original sample results. If the dilution does not met this criteria, then flag the appropriate elements with an "E" to indicate that interference exists. **The "E" flag is not used for DOD-QSM analyses. Refer to the DOD-QSM "J" flag.**

9.7.2.1 To meet the requirements of the DOD-QSM, a PDS must be prepared and analyzed when the serial dilution acceptance criteria are not met or all sample analyte concentrations are less than 50 times the L**OD**.

9.8 Field and/or Equipment Blanks

9.8.1 Samples identified as field and/or equipment blanks should not be used for sample spike, duplicate, or serial dilution analysis. They are supplied to the laboratory at the discretion of the client.

9.9 Contingency

9.9.1 If due to a lab accident or to QC failures, a re-preparation and analysis are required for the sample and insufficient sample volume remains, the Project Manager must be alerted and will contact the client for direction on how to proceed.

9.9.2 If persistent contamination occurs in the laboratory, analysis must be halted until the source of the contamination can be identified and isolated. When the contamination issue is resolved, samples analysis may proceed.

9.9.3 Any other issues that potentially effect data quality should also be addressed with the Project Manager.

10.0 Calibration and Standardization

10.1 For Method 6010C, a lower limit of quantitation check (LLQC) is analyzed after the PQL is determined and on an as-needed basis to demonstrate the desired detection capability. The LLQC and the Low Range Standard (LRS) are prepared at the same concentration. The only difference is that the LLQC is carried through the entire sample preparation and analytical procedure. Lower limits of quantitation are verified when all analytes in the LLQC are detected within ± 30% of their true values.

10.1.1 The LRS, for Method 6010B, is a standard at the **RL**, with advisory acceptance criteria of ± 50%.

10.1.2 To meet the requirements of the DOD-QSM, the recovery of each analyte in the LRS **(LLICV)** must fall within ± 20% of the expected value.

10.2 The instrument calibration standards are analyzed at the beginning of the analytical sequence and entered on the Trace ICP run log (Attachment 3). Calibration is further discussed in the Procedure section that follows.

10.3 Initial Calibration

10.3.1 The initial calibration consists of a zero concentration standard or calibration blank (ICB) and calibration standard. The analytes are divided into the following four standard solutions and analyte concentrations:

Standard Name	Analyte – concentration in µg/L
RSTD-1	Cd, Cr, Cu, Pb, Ni, Se, Tl, and Zn = 2,000; Ag = 200,
RSTD-2	As, Ba, Be, Co, Mn, Mo, and V = 2,000; Fe = 50,000
RSTD-3	K, Na, Al, Mg, and Ca = 100,000
RSTD-4	Sn, Bi, Ti, Sb, and B = 2, 000

10.3.2 The calibration blank consists of 5% HCl and **1**% HNO_3 in reagent water.

10.3.2.1 A calibration blank is analyzed as part of both the initial calibration (ICB) and continuing calibration (CCB).

10.4 Initial Calibration Verification (ICV)

10.4.1 The ICV consists of second source mid-level calibration standard.

10.4.1.1 For Method 6010C, a low-level initial calibration verification (LLICV) standard is also prepared, at the **RL**, and is from the same source as the **calibration standard**.

10.4.2 The EPA ICV1 solution is used to prepare the ICV and LLICV standards and contain all of the standards in the table in section 10.3.

10.4.3 The results of the ICV must agree within ± 10% of the true value for each component. If this criterion is not met, terminate the run and re-calibrate the instrument. If the re-calibration does not produce acceptable ICV results, shut down the instrument and perform instrument maintenance.

10.4.3.1 The suggested acceptance criterion for the LLICV is ± 30% of its true vale.

10.4.3.2 To meet the requirements of the DOD-QSM, the recovery of each analyte in the LLICV must fall within ± 20% of the expected value.

10.4.4 Follow the ICV/LLICV with the ICB. The absolute value of the blank must be less than the laboratory reporting limit (PQL). If not, repeat the blank analysis. If still above the reporting limit, terminate the analysis and recalibrate. If re-calibration does not produce acceptable ICB results, shut down the instrument and perform instrument maintenance.

10.**4**.4.1 To meet the requirements of the DOD-QSM, the analyte concentration in the ICB must be ≤ LOD.

10.5 Continuing Calibration Verification (CCV)

10.5.1 The CCV consists of a calibration blank (CCB) and a continuing calibration standard. The continuing calibration standard consists of the same standard solutions presented in **Section** 10.3. The concentrations of the analytes is ½ that of the initial calibration standard.

10.5.1.1 For Method 6010C, a low-level continuing calibration verification (LLCCV) standard is also prepared, at the **RL**, and is from the same source as the **calibration standard**. It is analyzed every 19 samples and at the end of the analytical run.

10.5.2 Verify the calibration every 10 samples and at the end of analytical run.

10.5.3 The results of the CCV must agree within ± 10% of the expected value. If not, terminate the analysis, correct the problem, and recalibrate the instrument.

10.**5**.3.1 The suggested acceptance criterion for the LLICV is ± 30% of its true vale.

10.5.4 A CCB must be analyzed at each wavelength used for analysis immediately after every continuing calibration standard and every 10 samples.

10.5.5 The acceptance criteria stated in **Sections** 10.4.4 and 10.4.4.1 also apply to the CCB.

10.6 Interference Check Sample (ICS)

10.6.1 The ICS consists of the ICSA and ICSAB solutions. Analyze the ICSA and ICSAB consecutively at the beginning the analytical run.

10.6.2 The results of the ICS must agree within ± 20% of the accepted values **or 2X the RL, whichever is greater**. If not terminate the analysis and recalibrate the instrument. If re-calibration does not fix the problem, shut down the instrument and perform instrument maintenance.

10.6.2.1 To meet the requirements of the DOD-QSM, the absolute value of the concentration of all the non-spiked analytes in the ICS-A must be < LOD (unless the analyte is a verified trace impurity from one of the spiked analytes).

11.0 <u>Procedure</u>

Documentation must follow the requirements in Quality Control SOP 13.6, "Proper Documentation Procedures".

11.1 TJA Trace Analyzer Set Up and Operating Procedure

11.1.1 Cooling Water

11.1.1.1 Turn on the recirculation pump. Thirty (30) psig is required at a flow rate of 700 mL/min.

11.1.2 Argon Supply

11.1.2.1 Open the argon supply to the instrument.

11.1.2.2 A volume rate of 30 SCFH and delivery pressure of 60 psig is required.

11.1.3 Venting System

11.1.3.1 A permanent vent has been installed to provide a proper draft in the torch compartment. A torch fan is permanently installed to force a 22 mph-draft across the end of the plasma torch.

11.1.4 Water in Drain Barrel

11.1.4.1 A hose is connected to the drain outlet from the spray chamber to allow the flow of unused sample waste from the chamber. This drain line acts as a positive seal to the spray chamber; therefore, liquid must always be present in the drain line.

11.2 Power Up (TJA Trace Analyzer)

11.2.1 To start the ICP Trace Analyzer, turn on the video display, the printer, the computer, and the autosampler.

11.2.2 At the "C" prompt, Type "P" and press “ENTER.” This will start the Thermospec™ software and bring up the main menu.

11.2.3 To start the RF generator and the plasma torch, select “SETUP.” Then select “PLASMA CONTROL PANEL” and press “ENTER.” Select “F1.”

11.2.4 The default startup time, during which argon purges the spray chamber and the plasma torch, is 90 seconds. The purge time can be reduced to as little as 20 seconds by pressing “PURGE TIME” if the plasma has been off for less than 15 minutes.

11.2.5 After the purge time and power have been set, the automated plasma startup sequence is initiated by pressing “CONTINUE.”

11.2.6 If the pump and gas have not been started, select "F2" and start the pump rate at 99 RPM and switch the nebulizer gas to "ON."

11.2.7 The total flush time and rinse time between samples is set at 60 seconds.

11.2.8 Press "LEVELS" if you want to change any of the plasma operating conditions.

11.2.9 The plasma torch should be allowed to run for at least 30 minutes after ignition to reach optimum stability.

11.2 Analysis

11.2.1 Profile

11.2.1.1 Profiling the instrument assures that the optical pathway is clean and in alignment. Emission intensities are essential to accurate data.

11.2.1.2 At the THERMOSPEC main menu, select setup and highlight profile then enter.

11.2.1.3 Begin aspirating 1 ppm As standard for analysis.

11.2.1.4 Press F3 to Automatic Profile. When the sample is sufficiently saturating the spray chamber and torch (60 seconds), press "F1", "RUN".

11.2.1.4.1 At the end of the integration, a peak graph will be displayed. Note the intensity reading. This will indicate a need to clean the optical path or adjust the alignment.

11.2.1.4.2 Also note the peak position on the graph. This value should be between ± 0.**2**. If it is not, the spectrum shifter must be adjusted, and the profile rerun. Continue this process until the peak position is acceptable.

11.2.1.5 Discontinue the arsenic when profiling is complete. Exit profile to the main menu.

11.3 Autosampler Table Setup

11.3.1 Obtain all data necessary from each case that will be set up on the run, i.e. preparation logs, log-in chain of custody reports from the LIMS. The information contained on these sheets will be used to create the autosampler table.

11.3.2 From the main menu of Thermospec, select "OPERATION," and then "Autosampler Setup," then press enter. The software will prompt for an autosampler table name. An existing table can be edited from this point, or a new autosampler table name can be typed in at this point. Press enter. Press F3 "Add Set." Enter the appropriate run parameters to be used. Parameters that should always be entered here are Method Name, Rinse Time (60 seconds), # of Unknowns in this set, Default Limit Check Table Name (Sample). Press the F1 "EdSamples" key. This will allow for sample IDs to be entered.

11.3.3 Under the column titled "Sample Name," enter the CompuChem sample ID. Be certain the proper check table is selected for each analysis that is assigned. The "F" key allow for various modifications to the autosampler table. Use these keys as necessary. It is very important that the proper QC samples be inserted into the table at the necessary frequencies. See section 9.0 for a description of necessary QC and frequencies.

11.3.4 Also, if the "Alt" key on the keyboard is pressed, additional options will appear. One of these options is "EdSampInfo." This option is selected by pressing the "Alt" key and the "F2" key simultaneously. From this screen, additional comments can be added that will appear on the raw data printout. Under the column titled "Comment," the SDG, client sample ID and dilution of the sample should be entered.

11.3.5 When all entries are finished, press the "F9," Done/Keep key to save the table. It is important to remember the name of the table created, as this will be used to start the analysis.

11.3.6 Create a configuration file to store all analytical data. From the main menu of THERMOSPEC select "SETUP" and highlight "CONFIGURATION." Press "Enter" twice then "F9" four times. This will provide the screen to enter the configuration file name. Configuration file names should identify the analyst and the date of the analysis, as well as the instrument being used (P3 or P4). Use the following scheme (iimmdd) to construct the file name. The letter "i" for initials, the "m" for

the month, and the letter "d" for the day. If there are more runs in a day, letters of the alphabet are used as a suffix. In this example: P3JC0922B, identifies a third run on September 22 by analyst JC on instrument P3. JUNK files should be used between analyses to prevent files from being corrupted with other data.

11.3.7 Proceed to analysis. From the main menu of THERMOSPEC select "OPERATION." Highlight "ANALYSIS" then "Enter." Confirm that the correct method is being used and select the autosampler table to be used. Continue to follow on-screen instructions to initiate the run.

IMPORTANT: If the run should fail at any time, remember to change the configuration file name before restarting the analytical run.

11.4 Standardization and Analysis

11.4.1 Start autosampler table and follow the instructions.

11.4.1.1 Select "Operation" and highlight "Analysis."

11.4.1.2 Enter the correct method of analysis and select the autosampler table for samples to be analyzed.

11.4.2 Solid samples and liquid samples have different matrices due to sample preparation procedures. Calibration standards and quality control standards should be prepared to match the matrix of the samples being analyzed. While constructing autosampler tables, give consideration to the matrix of the samples.

11.4.3 Fill all standards cups and QC cups with the appropriate solutions and enter the information on the Trace ICP Run Log (Attachment 3.) The autosampler table provides the information for cup positions. Standards cups positioning may change depending on the number of samples.

Caution: Accuracy of the sequence setup is extremely important. Improper cup positioning will seriously affect analysis to the point that there may not be any salvageable data.

11.4.4 Press "F1" to begin the analytical run.

Caution: Sample racks should be loaded accurately following the rows and positions provided by the autosampler table.

Samples in the wrong position can produce erroneous data that may not be detectable.

11.4.5 Although, software drives the instrument operation, if possible the instrument should not be left completely unattended. In the course of the run, matrix spike analyses must be evaluated to determine percent recoveries. Some samples will have concentrations of analytes that are beyond the established linear ranges and will need to be diluted and reanalyzed within those ranges. For samples submitted for North Carolina compliance reporting, dilutions and re-analyses are required whenever target analytes exceed the highest calibration standard. Serial dilution analyses should be evaluated for proper dilution. Responding to the need for dilutions or a PDS analysis quickly within the same analytical run saves time by not requiring an additional run and improves productivity.

11.4.6 Attention should be given to the QC analyses. Analytes may be found to be outside of their established control limits. The loss of one or more analytes does not necessarily mean the run has ended. Early detection of failed analytes by the analyst will prevent lost time and productivity.

11.4.7 Standards cups have limited capacity and should be filled frequently and monitored at all times.

11.4.8 The analytical run is not complete until all final paperwork is complete. The run log must be completed by the analyst and the QC/Standards Preparation log completed for the day, as well as completing the internal chain of custody form (Attachment 4).

11.5 Transferring Data

11.5.1 At the completion of the analytical run, exit analysis and return to the THERMOSPEC main menu. Change the configuration file name.

11.5.2 Exit THERMOSPEC and return to Desktop. Double-click on the Explorer icon. While in Explorer, open the STATION directory in the left column, and then open the BIN directory. In the right column, find the name of the file from the analytical run that was just finished. Next, find the MARRS directory in the left column and open that directory. Click on the file name in the right column and copy it to the appropriate directory in MARRS (P3 ICP Trace Files or P4 ICP Trace Files.) Explorer can then be closed.

11.5.3 Transfer the file to the computer used to run the **ICP Checker** program. The **ICP Checker** function combines two pages of data onto one page. **The run log is also generated at this time.**

11.6 Instrument Shutdown

11.6.1 TJA Trace Analyzer (P3 or P4)

11.6.1.1 Aspirate reagent water for approximately one minute.

11.6.1.2 From the MAIN MENU go to SETUP and PLASMA CONTROL PANEL and press enter.

11.6.1.3 Press F7 for PLASMA SHUT off.

11.6.1.4 Remove pump tubing from peristaltic pumps.

12.0 Data Analysis and Calculations

Calculations must be consistent with the Quality Control SOP 13.4, "Numerical Data Reduction".

12.1 Calculation of the mean or average of a set of values:

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

where: n = total number of values
x_i = each individual value used to calculate the mean
x = the mean of n

12.2 Calculation of the standard deviation of a set of values:

$$Standard\ deviation = \sqrt{\frac{\sum_{i=1}^{n}\left(X_n - \overline{X}\right)^2}{n-1}}$$

12.3 Calculation of percent recovery:

12.3.1 LCS and surrogates:

$$\%R = \frac{Amount\ found}{Amount\ spiked}\ x\ 100$$

12.3.2 Matrix spikes:

$$\%\ R = \frac{Amount\ in\ spiked\ sample - Amount\ in\ unspiked\ (native)\ sample}{Amount\ spiked}\ x\ 100$$

12.4 Calculation of % RSD

$$\%RSD = \left(\frac{Standard\ deviation}{\overline{X}}\right) \times 100$$

12.5 Calculation of RPD

$$RPD = \frac{|Value\ 1\ -\ Value\ 2|}{(Value\ 1\ +\ Value\ 2)/2}\ x100$$

12.6 Calculation of %Difference (%D)

$$\%Diff = \frac{Value\ -\ \overline{Reference\ \ value}}{\overline{Reference\ \ value}}\ x\ 100$$

12.7 Calculating Dilutions

12.7.1 If a sample concentration exceeds the linear range of the instrument, a dilution reanalysis must be performed. For samples submitted for DOD-QSM and North Carolina compliance reporting, dilutions and re-analyses are required whenever target analytes exceed the highest calibration standard.

12.7.2 Determine a level of dilution that will result in a value within the upper half of the linear range or, for samples submitted for DOD-QSM and North Carolina compliance reporting, within the upper half of the calibration range. This is an acceptable dilution.

12.7.3 A 10x dilution is performed using 1-mL sample plus 9-mL diluent for a total volume of 10 mL. It should be recorded on the run log as “10x (1 mL in 10 mL).”

12.8 Concentration

12.8.1 All results for aqueous samples are reported in µg/L as follows.

$$\text{Concentration } (\mu g/L) = \frac{C \times V \times D}{W}$$

Where: C = Concentration (µg/L) from curve
V = Final volume of digestate (L)
W = Volume of sample (L)
D = Dilution factor

12.8.2 All results for solid samples are reported in mg/Kg as follows.

12.8.2.1 A separate determination of percent solids must be performed.

12.8.2.2 The concentration determined in the digestate is to be reported on the basis of the dry weight of the sample.

$$\text{Concentration (mg/Kg)} = \frac{C * V}{W * S}$$

Where: C = Concentration (µg/L)
V = Final volume of digestate (L)
W = Weight of wet sample (gm)
S = % Solid / 100
D = Dilution factor

13.0 Method Performance

This method was validated through in-house laboratory studies of method detection limits, instrument detection limits, and precision and accuracy for single analyst. The data are retained by the QA department.

14.0 Pollution Prevention

The solvents used in this procedure pose little threat to the environment when recycled and managed properly. Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The EPA has established a preferred hierarchy of environmental management techniques that places

pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency recommends recycling as the next best thing. See SOP 12.1, "Hazardous Waste Disposal" requiring laboratory procedures for recycling waste streams.

15.0 Waste Management

It is the laboratory's responsibility to comply with all federal, state, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions, and to protect the air, water, and land by minimizing and controlling all releases from fume hoods and bench operations. Compliance with all sewage discharge permits and regulations is also required.

Samples preserved with HCl, HNO_3, or H_2SO_4 to pH <2 are hazardous and must be handled as hazardous waste.

Refer to the Hazardous Waste Management and Safety SOPs located in the lab.

16.0 References

16.1 "Test Methods for Evaluating Solid Wastes: Physical/Chemical Methods", SW-846, 3rd Edition, Update III, 12/96, Method 6010B, Update IV, February 2007, Method 6010C, Revision 3

16.2 Standard Methods for the Examination of Water and Wastewater, 20th (1998) Edition, Method 1080

16.3 Code of Federal Register, 40 CFR, Part 136, "Guidelines for Establishing Test Procedures for Priority Pollutants"

16.4 Quality Control SOP 13.6, "Proper Documentation Procedures"

16.5 Quality Control SOP 13.4, "Numerical Data Reduction"

16.6 NELAC Standards, effective July 2003**, plus revisions**

16.7 EPA QA/G6: Guidance for the Preparing of Standard Operating Procedures (SOPs) EPA/600/B-07/001, April 2008.

16.8 CompuChem Quality Manual, Revision **13**, **November 17, 2009, plus revisions**

16.9 Sample Control SOP 4.6, "Storing Samples"

16.10 TJA Trace Analyzer Set-up and Operating Manual

16.11 Department of Defense Quality Systems Manual of Environmental Laboratories, Version **4.1**, **April 22, 2009**

17.0 Attachments as Tables, Diagrams, and Flowcharts

17.1 Attachment 1 – Analyte Concentration Equivalents Arising from Interference at the 100 mg/L Level

17.2 Attachment 2 – **Example** Daily Standards/QC Preparation for Trace ICP (P3&P4)

17.3 Attachment 3 – Example Trace ICP Run Log (P3)

17.4 Attachment 4 – **Example** Internal Chain of Custody for Metals Analysis

17.5 Attachment 5 – Target Analytes

Attachment 1

Analyte Concentration Equivalents Arising from Interference at the 100-mg/L Level

Analyte	Wavelength (ηm)	Al	Ca	Cr	Cu	Fe	Mg	Mn	Ni	Tl	V
Aluminum	308.215	--	--	--	--	--	0.21	--	--	_--	1.4
Antimony	206.833	0.47	--	2.9	--	0.08	--	--	--	0.25	0.45
Arsenic	193.696	1.3	--	0.44	--	--	--	--	--	--	1.1
Barium	455.403	--	--	--	--	--	--	--	--	--	--
Beryllium	313.042	--	--	--	--	--	--	--	--	0.04	0.05
Boron	249.773	0.04	--	--	--	0.32	--	--	--	--	--
Cadmium	226.502	--	--	--	--	0.03	--	--	0.02	--	--
Calcium	317.933	--	--	0.08	--	0.01	0.01	0.04	--	0.03	0.03
Chromium	267.716	--	--	--	--	0.003	--	0.004	--	--	0.04
Cobalt	228.616	--	--	0.03	--	0.005	--	--	0.03	0.15	--
Copper	324.754	--	--	--	--	0.003	--	--	--	0.05	0.02
Iron	259.940	--	--	--	--	--	0.12	--	--	--	--
Lead	220.353	0.17	--	--	--	--	--	--	--	--	--
Magnesium	231.604	--	0.02	0.11	--	0.13	--	0.25	--	0.07	0.12
Manganese	196.026	0.005	--	0.01	--	0.002	0.002	--	--	--	--
Molybedenum	202.030	0.05	--	--	--	0.03	--	--	--	--	--
Nickel	279.079	--	--	--	--		--	--	--	--	--
Selenium	257.610	0.23	--	--	--	0.09	--	--	--	--	--
Silicon	288.158	--	--	0.07	--	--	--	--	--	--	0.01
Sodium	588.995	--	--		--	--	--	--	--	0.08	--
Thallium	190.864	0.30	--		--	--	--	--	--	--	--
Vanadium	292.402	--	--	0.05	--	0.005	--	--	--	0.02	--
Zinc	213.856	--	--	--	0.14	--	--	--	0.29	--	--

[a] Dashes indicate that no interference was observed even when interferents were introduced at the following levels:

Al, Ca, Mg - 1000 mg/L; Ca, Fe - 1000 mg/L; Cr, Cu, Mn, Tl, V - 200 mg/L

[b] The figures recorded as analyte concentrations are not the actual observed concentrations; to obtain those figures, add the listed concentration to the interferent figure.

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Attachment 2

Daily Standards/QC Preparation Log for Trace ICP (P3 & P4) 1 of 3 CompuChem a division of Liberty Analytical Corp. **Worksheet 1 P(6) 2**

STANDARDS and REAGENTS TRACEABILITY

Seq. File Name:_____

	Ref #*	Manufacturer	Lot #	Expiration Date
HNO_3 [Baker Instra-analyzed Trace-Metals grade]		JT Baker		
HCl [Baker Instra-analyzed Trace-Metals grade]		Caledon		
SM-770-027 multi-element standard mix (RSTD-1)	9G08002	High Purity	0916328	06/15/10
SM-770-028 part A multi-element standard mix (RSTD-2A)	9J22002	High Purity	0928011	10/12/2010
SM-770-028 part B multi-element standard mix (RSTD-2B)	9J22001	High Purity	0928012	10/12/2010
SM-770-029 part A multi-element standard mix (RSTD-3A)	9G08004	High Purity	0805135	04/16/10
SM-770-029 part B multi-element standard mix (RSTD-3B)	9G08005	High Purity	0906204	10/16/10
SM-770-030 multi-element standard mix (RSTD-4)	9G08001	High Purity	0916327	06/15/10
SPEX-R multi-element standard mix	0A04007	High Purity	0916301	06/15/10
ICP-AES-CRQL-R multi-element standard mix	9I04002	High Purity	0923808	08/28/10
ICV1 multi-element standard mix	0B04003	EPA	0307	02/04/11
ICSA multi-element standard mix	0B04002	EPA	1206	02/04/11
ICSB multi-element standard mix	0B04001	EPA	0203	02/04/11
SM-770-031 multi-element standard mix (PDS-R)	9I22001	High Purity	0926418	09/17/10
ARSENIC (As) 1,000 PPM single-element standard	9F17001	High Purity	0911221	12/05/10
Internal Mix	0B04004	High Purity	0934101	12/10/10
SM-770-040 multi-element CCV mix (Soln A)	9F09004	High Purity	0912103	05/01/10
SM-770-040 multi-element CCV mix (Soln B)	9F09004	High Purity	0912104	05/01/10
SM-770-042 (LRS 6010B)	0B23007	High Purity	1004021	02/10/11

Multi-Element Stock Standard Concentrations:

Stock Standard	Analyte Concentrations (µg/mL)
RSTD-1 multi-element standard mix	Cd:1,000 Cr:1,000 Cu:1,000 Pb:1,000 Ni:1,000 Se:1,000 Ag:100 Tl:1,000 Zn:1,000
RSTD-2A/2B multi-element standard mix	Part A: As:1,000 Ba:1,000 Be:1,000 Co:1,000 Mn:1,000 Mo:1,000 V:1,000 Part B: Fe:25,000
RSTD-3A/3B multi-element standard mix	Part A: Ca:10,000 Mg:10,000 K:10,000 Na:10,000 Part B: Al:10,000
RSTD-4 multi-element standard mix	Sb:1,000 Bi:1,000 B:1,000 Sn:1,000 Ti:1,000
SPEX-R multi-element standard mix	Mo:1,000 Sn:1,000 Bi:1,000 Ti:1,000 B:1,000
ICP-AES-CRQL-R multi-element standard mix	Ag:10 Be:5 Cd:5 Co:50 Cr:10 Cu:25 Mn:15 Ni:40 Tl:25 V:50 Zn:60 Pb:10 Se:35 As:10 Sb:60
PDS-R multi-element standard mix	Al:400 Ba:400 Ag:20 Be:10 Cd:10 Co:100 Cr:20 Cu:50 Fe:200 Mn:30 Ni:80 Tl:20 V:100 Zn:40 Pb:6 Se:10 As:20 Sb:120
Internal Mix	Li:50,000 Y:250
LRS 6010B multi-element standard mix	Al: 20 Sb:1 As:1 Ba:20 Be:0.5 Bi:2 B:2 Cd:0.5 Ca:500 Cr:1 Co:0.5 Cu:0.5 Fe:10 Pb:0.3 Mg:500 Mn:1 Mo:2 Ni:0.5 K:500 Se:0.5 Ti:0.5 V:2 Zn:2

Entered By: _____

Reviewed By: _____ Date: _____

*Ref# = Logbook ID, Page number, and item number from Materials Receipt Log

03/25/10: jcf

**High Purity is abbreviated "HP" on reporting forms

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Attachment 2 (continued)

Daily Standards/QC Preparation Log for Trace ICP (P3 & P4) 2 of 3 CompuChem a division of Liberty Analytical Corp. **Worksheet 1 P(6) 2**

Standard Lot Number*	LIMS ID Number	Preparation instructions	Resultant Analyte Conc. (µg/L)
S0/ICB/CCB–		Place in a 500 mL volumetric flask: 100 mL deionized water, 20 mL concentrated HNO_3, and 100 mL concentrated HCl. Bring up to volume with deionized water. Transfer to a 2L Teflon bottle and add 1.5L deionized water. Final volume 2 L. Prepare as needed.	N/A
RSTD-1–		In a 200 mL volumetric flask, combine 150 mL deionized water, 2 mL concentrated HNO_3, and 10 mL concentrated HCl. Pipet 0.4 mL RSTD-1 into flask. Bring up to 200 mL volume with deionized water. Prepare as needed.	Cd:2,000 Cr:2,000 Cu:2,000 Pb:2,000 Ni:2,000 Se:2,000 Ag:200 Tl:2,000 Zn:2,000
RSTD-2–		In a 200 mL volumetric flask, combine 150 mL deionized water, 2 mL concentrated HNO_3, and 10 mL concentrated HCl. Pipet 0.4 mL each RSTD-2A and RSTD-2B into flask. Bring up to 200 mL volume with deionized water. Prepare as needed.	As:2,000 Ba:2,000 Be:2,000 Co:2,000 Fe:50,000 Mn:2,000 Mo:2,000 V:2,000
RSTD-3–		In a 200 mL volumetric flask, combine 150 mL deionized water, 2 mL concentrated HNO_3, and 10 mL concentrated HCl. Pipet 2.0 mL each RSTD-3A and RSTD-3B into flask. Bring up to 200 mL volume with deionized water. Prepare as needed.	K:100,000 Na:100,000 Al:100,000 Mg:100,000 Ca:100,000
RSTD-4–		In a 200 mL volumetric flask, combine 150 mL deionized water, 2 mL concentrated HNO_3, and 10 mL concentrated HCl. Pipet 0.4 mL RSTD-4 into flask. Bring up to 200 mL volume with deionized water. Prepare as needed.	Sn:2,000 Bi:2,000 Ti:2,000 Sb:2,000 B:2,000
ICV1–		Place in a 500 mL volumetric flask: 300 mL deionized water, 5 mL concentrated HNO_3 and 25 mL concentrated HCl. Pipet 50.0 mL ICV1 into flask and 0.55 mL Compuchem SPEX-R. Bring up to volume with deionized water. Transfer to a 500 mL Teflon bottle. Final volume 500 mL. Prepare as needed.	Al:2,521 Ba:497 K:10,021 Mg:6,074 Na:10,097 Ca:10,026 Ag:501 Be:495 Cd:496 Co:499 Cr:490 Cu:492 Fe:5,082 Mn:499 Ni:503 Tl:1,028 V:501 Zn:1,025 Pb:1002 Se:1,029 As:999 Sb:994 Mo:1,100 Sn:1,100 Bi:1,100 Ti:1,100 B:1,100
CCV/CVS1–		Place in a 500-mL volumetric flask: 300 mL deionized water, 20 mL concentrated HNO_3 and 100 mL concentrated HCl. Add 50 mL of SM-770-40 Soln A and Soln B. Bring up to volume with deionized water. Transfer to a 2000mL Teflon bottle and add 1.5 L of deionized water. Prepare as needed.	Al:50,000 Ba:1,000 K:50,000 Mg:50,000 Na:50,000 Ca:50,000 Ag:100 Be:1,000 Cd:1,000 Co:1,000 Cr:1,000 Cu:1,000 Fe:25,000 Mn:1,000 Ni:1,000 Tl:1,000 V:1,000 Zn:1,100 Pb:1,000 Se:1,000 As:1,000 Mo:1,000 Sn:1,000 Bi:1,000 Ti:1,000 Sb:1,000 B:1,000
LRS-		In a 500 mL volumetric flask, combine 200 mL deionized water, 5 mL concentrated HNO_3 and 25 mL concentrated HCl. Pipet 5.0 mL of LRS 6010B. Bring up to volume with deionized water and transfer to a 500 mL Teflon bottle. Final volume 500 mL. Prepare as needed.	Al:200 Ba:200 K:5,000 Mg:5,000 Na:5,000 Ca:5,000 Ag:5 Be:5 Cd:5 Co:10 Cr:10 Cu:5 Fe:100 Mn:10 Ni:5 Tl:10 V:20 Zn:20 Pb:3 Se:5 As:10 Mo:20 Sn:20 Bi:20 Ti:20 Sb:10 B:20

Standard Solutions Prepared By: _____

Entered By: _____

Reviewed By: _____ Date: _____

*Standard Lot Number consists of standard ID, date prepared, and initials of preparer. 03/25/10: jcf

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Attachment 2 (continued)

Daily Standards/QC Preparation Log for Trace ICP (P3 & P4) 3 of 3 CompuChem a division of Liberty Analytical Corp. **Worksheet 1 P(6) 2**

Standard Lot Number*	LIMS ID Number	Preparation instructions	Resultant Analyte Conc. (µg/L)
As-		In a 100 mL volumetric flask, combine 50 mL deionized water, 1 mL concentrated HNO_3, 5 mL concentrated HCl, and 0.1 mL 1000-ppm As standard. Bring to final 100 mL volume	As:1,000
ICSA-		In a 500-mL volumetric flask, combine 350 mL deionized water, 5 mL concentrated HNO_3, and 25 mL concentrated HCl. Pipet 50.0 mL ICSA into flask. Bring up to volume with deionized water and transfer to a 500mL Teflon bottle. Final volume 500 mL.	Al:244,100 Ba:2 Ca:234,900 Co:4 Cr:43 Cu:23 Fe:95,600 Mg:247,500 Mn:19 Ni:21 Zn:28 Pb:10
ICSAB-		In a 500-mL volumetric flask, combine 350 mL deionized water, 5 mL concentrated HNO_3, and 25 mL concentrated HCl. Pipet 50.0 mL ICSA and 50.0 mL ICSB into flask. Add 0.5 mL Compuchem SPEX-R. Bring up to volume with deionized water and transfer to a 500mL Teflon bottle. Final volume 500 mL.	Ag:206 Al:241,100 Ba:495 Be:475 Ca:231,100 Cd:940 Co:461 Cr:511 Cu:548 Fe:94,800 Mg:251,100 Mn:502 Ni:984 Tl:103 V:494 Zn:1028 Pb:61 Se:53 Sb:589 As:101 Sn:1,000 Bi:1,000 Mo:1,000 Ti:1,000 B:1,000
EPA-CRI-		In a 500 mL volumetric flask, combine 300 mL deionized water, 5 mL concentrated HNO_3 and 25 mL concentrated HCl. Pipet 0.50 mL ICP-AES-CRQL-R and 25 µL Compuchem SPEX-R into flask. Bring up to volume with deionized water and transfer to a 500mL Teflon bottle. Final volume 500 mL. Prepare as needed.	Ag:10 Be:5 Cd:5 Co:50 Cr:10 Cu:25 Mn:15 Ni:40 Tl:25 V:50 Zn:60 Pb:10 Se:35 As:10 Sb:60 Sn:50 B:50 Mo:50 Bi:50 Ti:50
P3RINSE-		In a 10 L container, combine 8 L deionized water and 400 mL concentrated HNO_3 Fill with deionized water. Final volume 10 L.	N/A
P4RINSE-		In a 10 L container, combine 8 L deionized water and 400 mL concentrated HNO_3 Fill with deionized water. Final volume 10 L.	N/A
P5RINSE-		In a 10 L container, combine 8 L deionized water and 400 mL concentrated HNO_3 Fill with deionized water. Final volume 10 L.	N/A
P3INTSTD-		In a 10 L container, combine 8 L deionized water, 400 mL concentrated HNO_3, and 200 mL Internal Mix. Fill with deionized water. Final volume 10 L.	Li:1,000,000 Y:5,000
P4INTSTD-		In a 10 L container, combine 8 L deionized water, 400 mL concentrated HNO_3, and 200 mL Internal Mix. Fill with deionized water. Final volume 10 L.	Li:1,000,000 Y:5,000
P5INTSTD-		In a 10 L container, combine 8 L deionized water, 400 mL concentrated HNO_3, and 200 mL Internal Mix. Fill with deionized water. Final volume 10 L.	Li:1,000,000 Y:5,000

Standard Solutions Prepared By: _____

Entered By: _____

Reviewed By: _____ Date: _____

*Standard Lot Number consists of standard ID, date prepared, and initials of preparer.

03/25/10: jcf

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Attachment 3

Daily Instrument **Maintenance:** _____

Nebulizer pressure: _____
Peak position: _____
Peak intensity: _____
Vernier position: _____

Printed:

Method(s (circle **ILM05.4** **6010B** **6010C** **Other** _____

Operator(s) _____ **Date/Time** _____ **to** _____

↑	Specified element(s) fail(s) high
↓	Specified element(s) fail(s) low
RR	Re-run sample(s) neat
RR #X	Re-run at a #-fold dilution
#X	Sample run at a #-fold dilution (aliquot of sample diluted with acidified water)
L	Matrix = leachate
W	Matrix = water
S	Matrix = solid
B	Matrix = biological tissue

SDG	Matrix	Comments
1001011		
1001015		

ICP Run Log

File Name:

Sample ID	Client ID	Sample	DF	Date	Time	SDG	Action Needed

The presence of the Chemist's/Analyst's employee ID number, or signature, on this run log attests that strict compliance with the method's SOP has occurred. Any SOP deviations require documentation by the responsible chemist/analyst together with the chemist's/analyst's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation.

Reviewed By: _____ Date: _____ Page 1 of 1

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Attachment 4

INTERNAL DIGESTION COC

Printed: 5/28/2010 2:13:28PM

Lab Number	Client ID	Sample Type	

Relinquished By	Date	Received By	Date
Relinquished By	Date	Received By	Date
Relinquished By	Date	Received By	Date
Relinquished By	Date	Received By	Date

Page 1 of 1

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Attachment 5

Analyte	
Aluminum	Al
Antimony	Sb
Arsenic	As
Barium	Ba
Beryllium	Be
Cadmium	Cd
Calcium	Ca
Chromium	Cr
Cobalt	Co
Copper	Cu
Iron	Fe
Lead	Pb
Magnesium	Mg
Manganese	Mn
Nickel	Ni
Potassium	K
Selenium	Se
Silver	Ag
Sodium	Na
Thallium	Tl
Vanadium	V
Zinc	Zn
Bismuth	Bi
Molybdenum	Mo
Tin	Sn
Titanium	Ti
Boron	B

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Cary, NC 27513

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SOP DOCUMENTATION FORM

This form must accompany all new and revised Standard Operating Procedures (SOPs) when you turn them in to Quality Assurance for review. Please fill out the entire block below (except effective date).

This is a new procedure _____ revised procedure ✓ outdated procedure (archive) _____

- Procedure Code: IP316 SOP Section #: 3.2.1.9 Revision #: 5

SOP Title: Determination of Metals by Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) by SW-846 Method 6020/6020A

Effective date: (QA fills in) 07-07-2010

- Procedure prepared by: Bob McGuire Date: 07-07-2010
- Procedure approved by: (If the manager prepared the SOP, a qualified second party should sign) [signature] Date: 070710
- Reason for change: Annual Review and addition of DOD-QSM Protocols
- This procedure meets the requirements of the following approved method references: SW-846, 3RD Edition, Update III 12/96, Method 6020, and Update IV, Method 6020A 2/07; DoD Quality Systems Manual for Environmental Laboratories Version 4.1, 4/22/09

Procedure approved by a QA Representative (unless QA Representative signed above):

_____ Date: _____

On an annual basis: Lab managers are required to review lab practices and revise the SOP if necessary. If no revision is necessary, indicate by your signature that the SOP has been reviewed.

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Instrument Procedure 316: Determination of Metals by Inductively Coupled Plasma – Mass Spectrometry (ICP-MS) by SW-846 Method 6020/**6020A**

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Instrument Procedure 316: Determination of Metals by Inductively Coupled Plasma – Mass Spectrometry (ICP-MS) by SW-846 Method 6020/**6020A**

1.0 Scope and Application

This Standard Operating Procedure (SOP) describes the determination of trace concentration of elements in water samples and in waste extracts or digests. When dissolved constituents are required, samples must be filtered and acid-preserved prior to analysis. No digestion is required prior to analysis for dissolved elements in water samples. Acid digestion prior to filtration and analysis is required for groundwater, aqueous samples, industrial wastes, soil, sludge, sediment and other solid wastes for which total (acid-leachable) elements are required.

Staff members performing the procedures described in this SOP are responsible for reading, understanding, and complying with the SOP requirements. Supervisors are responsible for directing the analyst to the controlled SOP, and providing adequate explanation of the material contained therein.

This procedure is restricted to use by or under the supervision of analysts experienced in the instrumentation or preparative methods and who have demonstrated the ability to generate acceptable results through QC samples and analyst capability studies.

2.0 Summary of Method

The method measures ions produced by a radio-frequency inductively coupled plasma. Analyte species originating in a liquid are nebulized and the resulting aerosol transported by argon gas into the plasma torch. The ions produced are entrained in the plasma gas and introduced, by means of an interface, into a mass spectrometer. The ions produced in the plasma are sorted according to their mass-to-charge ratio and quantified with a channel electron multiplier. Interferences must be assessed and valid corrections applied or the data flagged to indicate problems. Interference correction must include compensation for background ions contributed by the plasma gas, reagents, and constituents of the sample matrix.

3.0 Definitions

3.1 Dissolved metals – metals that will pass through a 0.45 micron membrane filter.

3.2 Total metals – the concentration of metals determined on an unfiltered liquid sample following vigorous digestion.

3.3 Method Detection Limit (MDL) - The MDL is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from the analysis of a sample in a given matrix containing the analyte. A minimum of seven sample replicates is required to calculate a statistical MDL. The MDL is an approximation of the DL. Any analyte concentration result at or above the MDL must also meet all qualitative identification criteria required by the test method in order to be reported as present. Method detection limit (MDL) – The minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater that zero and is determined from analysis of a sample in a given matrix containing the analyte (40 CFR, Part 136, Appendix B).

3.4 Detection Limit (DL) - The DL is the smallest analyte that can be demonstrated to be different from zero or a blank concentration at the 99 % level of confidence. The false positive rate at the DL is 1% and the false negative rate is 50%. Any analyte concentration result at or above the DL must also meet all qualitative identification criteria required by the test method in order to be reported as present.

3.5 Limit of Detection (LOD) – The LOD is the smallest concentration of an analyte that must be present in a sample in order to be detected at a 99% confidence level. The false negative rate at the LOD is 1 %. For DoD-QSM, non-detect sample results are reported as < LOD. Numeric values of measurements between the DL and the LOQ are reported as estimates. The DL < LOD ≤ LOQ.

3.6 Limit of Quantitation (LOQ) – The Limit of Quantitation is the lowest concentration of a substance that produces a quantitative result within specified limits of precision and bias. The LOQ must be within the calibration range.

3.7 Reporting Limit (RL) –

3.7.1 For Non-DoD work, the laboratory reporting limit is based on the lowest multipoint calibration standard concentration.

3.7.2 The DoD-QSM defines the reporting limit as being the lowest concentration value specified by the client that meets project requirements for reporting data with known precision and bias for a specific analyte in a specific matrix. The LOQ cannot be greater than

the RL. Data reported between the DL and the LOQ must be flagged as estimated values.

3.8 Reporting Units – µg/L for water, mg/Kg for soils

3.9 A Sample Delivery Group (SDG) is defined by the following, whichever is more frequent:

- each 20 field samples (excluding PE samples) received within a case, or
- each 7 calendar day period during which field samples in a case are received beginning with the receipt of the first sample.

NOTE: The DOD-QSM and SC DHEC do not accept the SDG approach, unless the samples are prepared in a single batch. When a group of up to 20 field samples of a similar matrix are prepared as one batch, method-specified QC samples such as a method blank, laboratory control sample, matrix spike, matrix spike duplicate, and matrix duplicate must also be prepared together. If samples are batched together from different sites, project-specific QC must be processed.

3.10 m/z = mass to charge ratio

3.11 Instrument Detection Limits (IDL) - determined by multiplying by three the standard deviation obtained for the analysis of a standard solution (each analyte in reagent water) at a concentration of 3x to 5x IDL on three nonconsecutive days with seven consecutive measurements per day.

3.12 DOD-QSM – Department of Defense Quality Systems Manual

4.0 Interferences

4.1 Isobaric elemental interferences result from isotopes of different elements forming singly or double charged ions of the same nominal mass-to-charge ratio that cannot be resolved by the mass spectrometer. All elements determined by this method have at least one isotope free of isobaric elemental interference. Only selenium-82, of the analytical isotopes recommended, has an isobaric elemental interference. If greater sensitivity is desired, alternative analytical isotopes with higher natural abundances can be selected, but an isobaric elemental interference may occur. When this happens, all data obtained must be corrected by measuring the signal from another isotope of the interfering element and subtracting the appropriate signal ratio from the isotope of interest. Records need to be

maintained of this correction process and should be included in the submitted data package.

4.2 Physical interferences are generally considered to be effects associated with the ICP analysis, especially with samples containing high dissolved solids concentrations. Deposits can form on the extraction and/or skimmer cones, reducing the effective diameter and, therefore, the ion transmission. Physical interferences may occur in the transfer of solution to the nebulizer, at the point of aerosol formation and transport to the plasma, or during the excitation and ionization processes within the plasma.

4.3 Abundance sensitivity relates to the degree the wings of a mass peak contribute to adjacent masses. It is affected by ion energy and mass filter operating pressure. The wing overlap interference may result when a small ion peak is being measured adjacent to a large peak. When this occurs, the resolution of the spectrometer should be adjusted to minimize the condition.

4.4 Isobaric polyatomic ion interferences are caused by ions comprised of more than one atom that have the same nominal mass-to-charge ratio as the isotope of interest and cannot be resolved by the spectrometer. The ions are generally formed in the plasma or interface system from support gases or sample components. These interferences must be recognized and appropriate correction made to the data unless they can be avoided by selecting alternative analytical isotopes.

4.5 Memory interferences occur when isotopes of elements in a previous sample contribute to the signals measured in a new sample. These memory effects (carry over) may develop from sample deposition on the sampler and skimmer cones or from the buildup of sample material in the plasma torch and spray chamber. Flushing the system with a rinse blank between samples can minimize the effect. This problem should be recognized during an analytical run and suitable rinse time used to eliminate it.

By analyzing a standard containing the elements at 10X the upper end of the linear range and following that with the analysis of the rinse blank at designated intervals, the analyst should be able to estimate suitable rinse times. From the length of time necessary to reduce analyte signals to within a factor of 10 of the MDL, the analyst has the necessary rinse time. The assessment of memory interferences can also take place by using a minimum of three replicate integrations for data acquisition. If the integrated signal value drops drop consecutively, this may be a sign to the analyst of a memory effect and that should direct the analyst to evaluate the analyte concentration in the previous

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sample to determine if it had a high value. If suspected, the sample should be reanalyzed after a long rinse period.

5.0 Safety

5.1 Many metal salts are extremely toxic if inhaled or swallowed, so wash your hands after handling salts.

5.2 Appropriate protective equipment and clothing must be used under the assumption that all samples are potentially hazardous. During sample preparation, safety glasses, gloves and lab coats are a minimum requirement. The persistent presence of noxious odors may be indicative of failure of the laboratory ventilation system and must be reported to a supervisor or manager.

5.3 Laboratory staff must review the Chemical Hygiene Plan for general safety policies, and Material Safety Data Sheets (MSDS) for solvents and reagents used in the laboratory. The Chemical Hygiene Plan and MSDS are located in the Quality Assurance department.

6.0 Equipment and Supplies

6.1 Graduated cylinders

6.2 Various volumetric flasks (Type A)

6.3 Analytical Balance - OHAUS E-400

6.4 ICP-MS

6.4.1 Perkin Elmer ELAN DRC-e

6.4.2 A radio-frequency generator compliant with Federal Communications Commission (FCC) regulations.

6.4.3 A variable speed peristaltic pump

6.4.4 A mass-flow controller on the nebulizer gas supply is required.

6.4.5 Autosampler - Elemental Scientific, Inc.-SC-4 Fast

6.4.6 Dynamic Reaction Chamber

6.5 A high purity (99.99%) argon gas supply.

7.0 Reagents and Standards

7.1 Reagents

Note: Reagents may contain elemental impurities that might affect the integrity of analytical data. Owing to the high sensitivity of Inductively Coupled Plasma - Mass Spectrometry (ICP-MS), high-purity reagents should be used whenever possible. All acids used must be of ultra high-purity grade. Suitable acids are available from a number of manufacturers or may be prepared by sub-boiling distillation. Nitric acid is preferred for ICP-MS in order to minimize polyatomic ion interferences. Several polyatomic ion interferences result when hydrochloric acid (HCl) is used, however, it should be noted that HCl is required to maintain stability in solutions containing antimony and silver. When HCl is used, corrections for the chloride polyatomic ion interferences must be applied to all data.

7.1.1 Reagent Water-All water used during preparation should be reagent-grade Type I with regard to resistivity of > 10 megohm-cm (20th Edition of Standard Methods, Method 1080), and referred throughout this SOP as reagent water.

7.1.2 Nitric Acid – Concentrated**, distilled** (specific gravity 1.41).

7.1.2.1 Nitric acid (1:1) - Add 50 milliliters (mL) conc. HNO_3 to approximately 30 mL of reagent water and dilute to 100 mL.

7.1.3 **Hydrochloric acid – Concentrated, distilled (specific gravity 1.19).**

7.1.3.1 Hydrochloric acid (1:1) - Add 50 mL conc. HCl to approximately 30 mL of reagent water and dilute to 100 mL.

7.2 Stock Standard Solutions - commercially available

Note: Stock standard solutions may be purchased from a reputable commercial source**, such as High Purity or NSI,** or prepared from ultra high-purity grade chemicals or metals (99.99-99.999% pure).

7.2.1 Refer to the QC/Standards Prep for ICP-MS Logbook, Attachment 2, for details on standard and QC sample sources and preparation.

7.2.2 Label and refer to these solutions as Calibration Standards.

7.2.3 Calibration standards must be verified using an independent source (EPA Quality Control sample) immediately after instrument calibration.

7.3 Working Standards

7.3.1 Multi-elemental Calibration Standard Solutions

Care must be taken in the preparation of multi-elemental calibration standard solutions to ensure that the elements are compatible and stable. Fresh calibration standards should be prepared weekly. (**Calibration b**lanks are prepared daily.)

Note: Reference to all working standards can be found in Attachment 2.

7.3.1.1 S0/ICB/CCB

Place into a 100 **mL** volumetric flask 1.0 **mL** of HNO_3 and 1.0 mL of Internal Standard **Solution (See Section 7.3.2)**. Fill to volume with reagent water.

The resulting concentration of the analytes in the ICB/CCB must be less the PQL. **For DoD QSM, the concentrations of the analytes must be ≤ LOD.**

7.3.1.2 **6020-MS1/LLICV/LLCCV**

Place into a **200** mL volumetric flask, **2**.0 **mL** of HNO_3 and **2**.0 mL of Internal Standard. Pipet 0.2**00 mL** of **CP-MS-CRQL** into the flask. Fill to volume with reagent water.

7.3.1.3 **6020-M**S2

Place into a 100 mL volumetric flask, 1.0 **mL** of HNO_3 and 1.0 **mL** of Internal Standard. Pipet 0.20**0 mL** of **CP-MS-CRQL** into the flask. Fill to volume with reagent water.

7.3.1.**4 6020-MS3**

Place into a 100 **mL** volumetric flask, 1.0 **mL** of HNO_3 and 1.0 **mL** of Internal Standard. Pipet 0.**125 mL** of **CAL** Standard into the flask. Fill to volume with reagent water.

7.3.1.5 6020-MS4

Place into a 100 mL volumetric flask, 1.0 mL HNO_3 and 1.0 mL of Internal Standard. Pipet 0.250 mL of CAL Standard into the flask. Fill to volume with reagent water.

7.3.1.6 6020-MS5

Place into a 100 mL volumetric flask, 1.0 mL HNO_3 and 1.0 mL of Internal Standard. Pipet 0.500 mL of CAL Standard into the flask. Fill to volume with reagent water.

7.3.1.7 CCV

Place into a 200 mL volumetric flask, 2.0 mL HNO_3 and 2.0 mL of Internal Standard. Pipet 0.600 mL of CAL Standard into the flask. Fill to volume with reagent water.

7.3.2 Internal Standard Solution

Place in a 100 **mL** volumetric flask, 50 **mL** of deionized water and 1**.0 mL** of HNO_3. Pipet 2.0 **mL** of Lithium6 single element standard, **1.0 mL** of Scandium single element standard, **1.0 mL** of Indium single element standard, **1.0 mL** of Terbium single element standard, and **1.0 mL** of Bismuth single element standard. Dilute to volume with reagent water.

Resultant Concentrations: Lithium 20**,000** ppb, Scandium **10,000** ppb, Indium **10,000** ppb, Terbium **10,000** ppb, and Bismuth **10,000** ppb

7.3.3 Tuning Solutions

These solutions are used for instrument optimization, tuning, stability, and resolution prior to analysis.

7.3.3.1 **Smart Tune** Solution

This solution is used during the optimization of the ICP-MS (autolen tuning, gas flow, detector voltages, torch box alignment, mass calibration, RF power, and pole bias)

Smart Tune Solution is obtained from Perkin Elmer as a working solution.

Resultant Concentration: 10 ppb of Ba, Be, Ce, Co, In, Mg, Pb, Rh, and U.

7.3.3.2 Pre-Calibration Tune Solution

Place into a 100 **mL** volumetric flask, 1.0 **mL** of **Pre-**Tuning **Solution**, and 1.0 **mL** of distilled nitric acid. Dilute to volume with reagent water. This solution is used to check the resolution and stability of the ICP-MS.

Resultant Concentration: 100 ppb of Be, Mg, Co, In, and Pb

7.3.4 Initial Calibration Verification (ICV)

The ICV solution independently verifies the accuracy of the initial calibration for each target analyte. The ICV is obtained from the USEPA and is **a** second source standard. Refer to Attachment 2 for all resultant analyte concentrations.

Place into a **2**00 **mL** volumetric flask, **2.0 mL** distilled nitric acid and **2.0 mL** Internal Standard. Pipet **4.0** mL of ICV (**0307**) multi-element solution, **and 2.2 mL** of 10 **µ**g/mL Molybdenum**.**

7.3.5 Interference Check Sample (ICS)

This solution is **for** verifying that correction equations for elemental or polyatomic isobaric interferences are being properly applied. The coefficients in the correction equations were calculated using natural isotopic abundances, and assuming zero instrumental fractionation. However; the correction equation shall not be applied if the appropriate interference check sample measurement demonstrates absence of interferences above the PQL. Refer to Attachment 2 for resultant analyte concentrations.

Interference Check Sample consists of two solutions: ICSA containing only the interferents; ICSAB contains both the interferents and target analytes.

7.3.5.1 ICSA Solution

Place into a 200 **mL** volumetric flask, 2 **mL** distilled nitric acid and 2 **mL** Internal Standard. Pipet 20 **mL** of ICS Part A into flask. Dilute to volume with reagent water.

7.3.5.2 ICSAB Solution

Place in a 200 **mL** volumetric flask, 2 **mL** distilled nitric acid and 2 **mL** Internal Standard. Pipet 20 **mL** of ICS Part A and 20 **mL** of ICS Part B into flask. Dilute to volume with reagent water.

7.3.6 **Low Level Initial Calibration Verification/Low Level Continuing Calibration Verification (LLICV/LLCCV) Standard**

The concentrations of the **analytes** in the **LLICV/LLCCV Standard** are at the **RL**.

Place into a 200 mL volumetric flask, 2**.0 mL** distilled nitric acid and 2**.0 mL** Internal Standard. Pipet 0.2 **mL** of CP-MS-CRQL into **the** flask. Dilute to volume with reagent water.

7.3.7 Method Detection Limit Solution (MDLs)

The MDL Solution shall be a concentration of 3 to 5 times the expected MDL values.

Refer to Standards/QC Preparation LDR/MDL/IDL for ICP-MS for preparation procedures and actual analytes concentrations. (Attachment 4)

7.3.8 Instrument Detection Limits Solution (IDLs)

The IDL Solution shall be prepared at a concentration of 3 to 5 times the instrument manufacturer's suggested instrument detection limits.

Refer to Standards/QC Preparation LDR/MDL/IDL for ICP-MS for preparation procedures and actual analyte concentrations. (Attachment 4)

7.3.9 Linear Dynamic Range (LDR)

The LDR solution determines the linearity of the instrument for each analyte. Due to the varying response signals of the analytes the LDR varies for each analyte; several solutions are prepared in order to meet the criteria.

Refer to Standards/QC Preparation LDR/MDL/IDL for ICP-MS for preparation procedures and actual analytes concentrations. (Attachment 4)

8.0 Sample Preservation and Storage

8.1 All samples must be collected in glass or polyethylene containers. Water/aqueous samples must be preserved with nitric acid to pH less than 2 immediately after collection.

8.2 For the determination of dissolved metals, the sample must be filtered through a 0.45 micrometer (μm) pore diameter membrane filter at the time of collection or as soon as possible. Use a portion of the sample to rinse the filter flask, discard this portion, and collect the required volume of filtrate. Preserve the filtrate with nitric acid to pH less than 2 immediately after filtration.

8.3 Acid preservation of the sample must occur at least 24 hours prior to sample analysis.

8.4 After 60 days the samples may be disposed of in a manner that complies with all applicable regulations.

8.5 Sample digestates must be stored until 365 days after delivery of the data report.

8.6 The maximum holding time for metals is 180 days from sampling.

9.0 Quality Control

9.1 Linear Dynamic Range (LDR)

9.1.1 For all ICP-MS analyses, a LDR check standard must be analyzed and reported. The upper limit of the linear calibration range is established for

each analyte by determining the signal responses from a minimum of three different concentration standards, one of which is close to the upper limit of the linear range. The linear calibration range used for the analysis of samples is determined from the resulting data. The upper LDR limit is an observed signal no more than 10% below the level extrapolated from lower standards.

9.1.2 Determined sample analyte concentrations that are greater than 90% of the determined upper LDR limit must be diluted and re-analyzed. The LDRs must be verified whenever a change in instrument hardware operating conditions indicate they should be re-determined, or verified quarterly.

9.13 To meet the requirements of the DOD-QSM, the linear dynamic range of the instrument must be verified every 6 months by analyzing a high level standard. The recovery of the analytes must be within ± 10% of the **true** value.

9.2 Initial Calibration Verification (ICV)

9.2.1 Analyze the ICV standard following the initial calibration, before any samples are analyzed.

9.2.2 The results of the ICV must agree within 10% of the **true** values **for each analyte**.

9.2.3 The ICV solution is run at each mass used for reporting final results.

9.2.4 Follow the ICV with the Initial Calibration Blank (ICB).

9.2.4.1 Any analyte present in the blank must be less than the PQL.

9.2.4.2 To meet the requirements of the DOD-QSM, any analytes detected in the ICB must be **≤ LOD**.

9.2.5 If criteria are not met, the run must be terminated and the instrument re-calibrated. If re-calibration does not fix the problem, shut down the instrument and request instrument service.

9.3 **Low Level Initial Calibration Verification/Low Level Continuing Calibration Verification (LLICV/LLCCV)** Standard

9.3.1 To verify linearity near the **RL**, a standard at the **RL** (**LLICV**) is prepared, in the same acid matrix as the calibration standards, and analyzed at the beginning of each sample analysis run**.**

9.3.2 The **LLICV** is run for every required isotope used for the analysis of all Inductively Coupled Plasma - Mass Spectrometry (ICP-MS) analytes. Information regarding the **LLICV** is reported on Form II.

9.3.3 If the percent recovery of the **LLICV** falls outside the control limits of 70 - 130% for one or more analytes, the **LLICV** is re-analyzed immediately **(after corrective action)** for those analytes only. If the results of the re-analysis for those analytes fall within the control limits, no further corrective action is required. If the results of the re-analysis for those analytes do not fall within the control limits, the analysis is terminated, the problem corrected, the instrument recalibrated, the **LLICV** analyzed, and the samples associated with the **LLICV** re-analyzed. **The above criteria also apply to the LLCCV standard.**

9.3.4 A LLCCV standard is run after every 19 samples and at the end of the sequence.

9.4 Interference Check Sample

9.4.1 Follow the **ICB** analysis with the Interference Check samples (ICSA and ICSAB, consecutively). The **Interference** Check samples are analyzed at the beginning of the analytical run. The Interference Check samples should be followed, immediately, by the analysis of a **LLCCV and a** CCV/CCB pair. **The ICSA and ICSAB are also run every 12 hours.**

9.4.2 The Interference Check samples consist of two solutions: Solution A (ICSA) and Solution AB (ICSAB). Solution A contains the interferents and Solution AB consists of the analytes and interferents (see Attachment 5).

9.4.3 The analytical results of ICS Solution A (ICSA) shall fall within the control limit of ± 3 times the PQL of the analyte's true value or ± 20% of the analyte's true value (the true value is zero unless otherwise stated) in the ICSA, whichever is greater. If not, the analysis is terminated, the problem corrected, the instrument recalibrated, and the analytical samples re-analyzed. The ICSA results for these analytes are reported from an undiluted sample analysis

9.4.4 ICS reference material may be obtained from EPA or an independent source such as ERA. Because the values may vary with each lot purchased, the analyte concentrations shown in the table below are typical and provided as an example only. Certificates of analysis with true values for each lot are maintained in a three ring binder in the laboratory.

9.4.5 Results for the ICS Solution AB (ICSAB) during the analytical runs shall fall within the control limit of ± 3 times the PQL of the true value or ± 20% of the true value, whichever is greater, for the analytes included in the ICSAB. If not, the analysis is terminated, the problem corrected, the instrument recalibrated, and the analytical samples re-analyzed.

9.4.6 To meet the requirements of the **DOD**-QSM, the absolute value of all analytes not spiked in the ICS-A must be < **LOD**, unless the analyte is a verified trace impurity from one of the spiked analytes. The analyte recoveries in the ICS-AB must be within ± 20%.

9.4.6.1 If the ICS do not meet the criteria in **Section** 9.4.6, terminate analyses. Correct problem and reanalyze ICS and any associated samples.

9.4.6.2 If corrective actions fail, qualify data in the narrative. Refer to the DOD-QSM "Q" flag.

9.5 Continuing Calibration Verification (CCV)

9.5.1 Verify the calibration at the beginning of the analytical sequence, every 10 samples, and at the end of analytical run.

9.5.2 The results of the check standard must agree within ±10% of the true value. If not, terminate the analysis, correct the problem, and recalibrate the instrument.

9.6 Continuing Calibration Blank (CCB)

9.6.1 A calibration blank must be analyzed immediately after each initial and continuing calibration verification standard at a frequency of 10%.

9.6.2 Calibration blanks are prepared using same acid volumes as calibration standards.

9.6.3 Any analyte present in the CCB must be less than the **RL**.

9.6.3.1 To meet the requirements of the DOD-QSM, analytes in the CCB must be ≤ **LOD**.

9.6.3.2 If the CCB fails the criteria in **Section** 9.6.3.1, re-prepare and reanalyze the CCB and the previous 10 samples.

9.6.4 If criteria are not met, terminate the analysis and recalibrate. If re-calibration does not fix the problem, shut down the instrument and request instrument service.

9.7 Preparation Blank Analysis

9.7.1 A preparation blank is prepared with each digestion batch of up to 20 samples.

9.7.2 This blank is used to ascertain whether sample concentrations reflect contamination.

9.7.3 The blank must contain absolute values of analyte concentrations at less than or equal to the **RL**.

9.7.3.1 To meet the requirements of the DOD-QSM, the concentrations of any analytes in the preparation blank must be ≤ ½ the **RL**.

9.7.3.2 If the preparation blank fails the criteria in **Section** 9.7.3.1, re-prepare and analyze the associated samples.

9.7.4 If the blank exceeds the **RL**, the entire sample batch associated with the blank must be re-prepared along with a new preparation blank. The only circumstance under which the method blank can be reported with analyte values greater than the **RL** is when the concentration of the affected analyte in the sample exceeds the blank concentration by a factor of 10 or more or all samples are less than the PQL.

9.8 Spiked Sample

9.8.1 **A matrix** spike **and matrix spike duplicate** must be prepared with each SDG.

9.8.2 If the sample concentration is less than four times the amount spiked and the recovery of the spike is less than 75% or greater than 125%, the

corresponding element is flagged with an "N" on Form 1 to indicate that the element did not recover in the matrix spike acceptably (See Attachment 3 for spiking levels.)

9.8.3 Prepare and analyze a Post Digestion Spike (PDS) for those elements flagged with an "N".

The PDS should be spiked **between 10 – 100X** the **RL**.

9.8.4 To meet the requirements of the **DOD**-QSM, the matrix spike is evaluated with the same control limits as the LCS (± 20%). The RPD between duplicate matrix spikes or duplicate sample should be < 20%.

9.8.4.1 If the duplicate matrix spikes do not meet the criteria in **Section** 9.8.4, contact the client for guidance. Qualify the specific analytes in the original sample in the narrative. Refer to the DOD-QSM "J" flag.

9.9 Duplicate Sample

9.9.1 A duplicate sample analysis should be performed once per SDG.

9.9.2 If the sample and duplicate do not agree within a 20% RPD when the concentration is either greater than or equal to 5 X **RL**, or ± **RL** when the concentration is < 5 X PQL, then the affected element is flagged with an "*" to indicate poor duplication of results.

9.9.3 See **Section** 9.8.**4** for the DOD-QSM duplicate sample criteria.

9.10 Laboratory Control Sample (LCS)

9.10.1 A water/aqueous Laboratory Control Sample is prepared with each digestion batch of up to 20 samples.

9.10.2 The results of the aqueous LCS must agree within ± 20% of the true values for all the elements.

If the aqueous LCS falls outside these control limits, the samples associated with that LCS must be re-digested and reanalyzed.

9.11 Serial Dilution

9.11.1 One serial dilution must be performed for each SDG.

9.11.2 Perform a 5x serial dilution on the sample to determine if a chemical or physical interference exists.

9.11.3 If the analyte concentration is 50 times or more above the instrument detection limit in the original sample, the serial dilution must then agree within 10% of the original sample. If not**,** then flag the appropriate elements with an "E" to indicate that an interference exists. **The "E" flag is not used for DOD-QSM analyses.**

9.11.4 To meet the requirements of the DOD-QSM, a 5-fold dilution is performed for each preparatory batch on a sample with analyte concentration (s) > **50X LOQ**. The dilution must agree within ± 10% of the original sample.

9.11.4.1 If the serial dilution fails**,** a post-digestion spike (PDS) is performed.

9.11.4.2 The recovery for the PDS must be within the 75-125% of the expected value.

9.11.4.3 If the PDS fails, qualify the sample results as estimates in the narrative. Refer to the DOD-QSM "J" flag.

9.12 Field Blanks

9.12.1 Samples identified as field blanks should not be used for sample spike, duplicate, or serial dilution analysis.

9.13 Sample Tracking Records

9.13.1 Each sample bottle must be labeled with a CompuChem sample identification number.

9.14 Instrument Printout

9.14.1 Because of the nature of the data being collected, all analytical data generated must be labeled so that it can be identified.

9.14.2 Note any dilutions, duplicate analysis, spike analysis, and blank and standard analyses.

9.15 Internal Standards

9.15.1 The analyst shall monitor all responses from the internal standards through the analytical run. The absolute response of any ONE internal standard must not deviate more than 30 – 120% of the original response in the calibration blank **for Method 6020 and DOD-QSM analyses. For Method 6020A, corrective action is required if the response of any internal standard falls below 70%.** If deviations greater than these are observed in field samples, matrix spikes, or duplicate samples, the original sample shall be diluted by a factor of five, internal standard added, and the sample reanalyzed. Continue to dilute sample by factors of 5, until the Internal Standard comes within control.

9.16 Contingency

9.16.1 If due to a lab accident or to QC failures, a re-preparation and analysis are required for the sample and insufficient sample volume remains, the Project Manager must be alerted and will contact the client for direction on how to proceed.

9.16.2 If persistent contamination occurs in the laboratory, analysis must be halted until the source of the contamination can be identified and isolated. When the contamination issue is resolved, samples analysis may proceed.

9.16.3 Any other issues that potentially effect data quality should also be addressed with the Project Manager.

10.0 Calibration and Standardization

10.1 The instrument calibration standards are analyzed at the beginning of the analytical sequence, in the order shown in the ICP-MS Run Log (Attachment 1) and must meet acceptance criteria before samples can be analyzed. Calibration is further discussed in the Procedure section that follows.

10.2 A **six**-point calibration curve **(initial calibration blank and 5 concentration levels)** is prepared for the ICP-MS. This calibration is performed daily. To meet the requirements of the DOD-QSM **and Method 6020,** the correlation coefficient of the calibration curve must be ≥ 0.995. **For Method 6020A, the correlation coefficient must be ≥ 0.998.**

10.3 The calibration curve is verified by the ICV and CCV. The ICV and CCV must meet acceptance criteria or a new calibration is required.

11.0 Procedure

Documentation must follow the requirements in Quality Control SOP 13.6, "Proper Documentation Procedures".

11.1 Pre-Tune Optimization

Prior to running any analytical sequence, the instrument parameters MUST be optimized.

11.1.1 Alignment of the Sampler and Skimmer Cones.

11.1.1.1 Aspirate the "Smart Tune Solution."

11.1.1.2 Under the "Method" tab, open the workspace "X-Y alignment" and run the method.

11.1.1.2 Select the "Realtime" display and rotate the X-Y alignment controls clockwise and counter-clockwise until a maximum count for In 115 is achieved.

11.1.2 Optimization of the Autolen, Nebulizer Gas Flow, Lens Voltage, and Detector Voltages.

11.1.2.1 Aspirate the "Smart Tune Solution."

11.1.2.2 Under the "Smarttune" workspace, open "Smarttune OPT1" and run the workspace.

Note: The workspace contains the manufacturer's recommended optimization ranges. During the acquisition phase, the instrument will be optimizes for each of these parameters. If the criteria cannot be met, a "failed" message will appear. Refer to the instrument manual or call the Perkin Elmer Help hotline to correct failing parameters.

11.1.3 Dual Detector Calibration.

Dual Detector Calibration is achieved by producing 1 – 3 million counts for each target element. Since some elements are more

sensitive than others, the solution concentration varies for each element and from each calibration attempt.

A valid Dual Detector Calibration contains at least 21 data points and a correlation coefficient of ≥ 0.998. The summary page displays the number of data points and the correlation coefficient used to determine the Dual Detector coefficient. If this criterion is not met for all target elements, adjust the analyte concentration in the solution and re-determine the Dual Detector Calibration coefficients.

11.1.3.1 Aspirate the Dual Detector Calibration solution.

11.1.3.2 Under the "Smarttune" workspace, open "SmartTune Dual1" and run the workspace.

11.1.3.3 Verify that all criteria have been met for the target elements. Save and load the workspace.

11.2 Tune Verification

Prior to running any analytical sequence, the mass resolution and stability must be verified.

Tune verification is achieved by analyzing 5 replicates of the 100 ppb Tune Solution. The %RSD for the 5 replicates must be < 5%. The mass resolution must be verified to be within 0.1 amu over the mass range of 6 – 120 amu and the peak width at 10% peak height must be within 0.60 – 0.80 amu.

11.2.1 Mass Resolution

11.2.1.1 Aspirate the "100 PPB Tune Solution."

11.2.1.2 Under the "Smarttune" workspace, open "SmarttuneRES1" and run the workspace.

Note: The workspace contains the manufacturer's recommended AMU ranges. During the acquisition phase, the instrument will adjust the DAC values to meet criteria. Refer to the instrument manual or call the Perkin Elmer Help hotline to correct failing parameters.

11.2.1.3 Save the parameter by opening the "Tuning" window on the menu bar.

11.2.2 Instrument Stability

11.2.2.1 Aspirate the "100 PPB Tune Solution."

11.2.2.2 From the menu bar, select the Worksheet window and open "6020 TUNE" located in the 6020 folder. Open the report tab, and define the file name of the tune as PEMSATUNEMMDDYY and save the worksheet.

11.2.2.3 From the menu bar, select the Sample window. Under the Manual tab, populate the sample field with "TUNE" and populate the detail field with "100 PPB Tuning Soln at 10% Peak Height".

11.2.2.4 Run the workspace by clicking on the "Analyze Sample" button. Once completed verify that the %RSD does not exceed 5 percent. If so, refer to instrument manual or call Perkin Elmer Help hotline for help.

11.3 Instrument Calibration and Sample Analysis

Prior to running the calibration, a method was built to contain all instrument operating and acquisition parameters, configurations, timing parameters, and calibration and verification sequences in accordance with the SW-846 Methods 6020/6020A.

11.3.1 From the menu bar, select the Worksheet window and open "6020AA" located in the 6020 folder. Open the report tab, and define the file name of the sequence file as PEMSIIIMMDDYY and save the worksheet.

11.3.2 From the menu bar, select the Sample window and open the Sample tab.

11.3.3 From the desktop, launch "Sample Table" and enter in the preparation batch number. Hit "Build ICPMS Table". Using this sample table populate the ELAN's sample table fields with the following: Batch ID field with SDG number, the Sample ID field with the sample IDs, and the Description field with the client ID. In the

"Measure Action" column select the command "Run Blank, Stds, and Sample." Save the Autosampler table as the same name as the sequence file name and print. Label and pour up sample tubes according to Autosampler table

11.3.4 Begin the Analyses by selecting the samples of interest and clicking on Analyze Batch.

11.3.5 Once analyses are complete, the data undergo a peer review process to verify all acceptance criteria have been met. Samples associated with failing acceptance criteria are re-analyzed.

12.0 Data Analysis and Calculations

Calculations must be consistent with the Quality Control SOP 13.4, "Numerical Data Reduction".

12.1 Calculation of the mean or average of a set of values:

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

where: n = total number of values
x_i = each individual value used to calculate the mean
x = the mean of n

12.2 Calculation of the standard deviation of a set of values:

$$\text{Standard deviation} = \sqrt{\frac{\sum_{i=1}^{n}\left(X_n - \overline{X}\right)^2}{n-1}}$$

12.3 Calculation of percent recovery:

12.3.1 LCS and surrogates:

$$\%R = \frac{Amount\ found}{Amount\ spiked}\ x\ 100$$

12.3.2 Matrix spikes:

$$\% R = \frac{Amount\ in\ spiked\ sample - Amount\ in\ unspiked\ (native)\ sample}{Amount\ spiked} x\ 100$$

12.4 Calculation of % RSD

$$\%RSD = \left(\frac{Standard\ deviation}{\overline{X}}\right) \times 100$$

12.5 Calculation of RPD

$$RPD = \frac{|Value\ 1\ -\ Value\ 2|}{(Value\ 1\ +\ Value\ 2)/2} x100$$

12.6 Calculation of %Difference (%D)

$$\%Diff = \frac{Value\ -\ \overline{Reference\ \ value}}{\overline{Reference\ \ value}}\ x\ 100$$

12.7 Concentration of aqueous samples

$$\mu g / L = \frac{(C)(V)(D)}{(W)}$$

where: C - Concentration (mg/l) D- Dilution factor
V - Final volume of digestate (L) W - Volume of sample (L)

12.8 Calculating Dilutions

If a sample concentration exceeds the linear range of the instrument, a dilution must be performed. A 10x dilution is performed using 1 mL sample plus 9 mL diluent for a total volume of 10 mL. It should be recorded on the run log as "10x (1 mL in 10 mL)."

13.0 <u>Method Performance</u>

This method was validated through in-house laboratory studies of method detection limits and precision and accuracy for a single analyst. The data are retained by the QA department.

14.0 Pollution Prevention

The solvents used in this procedure pose little threat to the environment when recycled and managed properly. Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The EPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency recommends recycling as the next best thing. See SOP 12.1, "Hazardous Waste Disposal", regarding laboratory procedures for recycling solvent waste streams.

15.0 Waste Management

It is the laboratory's responsibility to comply with all federal, state, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions, and to protect the air, water, and land by minimizing and controlling all releases from fume hoods and bench operations. Compliance with all sewage discharge permits and regulations is also required.

Samples preserved with HCl or H_2SO_4 to pH <2 are hazardous and must be handled as hazardous waste.

Refer to the Hazardous Waste Management and Safety SOPs located in the lab.

16.0 References

16.1 "Test Methods for Evaluating Solid Wastes: Physical/Chemical Methods", SW-846, 3rd Edition, Update III, 12/96 **and Update IV 2/07**, Method**s** 6020/**6020A**

16.2 ICP-MS Operating Manual for VG PQ Excell Thermo Elemental

16.3 Standard Methods for the Examination of Water and Wastewater, 20th Edition (1998), Method 1080

16.4 Quality Control SOP **13.6**, "Proper Documentation Procedures"

16.5 Quality Control SOP **13.4**, "Numerical Data Reduction"

16.6 NELAC Standards, **effective July** 2003**, plus revisions**

16.7 EPA QA/G6: Guidance for Preparing Standard Operating Procedures EPA/600/B-07/001, April 2007.

16.8 CompuChem Quality Manual, Revision **13**, **November 17, 2009, plus revisions**

16.9 Department of Defense Quality Systems Manual for Environmental Laboratories, Version **4.1**, **April 22, 2009**

17.0 Attachments as Tables, Diagrams, and Flowcharts

17.1 Attachment 1 – **Example** ICP-MS Run Log

17.2 Attachment 2 – **Example** Standards/QC Preparation for ICP-MS

17.3 Attachment 3 – Spiking Levels

17.4 Attachment 4 – LDR/MDL/IDL Preparation Sheets

17.5 Attachment 5 – Certified Values for Interference Check Sample for ICP-MS

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Attachment 1

Daily Instrument **Maintenance:** _____

Nebulizer pressure: _____
Peak position: _____
Peak intensity: _____
Vernier position: _____

Printed:

Method(s (circle **ILM05.4** **6010B** **6010C** **Other** _____

Operator(s) _____ **Date/Time** _____ **to** _____

↑	Specified element(s) fail(s) high
↓	Specified element(s) fail(s) low
RR	Re-run sample(s) neat
RR #X	Re-run at a #-fold dilution
#X	Sample run at a #-fold dilution (aliquot of sample diluted with acidified water)
L	Matrix = leachate
W	Matrix = water
S	Matrix = solid
B	Matrix = biological tissue

SDG	Matrix	Comments
1001011		
1001015		

ICP Run Log

File Name:

Sample ID	Client ID	Sample	DF	Date	Time	SDG	Action Needed

The presence of the Chemist's/Analyst's employee ID number, or signature, on this run log attests that strict compliance with the method's SOP has occurred. Any SOP deviations require documentation by the responsible chemist/analyst together with the chemist's/analyst's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation.

Reviewed By: _____ Date: _____ Page 1 of 1

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Attachment 2

Standards/QC Preparation for ICP-MS (PEMS) 1 of 3 CompuChem a division of Liberty Analytical Corp. **WORKSHEET 1 AA(1)**

STANDARDS and REAGENTS TRACEABILITY Seq. File Name: _____.

STANDARD / REAGENT	Reference # *	Manufacturer	Lot #	Expiration Date
Nitric Acid (HNO3)	NHO3-D-112009-DDD	JT Baker	H12022	11/10
Hydrochloric Acid (HCl)	HCL-D-101209-DDD	Caledon	71129	10/10
ICP-MS-TS-3 (Pre Tune Soln)	9I04001	High Purity	0904345	08/28/10
Q-6042-M (CAL Standard)	0B18009	NSI	020310	02/28/12
ICV-1 (0307) multi-element solution	9L15002	EPA	0307	12/10
SM-770-032 (CP-MS-CRQL-Rev multi-element solution)	9J22003	High Purity	0928516	10/12/10
ICSA (0803) multi-element solution	9C30002	EPA	0803	12/10
ICSAB (0803) multi-element solution	9C30003	EPA	0803	12/10
LITHIUM^6 (Li^6) 1000 mg/L single element standard	0B16007	High Purity	0911701	07/20/11
SCANDIUM (Sc) 1,000 mg/L single element standard	8L17019	High Purity	0801101	06/15/10
INDIUM (In) 1,000 mg/L single element standard	8L17017	High Purity	0808613	06/15/10
TERBIUM (Tb) 1,000 mg/L single element standard	8L17018	High Purity	0811919	06/15/10
BISMUTH (Bi) 1,000 mg/L single element standard	0B16008	High Purity	1000418	07/20/11
TIN (Sn) 10 µg/mL single element standard	7M1-42-12	NSI	1020008-SN	10/10
MOLYBDENUM (Mo) 10 µg/mL single element standard	7M1-42-13	NSI	1020008-MO	10/10
Water Spike Sample D ICP-MS Matrix Spike multi-element solution	9I15001	High Purity	0934201	12/10/10

*Ref# = Logbook ID, Page number, and item number from Materials Receipt Log

Multi-Element Stock Standard Concentrations:

Stock Standard	Analyte Concentrations (µg/mL)
Pre Tune Solution	Be: 10 Mg: 10 Co: 10 In: 10 Pb: 10
CAL standard	Al: 1000 Sb: 100 As: 100 Ba: 100 Be: 100 B: 100 Cd: 100 Ca: 1000 Cr: 100 Co: 100 Cu: 100 Fe: 1000 Pb: 100 Mg: 1000 Mn: 100 Mo: 100 Ni: 100 K: 1000 Se: 100 Si: 100 Ag: 100 Na: 1000 Tl: 100 Ti: 100 V: 100 Zn: 100 Sn: 100 Sr: 100
CP-MS-CRQL-Rev multi-element solution	Be: 1 V: 5 Cr: 2 Mn: 1 Co: 1 Ni: 1 Cu: 2 Zn: 2 As: 1 Se: 5 Ag: 1 Cd: 1 Sb: 2 Ba: 10 Tl: 1 Pb: 1 Al: 30 Sn: 1 Mo: 1

Entered By: _____

Reviewed By: _____ Date: _____

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Attachment 2 (continued)

Standards/QC Preparation for ICP-MS (PEMS) 2 of 3 CompuChem a division of Liberty Analytical Corp. **WORKSHEET 1 AA(1)**

Standard Lot Number *	Preparation Instructions	Resultant Analyte Conc. (µg/L)
Instrument Tune Solution– 02 16 09- JCF	Place in a 500-mLvolumetric flask: 0.5 mL of PRE-Tuning solution and 5 mL distilled nitric acid. Dilute to volume with deionized water	Li^7: 10 Be: 10 Mg: 10 Co: 10 In: 10 Ce: 10 Pb: 10 U: 10
Internal Standard– 02 16 10 – JCF	Place in a 100-mLvolumetric flask: 50 mL of deionized water , 1.0 mL of distilled nitric acid. Pipet: 2.0 mL of $Lithium^6$, 1.0 mL of Scandium, 1.0 mL of Indium, 1.0 mL of Terbium, and 1.0 mL of Bismuth. Dilute to volume with deionized water	Li^6: 20000 Sc: 10000 In: 10000 Tb: 10000 Bi: 10000
S0/ICB/CCB– 03 08 10 – JCF	Place in a 100-mL volumetric flask: 1 mL distilled nitric acid and 1mL Internal Standard. Dilute to volume with deionized water. Prepare Daily.	Li^6: 200 Sc: 100 In: 100 Tb: 100 Bi: 100
S 6020-MS1/LLICV/LLCCV– 03 08 10 – JCF	Place in a 200-mL volumetric flask: 2 mL distilled nitric acid and 2 mL Internal Standard. Pipet 0.200 mL of CP-MS-CRQL, into flask. Dilute to volume with deionized water	Li^6: 200 Be: 1 Al: 30 Sc: 100 V: 5 Cr: 2 Mn: 1 Co: 1 Ni: 1 Cu: 2 Zn: 2 As: 1 Se: 5 Mo: 1 Ag: 1 Cd: 1 In: 100 Sn: 1 Sb: 2 Ba: 10 Tb: 100 Tl: 1 Pb: 1 Bi: 100
S 6020-MS2 –03 08 10 – JCF	Place in a 100-mL volumetric flask: Pipet 1.0 mL distilled nitric acid and 1 mL Internal Standard. Pipet 0.200 mL of CP-MS-CRQL, into flask. Dilute to volume with deionized water.	Li^6: 200 Be: 2 Al: 60 Sc: 100 V: 10 Cr: 4 Mn: 2 Co: 2 Ni: 2 Cu: 4 Zn: 4 As: 2 Se: 10 Mo: 2 Ag: 2 Cd: 2 In: 100 Sn: 2 Sb: 4 Ba: 20 Tb: 100 Tl: 2 Pb: 2 Bi: 100
S 6020-MS3–03 08 10 – JCF	Place in a 100-mL volumetric flask: 1 mL distilled nitric acid and 1 mL Internal Standard. Pipet 0.125 mL of CAL Standard into flask. Dilute to volume with deionized water	Li^6: 200 Be: 125 Al: 1250 Sc: 100 V: 125 Cr: 125 Mn: 125 Co: 125 Ni: 125 Cu: 125 Zn: 125 As: 125 Se: 125 Mo: 125 Ag: 125 Cd: 125 In: 100 Sn: 125 Sb: 125 Ba: 125 Tb: 100 Tl: 125 Pb: 125 Bi: 100 Al: 1250 Ca: 1250 Na: 1250 Mg: 1250 Fe: 1250 K: 1250
S 6020-MS4–03 08 10 – JCF	Place in a 100-mL volumetric flask: 1 mL distilled nitric acid and 1 mL Internal Standard. Pipet 0.250 mL of CAL Standard into flask. Dilute to volume with deionized water	Li^6: 200 Be: 250 Al: 2500 Sc: 100 V: 250 Cr: 250 Mn: 250 Co: 250 Ni: 250 Cu: 250 Zn: 250 As: 250 Se: 250 Mo: 250 Ag: 250 Cd: 250 In: 100 Sn: 250 Sb: 250 Ba: 250 Tb: 100 Tl: 250 Pb: 250 Bi: 100 Al: 2500 Ca: 2500 Na: 2500 Mg: 2500 Fe: 2500 K: 2500

*Standard Lot Number consists of standard ID, date prepared, and initials of preparer.

Standard Solutions Prepared By: _____

Entered By: _____ _____ Date: _____

Reviewed By: _____ Date: _____

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Attachment 2 (continued)

Standards/QC Preparation for ICP-MS (PEMS) 3 of 3 CompuChem a division of Liberty Analytical Corp. **WORKSHEET 1 AA(1)**

Standard Lot Number *	Preparation Instructions	Resultant Analyte Conc. (µg/L)
S 6020-MS5–03 08 10 – JCF	Place in a 100-mL volumetric flask: 1 mL distilled nitric acid and 1 mL Internal Standard. Pipet 0.50 mL of CAL Standard into flask. Dilute to volume with deionized water	Li^6: 200 Be: 500 Al: 5000 Sc: 100 V: 500 Cr: 500 Mn: 500 Co: 500 Ni: 500 Cu: 500 Zn: 500 As: 500 Se: 500 Mo: 500 Ag: 500 Cd: 500 In: 100 Sn: 500 Sb: 500 Ba: 500 Tb: 100 Tl: 500 Pb: 500 Bi: 100 Al: 5000 Ca: 5000 Na: 5000 Mg: 5000 Fe: 5000 K: 5000
ICV– 03 08 10 – JCF	Place in a 200-mL volumetric flask: 2 mL distilled nitric acid, and 2 mL Internal Standard. Pipet 4.0 ml of ICV (0307) multi-element solution, 2.2 mL of 10 µg/mL Molybdenum and 2.2 mL of 10 µg/mL Tin into flask. Dilute to volume with deionized water. (Note: Tin must be from a source different than that used for the calibration standards)	Al: 504 Sb: 199 As: 200 Ba: 99 Be: 99 Ca: 2005 Cr: 98 Co: 100 Cu: 98 Fe: 1016 Pb: 200 Mg: 1215 Mn: 100 Ni: 101 K: 2004 Se: 206 Ag: 100 Na: 2019 Tl: 206 V: 100 Zn: 205 Cd: 99 Li^6: 200 Sc: 100 In: 100 Tb: 100 Bi: 100 Mo: 110 Sn: 110
ICSA– 03 08 10 – JCF	Place in a 200-mL volumetric flask: 2 mL distilled nitric acid and 2 mL Internal Standard. Pipet 20.0 mL of ICS Part A (0803) into flask. Dilute to volume with deionized water.	Al: 100000 Sb: 1.5 As 0.1 Ba: 1.2 Be: 0 Cd: 0.7 Ca: 100000 C: 200000 Cl: 1000000 Cr: 21 Co: 1 Cu: 8 Fe: 10000 Pb: 4 Mg: 100000 Mn: 7 Mo: 2000 Ni: 6 P: 100000 K: 10000 Se: 0.3 Ag: 0 Na: 100000 S: 100000 Tl: 0 Ti: 2000 V: 0.5 Zn: 11, Li^6: 200 Sc: 100 In: 100 Tb: 100 Bi: 100
ICSAB– 03 08 10 – JCF	Place in a 200-mL volumetric flask: 2 mL distilled nitric acid and 2 mL Internal Standard. Pipet 20.0 mL of ICS Part A (0803) and 20.0 mL of ICS Part B (0803) and 0.400 mL of 10 µg/mL Tin into flask. Dilute to volume with deionized water.	Al: 100000 Sb: 22 As 19 Ba: 22 Be: 19 Cd: 20 Ca: 100000 C: 200000 Cl: 1000000 Cr: 40 Co: 20 Cu: 25 Fe: 10000 Pb: 25 Mg: 100000 Mn: 27 Mo: 2000 Ni: 24 P: 100000 K: 10000 Se: 19 Ag: 18 Na: 100000 S: 100000 Tl: 21 Ti: 2000 V: 19 Zn: 29, Li^6: 200 Sc: 100 In: 100 Tb: 100 Bi: 100
CCV– 03 08 10 – JCF	Place in a 200-mL volumetric flask: 2 mL distilled nitric acid, and 2 mL Internal Standard. Pipet 0.600 mL of CAL Standard. Dilute to volume with deionized water.	Li^6: 200 Be: 300 Sc: 100 V: 300 Cr: 300 Mn: 300 Co: 300 Ni: 300 Cu: 300 Zn: 300 As: 300 Se: 300 Mo: 300 Ag: 300 Cd: 300 In: 100 Sn: 300 Sb: 300 Ba: 300 Tb: 100 Tl: 300 Pb: 300 Bi: 100 Al: 3000 Na: 3000 Ca: 3000 K:3000 Mg: 3000 Fe: 3000

*Standard Lot Number consists of standard ID, date prepared, and initials of preparer.

Standard Solutions Prepared By: _____

Entered By: _____ Date: _____

Reviewed By: _____ Date: _____

The presence of the Chemist's/Analyst's employee ID number, or signature, on this run log attests that strict compliance with the method's SOP has occurred. Any SOP deviations require documentation by the responsible chemist/analyst together with the chemist's/analyst's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation.

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Attachment 3

Spiking Levels for Spike Sample Analysis

Analyte	Spike (µg/L)
Sb	100
As	40
Ba	2000
Be	50
Cd	50
Cr	200
Co	500
Cu	250
Pb	20
Mn	500
Ni	500
Se	10
Ag	50
Tl	50
V	500
Zn	500

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Attachment 4

Standards Preparation Log for ICP-MS (PEMS) Linear Range Standard (LDR) Studies 1 of 2
Worksheet 1 P(B) Rev. 3

STANDARDS and REAGENTS TRACEABILITY

	Ref #*	Manufacturer	Lot #	Expiration Date
Q-6042-M (CAL standard)	0B18009	NSI	020310	02/01/12
Barium (1000 ppm stock standard)	8L17007	High Purity	0830327	06/15/10
Manganese (1000 ppm stock standard)	8L17012	High Purity	0805617	06/15/10
Zinc (1000 ppm stock standard)	9L31017	High Purity	0916203	06/11/11

Multi-Element Stock Standard Concentrations:

Stock Standard	**Analyte Concentrations (µg/mL)**
CAL standard	Al: 1000 Sb: 100 As: 100 Ba: 100 Be: 100 B: 100 Cd: 100 Ca: 1000 Cr: 100 Co: 100 Cu: 100 Fe: 1000 Pb: 100 Mg: 1000 Mn: 100 Mo: 100 Ni: 100 K: 1000 Se: 100 Si: 100 Ag: 100 Na: 1000 Tl: 100 Ti: 100 V: 100 Zn: 100 Sn: 100 Sr: 100

Entered By: J. FELDHAUS

Reviewed By:_____ Date:_____

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Attachment 4 (continued)

Standards Preparation Log for ICP-MS (PEMS) Linear Range Standard (LDR) Studies 2 of 2
Worksheet 1 P(B) Rev. 3

Standard Lot Num.**	Preparation instructions	True Values (ppb)
LDR-0.5-041310-JCF	Place in a 100-mL volumetric flask: Pipet 1.0 mL distilled nitric acid, and 1 mL Internal Standard. 0.5 ml of CAL Standard into flask. Dilute to volume with deionized water	Sb: 500 As: 500 Ba: 500 Be: 500 Cd: 500 Cr: 500 Co: 500 Cu: 500 Pb: 500 Mg: 500 Mn: 500 Ni: 500 Se: 500 Ag: 500 Tl: 500 V: 500 Zn: 500
LDR-1.0-041310-JCF	Place in a 100-mL volumetric flask: Pipet 1.0 mL distilled nitric acid, and 1 mL Internal Standard. 1.0 ml of CAL Standard into flask. Dilute to volume with deionized water	Sb: 1000 As: 1000 Ba: 1000 Be: 1000 Cd: 1000 Cr: 1000 Co: 1000 Cu: 1000 Pb: 1000 Mg: 1000 Mn: 1000 Ni: 1000 Se: 1000 Ag: 1000 Tl: 1000 V: 1000 Zn: 1000
LDR-2.0-041310-JCF	Place in a 100-mL volumetric flask: Pipet 1.0 mL distilled nitric acid, and 1 mL Internal Standard. 2.0 ml of CAL Standard into flask. Dilute to volume with deionized water	Sb: 2000 As: 2000 Ba: 2000 Be: 2000 Cd: 2000 Cr: 2000 Co: 2000 Cu: 2000 Pb: 2000 Mg: 2000 Mn: 2000 Ni: 2000 Se: 2000 Ag: 2000 Tl: 2000 V: 2000 Zn: 2000
LDR-3.0-041310-JCF	Place in a 100-mL volumetric flask: Pipet 1.0 mL distilled nitric acid, and 1 mL Internal Standard. 3.0 ml of CAL Standard into flask. Dilute to volume with deionized water	Sb: 3000 As: 3000 Ba: 3000 Be: 3000 Cd: 3000 Cr: 3000 Co: 3000 Cu: 3000 Pb: 3000 Mg: 3000 Mn: 3000 Ni: 3000 Se: 3000 Ag: 3000 Tl: 3000 V: 3000 Zn: 3000
LDR-4.0-041310-JCF	Place in a 100-mL volumetric flask: Pipet 1.0 mL distilled nitric acid, and 1 mL Internal Standard. 4.0 ml of CAL Standard into flask. Dilute to volume with deionized water	Sb: 4000 As: 4000 Ba: 4000 Be: 4000 Cd: 4000 Cr: 4000 Co: 4000 Cu: 4000 Pb: 4000 Mg: 4000 Mn: 4000 Ni: 4000 Se: 4000 Ag: 4000 Tl: 4000 V: 4000 Zn: 4000
LDR-MnBaZn-041310-JCF	Place in a 100-mL volumetric flask: Pipet 1.0 mL distilled nitric acid, and 1 mL Internal Standard. 1.0 ml of Ba, Mn, and Zn 1000 ppm stock standard into flask. Dilute to volume with deionized water	Ba: 10000 Mn: 10000 Zn: 10000

**Standard Lot Number consists of standard ID, date prepared, and initials of preparer.

Applies to Seq. File(s): PEMSJCF041310

Standard Solutions Prepared By: _____

Entered By: J. FELDHAUS

Reviewed By: _____ Date: _____

07/06/06:jbb

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Attachment 5

"Certified Values" for Interference Check Sample ICP-MS
Part A (0803) and Part A (0803) Mixed with Part B (0803)

Element	**Part A** µg/L	**Part A + B** µg/L
Al	[100000]	[100000]
SB	(1.5)	22
Ba	(1.2)	22
Be	(0)	19
Cd	(0.7)	20
Ca	[100000]	[100000]
C	[200000]	[200000]
Cl	[1000000]	[1000000]
Cr	21	40
Co	1	20
Cu	8	25
Fe	[100000]	[100000]
Pb	4	25
Mg	[100000]	[100000]
Mn	7	27
Mo	[2000]	[2000]
Ni	6	24
P	[100000]	[100000]
K	[100000]	[100000]
Se	(0.3)	19
Ag	(0)	18
Na	[100000]	[100000]
S	[100000]	[100000]
Tl	(0)	21
Ti	[2000]	[2000]
V	(0.5)	19
Zn	11	29

[] Indicates analytes that do not require ICP-MS Determination in the ICS.

() Indicates analyte values that are less than the CRQL and the value is to be used as a set point for +/- 3 times CRQL acceptance criteria calculations.

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501 Madison Avenue
Cary, NC 27513

NELAP accredited

SOP DOCUMENTATION FORM

This form must accompany all new and revised Standard Operating Procedures (SOPs) when you turn them in to Quality Assurance for review. Please fill out the entire block below (except effective date).

This is a new procedure _____ revised procedure ✓ outdated procedure (archive) _____

- Procedure Code: _____ SOP Section #: 3.3.4 Revision #: 24

SOP Title: Automated Cold Vapor Determination for Mercury by CLP, SW-846 and MCAWW

Effective date: (QA fills in) 4/6/11

- Procedure prepared by: Judith Mozer Date: 4/6/11
- Procedure approved by: (If the manager prepared the SOP, a qualified second party should sign) [illegible] Date: 04/06/11
- Reason for change: annual review
- This procedure meets the requirements of the following approved method references: USEPA CLP SOW ILM05.4, SW-846 3rd Edition, Updates III and IV, 9/94 and 2/07 Method 7470A, Methods 7471A/7471B, MCAWW, 1994 Method 245.1, Rev. 3.0, DoD-QSM, Version 4.2, October 25, 2010

Procedure approved by a QA Representative (unless QA Representative signed above):

_____ Date: _____

On an annual basis: Lab managers are required to review lab practices and revise the SOP if necessary. If no revision is necessary, indicate by your signature that the SOP has been reviewed.

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Instrument Procedure 005: Automated Cold Vapor Determination for Mercury by CLP, SW-846, and MCAWW

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Instrument Procedure 005: Automated Cold Vapor Determination for Mercury by CLP, SW-846, and MCAWW

1.0 Scope and Application

1.1 This Standard Operating Procedure (SOP) describes the determination mercury in drinking and surface waters, as well as soil and sediment samples after appropriate preparation. It may be applicable also to saline waters, waste waters, effluents, and domestic sewages, providing potential interferences are not present.

1.2 The working range is 0.20 to 10.0 µg Hg/L

1.3 Staff members performing the procedures described in this SOP are responsible for reading, understanding, and complying with the SOP requirements. Supervisors are responsible for directing the analyst to the controlled SOP, and providing adequate explanation of the material contained therein.

1.4 This procedure is restricted to use by or under the supervision of analysts experienced in the instrumentation or preparative methods and who have demonstrated the ability to generate acceptable results through QC samples and analyst capability studies.

2.0 Summary of Method

2.1 The flameless AA procedure is a physical method based on the absorption of radiation at 253.7 ηm by mercury vapor. The mercury is reduced to the elemental state and aerated from solution. The mercury vapor passes through a cell positioned in the light path of an atomic absorption spectrophotometer. Absorbance (peak height) is measured as a function of mercury concentration.

2.2 In addition to inorganic forms of mercury, organic mercurials may also be present. These organo-mercury compounds will not respond to the flameless atomic absorption technique unless they are first broken down and converted to mercuric ions. Potassium permanganate oxidizes many of these compounds, but recent studies have shown that a number of organic mercurials, including phenyl mercuric acetate and methyl mercuric chloride, are only partially oxidized by the reagent. Potassium persulfate has been found to give approximately 100% recovery when used as the oxidant for these compounds.

Therefore, a persulfate oxidation step following the addition of the permanganate was included during digestion to ensure that organo-mercury compound(s), if present, will be oxidized to the mercuric ion before measurement.

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3.0 Definitions

3.1 Method Detection Limit (MDL) - The MDL is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from the analysis of a sample in a given matrix containing the analyte **(40 CFR, Part 136, Appendix B)**. A minimum of seven sample replicates is required to calculate a statistical MDL. The MDL is an approximation of the DL. Any analyte concentration result at or above the MDL must also meet all qualitative identification criteria required by the test method in order to be reported as present.

3.2 Detection Limit (DL) - The DL is the smallest analyte that can be demonstrated to be different from zero or a blank concentration at the 99 % level of confidence. The false positive rate at the DL is 1% and the false negative rate is 50%. Any analyte concentration result at or above the DL must also meet all qualitative identification criteria required by the test method in order to be reported as present.

3.3 Limit of Detection (LOD) – The LOD is the smallest concentration of an analyte that must be present in a sample in order to be detected at a 99% confidence level. The false negative rate at the LOD is 1 %. For DoD-QSM, non-detect sample results are reported as < LOD. Numeric values of measurements between the DL and the LOQ are reported as estimates. The DL $<$ LOD $\leq$ LOQ.

3.4 Limit of Quantitation (LOQ) – The Limit of Quantitation is the lowest concentration of a substance that produces a quantitative result within specified limits of precision and bias. The LOQ must be within the calibration range.

3.5 Reporting Limit (RL) –

3.5.1 For Non-DoD work, the laboratory reporting limit is based on the lowest multipoint calibration standard concentration.

3.5.2 The DoD-QSM defines the reporting limit as being the lowest concentration value specified by the client that meets project requirements for reporting data with known precision and bias for a specific analyte in a specific matrix. The LOQ cannot be greater than the RL. Data reported between the DL and the LOQ must be flagged as estimated values.

3.6 Reporting Units – µg/L for water and mg/Kg for soil

3.7 A Sample Delivery Group (SDG) is defined by the following, whichever is more frequent:

- each 20 field samples received within a case, or
- each 7 calendar day period during which field samples in a case are received (14 calendar days if requested by the client) beginning with the receipt of the first sample.

NOTE: The DoD-QSM and SC DHEC do not accept the SDG approach, unless the samples are prepared in a single batch. When a group of up to 20 field samples of a similar matrix are prepared as one batch, method-specified QC samples such as a method blank, laboratory control sample, matrix spike, matrix spike duplicate, and matrix duplicate must also be prepared together. If samples are batched together from different sites, project-specific QC must be processed.

3.8 SC DHEC – South Carolina Department of Health and Environmental Control

3.9 CRQL – Contract Required Quantitation Limit (for ILM05.4)

3.10 **DoD**-QSM – Department of Defense Quality Systems Manual

3.11 Digestion Batch – a group of up to 20 field samples of a similar matrix, method-specified QC samples such as a method blank, laboratory control sample, matrix spike, matrix spike duplicate, and matrix duplicate prepared together at the same time.

3.12 LIMS – Laboratory Information Management System

4.0 Interferences

4.1 Some sea waters, waste waters, and sediment samples which are high in chlorides have shown a positive interference, probably due to the formation of free chlorine which will absorb radiation at 253 ηm.

4.2 Interference from certain volatile organic materials that will absorb at this wavelength is also possible. A preliminary run under oxidizing conditions, without stannous chloride, would determine if this type of interference is present.

5.0 Safety

5.1 Appropriate protective equipment and clothing must be used under the assumption that all samples are potentially hazardous. During sample preparation, glasses, gloves and lab coats are a minimum requirement. The

persistent presence of noxious odors may be indicative of failure of the laboratory ventilation system and must be reported to a supervisor or manager.

5.2 Laboratory staff must review the Chemical Hygiene Plan for general safety policies, and Material Safety Data Sheets for reagents used in the laboratory. The Chemical Hygiene Play and the MSDS are located in the Quality Assurance department.

6.0 Equipment and Supplies

6.1 Atomic Absorption Spectrophotometer: Leeman Labs, Inc. HYDRA AA/PS200II Automated Mercury Analysis System **with Win Hg Runner Software, Version 1.7**

6.2 Volumetric flasks (100-mL, 1-L, and 2-L)

6.3 13 x 100 mm glass culture tubes

6.4 Element DataSystem® LIMS computer software by Promium

7.0 Reagents and Standards

Record all reagent and standard preparations in the Standards/QC Preparation Log for Cold Vapor Mercury (Attachment 1) **or in LIMS**. All purchased chemicals and reagents that do not arrive with an expiration date, must be assigned an expiration date **five** years from receipt date. All lab prepared regents must be assigned an expiration date one year from preparation date.

Note: All spiking standard information is entered into the LIMS. To obtain information on any standard, access Element, click on "Laboratory," and scroll down and access "Standards." Standards can be sorted by Department. Select the standard you would like to access. The view will show lot number, prepared dates, solvent, vendor, composition, and concentration.

Note: All reagents and standards must be ACS (American Chemical Society) grade or equivalent. All standards and reagents are subject to change in vendor and in concentration. The Reporting Limits are also subject to change, but must remain at or above the lowest point in the calibration.

7.1 Reagent water- All water used during preparation should be reagent-grade Type I with regard to resistivity of >10 megohm-cm (20th Edition of standards Methods, Method 1080), and referred throughout this SOP as reagent water.

7.2 Stannous chloride (10%) - Dissolve 100 grams into 500 mL of reagent water contained in a 1 L volumetric flask. Add 250 mL of concentrated HCl and dilute to volume with reagent water. Pour this solution into the reductant bottle and connect the reductant line from the pump. (Stannous sulfate may be substituted.)

7.3 NH_2OH-HCl (24%) - Dissolve 240 grams of hydroxylamine chloride and 240 grams sodium chloride in 2000 mL reagent water. (Sodium chloride-hydroxylamine sulfate may be used instead.)

7.4 Hydrochloric Acid (Concentrated) - J. T. Baker, "Instra-Pure"

7.4.1 Hydrochloric acid (10%) - Add 200 mL concentrated HCl to a 2 L volumetric flask containing 1 L of reagent water. Dilute to volume with reagent water.

CAUTION: Always pour acid into water.

7.5 The calibration standards are prepared by the inorganics sample preparation technician and are digested before use, following the appropriate sample preparation procedure (SPP).

8.0 <u>Sample Preservation and Storage</u>

8.1 Samples preserved and stored according to the tables in Sample Control SOP 4.1, “Receiving Samples” and 4.6, “Storing Samples.” Sample holding times are also listed.

8.2 Aqueous samples should be preserved by acidification with nitric acid to a pH of ≤ 2 at the time of collection. Mercury samples not preserved at the time of collection with nitric acid to a pH of < 2 are preserved in-house. Samples must be preserved with nitric acid to a pH of <2, with thorough mixing, at least 24 hours prior to analysis. If only dissolved mercury is to be determined, the sample is filtered before the acid is added. For total mercury, the filtration step is omitted. Aqueous samples for all methods except ILM05.4 must be stored at room temperature or may be refrigerated at 2-6 ^{o}C.

8.3 Aqueous samples received for analysis using the ILM05.4 statement of work must be refrigerated at 2-6 ^{o}C.

8.4 For MCAWW, it is recommended that samples be sent to the lab as soon as possible after collection and acid preserved upon receipt. After acidification, the samples should be mixed, held for 16 hours, and then the pH verified to be ≤ 2. If the sample pH is > 2, repeat the process.

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8.5 Soil samples are not preserved with acid. The soil samples are stored at 2-6 ^{o}C until sample preparation.

9.0 Quality Control

9.1 Preparation Blank

9.1.1 For every 20 samples or for each digestion batch, whichever is more frequent, analyze a preparation blank. This blank is used to ascertain whether sample concentrations reflect contamination.

9.1.1.1 For CLP the blank must not contain mercury at a level above the CRQL.

9.1.1.2 For SW-846 the blank must not contain mercury at a level above the reporting limit (PQL).

9.1.1.3 For the **DoD**-QSM, the preparation blank must not contain mercury at a level above one-half the reporting limit (RL).

9.1.1.4 For MCAWW, the blank must not contain mercury at a level ≥ 10% of the analyte concentration determined in the sample or > 2.2X the analyte MDL, whichever is greater.

9.1.2 If the blank does not meet the applicable criteria above, the entire sample batch associated with the preparation blank must be re-prepared along with a new blank.

9.**1**.2.1 The only circumstance under which the preparation blank can be reported with values greater than the CRQL for CLP is when the concentration of mercury in the sample exceeds the blank concentration by a factor of 10 or more.

9.1.3 Values between the CRQL and the MDL (for CLP) or LOD and DL (for **DoD**-QSM) are reported with a "J" flag.

9.2 Matrix Spike

9.2.1 A matrix spike shall be prepared with every 20 samples or each digestion, whichever is more frequent. Samples identified as field blanks and Performance Evaluation (PE) samples, exclusive of Quarterly Blinds, shall

not be used for spiked sample analysis. For MCAWW, the matrix spike is prepared every 10 water samples.

9.2.1.1 A matrix spike duplicate is also prepared with every 20 samples for SW-846.

9.2.2 The spike recovery of the matrix spike should be within 70-130% for MCAWW and within 75-125% for CLP, and 80-120% for SW-846. The relative percent difference (RPD) between the duplicated matrix spikes should be ± 20.

9.2.2.1 If the sample concentration is less than four times the amount spiked and the recovery of the spike is less than 75% or greater than 125%, the corresponding element is flagged with an "N" on Form I to indicate that the element did not recover the matrix spike acceptably.

9.2.3 To meet the requirements of the **DoD**-QSM, the matrix spike recovery should meet the LCS control limits. The RPD between the matrix spikes should be ≤ 20%.

9.2.3.1 If the **DoD**-QSM acceptance limits are not met for the matrix spikes, contact the client for guidance.

92.3.2 If the results are reported that are associated with failing matrix spikes, indicate the specific analytes in the original sample in the narrative. Refer to the **DoD**-QSM “J” flag.

9.3 Sample Duplicate

9.3.1 A duplicate sample is prepared with every 20 samples or each digestion, whichever is more frequent. Samples identified as field blanks and Performance Evaluation (PE) samples, exclusive of Quarterly Blinds, shall not be used for duplicate sample analysis. A duplicate sample is not required for MCAWW.

9.3.2 If the sample and duplicate do not agree within 20% RPD, then the affected element is flagged with an "*" on Form I to indicate poor results duplication.

9.4 Laboratory Control Sample (LCS)

9.4.1 An LCS is prepared with every 20 samples or each digestion batch, whichever is more frequent. (An LCS is not required for CLP waters.)

9.4.2 The solid EPA LCS/ERA PPT has special control limits, which have been provided by EPA/ERA. The true value and acceptance range are subject to change without notice based upon the current lot purchased. See the certificate of analysis or the standard preparation log for the current lot in use.

9.4.3 For SW-846, in-house determined statistical limits are used. The statistical control limits are ± 20% for aqueous LCS. The solid LCS has special control limits, which have been provided by ERA. The true value is subject to change without notice based upon the current lot purchased. See the certificate of analysis or the standard preparation log for the current lot in use.

9.4.4 To meet the requirements for the **DoD**-QSM, the LCS must meet the recovery control limits of 80 - 120%.

9.4.5 To meet the requirements of the MCAWW, the LCS must meet the recovery limits of 85 - 115%. In calculating the recovery results for the MCAWW, the analyte concentration from the preparation blank must be subtracted form the LCS.

9.4.6 If the LCS fails acceptance criteria, re-analyze. If the LCS continues to fail and no instrument malfunctions or calibration failures are detected, the LCS and all associated samples and QC samples are re-digested.

9.5 CRQL Check Standard (CRI)

9.5.1 Analyze the CRI (ILM05.4) at the CRQL at the beginning of each sample analysis sequence to verify linearity near the CRQL. The CRI is repeated as the 20th sample, 40th sample, etc.

9.5.2 The acceptance criterion is ± 30% for ILM05.4.

9.6 Serial Dilution

9.6.1 For SW-846, perform a serial dilution (1:5) on one sample per analytical batch (or when a new or unusual matrix is encountered) when the analyte concentration is greater than 25 times the MDL.

9.6.2 The recovery of the analyte in the diluted sample must be within ± 10% of that in the undiluted sample.

9.6.3 If the serial dilution fails, prepare and analyze a spiked portion of the sample at 2.5 times the analyte level.

9.6.4 If the recovery is not between 85-110%, calculate the concentration of mercury in all samples in the batch by the method of standard additions. See Section 12.9.

9.7 Contingency

9.7.1 If, due to a lab accident or to QC failure, a re-preparation is required for the sample and insufficient volume remains, the Project Manager must be alerted and will contact the client for direction on how to proceed.

9.7.2 If persistent contamination occurs in the laboratory, analyses must be halted until the source can be identified and isolated. When the contamination issue is resolved, sample analyses may proceed.

9.7.3 Any other issues that potentially affect data quality must be addressed with the Project Manager.

10.0 Calibration and Standardization

See Section 11.0 for instrument procedures.

Note: Only one read (burn) is obtained for each analytical run.

Note: The laboratory reporting limit is at or above the lowest initial calibration standard concentration.

10.1 Initial Calibration

10.1.1 The **Leeman HYDRA AA/**PS200II must be calibrated before you can run samples. The following procedure is performed after the start-up (**Section** 11.4) and before running samples. Calibration standards are digested along with samples.

10.1.2 To perform a standard calibration, click on the WinHG icon on the desktop. The WinHG runner 1.7 screen will appear. Tighten the tubing clamps on the pump. Under the Control tab, turn pump on. The lamp should already be on, as well as the gas (0.10 LPM). Under the sample

tab, select the rack to be run. Racks are built in the Rack Editor and batches are transferred from the Sample Table on the desktop. When the Sample Table icon is clicked on, a list of sample batches appears. Click on the batch to be run and click on the Build Hg Table button at the bottom of the page. A blank table appears; press Ctrl-Shift-L and the batch will appear. Copy and paste the batch to the Rack Editor. The Client ID will be in the first columns and the laboratory ID numbers in the second column. The calibration standards will be in the far right column.

A template with the opening sequence is stored in the Rack Editor. Click on File and then open Rack 1. The continuing calibration standards can be added in the right column, where needed. Name the Rack by clicking File-Save As (usually V4mmddyy or V4mmddyA or V4mmddyB, etc.). When the rack is ready to run, select it from the drop-down list on the WinHg runner, under the Sample tab, and set the beginning and end cups. Under the Move Tip tab, press To Rinse. Click on the Run Auto button and the system will run the standards and then the samples. It is assumed that the six standards have been loaded as standards 1-6 on the standards screen.

10.1.3 The results of the calibration are automatically stored. To review the results, open the Data Base by clicking on the DB button at the top of the WinHg runner screen, then the calibration tab. The instrument generates a calibration curve based on linear regression.

10.1.3.1 The correlation coefficient must be ≥ 0.995. A forced intercept calibration model is not utilized.

10.1.3.2 For ILM05.4, standards must be within 5% of the true value (except the CRQL standard).

10.1.3.3 If above criteria are not met, check for outliers or reanalyze the entire curve. It may only be necessary to reanalyze a single outlier in order to verify the initial results. See Section 10.5.

10.2 Initial Calibration Verification/Initial Calibration Blank (ICV/ICB)

10.2.1 The ICV is digested with samples and prepared with each sample batch. The results of the ICV must agree within 10% for SW-846 and **DoD**, 5% for MCAWW, and 20% for CLP, of the "true" values. If not, the run must be terminated and the instrument recalibrated. If recalibration does not fix the problem, shut down the instrument, label with an "OUT OF CALIBRATION" tag, and request instrument service.

10.2.2 Follow the ICV with the initial calibration blank (ICB). The mercury results for the blank must be less than the EPA CRQL for CLP or less than the reporting limit (PQL) for SW-846. If not, terminate the analysis and recalibrate. A reanalysis of the ICB may be performed for SW-846 prior to recalibration. If recalibration does not fix the problem, shut down the instrument, label with an "OUT OF CALIBRATION" tag, and request instrument service.

10.2.2.1 The **DoD**-QSM and MCAWW require that the results for the ICB must be less than the MDL for MCAWW and less than or equal to the LOD for **DoD**.

10.3 Continuing Calibration Verification/Continuing Calibration Blank (CCV/CCB)

10.3.1 Verify the calibration every 10 samples and at the end of the analytical sequence using the 5.0 µg/L level calibration standard. The results of the check standard must agree within ± 20% of the true value. If not, terminate the analysis, correct the problem, and recalibrate the instrument.

10.3.1.1 For North Carolina regulatory work and for MCAWW, the check standard must agree within ± 10%.

10.3.2 Follow the CCV with the continuing calibration blank (CCB).The results for the CCB must be less than the CRQL for CLP or less than the reporting limit (PQL) for SW-846. If not, terminate the analysis and recalibrate. A reanalysis of the ICB may be performed for SW-846 prior to recalibration. If recalibration does not fix the problem, shut down the instrument, label with an "OUT OF CALIBRATION" tag, and request instrument service.

10.3.2.1 The **DoD**-QSM and the MCAWW require that the results for the CCB must be less than the MDL (for MCAWW) and less than or equal to the LOD for **DoD**.

10.4 If the calibration results are acceptable, begin running samples.

10.5 If the calibration results are unacceptable**,** rerun the standards to verify results. When an acceptable calibration is achieved, you can begin running the samples. If an acceptable calibration is not achieved upon reanalysis of the initial calibration, ICV, CCV, or CCB the entire batch must be re-digested and reanalyzed. If re-digestion and reanalysis, including all procedures in Section 11.0 regarding instrument set up and maintenance, does not yield acceptable

results, shut down the instrument, label with an "OUT OF CALIBRATION" tag, and request instrument service. After appropriate service, the entire batch must be re-digested and reanalyzed.

10.5.1 Samples bracketed by an acceptable Initial Calibration, ICV, ICB, CCV and CCB do not need to be re-digested and reanalyzed if subsequent closing CCVs/CCBs fail.

11.0 Procedure

Documentation must follow the requirements in Quality Control SOP 13.6, "Proper Documentation Procedures"

Note**:** Only one read (burn) is obtained for each analytical run.

11.1 Powering up the system

11.1.1 Bring up the WinHg runner screen, go to the Control tab, and press "On," under Hg Lamp. Let the lamp warm up for at least an hour. (This should only be done if the system has been off, such as after a power failure. Otherwise the system should remain on at all times.

11.1.2 Press the "Power On" button on the back of the PS200II unit if the unit is powered off.

11.1.3 Check the reductant volume and refresh, if needed.

11.1.4 Clean the rinse tank using standard lab cleaning practices, and add fresh rinse.

11.2 Sample Analysis

Prior to analysis all samples and standards are digested following the appropriate method sample preparation procedure (SPP). The soil SOP is SPP –162, "Solid Sample Mercury Digestion by SW-846 **Methods 7471A and 7471B**." The water SOP is SPP –074, "Mercury in Water, Manual Digestion Procedure for EPA CLP and SW-846, and MCAWW."

Note: The PS200II must be calibrated before you can run samples. The calibration procedure is given in **Section** 10.0. Autosampler tables automatically go through the calibration process and proceed to run the samples.

Note: See Section 9.0 for QC samples, acceptance criteria, and corrective actions for QC failures.

11.2.1 Just before analysis, add 55 mL of DI water to all soil samples and 50 mL of reagent water to all standards. Next, add 6 mL of hydroxylamine hydrochloride solution to reduce excess permanganate, and mix until the sample is clear. The Leeman HYDRA AA/PS200II automatically adds the appropriate amount of stannous chloride during analysis. Pour standards and samples into tubes and load into autosampler racks based upon the set-up of the Rack Editor.

11.2.2 Arrange standards in increasing concentrations and calibrate instrument.

11.2.3 Analyze a solution from a different stock source than the standards for the initial calibration verification (ICV). Determine that the measured value is in agreement with the certified value. If not, recalibrate after determining the problem.

11.2.4 Analyze the calibration blank and preparation blank(s). If the calibration blank contains mercury at a value that is greater than the reporting limit terminate the analysis, correct the problem, and recalibrate. The **DoD-**QSM requires that the results for the calibration blank must be < the MDL/LOD and < ½ RL for the preparation blank.

11.2.5 Analyze the CRI standard at the beginning of each sample analysis to verify linearity near the CRQL.

11.2.6 Analyze samples, sample spike(s), and duplicate(s) monitoring quality control requirements. A serial dilution must also be analyzed for SW-846 methods. This should be a dilution of one sample within each SDG, and/or each sample matrix. This dilution is 1 in 5 (5x).

11.2.7 Verify the calibration every 10 samples and at the end of the analytical run with a CCV followed by the CCB. Samples must be bracketed by passing CCV/CCB samples. Samples associated with a failing CCV or CCB must be re-analyzed.

11.2.8 Generate the mercury run log (Attachment 4). When sample analysis is complete, the run log and original raw data is copied and placed in all associated SDG folders.

11.3 Transferring Data

11.3.1 In Database, go to the Report tab and press Generate Report. Click on Generate and the raw data will print. Highlight the PRN button and name the file as the run was named (e.g., V4mmddyy, etc.) and click Generate again. The PRN file is then used to generate the Mercury Run Log. Go to the ICP Check icon (Instrument Data Review) on the desktop and locate the PRN file from the drop-down list. Click on Mercury Run Log. The run log screen will appear and then print.

11.4 Shutdown Procedure

In routine operation, where the system is likely to be used daily, just turn the pump off under the WinHg runner control tab, move the tip To Air under the Sample tab, loosen the clamps on the pump housing, and take the lines out of the reagent vessels. For long term shut down, turn off the analyzer by flipping the switch on the back of the unit.

NOTE**:** Before shutting down the instrument, word "Idle" should appear in the field on the top of the WinHg runner screen. To interrupt or stop an ongoing procedure, press the STOP key. The instrument can then be shut down.

12.0 Data Analysis and Calculations

Calculations must be consistent with the QC SOP 13.4, "Numerical Data Reduction."

12.1 Linear Calibration using Least Squares Regression

$$y = ax + b$$

where: y = Instrument response (peak area)
a = Slope of the line (coefficient of x)
x = Concentration of the calibration standard
b = The intercept

Linear Regression by Least Squares:

$$y_1^{'} = ax_i + b$$

Where: b = intercept
x_i = Mass of the analyte in the ith calibration standard aliquot injected
$y_1^{'}$ = calculated response for the ith calibration standard

The sum of the squares of the differences is minimized to obtain a and b:

$$\sum_{i=1}^{N}(y_i - y_1^{'})^2$$

12.2 Correlation Coefficient r:

$$r = \frac{N\left[\sum_{i=1}^{N}(x_i y_i)\right] - \left[\sum_{i=1}^{N}(x_i)\right]\left[\sum_{i=1}^{N}(y_i)\right]}{\sqrt{N\left[\sum_{i=1}^{N}(x_i^2)\right] - \left[\sum_{i=1}^{N}(x_i)\right]^2} \; x \sqrt{N\left[\sum_{i=1}^{N}(y_i^2)\right] - \left[\sum_{i=1}^{N}(y_i)\right]^2}}$$

Where: r = Correlation Coefficient
N = number of data points (equals 5 in a 5 point curve)
y = response
i = index variable (first data point i = 1)
x = Mass of the analyte in the calibration standard aliquot injected

12.3 Concentration Calculations: read the 'digestion concentration" from the calibration curve, directly from the instrument read-out or from the method of standard additions (see Section 12.10).

12.3.1 Concentration of Mercury in aqueous samples =

$$\frac{\text{(digestion concentration (µg/L)) (digestate volume (L))(dilution factor)}}{\text{(sample volume (L))}}$$

12.3.2 Concentration of Mercury in soil samples =

$$\frac{\text{(digestion concentration (µg/L)) (digestate volume (L)) (dilution factor)}}{\text{(sample weight (g)) (\% solid)}}$$

12.4 Calculation of percent recovery:

12.4.1 LCS and surrogates:

$$\%R = \frac{Amount\ found}{Amount\ spiked}\ x\ 100$$

12.4.2 Matrix spikes:

$$\% R = \frac{Amount\ in\ spiked\ sample - Amount\ in\ unspiked\ (native)\ sample}{Amount\ spiked} x\ 100$$

12.5 Calculation of % RSD

$$\%RSD = \left(\frac{Standard\ deviation}{\overline{X}}\right) \times 100$$

12.6 Calculation of RPD

$$RPD = \frac{|Value\ 1 - Value\ 2|}{(Value\ 1 + Value\ 2)/2} x100$$

12.7 Calculation of %Difference (%D)

$$\%Diff = \frac{Value - \overline{Reference\ value}}{\overline{Reference\ value}} x\ 100$$

12.8 Dilutions

12.8.1 Sample concentrations falling above the analytical range, i.e. highest calibration standard concentration, must be diluted.

12.8.2 A sample dilution must yield a value within the upper half of the analytical concentration range to be acceptable.

12.8.3 The level of dilution selected is determined by the detected concentration and the expertise of the analyst.

12.8.4 Samples are analyzed undiluted unless in the analyst's technical judgement a dilution is required based on the appearance of the sample, prior knowledge of the client or site, instrument problems related to analysis of a particular sample set, etc.

12.9 Method of Standard Additions:

To equal volumes of the sample are added a series of standard solutions containing different known quantities of mercury. All solutions are diluted to the same final volume.

Prepare addition one so that the resulting concentration is approximately 50 percent of the expected absorbance from the indigenous (from the sample matrix) analyte in the sample.

Prepare additions 2 and 3 so that the concentrations are approximately 100 and 150 percent of the expected endogenous (from the sample itself) sample absorbance.

The absorbance of each solution is determined and the result plotted on the vertical axis of a graph with the concentrations of the known standards on the horizontal axis. Extrapolate the resulting line to zero absorbance. The point of the interception with the abscissa (x-coordinate) is the endogenous concentration of the sample. See Attachment 3.

13.0 Method Performance

This method was validated through in-house laboratory studies of method detection limits and precision and accuracy for single analyst. The data are retained by the QA department.

14.0 Pollution Prevention

The solvents used in this procedure pose little threat to the environment when recycled and managed properly. Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The EPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency recommends recycling as the next best thing.

15.0 Waste Management

It is the laboratory's responsibility to comply with all federal, state, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions, and to protect the air, water, and land by minimizing and controlling all releases from fume hoods and bench operations. Compliance with all sewage discharge permits and regulations is also required. See SOP 12.1, "Hazardous Waste Disposal", regarding laboratory procedures for recycling solvent waste streams.

Samples preserved with HCl, HNO_3, or H_2SO_4 to pH <2 are hazardous and must be must be handled as hazardous waste.

Refer to the Hazardous Waste Management and Safety SOPs located in the lab.

16.0 References

16.1 "Leeman PS200 Set-up and Operation Manual"

16.2 U.S. EPA CLP SOW for Inorganic Analysis, ILM05.4

16.3 "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, 3rd edition, Update III, Methods 7470A/7471A, Revision 1, 9/94 and Update IV, Method 7471B, Revision 2, February 2007

16.4 Methods for Chemical Analysis of Water and Wastes (MCAWW), Method 245.1, Revision 3.0, 1994

16.5 Quality Control SOP, 13.6, "Proper Documentation Procedures"

16.6 Quality Control SOP 13.4, "Numerical Data Reduction"

16.7 NELAC Standards, effective, July 2003, plus revisions

16.8 **QA/G6: Guidance for Preparing Standard Operating Procedures (SOPs) EPA/600/B-07/001, April 2007**.

16.9 Standard Methods for the Examination of Water and Wastewater, 20th (1998) Edition, Method 1080

16.10 Code of Federal Register, 40 CFR, Part 136, "Guidelines for Establishing Test Procedures for Priority Pollutants"

16.11 CompuChem Quality Manual, Revision 13, November 17, 2009

16.12 Sample Control SOP 4.6, "Storing Samples"

16.13 Department of Defense Quality Systems Manual of Environmental Laboratories, Version 4.**2**, **10**/**25**/**2010**

17.0 Attachments as Tables, Diagrams and Flowcharts

17.1 Attachment 1 – Example Standards/QC Preparation Log for Cold Vapor Mercury

17.2 Attachment 2 – Example Mercury Run Log

17.3 Attachment 3 – Standard Addition Plot from SW-846 7000B

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Attachment 1

Standards/QC Preparation Log for ICP Metals/Mercury Page 1 of 3 **Case/SDG:**_____
COMPUCHEM a division of Liberty Analytical Corp. Worksheet 1Q (1) 2

REAGENTS	REF#[1]	MANUFACTURER	LOT#	EXPIRATION DATE
SULFURIC ACID (H_2SO_4)	0C02009	CALEDON	68764	10/12
NITRIC ACID (HNO_3)	0B02020	JT BAKER	H20053	02/13
POTASSIUM PERMANGANATE ($KMnO_4$)	9L30017	JT BAKER	H32614	12/12
HYDROCHLORIC ACID (HCL)	9L29009	CALEDON	71900	12/12
POTASSIUM PERSULFATE ($K_2S_2O_8$)	0C02011	JT BAKER	H02H06	05/12
HYDROGEN PEROXIDE (H_2O_2)	0C02013	CALEDON	69862	10/10
STANDARDS				
XCL 20R	0B26007	HIGH PURITY	0925409	09/11/10
XCL LCS 10XR	9L15003	HIGH PURITY	0935232	12/10/10
ERA PPT (540)	0C01027	ERA	540	12/03/10
EPA LCS (0405)	0B26009	EPA	0405	08/05/10
ICV-1 (0307)	0B04003	EPA	0307	03/12/11
ILM05.3 MATRIX SPIKE	9L15006	HIGH PURITY	0916332	06/15/10
SILVER (Ag) 100ppm	9L15009	HIGH PURITY	0934323	12/15/10
TCLP 500	9L21002	HIGH PURITY	0934202	12/10/10
ARSENIC (As) 1000ppm	9F17001	HIGH PURITY	0911221	12/05/10
MERCURY (Hg) 20ppm	9L15007	HIGH PURITY	0916320	06/15/10
ICV-5 (0508) Hg	0C01026	EPA	0508	09/15/10

[1]Ref#=Logbook ID, Page number, and item number from Materials Receipt Log
[2]Standard Lot Number consist of standard ID, date prepared, and initials of preparer

STANDARD SOLUTIONS PREPARED BY:_____ DATE:_____

ENTERED BY:_____ DATE:_____

REVIEWED BY:_____ DATE:_____

The presence of the Chemist's/Analyst's employee ID number, or signature, on this worksheet attests that strict compliance with the method's SOP has occurred. Any SOP deviations require documentation by the responsible chemist/analyst together with the chemist's/analyst's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation.

12/03/07:RM

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Attachment 1 (Continued)

Standards/QC Preparation Log for ICP Metals/Mercury Page 2 of 3 **Case/SDG:**_____

COMPUCHEM a division of Liberty Analytical Corp. Worksheet 1Q (1) 2

STANDARD LOT NUMBER[2]	PREPARATION INSTRUCTIONS
Hg 100ppb-03-15-10-DD	Place in a 100mL volumetric flask: 0.5mL of 20ppm Hg stock solution 2.5mL of concentrated HNO_3 Baker instra-analyzed Trace Metals grade or equivalent Dilute to 100mL volume with reagent water (**PREPARE DAILY**)
$K_2S_2O_8$- 03-15-10-DD Potassium Persulfate	Place in a 1000mL Erlenmeyer to a re-pipettor bottle (**PREPARE AS NEEDED**)
$KmnO_4$. 03-15-10 –DD Potassium Permanganate	Place in a 2000mL volumetric flask: 100.0g of $KmnO_4$ Baker instra-analyzed Trace Metals grade or equivalent Dilute to 2000mL with reagent water (**PREARE AS NEEDED**)
HNO_3- 03-09-10 - JR Nitric Acid	Place in a 2000mL volumetric flask: 500mL of Deionized water 1000mL of concentrated HNO_3 Baker instra-analyzed Trace Metals grade or equivalent Dilute to 2000mL with reagent water (**PREPARE AS NEEDED**)
HCl- 02-12-10 - JR Hydrochloric Acid	Place in a 2000mL volumetric flask: 500mL of Deionized water 1000mL of concentrated HCl Baker instra-analyzed Trace Metals grade or equivalent Dilute to 2000mL with reagent water (**PREPARE AS NEEDED**)
Aqua Regia- 02-10-10 - DD	Place in a 1000mL container: 600mL of Concentrated HCL 200mL of Concentrated HNO3 **(PREPARE AS NEEDED)**

[1]Ref#=Logbook ID, Page number, and item number from Materials Receipt Log
[2]Standard Lot Number consist of standard ID, date prepared, and initials of preparer

STANDARD SOLUTIONS PREPARED BY:_____ DATE:_____

ENTERED BY:_____ DATE:_____

REVIEWED BY:_____ DATE:_____

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12/03/07:RM

REVIEWED BY:_____ DATE:_____

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Attachment 1 (Continued)

Standards/QC Preparation Log for ICP Metals/Mercury Page 3 of 3 **Case/SDG:**_____
COMPUCHEM a division of Liberty Analytical Corp. Worksheet 1Q (1) 2

STANDARD LOT NUMBER[2]	PREPARATION INSTRUCTIONS	Resultant Analyte Concentration
ICV-5- 03-15-10-DD	Pipet into a 300mL BOD Bottle 1.0mL of ICV-5 and 99mL of reagent water. Digest according to sample preparation instructions	4.0µg/L
S0/ICB/CCB- 03-15-10-DD	Pipet into a 300mL BOD Bottle 100mL of reagent water Digest according to sample preparation instructions	0.0µg/L
S0.2/CRA/CRI- 03-15-10-DD	Pipet into a 300mL BOD Bottle 0.2mL of Hg 100ppb and 99.8mL of reagent water Digest according to sample preparation instructions	0.2µg/L
S0.5- 03-15-10-DD	Pipet into a 300mL BOD Bottle 0.5mL of Hg 100ppb and 99.5mL of reagent water Digest according to sample preparation instructions	0.5µg/L
S1.0- 03-15-10-DD	Pipet into a 300mL BOD Bottle 1.0mL of Hg 100ppb and 99mL of reagent water Digest according to sample preparation instructions	1.0µg/L
S5.0/CCV- 03-15-10-DD	Pipet into a 300mL BOD Bottle 5.0mL of Hg 100ppb and 95mL of reagent water Digest according to sample preparation instructions	5.0µg/L
S10.0- 03-15-10-DD	Pipet into a 300mL BOD Bottle 10mL of Hg 100ppb and 90mL of reagent water Digest according to sample preparation instructions	10.0µg/L

[1]Ref#=Logbook ID, Page number, and item number from Materials Receipt Log
[2]Standard Lot Number consist of standard ID, date prepared, and initials of preparer

STANDARD SOLUTIONS PREPARED BY:_____ DATE:_____

ENTERED BY:_____ DATE:_____

REVIEWED BY:_____ DATE:_____

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Attachment 2

Maintenance: _____

Method(s) (circle one): **ILM04.1** **ILM05.4** **Others** 7470A 7471A

Operator(s): _____ **Date/Time** _____ **to** _____

Printed: 5/14/2009

↑	Specified element(s) fail(s) high
↓	Specified element(s) fail(s) low
RR	Re-run sample(s) neat
RR #X	Re-run at a #-fold dilution
#X	Sample run at a #-fold dilution (aliquot of sample diluted with acidified water)
L	Matrix = leachate
W	Matrix = water
S	Matrix = solid
B	Matrix = biological tissue

SDG	Matrix	Comments

Batch

HG Run Log

File Name:

Cup	Sample ID	Client ID	Sample Type	DF	Date	Time	Results	Comments

The presence of the Chemist's/Analyst's employee ID number, or signature, on this run log attests that strict compliance with the method's SOP has occurred. Any SOP deviations require documentation by the responsible chemist/analyst together with the chemist's/analyst's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation.

Reviewed By: _____ Date: _____ Page 1 of 1

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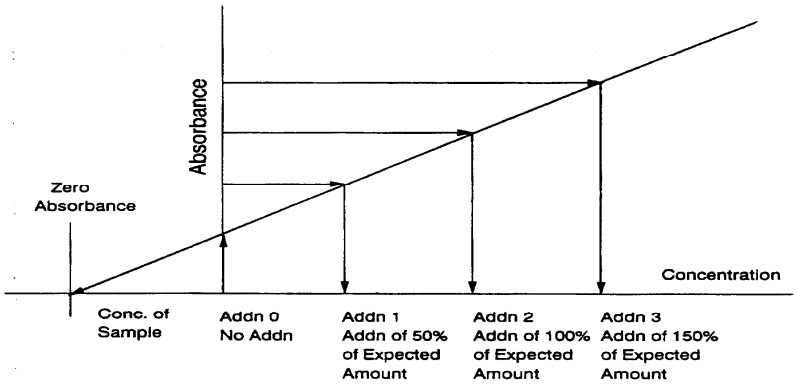
Attachment 3

FIGURE 1

STANDARD ADDITION PLOT



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501 Madison Avenue
Cary, NC 27513

NELAP accredited

SOP DOCUMENTATION FORM

This form must accompany all new and revised Standard Operating Procedures (SOPs) when you turn them in to Quality Assurance for review. Please fill out the entire block below (except effective date).

This is a new procedure _____ revised procedure ✓ outdated procedure (archive) _____

- Procedure Code: IP 802 & 809 SOP Section #: 3.6.2.2 Revision #: 16

SOP Title: Analysis of Soil Samples for Total Organic Carbon (TOC) by SW-846 Method 9060A, modified for soils, and Lloyd Kahn

Effective date: (QA fills in) 2-9-11

- Procedure prepared by: Judith Mozer Date: 2/1/2011
- Procedure approved by: (If the manager prepared the SOP, a qualified second party should sign) Date: 02-09-2011
- Reason for change: Addition of DoD procedures and protocols Annual review
- This procedure meets the requirements of the following approved method references: SW-846, 3RD Ed., Update IIIB, "/04, Method 9060A, modified for soils and Lloyd Kahn Method, "Determination of Total Organic Carbon in Sediment" July 1988 modified for Soil. DoD Quality Systems Manual for Environmental Laboratories, Version 4.2, 10/25/2010

Procedure approved by a QA Representative (unless QA Representative signed above):

_____ Date: _____

On an annual basis: Lab managers are required to review lab practices and revise the SOP if necessary. If no revision is necessary, indicate by your signature that the SOP has been reviewed.

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Annual Review—Signature: _____ Date: _____

Instrument Procedure 802 and 809: Analysis of Soil Samples for Total Organic Carbon (TOC) by SW-846 Method 9060A, modified for Soils, and Lloyd Kahn

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Instrument Procedure 802 and 809: Analysis of Soil Samples for Total Organic Carbon (TOC) by SW-846 Method 9060A, modified for Soils, and Lloyd Kahn

1.0 Scope and Application

Soil and sediment samples are analyzed using the SSM-5000A Solid Sample Module that is interfaced with the TOC-VCSH analyzer. The instrument converts any organic carbon to carbon dioxide (CO_2) by catalytic combustion. The carbon dioxide is measured directly with a non-dispersive infrared detector.

A reporting limit of 100 mg/Kg is required for the Lloyd Kahn method.

Staff members performing the procedures described in this SOP are responsible for reading, understanding, and complying with the SOP requirements. Supervisors are responsible for directing the analyst to the controlled SOP, and providing adequate explanation of the material contained therein.

This procedure is restricted to use by or under the supervision of analysts experienced in the instrumentation or preparative methods and who have demonstrated the ability to generate acceptable results through QC samples and analyst capability studies.

2.0 Summary

TOC in soil is composed of a variety of organic compounds in various oxidation states. A high temperature combustion method is used to measure TOC in soil. The sample is acidified to remove inorganic carbon, and introduced to a combustion oven (900°C) where all carbonaceous matter is oxidized to carbon dioxide. The carbon dioxide is bubbled through an acidified liquid and then routed through a mist trap to remove water and scrub out any corrosive species formed. The gas is swept to a non-dispersive infrared detector which is specific for carbon dioxide measurement.

For the Lloyd Kahn method, one sample in a 20 sample batch is analyzed in quadruplicate. Quadruplicate analyses are required by Method 9060A. Perform quadruplicate analyses unless instructed otherwise by the client. When run in quadruplicate, both the average and the range are reported.

3.0 Definitions

3.1 Method detection limit (MDL) – The minimum concentration of an analyte that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte (40 CFR, Part 136, Appendix B)**. A minimum of seven sample replicates is required to calculate a statistical MDL. The MDL is an approximation of the DL. Any analyte concentration result at or above the MDL must also meet all qualitative identification criteria required by the test method in order to be reported as present.**

3.2 Detection Limit (DL) - The DL is the smallest analyte that can be demonstrated to be different from zero or a blank concentration at the 99 % level of confidence. The false positive rate at the DL is 1% and the false negative rate is 50%. Any analyte concentration result at or above the DL must also meet all qualitative identification criteria required by the test method in order to be reported as present.

3.3 Limit of Detection (LOD) – The LOD is the smallest concentration of an analyte that must be present in a sample in order to be detected at a 99% confidence level. The false negative rate at the LOD is 1 %. For DoD-QSM, non-detect sample results are reported as < LOD. Numeric values of measurements between the DL and the LOQ are reported as estimates. The DL < LOD ≤ LOQ.

3.4 Limit of Quantitation (LOQ) – The Limit of Quantitation is the lowest concentration of a substance that produces a quantitative result within specified limits of precision and bias. The LOQ must be within the calibration range.

3.5 Reporting Limit (RL) –

3.5.1 For Non-DoD work, the laboratory reporting limit is based on the lowest multipoint calibration standard concentration. For organic methods, values detected below the reporting limit and above the MDL may be reported and qualified as an estimated concentration.

3.5.2 The DoD-QSM defines the reporting limit as being the lowest concentration value specified by the client that meets project requirements for reporting data with known precision and bias for a specific analyte in a specific matrix. The LOQ cannot be greater than

the RL. Data reported below the RL must be flagged as estimated values if they are also less than the LOQ.

3.3 Reporting Units – mg/Kg

3.4 A **Sample Delivery Group (**SDG**)** is defined by the following, whichever is more frequent:

- each 20 field samples received within a case, or
- each 7 calendar day period during which field samples in a case are received (14 calendar days if requested by the client) beginning with the receipt of the first sample.

NOTE: The DoD-QSM and SC DHEC do not accept the SDG approach, unless the samples are prepared in a single batch. When a group of up to 20 field samples of a similar matrix are prepared as one batch, method-specified QC samples such as a method blank, laboratory control sample, matrix spike, matrix spike duplicate, and matrix duplicate must also be prepared together at a rate of 5% for DoD-QSM. If samples are batched together from different sites, project-specific QC must be processed.

3.5 DoD-QSM – Department of Defense Quality Systems Manual

3.6 SC DHEC – South Carolina Department of Health and Environmental Control

4.0 Interferences

4.1 Volatile organics can be lost during sample blending, particularly if temperature is allowed to rise.

4.2 Avoid contaminated glassware, plastic containers, and rubber tubing.

5.0 Safety

Appropriate protective equipment and clothing must be used under the assumption that all samples are potentially hazardous. Safety glasses, gloves and lab coats are a minimum requirement. The persistent presence of noxious odors may be indicative of failure of the laboratory ventilation system and must be reported to a supervisor or manager.

Laboratory staff must review the Chemical Hygiene Plan for general safety policies, and Material Safety Data Sheets for reagents used in the laboratory.

6.0 Equipment **and** Supplies

6.1 Total organic analyzer-- Shimadzu, TOC-VCSH, model # H51104335168

6.1.1 Automatic sample injector - ASI-V, model # H52104301622

6.1.2 Solid Sample Module – SMM-5000A, model # H525043

6.2 Analytical balance capable of weighing to 0.001g for weighing samples and preparation of standards

6.3 Glassware – Prepare by handwashing with a non-phosphate biodegradable detergent, then rinsing three times with DI water.

6.3.1 100 mL volumetric flasks

6.3.2 Volumetric pipettes

7.0 Reagents and Standards

Standards and reagent traceability information must be documented on the Standards/QC Sample Preparation for TOC Soil **work**sheet. (Attachment 1)

Note: **All reagents and standards must be ACS (American Chemical Society) grade or equivalent, unless otherwise denoted.** All standards and reagents are subject to change in vendor and in concentration. The Reporting Limits are also subject to change, but must remain at or above the lowest point in the calibration.

7.1 Reagent Water-All water used during preparation must be reagent-grade Type I with regard to resistivity of > 10 megohm-cm (18th and 19th Editions of Standard Methods, Method 1080), and referred throughout this SOP as DI water.

7.2 Carrier gas: purified oxygen, carbon dioxide free, and containing less than 1 ppm hydrocarbon.

7.3 Quartz Wool (Used as soil media for standards and instrument blank)

7.4 Sulfuric acid (20%)-reagent grade – Cautiously add 200 **mL** of concentrated sulfuric acid to a one liter volumetric containing approximately 500 mL DI water. After cooling, dilute to the mark with DI water. This solution is used to prepare the calibration standards.

7.5 Phosphoric acid – 1:1 by volume solution used for Lloyd Kahn procedure

7.6 10,000 ppm Stock Calibration Standard

7.6.1 Potassium hydrogen phthalate (KHP), reagent grade, 10,000 ppm. This aqueous standard is purchased from Tekmar-Dohrman and is used as the primary stock standard.

7.7 10,000 ppm Second Source Stock Standard used for the Initial Calibration Verification (ICV) and the Laboratory Control Sample (LCS).

7.7.1 The ICV (6000 ppm) is prepared by adding 60 **µ**L of the Second Source Stock Standard (10,000ppm) to a sample boat containing a portion of quarts wool.

7.7.2 The LCS (6000 ppm) is prepared at by adding 60 **µ**L of the Second Source Stock Standard (10,000 ppm) to a sample boat containing a portion of quarts wool.

7.8 5,000 ppm Continuing Calibration Verification (CCV) Standard

7.8.1 The concentration of the continuing calibration standard is 5,000 ppm. This standard is prepared by adding 50 µL of the 10,000 ppm stock standard to a sample boat containing a of portion quarts wool.

7.9 Matrix Spike

7.9.1 The matrix spike and matrix spike duplicate (MS/MSD) are spiked using the 10,000 ppm stock standard. Based upon the results of the original un-spiked sample, the MS/MSD samples are then spiked at 1 to 5 times the sample concentration.

8.0 <u>Sample Preservation and Storage</u>

8.1 Samples are preserved, and stored according to the tables in Sample Control SOP 4.1, "Receiving Samples" and 4.6, "Storing Samples." Sample holding times are also listed.

8.2 Soil samples are not preserved. They must be refrigerated at 4 °C ± 2 °C in amber glass containers with TFE lined caps. Samples must be analyzed within 28 days of sampling**, except when using the Lloyd Kahn method, which requires analysis within 14 days**.

9.0 Quality Control

9.1 The ICV is run immediately after the instrument is calibrated with a separate source KHP standard. Acceptance criteria are ± 10% of the true value.

9.1.1 If the ICV fails, reanalyze. If it still fails, re-calibrate and reanalyze.

9.2 An initial calibration blank (ICB) is run after the ICV. This result must not be greater than the reporting limit. If the result is above the reporting limit, repeat the calibration.

9.2.1 To meet the requirements of the DoD-QSM, the concentration of the analyte in the blank must be < one-half the reporting limit.

9.3 The method blank or preparation blank (PB) is prepared with each batch of not more than 20 field samples. The results of the method blank must not exceed the reporting limit. If the result is above the reporting limit, reanalyze the blank. If the result is still above the reporting limit, recalibrate and reanalyze.

9.3.1 The DoD-QSM requires that the content of the method blank must be less than one-half of the reporting limit.

9.4 The LCS is prepared with each preparation batch of not more than 20 field samples. The recovery in the LCS must be within ± 10% of the true value. If the LCS fails reanalyze. If is still fails, recalibrate and reanalyze the entire batch.

9.5 A CCV and continuing calibration blank (CCB) are run after every 10 samples and at the end of the sequence. Acceptance criteria are the same as the ICV/ICB. If the CCV or CCB fails, the previous 10 samples must be reanalyzed.

9.6 A MS/MSD are prepared (if requested by the client) in a batch of not more than 20 field samples. The spike recovery should be between 75 and 125% and a relative percent difference should be ≤ 20%. If the duplicate matrix spike acceptance criteria are not met, but the LCS is acceptable, a sample matrix effect is indicated and the batch is in control.

10.0 Calibration and Standardization

10.1 Prepare the sample boat for analysis by heating it in the TC furnace of the Shimadzu, TOC-VCSH TOC analyzer at 900 °C for 20 minutes.

10.2 Calibrate the instrument at five levels using the 10,000 ppm Stock Standard Solution (Section 7.6).

10.2.1 Create a calibration curve by selecting "new calibration curve" on the instruments PC.

10.2.2 Select the "ssm system" (soil sample module)

10.2.3 Select "edit cal points manually".

10.2.4 Name your calibration curve and select "linear regression"

10.2.5 Using Quartz Wool as the soil matrix for the standards, analyze the calibration curve at 0 (ICB), 25, 50, 75, and 100 uL of the 10,000 ppm Stock Solution (Section 7.6).

10.3 A correlation coefficient of ≥ 0.995 must be achieved in order for the calibration to be acceptable. (See Attachment 3 for an example Calibration Curve)

10.4 Verifying the Calibration

10.4.1 The initial calibration is verified by analyzing the 6000 ppm ICV standard and a blank or ICB. The ICV results must be within ± 10% of the true value and the ICB < the reporting limit. If the ICV fails, re-analyze. If the re-analysis, analyze a new initial calibration.

10.4.1.1 To meet the requirements of the DoD-QSM, the concentration of the analyte in the blank must be < one-half the reporting limit.

10.4.2 A 5000 ppm continuing calibration verification (CCV) standard and a continuing calibration blank (CCB) are analyzed, after every 10 samples, and at the end of the analytical sequence. The results of the CCV must be within ± 10% of the true value and the CCB < the reporting limit. If the CCV fails, reanalyze it once. If it still fails, the instrument must be

recalibrated and the previous samples since the last passing CCV/CCB must be reanalyzed.

10.5 To meet the requirements of the DoD-QSM, the concentration of the analyte in the blank must be < one-half the reporting limit.

10.6 Refer to the TOC-V Series SSM-5000A "Solid Sample Module for Total Organic Carbon Analyzer" Users Manual for instrument operation instructions for calibration.

10.7 Pipette Calibration

10.7.1 Ensure pipettes have been calibrated at the required frequency before use according to Inorganics SOP 9.1, "Calibrating Automatic Pipettes in the Inorganics Laboratory."

10.8 Balance Calibration

10.8.1 Ensure the balance has been calibrated for the day prior to use following Quality Control SOP 13.17, "Analytical Balance Calibration and Maintenance."

11.0 Procedure

Documentation must follow the requirements in Quality Control SOP 13.6, "Proper Documentation Procedures."

11.1 Discard any foreign objects such as sticks, stones, and leaves. Thoroughly mix the sample, reducing any clumps, with a metal spatula in a plastic weighing boat to create a homogeneous, representative sample.

11.2 Prepare the sample boat using the procedure in **Section** 10.1. Remove the sample boat; add a tuft of quartz wool, then place it on the analytical balance. Tare the balance and transfer 10 to 20 mg of soil sample to the boat.

11.3 Add one drop of 20% sulfuric acid to the top of the sample in the boat. For Lloyd Kahn samples, add 1:1 phosphoric acid. Allow the sample to stand at room temperature for 3-5 minutes or until effervescence ceases.

11.4 Place the sample boat into the hatch port. Close the hatch, and allow the detector baseline to stabilize. Press "run." Enter the sample ID, press enter. Enter the sample weight in mg, and press "start."

11.5 Slowly push the boat into the combustion tube during the period "inject now." When the run is complete, pull the boat to the cooling position..

11.6 After completion of the integration, select "next" for the next sample and repeat **Sections** 11.2 through 11.6.

11.6.1 One in twenty Lloyd Kahn samples is analyzed in quadruplicate. Both the average and the range are reported. A RSD of 20% must be achieved for quad samples or the analysis must be repeated.

11.6.2 Method 9060A requires samples to be analyzed in quadruplicate. Both the average and the range are reported.

11.6.3 Perform quadruplicate analyses unless instructed otherwise by the client. Both the average and the range are reported.

11.7 Refer to the TOC-V Series SSM-5000A "Solid Sample Module for Total Organic Carbon Analyzer" users manual for instrument operation instructions for sample analysis.

11.8 Calculating Dilutions

11.8.1 Determine a level of dilution that will result in a value within the upper half of the calibration range. This is an acceptable dilution.

11.8.2 For example, 7.0 mg silica gel mixed with 2.9 mg sample yields a dilution factor of 3.41. A 10 mg aliquot of this mixture is transferred to the boat. It should be recorded on the run log as "3.41x (7.0 mg silica gel + 2.9 mg sample)."

12.0 Data Analysis and Calculations

Calculations must be consistent with the Quality Control SOP13.4, "Numerical Data Reduction."

12.1 The Shimadzu, TOC-VCSH TOC Analyzer automatically calculates the concentration of organic carbon. When carbon is detected, an electronic peak is generated and integrated by the Shimadzu, TOC-VCSH computer where its area is calculated. The computer then plots the area of the peak on the calibration curve.

12.4 Calculation of the mean or average of a set of values:

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

where: n = total number of values
x_i = each individual value used to calculate the mean
x = the mean of n

12.5 Calculation of the standard deviation of a set of values:

$$Standard\ deviation = \sqrt{\frac{\sum_{i=1}^{n}\left(X_n - \overline{X}\right)^2}{n-1}}$$

12.6 Calculation of percent recovery:

12.6.1 LCS:

$$\%R = \frac{Amount\ found}{Amount\ spiked}\ x\,100$$

12.6.2 Matrix spikes:

$$\%\,R = \frac{Amount\ in\ spiked\ sample - Amount\ in\ unspiked\ (native)\ sample}{Amount\ spiked}\ x\,100$$

12.7 Calculation of % RSD

$$\%RSD = \left(\frac{Standard\ deviation}{\overline{X}}\right) \times 100$$

12.8 Calculation of RPD

$$RPD = \frac{|Value\ 1\ -\ Value\ 2|}{(Value\ 1\ +\ Value\ 2)/2}\ x100$$

13.0 Method Performance

This method was validated through in-house laboratory studies of method detection limits and precision and accuracy for single analyst. The data are retained by the QA department.

14.0 Pollution Prevention

The solvents used in this procedure pose little threat to the environment when recycled and managed properly. Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The EPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency recommends recycling as the next best thing. See SOP 12.1, Hazardous Waste Disposal, regarding laboratory procedures for recycling solvent waste streams.

15.0 Waste Management

It is the laboratory's responsibility to comply with all federal, state, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions, and to protect the air, water, and land by minimizing and controlling all releases from fume hoods and bench operations. Compliance with all sewage discharge permits and regulations is also required.

Samples preserved with H_2SO_4 to pH <2 are hazardous and must be neutralized before being disposed, or must be handled as hazardous waste.

Refer to the Hazardous Waste Management and Safety SOPs located in the lab.

16.0 References

16.1 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846; 3rd Edition, Update IIIB, 11/04, Method 9060A, modified for soils, based on the TOC-V Series SSM-5000A "Solid Sample Module for Total Organic Carbon Analyzer" Users Manual.

16.2 Quality Control SOP, 13.6 "Proper Documentation Procedures"

16.3 Quality Control SOP, 13.4 "Numerical Data Reduction"

16.4 NELAC Standards, effective July 2003**, plus revisions**

16.5 QA/G6: Guidance for Preparing Standard Operating Procedures (SOPs) EPA/600/B-07/001, April 2007.

16.6 CompuChem Quality Manual, Revision **13**, **November 17**, 2009, plus revisions

16.7 Lloyd Kahn Method, "Determination of Total Organic Carbon in Sediment," July 1988, modified for soils

16.8 Department of Defense Quality Systems Manual for Environmental Laboratories, Version 4.2, October 25, 2010

17.0 Attachments as Tables, Diagrams, and Flowcharts

17.1 **Example TOC** Standards/QC Sample Preparation **Worksheet**

17.2 Example Calibration Curve

Attachment 1

Standards/QC Preparation for Total Organic Carbon (TOC) in Soil

COMPUCHEM a Division of Liberty Analytical Corporation WORKSHEET 1 H (8) 1 Sequence Filename: _____

STANDARDS AND REAGENTS TRACEABILITY*	REF #:	MANUFACTURER	LOT#	EXPIRATION DATE
TOC Second Source Stock Standard (10,000 ppm)	1U(6)1-17-27	Science Stuff Inc.	9092427	11-12-012
TOC Calibration Source Stock CAL Standard (10,000 ppm)	1U(6)1-18-17	NSI Solutions	020910	02/2012
Concentrated Sulfuric Acid (H_2SO_4)	0A07003	Caledon	140517	02/2012
Concentrated Phosphoric Acid (H_3PO_4) (LLOYD KAHN only)	1U(6)1-20-2	EMD	50091021	8-13-2015

REAGENT/STANDARD LOT NUMBER**	PREPARATION INSTRUCTIONS
20%-H_2SO_4 – 01 12 11 jm	Add 20-mL of concentrated H_2SO_4 to 80-mL of reagent water
50%-H_3PO_4 – 01 12 11 jm	Add 20-mL of concentrated H_3PO_4 to 20-mL of reagent water in a 40-mL vial.
TOC ICV – 01 21 11 jm 01 22 11 jm (Second Source)	6,000 ppm; Pipet 60-µL of TOC Second Source Stock into the weigh boat (set volume to 100 ul)
TOC LCS – 01 21 11 jm (Second Source)	6,000 ppm; Pipet 60-µL of TOC Second Source Stock into the weigh boat. (set volume to 100 ul)
TOC CCV – 01 21 11 jm 01 22 11 jm	5,000 ppm; Pipet 50-µL of TOC Calibration Stock into the weigh boat. (set volume to 100 ul)
TOC Matrix Spikes yields N/A	TOC Stock 10,000 ppm Standard / sample weight(mg) x volume(uL) of spike solution = MS/MSD True value
LOQ TV = 100 ppm - 01 21 11 jm	Pipet 100-µL of TOC Calibration Stock cal std into the weigh boat (set volume to 10000 ul)
LOD TV = 75 ppm - 01 22 11 jm	Pipet 75-µL of TOC Calibration Stock cal std into the weigh boat. (set volume to 10000 ul)

*Ref# = Logbook ID, Page number, and item number from Materials Receipt Log
**Standard Lot Number consists of standard ID, date prepared, and initials of preparer.

The presence of the Chemist's/Analyst's employee ID number, or signature, on this run log attests that strict compliance with the method's SOP has occurred. Any SOP deviations require documentation by the responsible chemist/analyst together with the chemist's/analyst's initials and the initials of the lab supervisor and a QA department representative, signifying approval of the deviation.

Standard Solutions Prepared and Entered By: _____ Date: _____

Reviewed By: _____ Date: _____

8/26/08:vr

Note: This page subject to change without notice.

Attachment 2

TOC-V Cal Curve Information
SSMCAL.2009_08_14_10_49_52.cal

Date of Creation 3:29:38 PM 8/15/2006
User
System SSM

Cal. Curve

Sample Name: CAL
Sample ID: 10000
Cal. Curve: SSMCAL.2009_08_14_10_49_52.cal
Status Completed
Comment:

Type	Anal.	Density
Standard	SSM-TC	1.000mg/uL

AbsC: 0.000ug

No.	Area	CNV	Abs C	Weight	Volume	Rem.	Ex.	Date / Time
1	0.000	0.000	0.000ug	0.000mg	0uL	*******		8/14/2009 11:29:51

Mean Area 0.000
Mean CNV 0.000
SD Area 0.000
CV Area 0.00%

AbsC: 250.0ug

No.	Area	CNV	Abs C	Weight	Volume	Rem.	Ex.	Date / Time
1	27.12	27.12	250.0ug	25.00mg	25uL	*******		8/14/2009 11:42:03

Mean Area 27.12
Mean CNV 27.12
SD Area 0.000
CV Area 0.00%

AbsC: 500.0ug

No.	Area	CNV	Abs C	Weight	Volume	Rem.	Ex.	Date / Time
1	53.60	53.60	500.0ug	50.00mg	50uL	*******		8/14/2009 11:54:27

Mean Area 53.60
Mean CNV 53.60
SD Area 0.000
CV Area 0.00%

AbsC: 750.0ug

No.	Area	CNV	Abs C	Weight	Volume	Rem.	Ex.	Date / Time
1	78.25	78.25	750.0ug	75.00mg	75uL	*******		8/14/2009 12:09:15

Mean Area 78.25
Mean CNV 78.25
SD Area 0.000
CV Area 0.00%

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ORIGINAL MASTER COPY CONTROLLED COPY
If the words above are not highlighted, this is an uncontrolled copy of this document.

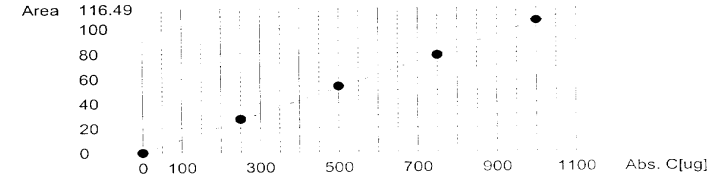
Attachment 2 (Continued)

AbsC: 1000ug

No.	Area	CNV	Abs C	Weight	Volume	Rem.	Ex.	Date / Time
1	105.9	105.9	1000ug	100.0mg	100uL	*******		8/14/2009 12:25:22 I

Mean Area	105.9
Mean CNV	105.9
SD Area	0.000
CV Area	0.00%

Slope:	0.1052
Intercept	0.000
r^2	0.999727
r	0.999864
Zero Shift	Yes



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Laboratory Quantitation Limits

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Analytical Method Information

Analyte	MDL	LOD	Reporting Limit	Surrogate %R	Duplicate RPD	LCS\ Matrix Spike %R	RPD
VOA-8260B 25ML D.O.D. in Water (SW 8260B)							
Preservation: Add HCl to pH<2; Store cool at 4°C							
Container: 01b_40mL VOA, cool, HCl		**Amount Required:** 3-40ml VIALS			**Hold Time:** 14 days		
Dichlorodifluoromethane	0.030	0.080	0.50 ug/L			30 - 155	30
Chloromethane	0.11	0.30	0.50 ug/L			40 - 125	30
Vinyl chloride	0.070	0.080	0.50 ug/L			50 - 145	30
Bromomethane	0.11	0.30	0.50 ug/L			30 - 145	30
Chloroethane	0.20	0.30	0.50 ug/L			60 - 135	30
Trichlorofluoromethane	0.060	0.080	0.50 ug/L			60 - 145	30
Acrolein	1.0	3.0	5.0 ug/L			50 - 150	30
1,1-Dichloroethene	0.040	0.080	0.50 ug/L			70 - 130	30
1,1,1-Trichloro-2,2,2-trifluoroethane	0.050	0.080	0.50 ug/L			50 - 150	30
Acetone	0.44	1.5	2.5 ug/L			40 - 140	30
Iodomethane	0.030	0.080	0.50 ug/L			50 - 150	30
1,1,2-Trichloro-1,2,2-trifluoroethane	0.050	0.080	0.50 ug/L			50 - 150	30
Carbon disulfide	0.020	0.080	0.50 ug/L			35 - 160	30
3-Chloropropene	0.050	0.080	0.50 ug/L			50 - 150	30
Acetonitrile	0.030	0.080	0.50 ug/L			50 - 150	30
Methyl acetate	0.14	0.30	0.50 ug/L			50 - 150	30
Methylene chloride	0.020	0.080	0.50 ug/L			55 - 140	30
Acrylonitrile	0.36	0.80	5.0 ug/L			50 - 150	30
trans-1,2-Dichloroethene	0.050	0.080	0.50 ug/L			60 - 140	30
Methyl tert-butyl ether	0.030	0.080	0.50 ug/L			65 - 125	30
1,1-Dichloroethane	0.020	0.080	0.50 ug/L			70 - 135	30
Chloroprene	0.020	0.080	0.50 ug/L			50 - 150	30
Vinyl acetate	0.060	0.16	1.0 ug/L			50 - 150	30
Isopropyl Ether	0.040	0.080	0.50 ug/L			50 - 150	30
cis-1,2-Dichloroethene	0.030	0.080	0.50 ug/L			70 - 125	30
2,2-Dichloropropane	0.030	0.080	0.50 ug/L			70 - 135	30
Propionitrile	1.4	4.0	25 ug/L			50 - 150	30
2-Butanone	0.28	0.40	2.5 ug/L			30 - 150	30
Methacrylonitrile	0.39	0.80	5.0 ug/L			50 - 150	30
Bromochloromethane	0.040	0.080	0.50 ug/L			65 - 130	30
Chloroform	0.030	0.080	0.50 ug/L			65 - 135	30
1,1,1-Trichloroethane	0.020	0.080	0.50 ug/L			65 - 130	30
Cyclohexane	0.020	0.080	0.50 ug/L			50 - 150	30
1,1-Dichloropropene	0.030	0.080	0.50 ug/L			75 - 130	30
Carbon tetrachloride	0.030	0.080	0.50 ug/L			65 - 140	30

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Analytical Method Information

Analyte	MDL	LOD	Reporting Limit	Surrogate %R	Duplicate RPD	LCS\ Matrix Spike %R	RPD
1,2-Dichloroethane	0.030	0.080	0.50 ug/L			70 - 130	30
Isobutyl alcohol	5.9	15	25 ug/L			50 - 150	30
Benzene	0.030	0.080	0.50 ug/L			80 - 120	30
Trichloroethene	0.030	0.080	0.50 ug/L			70 - 125	30
Methylcyclohexane	0.030	0.080	0.50 ug/L			50 - 150	30
1,2-Dichloropropane	0.12	0.30	0.50 ug/L			75 - 125	30
Dibromomethane	0.030	0.080	0.50 ug/L			75 - 125	30
1,4-Dioxane	5.4	15	25 ug/L			50 - 150	30
Methyl Methacrylate	0.56	0.80	5.0 ug/L			50 - 150	30
Bromodichloromethane	0.030	0.080	0.50 ug/L			75 - 120	30
2-Chloroethylvinyl ether	0.19	0.30	1.0 ug/L			50 - 150	30
cis-1,3-Dichloropropene	0.040	0.080	0.50 ug/L			70 - 130	30
4-Methyl-2-pentanone	0.42	1.5	2.5 ug/L			60 - 135	30
Toluene	0.030	0.080	0.50 ug/L			75 - 120	30
trans-1,3-Dichloropropene	0.050	0.080	0.50 ug/L			55 - 140	30
1,1,2-Trichloroethane	0.040	0.080	0.50 ug/L			75 - 125	30
Ethyl Methacrylate	0.41	0.80	5.0 ug/L			50 - 150	30
1,3-Dichloropropane	0.030	0.080	0.50 ug/L			75 - 125	30
Tetrachloroethene	0.060	0.080	0.50 ug/L			45 - 150	30
2-Hexanone	0.51	1.5	2.5 ug/L			55 - 130	30
Dibromochloromethane	0.040	0.080	0.50 ug/L			50 - 150	30
1,2-Dibromoethane	0.040	0.080	0.50 ug/L			80 - 120	30
1-Chlorohexane	0.050	0.080	0.50 ug/L			50 - 150	25
Chlorobenzene	0.020	0.080	0.50 ug/L			80 - 120	30
1,1,1,2-Tetrachloroethane	0.020	0.080	0.50 ug/L			80 - 130	30
Ethylbenzene	0.040	0.080	0.50 ug/L			75 - 125	30
m,p-Xylene	0.080	0.16	1.0 ug/L			75 - 130	30
o-Xylene	0.030	0.080	0.50 ug/L			80 - 120	30
Styrene	0.020	0.080	0.50 ug/L			65 - 135	30
Bromoform	0.030	0.080	0.50 ug/L			70 - 130	30
Isopropylbenzene	0.050	0.080	0.50 ug/L			75 - 125	30
1,1,2,2-Tetrachloroethane	0.050	0.080	0.50 ug/L			65 - 130	30
1,2,3-Trichloropropane	0.090	0.30	0.50 ug/L			75 - 125	30
Bromobenzene	0.040	0.080	0.50 ug/L			75 - 125	30
trans-1,4-Dichloro-2-butene	0.33	1.2	2.0 ug/L			50 - 150	30
n-Propylbenzene	0.030	0.080	0.50 ug/L			70 - 130	30
2-Chlorotoluene	0.040	0.080	0.50 ug/L			75 - 125	30

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Analytical Method Information

Analyte	MDL	LOD	Reporting Limit	Surrogate %R	Duplicate RPD	LCS\ Matrix Spike %R	RPD
4-Chlorotoluene	0.040	0.080	0.50 ug/L			75 - 130	30
1,3,5-Trimethylbenzene	0.030	0.080	0.50 ug/L			75 - 130	30
Pentachloroethane	0.070	0.080	0.50 ug/L			50 - 150	30
tert-Butylbenzene	0.030	0.080	0.50 ug/L			70 - 130	30
1,2,4-Trimethylbenzene	0.020	0.080	0.50 ug/L			75 - 130	30
sec-Butylbenzene	0.020	0.080	0.50 ug/L			70 - 125	30
1,3-Dichlorobenzene	0.040	0.080	0.50 ug/L			75 - 125	30
p-Isopropyltoluene	0.030	0.080	0.50 ug/L			75 - 130	30
1,4-Dichlorobenzene	0.030	0.080	0.50 ug/L			75 - 125	30
1,2-Dichlorobenzene	0.030	0.080	0.50 ug/L			70 - 120	30
n-Butylbenzene	0.020	0.080	0.50 ug/L			70 - 135	30
1,2-Dibromo-3-chloropropane	0.25	0.30	0.50 ug/L			50 - 130	30
1,2,4-Trichlorobenzene	0.060	0.080	0.50 ug/L			65 - 135	30
Hexachlorobutadiene	0.030	0.080	0.50 ug/L			50 - 140	30
Naphthalene	0.15	0.30	0.50 ug/L			55 - 140	30
1,2,3-Trichlorobenzene	0.060	0.080	0.50 ug/L			55 - 140	30
1,2-Dichloroethene (total)	0.030	0.080	0.50 ug/L			50 - 150	30
Xylenes (total)	0.030	0.080	0.50 ug/L			50 - 150	30
Tentatively Identified Compounds							
surr: Dibromofluoromethane	0.020	0.080		85 - 115			
surr: 1,2-Dichloroethane-d4	0.040	0.080		70 - 120			
surr: Toluene-d8	0.020	0.080		85 - 120			
surr: Bromofluorobenzene	0.020	0.080		75 - 120			
is: Fluorobenzene							
is: Chlorobenzene-d5							
is: 1,4-Dichlorobenzene-d4							

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Analytical Method Information

Analyte	MDL	LOD	Reporting Limit	Surrogate %R	Duplicate RPD	LCS\ Matrix Spike %R	RPD
VOA-8260B 5PPB D.O.D. in Soil (SW 8260B)							
Preservation: Store cool at 4°C							
Container: 5a_Encore		**Amount Required:** 50gm			**Hold Time:** 14 days		
Dichlorodifluoromethane	0.44	1.0	5.0 ug/kg			35 - 135	30
Chloromethane	0.32	1.0	5.0 ug/kg			50 - 130	30
Vinyl chloride	0.42	1.0	5.0 ug/kg			60 - 125	30
Bromomethane	0.58	1.0	5.0 ug/kg			30 - 160	30
Chloroethane	0.71	2.5	5.0 ug/kg			40 - 155	30
Trichlorofluoromethane	0.30	1.0	5.0 ug/kg			25 - 185	30
Acrolein	5.7	10	50 ug/kg			50 - 150	30
1,1-Dichloroethene	1.1	2.5	5.0 ug/kg			65 - 135	30
1,1,1-Trichloro-2,2,2-trifluoroethane	0.73	1.0	5.0 ug/kg			50 - 150	30
Acetone	5.0	6.3	12 ug/kg			20 - 160	30
Iodomethane	0.32	1.0	5.0 ug/kg			50 - 150	30
1,1,2-Trichloro-1,2,2-trifluoroethane	0.51	1.0	5.0 ug/kg			50 - 150	30
Carbon disulfide	0.14	0.25	5.0 ug/kg			45 - 160	30
3-Chloropropene	1.1	2.5	5.0 ug/kg			50 - 150	30
Acetonitrile	0.92	2.5	5.0 ug/kg			50 - 150	30
Methyl acetate	1.4	2.5	5.0 ug/kg			50 - 150	30
Methylene chloride	0.49	1.0	5.0 ug/kg			55 - 140	30
Acrylonitrile	3.7	10	50 ug/kg			50 - 150	30
trans-1,2-Dichloroethene	1.0	2.5	5.0 ug/kg			65 - 135	30
Methyl tert-butyl ether	0.39	1.0	5.0 ug/kg			50 - 150	30
1,1-Dichloroethane	0.47	1.0	5.0 ug/kg			75 - 125	30
Chloroprene	0.39	1.0	5.0 ug/kg			50 - 150	30
Vinyl acetate	0.21	0.25	5.0 ug/kg			50 - 150	30
Isopropyl Ether	0.21	0.25	5.0 ug/kg			50 - 150	30
cis-1,2-Dichloroethene	0.42	1.0	5.0 ug/kg			65 - 125	30
2,2-Dichloropropane	0.31	1.0	5.0 ug/kg			65 - 135	30
Propionitrile	10	13	250 ug/kg			50 - 150	30
2-Butanone	1.3	2.5	12 ug/kg			30 - 160	30
Methacrylonitrile	2.2	2.5	50 ug/kg			50 - 150	30
Bromochloromethane	0.53	1.0	5.0 ug/kg			70 - 125	30
Chloroform	0.31	1.0	5.0 ug/kg			70 - 125	30
1,1,1-Trichloroethane	0.50	1.0	5.0 ug/kg			70 - 135	30
Cyclohexane	0.31	1.0	5.0 ug/kg			50 - 150	30
1,1-Dichloropropene	0.32	1.0	5.0 ug/kg			70 - 135	30
Carbon tetrachloride	0.45	1.0	5.0 ug/kg			65 - 135	30

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Analytical Method Information

Analyte	MDL	LOD	Reporting Limit	Surrogate %R	Duplicate RPD	LCS\ Matrix Spike %R	RPD
1,2-Dichloroethane	0.27	1.0	5.0 ug/kg			70 - 135	30
Isobutyl alcohol	16	50	250 ug/kg			50 - 150	30
Benzene	0.31	1.0	5.0 ug/kg			75 - 125	30
Trichloroethene	0.32	1.0	5.0 ug/kg			75 - 125	30
Methylcyclohexane	0.28	1.0	5.0 ug/kg			50 - 150	30
1,2-Dichloropropane	0.63	2.5	5.0 ug/kg			70 - 120	30
Dibromomethane	1.2	2.5	5.0 ug/kg			75 - 130	30
1,4-Dioxane	48	120	250 ug/kg			50 - 150	30
Methyl Methacrylate	3.2	10	50 ug/kg			50 - 150	30
Bromodichloromethane	0.38	1.0	5.0 ug/kg			70 - 130	30
2-Chloroethylvinyl ether	0.69	2.5	5.0 ug/kg			50 - 150	30
cis-1,3-Dichloropropene	0.39	1.0	5.0 ug/kg			70 - 125	30
4-Methyl-2-pentanone	1.3	2.5	12 ug/kg			45 - 145	30
Toluene	0.34	1.0	5.0 ug/kg			70 - 125	30
trans-1,3-Dichloropropene	0.41	1.0	5.0 ug/kg			65 - 125	30
1,1,2-Trichloroethane	0.72	2.5	5.0 ug/kg			60 - 125	30
Ethyl Methacrylate	4.5	10	50 ug/kg			50 - 150	30
1,3-Dichloropropane	0.31	1.0	5.0 ug/kg			75 - 125	30
Tetrachloroethene	1.6	2.5	5.0 ug/kg			65 - 140	30
2-Hexanone	1.0	2.5	12 ug/kg			45 - 145	30
Dibromochloromethane	0.56	1.0	5.0 ug/kg			50 - 150	30
1,2-Dibromoethane	0.22	0.25	5.0 ug/kg			70 - 125	30
1-Chlorohexane	0.090	0.25	5.0 ug/kg			50 - 150	30
Chlorobenzene	0.25	0.25	5.0 ug/kg			75 - 125	30
1,1,1,2-Tetrachloroethane	0.32	1.0	5.0 ug/kg			75 - 125	30
Ethylbenzene	0.58	2.5	5.0 ug/kg			75 - 125	30
m,p-Xylene	0.14	0.50	10 ug/kg			80 - 125	30
o-Xylene	0.38	1.0	5.0 ug/kg			75 - 125	30
Styrene	0.080	0.25	5.0 ug/kg			75 - 125	30
Bromoform	1.1	2.5	5.0 ug/kg			55 - 135	30
Isopropylbenzene	0.22	0.25	5.0 ug/kg			75 - 130	30
1,1,2,2-Tetrachloroethane	0.37	1.0	5.0 ug/kg			55 - 130	30
1,2,3-Trichloropropane	0.91	2.5	5.0 ug/kg			65 - 130	30
Bromobenzene	0.55	1.0	5.0 ug/kg			65 - 120	30
trans-1,4-Dichloro-2-butene	1.8	4.0	20 ug/kg			50 - 150	30
n-Propylbenzene	0.21	0.25	5.0 ug/kg			65 - 135	30
2-Chlorotoluene	0.32	1.0	5.0 ug/kg			70 - 130	30

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Analytical Method Information

Analyte	MDL	LOD	Reporting Limit	Surrogate %R	Duplicate RPD	LCS\ Matrix Spike %R	RPD
4-Chlorotoluene	0.36	1.0	5.0 ug/kg			75 - 125	30
1,3,5-Trimethylbenzene	0.23	0.25	5.0 ug/kg			65 - 135	30
Pentachloroethane	0.56	1.0	5.0 ug/kg			50 - 150	30
tert-Butylbenzene	0.16	0.25	5.0 ug/kg			65 - 130	30
1,2,4-Trimethylbenzene	0.27	1.0	5.0 ug/kg			65 - 135	30
sec-Butylbenzene	0.27	1.0	5.0 ug/kg			65 - 130	30
1,3-Dichlorobenzene	0.27	1.0	5.0 ug/kg			70 - 125	30
p-Isopropyltoluene	0.31	1.0	5.0 ug/kg			75 - 135	30
1,4-Dichlorobenzene	0.21	0.25	5.0 ug/kg			70 - 125	30
1,2-Dichlorobenzene	0.36	1.0	5.0 ug/kg			75 - 120	30
n-Butylbenzene	0.27	1.0	5.0 ug/kg			65 - 140	30
1,2-Dibromo-3-chloropropane	0.65	2.5	5.0 ug/kg			40 - 135	30
1,2,4-Trichlorobenzene	0.35	1.0	5.0 ug/kg			65 - 130	30
Hexachlorobutadiene	0.72	2.5	5.0 ug/kg			55 - 140	30
Naphthalene	0.32	1.0	5.0 ug/kg			40 - 125	30
1,2,3-Trichlorobenzene	0.12	0.25	5.8 ug/kg			60 - 135	30
1,2-Dichloroethene (total)	0.42	1.0	5.0 ug/kg			50 - 150	30
Xylenes (total)	0.14	0.50	5.0 ug/kg			50 - 150	30
Tentatively Identified Compounds							
surr: Dibromofluoromethane	0.38	1.0		71 - 141			
surr: 1,2-Dichloroethane-d4	0.33	1.0		70 - 139			
surr: Toluene-d8	0.31	1.0		85 - 115			
surr: Bromofluorobenzene	0.54	1.0		85 - 120			
is: Fluorobenzene							
is: Chlorobenzene-d5							
is: 1,4-Dichlorobenzene-d4							

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Analytical Method Information

Analyte	MDL	LOD	Reporting Limit	Surrogate %R	Duplicate RPD	LCS\ Matrix Spike %R	RPD
SVOC 8270D DOD in Water (EPA 8270D)							
Preservation: Cool 4°C							
Container:2e_1000mL Glass, cool		**Amount Required:** 1L			**Hold Time:**7 days		
N-Nitrosodimethylamine	0.55	2.0	5.0 ug/L			25 - 110	30
Pyridine	0.71	2.0	5.0 ug/L			20 - 150	30
Ethyl Methacrylate	0.94	2.0	5.0 ug/L			20 - 150	30
2-Picoline	0.59	2.0	5.0 ug/L			20 - 150	30
N-Nitrosomethylethylamine	0.84	2.0	5.0 ug/L			20 - 150	30
Methyl Methanesulfonate	0.87	2.0	5.0 ug/L			20 - 150	30
N-Nitrosodiethylamine	0.98	2.0	5.0 ug/L			20 - 150	30
Ethyl Methanesulfonate	0.90	2.0	5.0 ug/L			20 - 150	30
Phenol	0.46	1.5	10 ug/L			20 - 150	30
Aniline	0.93	2.0	5.0 ug/L			20 - 150	30
Bis(2-chloroethyl)ether	0.97	2.0	5.0 ug/L			35 - 110	30
Pentachloroethane	0.85	2.0	5.0 ug/L			20 - 150	30
2-Chlorophenol	0.94	2.0	10 ug/L			35 - 105	30
1,3-Dichlorobenzene	1.1	2.0	5.0 ug/L			30 - 100	30
1,4-Dichlorobenzene	1.0	2.0	5.0 ug/L			30 - 100	30
Benzyl alcohol	0.99	2.0	5.0 ug/L			30 - 110	30
1,2-Dichlorobenzene	1.2	2.0	5.0 ug/L			35 - 100	30
2-Methylphenol	0.74	2.0	10 ug/L			40 - 110	30
2,2'-oxybis(1-Chloropropane)	0.99	2.0	5.0 ug/L			20 - 150	30
N-Nitrosopyrrolidine	2.2	3.0	5.0 ug/L			20 - 150	30
3-Methylphenol	0.83	2.0	10 ug/L			30 - 110	30
4-Methylphenol	0.83	2.0	10 ug/L			30 - 110	30
3 & 4-Methylphenol	0.83	2.0	10 ug/L			30 - 110	30
N-Nitroso-di-N-propylamine	1.1	2.0	5.0 ug/L			35 - 130	30
Acetophenone	0.99	2.0	5.0 ug/L			20 - 150	30
N-Nitrosomorpholine	1.1	2.0	5.0 ug/L			20 - 150	30
o-Toluidine	1.0	2.0	5.0 ug/L			20 - 150	30
Hexachloroethane	1.0	2.0	5.0 ug/L			30 - 100	30
Nitrobenzene	1.1	2.0	5.0 ug/L			45 - 110	30
N-Nitrosopiperidine	1.0	2.0	5.0 ug/L			20 - 150	30
Isophorone	0.95	2.0	5.0 ug/L			50 - 110	30
2-Nitrophenol	0.57	2.0	10 ug/L			40 - 115	30
2,4-Dimethylphenol	0.98	2.0	10 ug/L			30 - 110	30
Benzoic Acid	5.0	5.0	5.0 ug/L			20 - 150	30
o,o,o-Triethyl phosphorothioate	0.80	2.0	5.0 ug/L			20 - 150	30

Analytical Method Information

Analyte	MDL	LOD	Reporting Limit	Surrogate %R	Duplicate RPD	LCS\ Matrix Spike %R	RPD
Bis(2-chloroethoxy)methane	0.90	2.0	5.0 ug/L			45 - 105	30
2,4-Dichlorophenol	0.87	2.0	10 ug/L			50 - 105	30
1,2,4-Trichlorobenzene	1.2	2.0	5.0 ug/L			35 - 105	30
Naphthalene	1.2	2.0	5.0 ug/L			40 - 100	30
4-Chloroaniline	1.0	2.0	10 ug/L			15 - 110	30
2,6-Dichlorophenol	0.89	2.0	10 ug/L			20 - 150	30
Hexachloropropene	0.95	2.0	5.0 ug/L			20 - 150	30
Hexachlorobutadiene	1.5	2.0	5.0 ug/L			25 - 105	30
N-Nitroso-di-n-butylamine	0.96	2.0	5.0 ug/L			20 - 150	30
p-Phenylenediamine	7.5	7.5	7.5 ug/L			20 - 150	30
4-Chloro-3-methylphenol	0.86	2.0	10 ug/L			45 - 110	30
Safrole	1.0	2.0	5.0 ug/L			20 - 150	30
2-Methylnaphthalene	1.1	2.0	5.0 ug/L			45 - 105	30
1-Methylnaphthalene	1.1	2.0	5.0 ug/L			20 - 150	30
Hexachlorocyclopentadiene	0.76	2.0	5.0 ug/L			20 - 150	30
1,2,4,5-Tetrachlorobenzene	0.99	2.0	5.0 ug/L			20 - 150	30
2,4,6-Trichlorophenol	0.74	2.0	10 ug/L			50 - 115	30
2,4,5-Trichlorophenol	1.1	1.5	10 ug/L			50 - 110	30
Isosafrole	1.0	2.0	5.0 ug/L			20 - 150	30
2-Chloronaphthalene	1.2	2.0	5.0 ug/L			50 - 105	30
2-Nitroaniline	0.99	2.0	10 ug/L			50 - 115	30
1,4-Naphthoquinone	0.64	2.0	5.0 ug/L			20 - 150	30
Dimethylphthalate	0.76	2.0	5.0 ug/L			25 - 125	30
1,3-Dinitrobenzene	0.96	2.0	5.0 ug/L			20 - 150	30
2,6-Dinitrotoluene	0.89	2.0	5.0 ug/L			50 - 115	30
Acenaphthylene	0.95	2.0	5.0 ug/L			50 - 105	30
3-Nitroaniline	0.84	2.0	10 ug/L			20 - 125	30
Acenaphthene	1.1	2.0	5.0 ug/L			45 - 110	30
2,4-Dinitrophenol	5.1	6.0	10 ug/L			15 - 140	30
4-Nitrophenol	10	10	10 ug/L			20 - 150	30
Pentachlorobenzene	1.1	2.0	5.0 ug/L			20 - 150	30
2,4-Dinitrotoluene	0.84	2.0	5.0 ug/L			50 - 120	30
Dibenzofuran	1.1	2.0	5.0 ug/L			55 - 105	30
1-Naphthylamine	0.78	2.0	5.0 ug/L			20 - 150	30
2,3,4,6-Tetrachlorophenol	0.61	2.0	10 ug/L			20 - 150	30
2-Naphthylamine	1.3	2.0	5.0 ug/L			20 - 150	30
Diethylphthalate	0.62	2.0	5.0 ug/L			40 - 120	30

Analytical Method Information

Analyte	MDL	LOD	Reporting Limit	Surrogate %R	Duplicate RPD	LCS\ Matrix Spike %R	RPD
Zinophos	0.53	2.0	5.0 ug/L			20 - 150	30
4-Chlorophenyl-phenylether	1.0	2.0	5.0 ug/L			50 - 110	30
5-Nitro-o-toluidine	0.71	2.0	5.0 ug/L			20 - 150	30
Fluorene	1.0	2.0	5.0 ug/L			50 - 110	30
4-Nitroaniline	0.57	2.0	10 ug/L			35 - 120	30
4,6-Dinitro-2-methylphenol	1.4	1.5	10 ug/L			40 - 130	30
N-Nitrosodiphenylamine (1)	0.73	2.0	5.0 ug/L			50 - 110	30
1,2-Diphenyl Hydrazine	0.95	2.0	5.0 ug/L			55 - 115	30
Sulfotep	1.1	2.0	5.0 ug/L			20 - 150	30
1,3,5-Trinitrobenzene	0.65	2.0	5.0 ug/L			20 - 150	30
Diallate (trans)	0.42	2.0	5.0 ug/L			20 - 150	30
Phorate	0.57	2.0	5.0 ug/L			20 - 150	30
Phenacetin	0.67	2.0	5.0 ug/L			20 - 150	30
Diallate (cis)	0.38	2.0	5.0 ug/L			20 - 150	30
4-Bromophenyl-phenylether	0.74	2.0	5.0 ug/L			50 - 115	30
Hexachlorobenzene	0.77	2.0	5.0 ug/L			50 - 110	30
Dimethoate	3.9	4.0	5.0 ug/L			20 - 150	30
4-Aminobiphenyl	0.57	2.0	5.0 ug/L			20 - 150	30
Pentachlorophenol	0.62	2.0	10 ug/L			40 - 115	30
Pentachloronitrobenzene	0.69	2.0	5.0 ug/L			20 - 150	30
Pronamide	0.55	2.0	5.0 ug/L			20 - 150	30
Disulfoton	0.54	2.0	5.0 ug/L			20 - 150	30
Phenanthrene	0.82	2.0	5.0 ug/L			50 - 115	30
Anthracene	0.69	2.0	5.0 ug/L			55 - 110	30
Carbazole	0.58	2.0	5.0 ug/L			50 - 115	30
Methyl Parathion	2.7	3.0	5.0 ug/L			20 - 150	30
Di-n-butylphthalate	1.5	3.0	5.0 ug/L			55 - 115	30
Parathion	0.59	2.0	5.0 ug/L			20 - 150	30
4-Nitroquinoline-1-oxide	1.2	2.0	5.0 ug/L			20 - 150	30
Methapyrilene	5.0	5.0	5.0 ug/L			20 - 150	30
Isodrin	0.65	2.0	5.0 ug/L			20 - 150	30
Fluoranthene	0.61	2.0	5.0 ug/L			55 - 115	30
Benzidine	5.0	5.0	5.0 ug/L			20 - 150	30
Pyrene	1.6	3.0	5.0 ug/L			50 - 130	30
p-Dimethylaminoazobenzene	0.51	2.0	5.0 ug/L			20 - 150	30
Chlorobenzilate	1.5	2.0	5.0 ug/L			20 - 150	30
Famphur	5.0	5.0	5.0 ug/L			20 - 150	30

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Analyte	MDL	LOD	Reporting Limit	Surrogate %R	Duplicate RPD	LCS\ Matrix Spike %R	RPD
Butylbenzylphthalate	1.6	3.0	5.0 ug/L			45 - 115	30
3,3'-Dimethylbenzidine	1.4	2.0	5.0 ug/L			20 - 150	30
2-Acetylaminofluorene	1.7	2.0	5.0 ug/L			20 - 150	30
3,3'-Dichlorobenzidine	0.52	2.0	5.0 ug/L			20 - 110	30
bis(2-ethylhexyl)Phthalate	2.7	4.0	5.0 ug/L			40 - 125	30
Benzo (a) anthracene	1.5	3.0	5.0 ug/L			55 - 110	30
Chrysene	1.5	3.0	5.0 ug/L			55 - 110	30
Di-n-octylphthalate	1.6	3.0	5.0 ug/L			35 - 135	30
7,12-Dimethylbenz(a)anthracene	1.5	2.0	5.0 ug/L			20 - 150	30
Benzo (b) fluoranthene	0.55	2.0	5.0 ug/L			45 - 120	30
Benzo(k)fluoranthene	1.9	3.0	5.0 ug/L			45 - 125	30
Benzo (a) pyrene	0.56	2.0	5.0 ug/L			55 - 110	30
3-Methylcholanthrene	1.4	2.0	5.0 ug/L			20 - 150	30
Indeno(1,2,3-cd)pyrene	1.3	1.5	5.0 ug/L			45 - 125	30
Dibenzo(a,h)anthracene	1.7	3.0	5.0 ug/L			40 - 125	30
Benzo (g,h,i) perylene	1.7	3.0	5.0 ug/L			40 - 125	30
Kepone	5.0	5.0	5.0 ug/L			20 - 150	30
Diallate	0.80	2.0	10 ug/L			20 - 150	30
4-Chlorophenol	10	10	10 ug/L			20 - 150	30
2,5-Dichlorophenol	10	10	10 ug/L			20 - 150	30
a,a-Dimethylphenethylamine	15	15	15 ug/L			20 - 150	30
Aramite	0.79	2.0	5.0 ug/L			20 - 150	30
Benzaldehyde	0.94	1.5	5.0 ug/L			20 - 150	30
Caprolactam	3.0	3.0	5.0 ug/L			20 - 150	30
Atrazine	1.4	1.5	5.0 ug/L			20 - 150	30
1,1'-Biphenyl	1.0	1.5	5.0 ug/L			20 - 150	30
Hexachlorophene	40	40	40 ug/L			20 - 150	30
Dinoseb	10	10	10 ug/L			20 - 150	30
Tentatively Identified Compounds							
is: 1,4-Dichlorobenzene-d4							
is: Naphthalene-d8							
is: Acenaphthene-d10							
is: Phenanthrene-d10							
is: Chrysene-d12							
is: Perylene-d12							
surr: 2-Fluorophenol	1.7	2.0		20 - 110			
surr: Phenol-d5	0.53	2.0		10 - 110			

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Analytical Method Information

Analyte	MDL	LOD	Reporting Limit	Surrogate %R	Duplicate RPD	LCS\ Matrix Spike %R	RPD
surr: Nitrobenzene-d5	0.43	1.5		40 - 110			
surr: 2-Fluorobiphenyl	0.70	2.0		50 - 110			
surr: 2,4,6-Tribromophenol	1.3	2.0		40 - 125			
surr: Terphenyl-d14	1.0	2.0		50 - 135			

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Analytical Method Information

Analyte	MDL	LOD	Reporting Limit	Surrogate %R	Duplicate RPD	LCS\ Matrix Spike %R	RPD
SVOC 8270D DOD in Soil (EPA 8270D)							
Preservation: Cool 4°C							
Container: 4c_8OZ WM Glass, cool		**Amount Required:** 100gm			**Hold Time:** 14 days		
N-Nitrosodimethylamine	35	68	170 ug/kg			20 - 115	30
Pyridine	48	68	170 ug/kg			20 - 150	30
Ethyl Methacrylate	12	33	170 ug/kg			20 - 150	30
2-Picoline	37	68	170 ug/kg			20 - 150	30
N-Nitrosomethylethylamine	26	68	170 ug/kg			20 - 150	30
Methyl Methanesulfonate	20	68	170 ug/kg			20 - 150	30
N-Nitrosodiethylamine	20	68	170 ug/kg			20 - 150	30
Ethyl Methanesulfonate	23	68	170 ug/kg			20 - 150	30
Phenol	21	68	330 ug/kg			40 - 100	30
Aniline	14	33	170 ug/kg			20 - 150	30
Bis(2-chloroethyl)ether	16	33	170 ug/kg			40 - 105	30
Pentachloroethane	16	33	170 ug/kg			20 - 150	30
2-Chlorophenol	20	68	330 ug/kg			45 - 105	30
1,3-Dichlorobenzene	18	68	170 ug/kg			40 - 100	30
1,4-Dichlorobenzene	18	68	170 ug/kg			35 - 105	30
Benzyl alcohol	24	68	170 ug/kg			20 - 125	30
1,2-Dichlorobenzene	18	33	170 ug/kg			45 - 100	30
2-Methylphenol	23	68	330 ug/kg			40 - 105	30
2,2'-oxybis(1-Chloropropane)	21	68	170 ug/kg			20 - 150	30
N-Nitrosopyrrolidine	24	68	170 ug/kg			20 - 150	30
3-Methylphenol	23	68	330 ug/kg			40 - 105	30
4-Methylphenol	23	68	330 ug/kg			40 - 105	30
3 & 4-Methylphenol	23	68	330 ug/kg			40 - 105	30
N-Nitroso-di-N-propylamine	19	68	170 ug/kg			40 - 115	30
Acetophenone	18	33	170 ug/kg			20 - 150	30
N-Nitrosomorpholine	25	68	170 ug/kg			20 - 150	30
o-Toluidine	27	68	170 ug/kg			20 - 150	30
Hexachloroethane	18	68	170 ug/kg			35 - 110	30
Nitrobenzene	26	68	170 ug/kg			40 - 115	30
N-Nitrosopiperidine	24	68	170 ug/kg			20 - 150	30
Isophorone	18	68	170 ug/kg			45 - 110	30
2-Nitrophenol	17	33	330 ug/kg			40 - 110	30
2,4-Dimethylphenol	32	68	330 ug/kg			30 - 105	30
Benzoic Acid	170	330	170 ug/kg			20 - 150	30
o,o,o-Triethyl phosphorothioate	20	68	170 ug/kg			20 - 150	30

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Analytical Method Information

Analyte	MDL	LOD	Reporting Limit	Surrogate %R	Duplicate RPD	LCS\ Matrix Spike %R	RPD
Bis(2-chloroethoxy)methane	19	68	170 ug/kg			45 - 110	30
2,4-Dichlorophenol	20	68	330 ug/kg			45 - 110	30
1,2,4-Trichlorobenzene	17	33	170 ug/kg			45 - 110	30
Naphthalene	18	68	170 ug/kg			20 - 150	30
4-Chloroaniline	22	68	330 ug/kg			20 - 150	30
2,6-Dichlorophenol	21	68	330 ug/kg			20 - 150	30
Hexachloropropene	20	68	170 ug/kg			20 - 150	30
Hexachlorobutadiene	21	68	170 ug/kg			40 - 115	30
N-Nitroso-di-n-butylamine	35	68	170 ug/kg			20 - 150	30
p-Phenylenediamine	250	1700	250 ug/kg			20 - 150	30
4-Chloro-3-methylphenol	30	68	330 ug/kg			45 - 115	30
Safrole	18	68	170 ug/kg			20 - 150	30
2-Methylnaphthalene	21	68	170 ug/kg			45 - 105	30
1-Methylnaphthalene	20	68	170 ug/kg			20 - 150	30
Hexachlorocyclopentadiene	16	33	170 ug/kg			20 - 150	30
1,2,4,5-Tetrachlorobenzene	18	68	170 ug/kg			20 - 150	30
2,4,6-Trichlorophenol	29	68	330 ug/kg			45 - 110	30
2,4,5-Trichlorophenol	28	68	330 ug/kg			50 - 110	30
Isosafrole	22	68	170 ug/kg			20 - 150	30
2-Chloronaphthalene	100	140	170 ug/kg			45 - 105	30
2-Nitroaniline	31	68	330 ug/kg			45 - 120	30
1,4-Naphthoquinone	170	68	170 ug/kg			20 - 150	30
Dimethylphthalate	24	68	170 ug/kg			50 - 110	30
1,3-Dinitrobenzene	59	68	170 ug/kg			20 - 150	30
2,6-Dinitrotoluene	31	68	170 ug/kg			20 - 150	30
Acenaphthylene	20	68	170 ug/kg			45 - 105	30
3-Nitroaniline	21	68	330 ug/kg			25 - 110	30
Acenaphthene	20	68	170 ug/kg			45 - 110	30
2,4-Dinitrophenol	44	68	330 ug/kg			15 - 130	30
4-Nitrophenol	32	68	330 ug/kg			15 - 140	30
Pentachlorobenzene	20	68	170 ug/kg			20 - 150	30
2,4-Dinitrotoluene	31	68	170 ug/kg			50 - 115	30
Dibenzofuran	25	68	170 ug/kg			50 - 105	30
1-Naphthylamine	54	130	170 ug/kg			20 - 150	30
2,3,4,6-Tetrachlorophenol	30	68	330 ug/kg			20 - 150	30
2-Naphthylamine	42	130	170 ug/kg			20 - 150	30
Diethylphthalate	26	68	170 ug/kg			50 - 115	30

Analytical Method Information

Analyte	MDL	LOD	Reporting Limit	Surrogate %R	Duplicate RPD	LCS\ Matrix Spike %R	RPD
Zinophos	28	68	170 ug/kg			20 - 150	30
4-Chlorophenyl-phenylether	29	68	170 ug/kg			45 - 110	30
5-Nitro-o-toluidine	24	68	170 ug/kg			20 - 150	30
Fluorene	23	68	170 ug/kg			50 - 110	30
4-Nitroaniline	23	68	330 ug/kg			35 - 115	30
4,6-Dinitro-2-methylphenol	33	68	330 ug/kg			30 - 135	30
N-Nitrosodiphenylamine (1)	30	68	170 ug/kg			50 - 115	30
1,2-Diphenyl Hydrazine	28	68	170 ug/kg			20 - 150	30
Sulfotep	37	68	170 ug/kg			20 - 150	30
1,3,5-Trinitrobenzene	31	68	170 ug/kg			20 - 150	30
Diallate (trans)	28	68	170 ug/kg			20 - 150	30
Phorate	40	68	170 ug/kg			20 - 150	30
Phenacetin	36	68	170 ug/kg			20 - 150	30
Diallate (cis)	21	68	170 ug/kg			20 - 150	30
4-Bromophenyl-phenylether	20	68	170 ug/kg			45 - 115	30
Hexachlorobenzene	25	68	170 ug/kg			45 - 120	30
Dimethoate	54	68	170 ug/kg			20 - 150	30
4-Aminobiphenyl	34	130	170 ug/kg			20 - 150	30
Pentachlorophenol	37	68	330 ug/kg			25 - 120	30
Pentachloronitrobenzene	31	68	170 ug/kg			20 - 150	30
Pronamide	51	68	170 ug/kg			20 - 150	30
Disulfoton	28	68	170 ug/kg			20 - 150	30
Phenanthrene	28	68	170 ug/kg			50 - 110	30
Anthracene	26	68	170 ug/kg			55 - 105	30
Carbazole	34	68	170 ug/kg			45 - 115	30
Methyl Parathion	18	33	170 ug/kg			20 - 150	30
Di-n-butylphthalate	26	68	170 ug/kg			55 - 110	30
Parathion	30	68	170 ug/kg			20 - 150	30
4-Nitroquinoline-1-oxide	14	33	170 ug/kg			20 - 150	30
Methapyrilene	170	68	170 ug/kg			20 - 150	30
Isodrin	32	68	170 ug/kg			20 - 150	30
Fluoranthene	30	68	170 ug/kg			55 - 115	30
Benzidine	330	330	330 ug/kg			20 - 150	30
Pyrene	28	68	170 ug/kg			45 - 125	30
p-Dimethylaminoazobenzene	38	68	170 ug/kg			20 - 150	30
Chlorobenzilate	27	68	170 ug/kg			20 - 150	30
Famphur	170	68	170 ug/kg			20 - 150	30

Analytical Method Information

Analyte	MDL	LOD	Reporting Limit	Surrogate %R	Duplicate RPD	LCS\ Matrix Spike %R	RPD
Butylbenzylphthalate	34	68	170 ug/kg			50 - 125	30
3,3'-Dimethylbenzidine	84	260	170 ug/kg			20 - 150	30
2-Acetylaminofluorene	37	68	170 ug/kg			20 - 150	30
3,3'-Dichlorobenzidine	22	68	170 ug/kg			20 - 150	30
bis(2-ethylhexyl)Phthalate	66	68	170 ug/kg			45 - 125	30
Benzo (a) anthracene	28	68	170 ug/kg			50 - 110	30
Chrysene	32	68	170 ug/kg			55 - 110	30
Di-n-octylphthalate	34	68	170 ug/kg			40 - 130	30
7,12-Dimethylbenz(a)anthracene	25	68	170 ug/kg			20 - 150	30
Benzo (b) fluoranthene	29	68	170 ug/kg			45 - 115	30
Benzo(k)fluoranthene	16	33	170 ug/kg			45 - 125	30
Benzo (a) pyrene	28	68	170 ug/kg			50 - 110	30
3-Methylcholanthrene	30	68	170 ug/kg			20 - 150	30
Indeno(1,2,3-cd)pyrene	35	68	170 ug/kg			40 - 120	30
Dibenzo(a,h)anthracene	33	68	170 ug/kg			40 - 125	30
Benzo (g,h,i) perylene	34	68	170 ug/kg			40 - 125	30
Kepone	170	68	170 ug/kg			20 - 150	30
Diallate	26	68	170 ug/kg			20 - 150	30
4-Chlorophenol	170		170 ug/kg			20 - 150	30
2,5-Dichlorophenol	170		170 ug/kg			20 - 150	30
a,a-Dimethylphenethylamine	510		510 ug/kg			20 - 150	30
Aramite	36	68	170 ug/kg			20 - 150	30
Benzaldehyde	27	68	170 ug/kg			20 - 150	30
Caprolactam	59	68	170 ug/kg			20 - 150	30
Atrazine	47	130	170 ug/kg			20 - 150	30
1,1'-Biphenyl	17	68	170 ug/kg			20 - 150	30
Hexachlorophene	1400	1400	1400 ug/kg			20 - 150	30
Dinoseb	330	330	330 ug/kg			20 - 150	30
Tentatively Identified Compounds							
is: 1,4-Dichlorobenzene-d4							
is: Naphthalene-d8							
is: Acenaphthene-d10							
is: Phenanthrene-d10							
is: Chrysene-d12							
is: Perylene-d12							
surr: 2-Fluorophenol	170			35 - 105			
surr: Phenol-d5	170			40 - 100			

Analytical Method Information

Analyte	MDL	LOD	Reporting Limit	Surrogate %R	Duplicate RPD	LCS\ Matrix Spike %R	RPD
surr: Nitrobenzene-d5	170			35 - 100			
surr: 2-Fluorobiphenyl	170			45 - 105			
surr: 2,4,6-Tribromophenol	170			35 - 125			
surr: Terphenyl-d14	170			30 - 125			

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Analytical Method Information

Analyte	MDL	LOD	Reporting Limit	Surrogate %R	Duplicate RPD	LCS\ Matrix Spike %R	RPD
SVOC 8270D SIM FULL DOD in Water (SW8270D-SIM)							
Preservation: Cool 4°C							
Container: 2e_1000mL Glass, cool			**Amount Required:** 1L			**Hold Time:** 7 days	
Bis(2-chloroethyl)ether	0.00430	0.0200	0.0200 ug/L			20 - 150	30
Naphthalene	0.0160	0.0500	0.200 ug/L			40 - 110	30
Hexachlorobutadiene	0.0280	0.0500	0.200 ug/L			20 - 150	30
2-Methylnaphthalene	0.0260	0.0500	0.200 ug/L			45 - 105	30
1-Methylnaphthalene	0.0270	0.0500	0.200 ug/L			20 - 150	30
Acenaphthylene	0.0220	0.0500	0.200 ug/L			50 - 105	30
Acenaphthene	0.0260	0.0500	0.200 ug/L			45 - 110	30
4-Nitrophenol	0.115	0.250	1.00 ug/L			20 - 150	30
Fluorene	0.0230	0.0500	0.200 ug/L			50 - 110	30
Hexachlorobenzene	0.0710	0.250	1.00 ug/L			27 - 101	30
Pentachlorophenol	0.0920	0.250	1.00 ug/L			10 - 150	30
Phenanthrene	0.0170	0.0500	0.200 ug/L			50 - 110	30
Anthracene	0.0180	0.0500	0.200 ug/L			55 - 110	30
Fluoranthene	0.0210	0.0500	0.200 ug/L			55 - 115	30
Pyrene	0.0420	0.0500	0.200 ug/L			50 - 130	30
Benzo (a) anthracene	0.0160	0.0500	0.200 ug/L			45 - 120	30
Chrysene	0.0150	0.0500	0.200 ug/L			55 - 110	30
Benzo (b) fluoranthene	0.0130	0.0500	0.200 ug/L			45 - 120	30
Benzo(k)fluoranthene	0.0210	0.0500	0.200 ug/L			45 - 125	30
Benzo (a) pyrene	0.0150	0.0500	0.200 ug/L			55 - 110	30
Indeno(1,2,3-cd)pyrene	0.0320	0.0500	0.200 ug/L			45 - 125	30
Dibenzo(a,h)anthracene	0.0290	0.0500	0.200 ug/L			40 - 125	30
Benzo (g,h,i) perylene	0.0400	0.0500	0.200 ug/L			40 - 125	30
is: 1,4-Dichlorobenzene-d4							
is: Naphthalene-d8							
is: Acenaphthene-d10							
is: Phenanthrene-d10							
is: Chrysene-d12							
is: Perylene-d12							
surr: Nitrobenzene-d5	0.0240	0.200		40 - 110			
surr: 2-Fluorobiphenyl	0.0280	0.200		50 - 110			
surr: 2,4,6-Tribromophenol	0.0270	0.200		34 - 150			
surr: Terphenyl-d14	0.0300	0.200		50 - 135			

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Analytical Method Information

Analyte	MDL	LOD	Reporting Limit	Surrogate %R	Duplicate RPD	LCS\ Matrix Spike %R	RPD
SVOC 8270D SIM FULL DOD in Soil (SW8270D-SIM)							
Preservation: Cool 4°C							
Container: 4c_8OZ WM Glass, cool			**Amount Required:** 100g			**Hold Time:** 14 days	
Bis(2-chloroethyl)ether	0.13	0.67	0.67 ug/kg			20 - 150	30
Naphthalene	0.90	2.0	8.3 ug/kg			40 - 105	30
Hexachlorobutadiene	1.0	4.0	8.3 ug/kg			20 - 150	30
2-Methylnaphthalene	0.91	2.0	8.3 ug/kg			45 - 105	30
1-Methylnaphthalene	0.84	2.0	8.3 ug/kg			20 - 150	30
Acenaphthylene	0.76	2.0	8.3 ug/kg			50 - 105	30
Acenaphthene	0.65	2.0	8.3 ug/kg			45 - 110	30
4-Nitrophenol	5.2	13	33 ug/kg			20 - 150	30
Fluorene	0.63	2.0	8.3 ug/kg			50 - 110	30
Hexachlorobenzene	3.8	13	33 ug/kg			27 - 101	30
Pentachlorophenol	3.4	13	33 ug/kg			20 - 150	30
Phenanthrene	0.78	2.0	8.3 ug/kg			50 - 110	30
Anthracene	0.56	2.0	8.3 ug/kg			55 - 105	30
Fluoranthene	1.1	4.0	8.3 ug/kg			55 - 115	30
Pyrene	1.9	4.0	8.3 ug/kg			45 - 125	30
Benzo (a) anthracene	1.8	4.0	8.3 ug/kg			50 - 110	30
Chrysene	1.8	4.0	8.3 ug/kg			55 - 110	30
Benzo (b) fluoranthene	1.8	4.0	8.3 ug/kg			45 - 115	30
Benzo(k)fluoranthene	1.6	4.0	8.3 ug/kg			45 - 125	30
Benzo (a) pyrene	1.7	4.0	8.3 ug/kg			50 - 110	30
Indeno(1,2,3-cd)pyrene	1.9	4.0	8.3 ug/kg			40 - 125	30
Dibenzo(a,h)anthracene	1.6	4.0	8.3 ug/kg			40 - 125	30
Benzo (g,h,i) perylene	1.5	4.0	8.3 ug/kg			40 - 125	30
is: 1,4-Dichlorobenzene-d4							
is: Naphthalene-d8							
is: Acenaphthene-d10							
is: Phenanthrene-d10							
is: Chrysene-d12							
is: Perylene-d12							
surr: Nitrobenzene-d5		8.3		35 - 100			
surr: 2-Fluorobiphenyl		8.3		45 - 105			
surr: 2,4,6-Tribromophenol		8.3		35 - 125			
surr: Terphenyl-d14		8.3		30 - 125			

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Analytical Method Information

Analyte	MDL	LOD	Reporting Limit	Surrogate %R	Duplicate RPD	LCS\ Matrix Spike %R	RPD
GC-8081B/Pest DOD in Water (8081B)							
Preservation: Store cool at 4°C							
Container:2e_1000mL Glass, cool		**Amount Required:**			**Hold Time:**7 days		
alpha-BHC	0.0019	0.0045	0.025 ug/L			60 - 130	30
alpha-BHC [2C]	0.0019	0.0045	0.025 ug/L			60 - 130	30
gamma-BHC (Lindane)	0.0019	0.0045	0.025 ug/L			25 - 135	30
gamma-BHC (Lindane) [2C]	0.0019	0.0045	0.025 ug/L			25 - 135	30
Heptachlor	0.0024	0.0045	0.025 ug/L			40 - 130	30
Heptachlor [2C]	0.0024	0.0045	0.025 ug/L			40 - 130	30
Aldrin	0.0027	0.0045	0.025 ug/L			25 - 140	30
Aldrin [2C]	0.0027	0.0045	0.025 ug/L			25 - 140	30
beta-BHC	0.0095	0.010	0.025 ug/L			65 - 125	30
beta-BHC [2C]	0.0095	0.010	0.025 ug/L			65 - 125	30
delta-BHC	0.0032	0.0045	0.025 ug/L			45 - 135	30
delta-BHC [2C]	0.0032	0.0045	0.025 ug/L			45 - 135	30
Heptachlor epoxide	0.0028	0.0045	0.025 ug/L			60 - 130	30
Heptachlor Epoxide [2C]	0.0028	0.0045	0.025 ug/L			60 - 130	30
gamma-Chlordane	0.0021	0.0045	0.025 ug/L			60 - 125	30
gamma-Chlordane [2C]	0.0021	0.0045	0.025 ug/L			60 - 125	30
alpha-Chlordane	0.0020	0.0045	0.025 ug/L			65 - 125	30
alpha-Chlordane [2C]	0.0020	0.0045	0.025 ug/L			65 - 125	30
Endosulfan I	0.0043	0.0045	0.025 ug/L			50 - 110	30
Endosulfan I [2C]	0.0043	0.0045	0.025 ug/L			50 - 110	30
4,4'-DDE	0.0039	0.011	0.050 ug/L			35 - 140	30
4,4'-DDE [2C]	0.0039	0.011	0.050 ug/L			35 - 140	30
Dieldrin	0.0051	0.011	0.050 ug/L			60 - 130	30
Dieldrin [2C]	0.0051	0.011	0.050 ug/L			60 - 130	30
Endrin	0.0069	0.011	0.050 ug/L			55 - 135	30
Endrin [2C]	0.0069	0.011	0.050 ug/L			55 - 135	30
4,4'-DDD	0.0055	0.011	0.050 ug/L			25 - 150	30
4,4'-DDD [2C]	0.0055	0.011	0.050 ug/L			25 - 150	30
Endosulfan II	0.0055	0.011	0.050 ug/L			30 - 130	30
Endosulfan II [2C]	0.0055	0.011	0.050 ug/L			30 - 130	30
4,4'-DDT	0.0051	0.011	0.050 ug/L			45 - 140	30
4,4'-DDT [2C]	0.0051	0.011	0.050 ug/L			45 - 140	30
Endrin aldehyde	0.012	0.019	0.050 ug/L			55 - 135	30
Endrin Aldehyde [2C]	0.012	0.019	0.050 ug/L			55 - 135	30
Endosulfan sulfate	0.0068	0.011	0.050 ug/L			55 - 135	30

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Analytical Method Information

Analyte	MDL	LOD	Reporting Limit	Surrogate %R	Duplicate RPD	LCS\ Matrix Spike %R	RPD
Endosulfan Sulfate [2C]	0.0068	0.011	0.050 ug/L			55 - 135	30
Methoxychlor	0.015	0.025	0.25 ug/L			55 - 150	30
Methoxychlor [2C]	0.015	0.025	0.25 ug/L			55 - 150	30
Endrin ketone	0.0074	0.011	0.050 ug/L			75 - 125	30
Endrin Ketone [2C]	0.0074	0.011	0.050 ug/L			75 - 125	30
Toxaphene	0.48	1.0	2.5 ug/L				
is: Toxaphene (1)							
is: Toxaphene (2)							
is: Toxaphene (3)							
is: Toxaphene (4)							
is: Toxaphene (5)							
Toxaphene [2C]	0.48	1.0	2.5 ug/L				
is: Toxaphene (1) [2C]							
is: Toxaphene (2) [2C]							
is: Toxaphene (3) [2C]							
is: Toxaphene (4) [2C]							
is: Toxaphene (5) [2C]							
Technical Chlordane	0.24	0.50	0.80 ug/L				
is: Technical Chlordane (1)							
is: Technical Chlordane (2)							
is: Technical Chlordane (3)							
is: Technical Chlordane (4)							
is: Technical Chlordane (5)							
Technical Chlordane [2C]	0.24	0.50	0.80 ug/L				
is: Technical Chlordane (1) [2C]							
is: Technical Chlordane (2) [2C]							
is: Technical Chlordane (3) [2C]							
is: Technical Chlordane (4) [2C]							
is: Technical Chlordane (5) [2C]							
surr: DCB (A)	0.0	0.0		30 - 135			
surr: DCB (A) [2C]	0.0	0.0		30 - 135			
surr: TCX (A)	0.0	0.0		25 - 140			
surr: TCX (A) [2C]	0.0	0.0		25 - 140			

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Analytical Method Information

Analyte	MDL	LOD	Reporting Limit	Surrogate %R	Duplicate RPD	LCS\ Matrix Spike %R	RPD
GC-8081B/Pest DOD in Soil (8081B)							
Preservation: Store cool at 4°C							
Container:4c_8OZ WM Glass, cool		**Amount Required:**			**Hold Time:**14 days		
alpha-BHC	0.088	0.20	0.83 ug/kg			60 - 125	30
alpha-BHC [2C]	0.088	0.20	0.83 ug/kg			60 - 125	30
gamma-BHC (Lindane)	0.040	0.063	0.83 ug/kg			60 - 125	30
gamma-BHC (Lindane) [2C]	0.040	0.063	0.83 ug/kg			60 - 125	30
Heptachlor	0.12	0.20	0.83 ug/kg			50 - 140	30
Heptachlor [2C]	0.12	0.20	0.83 ug/kg			50 - 140	30
Aldrin	0.067	0.20	0.83 ug/kg			45 - 140	30
Aldrin [2C]	0.067	0.20	0.83 ug/kg			45 - 140	30
beta-BHC	0.14	0.20	0.83 ug/kg			60 - 125	30
beta-BHC [2C]	0.14	0.20	0.83 ug/kg			60 - 125	30
delta-BHC	0.079	0.20	0.83 ug/kg			55 - 130	30
delta-BHC [2C]	0.079	0.20	0.83 ug/kg			55 - 130	30
Heptachlor epoxide	0.053	0.20	0.83 ug/kg			65 - 130	30
Heptachlor Epoxide [2C]	0.053	0.20	0.83 ug/kg			65 - 130	30
gamma-Chlordane	0.066	0.20	0.83 ug/kg			65 - 125	30
gamma-Chlordane [2C]	0.066	0.20	0.83 ug/kg			65 - 125	30
alpha-Chlordane	0.081	0.20	0.83 ug/kg			65 - 120	30
alpha-Chlordane [2C]	0.081	0.20	0.83 ug/kg			65 - 120	30
Endosulfan I	0.077	0.20	0.83 ug/kg			15 - 135	30
Endosulfan I [2C]	0.077	0.20	0.83 ug/kg			15 - 135	30
4,4'-DDE	0.072	0.16	2.1 ug/kg			70 - 125	30
4,4'-DDE [2C]	0.072	0.16	2.1 ug/kg			70 - 125	30
Dieldrin	0.056	0.16	2.1 ug/kg			65 - 125	30
Dieldrin [2C]	0.056	0.16	2.1 ug/kg			65 - 125	30
Endrin	0.047	0.16	2.1 ug/kg			60 - 135	30
Endrin [2C]	0.047	0.16	2.1 ug/kg			60 - 135	30
4,4'-DDD	0.081	0.16	2.1 ug/kg			30 - 135	30
4,4'-DDD [2C]	0.081	0.16	2.1 ug/kg			30 - 135	30
Endosulfan II	0.089	0.16	2.1 ug/kg			35 - 140	30
Endosulfan II [2C]	0.089	0.16	2.1 ug/kg			35 - 140	30
4,4'-DDT	0.25	0.40	2.1 ug/kg			45 - 140	30
4,4'-DDT [2C]	0.25	0.40	2.1 ug/kg			45 - 140	30
Endrin aldehyde	0.13	0.40	2.1 ug/kg			35 - 145	30
Endrin Aldehyde [2C]	0.13	0.40	2.1 ug/kg			35 - 145	30
Endosulfan sulfate	0.062	0.16	2.1 ug/kg			60 - 135	30

Analytical Method Information

Analyte	MDL	LOD	Reporting Limit	Surrogate %R	Duplicate RPD	LCS\ Matrix Spike %R	RPD
Endosulfan Sulfate [2C]	0.062	0.16	2.1 ug/kg			60 - 135	30
Methoxychlor	0.29	3.3	8.3 ug/kg			55 - 145	30
Methoxychlor [2C]	0.29	3.3	8.3 ug/kg			55 - 145	30
Endrin ketone	0.051	0.16	2.1 ug/kg			65 - 135	30
Endrin Ketone [2C]	0.051	0.16	2.1 ug/kg			65 - 135	30
Toxaphene	15	33	83 ug/kg				
is: Toxaphene (1)							
is: Toxaphene (2)							
is: Toxaphene (3)							
is: Toxaphene (4)							
is: Toxaphene (5)							
Toxaphene [2C]	15	33	83 ug/kg				
is: Toxaphene (1) [2C]							
is: Toxaphene (2) [2C]							
is: Toxaphene (3) [2C]							
is: Toxaphene (4) [2C]							
is: Toxaphene (5) [2C]							
Technical Chlordane	3.6	13	27 ug/kg				
is: Technical Chlordane (1)							
is: Technical Chlordane (2)							
is: Technical Chlordane (3)							
is: Technical Chlordane (4)							
is: Technical Chlordane (5)							
Technical Chlordane [2C]	3.6	13	27 ug/kg				
is: Technical Chlordane (1) [2C]							
is: Technical Chlordane (2) [2C]							
is: Technical Chlordane (3) [2C]							
is: Technical Chlordane (4) [2C]							
is: Technical Chlordane (5) [2C]							
surr: DCB (A)	0.0	0.0		55 - 130			
surr: DCB (A) [2C]	0.0	0.0		55 - 130			
surr: TCX (A)	0.0	0.0		70 - 125			
surr: TCX (A) [2C]	0.0	0.0		70 - 125			

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Analytical Method Information

Analyte	MDL	LOD	Reporting Limit	Surrogate %R	Duplicate RPD	LCS\ Matrix Spike %R	RPD
6010 METALS DOD in Water (EPA 6010C)							
Preservation: Add HNO3 to pH<2							
Container:3n_500mL Plastic, HNO3		**Amount Required:** 50 mL			**Hold Time:**180 days		
Aluminum	31.0	100	200 ug/L		20	80 - 120	20
Antimony	1.97	15.0	30.0 ug/L		20	80 - 120	20
Arsenic	2.44	5.00	10.0 ug/L		20	80 - 120	20
Barium	15.2	100	200 ug/L		20	80 - 120	20
Beryllium	0.723	2.50	5.00 ug/L		20	80 - 120	20
Cadmium	0.635	2.50	5.00 ug/L		20	80 - 120	20
Calcium	122	2500	5000 ug/L		20	80 - 120	20
Chromium	0.750	5.00	10.0 ug/L		20	80 - 120	20
Cobalt	1.45	10.0	20.0 ug/L		20	80 - 120	20
Copper	1.00	2.50	5.00 ug/L		20	80 - 120	20
Iron	12.2	100	200 ug/L		20	80 - 120	20
Lead	1.60	5.00	10.0 ug/L		20	80 - 120	20
Magnesium	7.73	2500	5000 ug/L		20	80 - 120	20
Manganese	0.164	5.00	10.0 ug/L		20	80 - 120	20
Molybdenum	2.17	10.0	50.0 ug/L		20	80 - 120	20
Nickel	0.627	5.00	10.0 ug/L		20	80 - 120	20
Potassium	30.9	2500	5000 ug/L		20	80 - 120	20
Selenium	2.01	5.00	10.0 ug/L		20	80 - 120	20
Silver	0.637	2.50	5.00 ug/L		20	80 - 120	20
Sodium	156	2500	5000 ug/L		20	80 - 120	20
Thallium	2.92	15.0	30.0 ug/L		20	80 - 120	20
Tin	4.75	25.0	50.0 ug/L		20	80 - 120	20
Titanium	0.317	25.0	50.0 ug/L		20	80 - 120	20
Vanadium	1.50	10.0	20.0 ug/L		20	80 - 120	20
Zinc	4.17	15.0	30.0 ug/L		20	80 - 120	20

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Analytical Method Information

Analyte	MDL	LOD	Reporting Limit	Surrogate %R	Duplicate RPD	LCS\ Matrix Spike %R	RPD
6010 METALS DOD in Soil (EPA 6010C)							
Preservation: Cool 4°C							
Container:4a_2OZ WM Glass, cool		**Amount Required:** 1 gram			**Hold Time:**180 days		
Aluminum	1.88	10.0	20.0 mg/kg		20	80 - 120	20
Antimony	0.253	0.500	5.00 mg/kg		20	80 - 120	20
Arsenic	0.411	0.500	2.00 mg/kg		20	80 - 120	20
Barium	0.0673	10.0	20.0 mg/kg		20	80 - 120	20
Beryllium	0.0293	0.250	0.500 mg/kg		20	80 - 120	20
Cadmium	0.0630	0.250	0.500 mg/kg		20	80 - 120	20
Calcium	0.348	250	500 mg/kg		20	80 - 120	20
Chromium	0.133	0.500	1.00 mg/kg		20	80 - 120	20
Cobalt	0.236	0.250	2.00 mg/kg		20	80 - 120	20
Copper	0.0659	0.250	0.500 mg/kg		20	80 - 120	20
Iron	4.02	5.00	10.0 mg/kg		20	80 - 120	20
Lead	0.185	0.500	1.00 mg/kg		20	80 - 120	20
Magnesium	0.758	250	500 mg/kg		20	80 - 120	20
Manganese	0.0148	0.500	1.00 mg/kg		20	77 - 122	20
Molybdenum	0.139	1.00	2.00 mg/kg		20	80 - 120	20
Nickel	0.106	0.250	1.00 mg/kg		20	80 - 120	20
Potassium	1.86	250	500 mg/kg		20	80 - 120	20
Selenium	0.222	0.250	1.00 mg/kg		20	80 - 120	20
Silver	0.0350	0.250	0.500 mg/kg		20	75 - 120	20
Sodium	16.8	250	500 mg/kg		20	80 - 120	20
Thallium	0.179	0.500	5.00 mg/kg		20	80 - 120	20
Tin	0.366	1.00	10.0 mg/kg		20	80 - 120	20
Titanium	0.0200	1.00	2.00 mg/kg		20	80 - 120	20
Vanadium	0.0655	1.00	2.00 mg/kg		20	80 - 120	20
Zinc	0.643	1.00	2.00 mg/kg		20	80 - 120	20

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Analytical Method Information

Analyte	MDL	LOD	Reporting Limit	Surrogate %R	Duplicate RPD	LCS\ Matrix Spike %R	RPD
6020A ICP MS DOD in Water (EPA 6020A)							
Preservation: Add HNO3 to pH<2							
Container: 3n_500mL Plastic, HNO3		**Amount Required:**			**Hold Time:** 180 days		
Antimony	0.190	1.00	2.00 ug/L		20	80 - 120	
Arsenic	0.0880	0.500	1.00 ug/L		20	80 - 120	
Barium	0.690	5.00	10.0 ug/L		20	80 - 120	
Beryllium	0.0430	0.500	1.00 ug/L		20	80 - 120	
Cadmium	0.0450	0.500	1.00 ug/L		20	80 - 120	
Chromium	0.240	1.00	2.00 ug/L		20	80 - 120	
Cobalt	0.0450	0.500	1.00 ug/L		20	80 - 120	
Copper	0.240	1.00	2.00 ug/L		20	80 - 120	
Lead	0.0530	0.500	1.00 ug/L		20	80 - 120	
Manganese	0.230	0.500	1.00 ug/L		20	80 - 120	
Nickel	0.0930	0.500	1.00 ug/L		20	80 - 120	
Selenium	0.290	2.50	5.00 ug/L		20	80 - 120	
Silver	0.0420	0.500	1.00 ug/L		20	80 - 120	
Thallium	0.0440	0.500	1.00 ug/L		20	80 - 120	
Vanadium	0.170	2.50	5.00 ug/L		20	80 - 120	
Zinc	0.340	1.00	2.00 ug/L		20	80 - 120	
is: Bismuth							
is: Indium							
is: Lithium							
is: Scandium							
is: Terbium							

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Analytical Method Information

Analyte	MDL	LOD	Reporting Limit	Surrogate %R	Duplicate RPD	LCS\ Matrix Spike %R	RPD
6020A ICP MS DOD in Soil (EPA 6020A)							
Preservation: Store cool at 4°C							
Container: 4a_2OZ WM Glass, cool		**Amount Required:** 1 GRAM			**Hold Time:** 180 days		
Antimony	0.115	0.500	1.00 mg/kg		20	75 - 125	
Arsenic	0.169	0.250	1.00 mg/kg		20	75 - 125	
Barium	0.110	2.50	5.00 mg/kg		20	75 - 125	
Beryllium	0.0405	0.250	0.500 mg/kg		20	75 - 125	
Cadmium	0.0332	0.250	0.500 mg/kg		20	75 - 125	
Chromium	0.149	0.500	6.00 mg/kg		20	75 - 125	
Cobalt	0.0198	0.250	0.500 mg/kg		20	75 - 125	
Copper	0.0265	0.500	1.00 mg/kg		20	75 - 125	
Lead	0.0127	0.250	0.500 mg/kg		20	75 - 125	
Manganese	0.0414	0.250	0.500 mg/kg		20	75 - 125	
Nickel	0.0240	0.250	0.500 mg/kg		20	75 - 125	
Selenium	0.131	1.25	2.50 mg/kg		20	75 - 125	
Silver	0.0418	0.250	0.500 mg/kg		20	75 - 125	
Thallium	0.0164	0.250	0.500 mg/kg		20	75 - 125	
Vanadium	0.260	1.25	2.50 mg/kg		20	75 - 125	
Zinc	0.627	1.00	2.50 mg/kg		20	75 - 125	
is: Bismuth							
is: Indium							
is: Lithium							
is: Scandium							
is: Terbium							

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Analytical Method Information

Analyte	MDL	LOD	Reporting Limit	Surrogate %R	Duplicate RPD	LCS\ Matrix Spike %R	RPD
7470A/7471B Mercury DOD in Water (EPA 7470A)							
Preservation: Add HNO3 to pH<2							
Container: 3g_250mL Plastic, cool, HNO3		**Amount Required:** 50 mL			**Hold Time:** 28 days		
Mercury	0.0910	0.180	0.200 ug/L		20	80 - 120	20

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Analytical Method Information

Analyte	MDL	LOD	Reporting Limit	Surrogate %R	Duplicate RPD	LCS\ Matrix Spike %R	RPD
7470A/7471B Mercury DOD in Soil (EPA 7471B)							
Preservation:NA							
Container:4b_4OZ WM Glass, cool		**Amount Required:** 0.2 gram			**Hold Time:**28 days		
Mercury	0.00700	0.0100	0.0330 mg/kg		20	80 - 120	20

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Analytical Method Information

Analyte	MDL	LOD	Reporting Limit	Surrogate %R	Duplicate RPD	LCS\ Matrix Spike %R	RPD
7470A Hg TCLP DOD in Water (EPA 7470A)							
Preservation: Add HNO3 to pH<2							
Container: 2e_1000mL Glass, cool		**Amount Required:** 50 mL			**Hold Time:** 28 days		
Mercury	0.0910	0.180	0.200 ug/L		20	80 - 120	20

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Analytical Method Information

Analyte	MDL	LOD	Reporting Limit	Surrogate %R	Duplicate RPD	LCS\ Matrix Spike %R	RPD
7470A Hg TCLP DOD in Soil (EPA 7470A)							
Preservation: Cool 4°C							
Container:4c_8OZ WM Glass, cool		**Amount Required:** 100G			**Hold Time:**28 days		
Mercury	0.0910	0.180	0.200 ug/L		20	80 - 120	20

TEST AMERICA SUPPORTING INFORMATION

Laboratory Quality Assurance Plan

Cover Page:

Quality Assurance Manual

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Quality Assurance Manual
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REFERENCED CORPORATE SOPs AND POLICIES

SOP / Policy Reference	Title
CA-Q-S-001	Solvent and Acid Lot Testing and Approval
CA-Q-S-002	Acceptable Manual Integration Practices
CA-Q-S-004	Method Compliance & Data Authenticity Audits
CA-Q-S-006	Detection Limits
CA-Q-S-008	Management Systems Review
CW-Q-S-001	Corporate Document Control and Archiving
CW-Q-S-002	Writing a Standard Operating Procedure (SOPs)
CA-L-S-001	Internal Investigation of Potential Data Discrepancies and Determination for Data Recall
CA-L-S-002	Subcontracting Procedures
CA-L-P-001	Ethics Policy
CA-L-P-002	Contract Compliance Policy
CW-F-P-002	Authorization Matrix
CW-F-P-004	Procurement and Contracts Policy
CA-C-S-001	Work Sharing Process
CA-T-P-001	Qualified Products List
CW-F-S-007	Controlled Purchases Policy
CW-F-S-018	Vendor Selection
CA-Q-M-002	Corporate Quality Management Plan
CW-E-M-001	Corporate Environmental Health & Safety Manual

REFERENCED LABORATORY SOPs

SOP Reference	Title
AN100	Laboratory Support Equipment (Verification and Use)
AN41	Reagent and Standard Materials Procedures
BA80	Specific Conductance (Conductivity)
CU01	Sample Receipt Procedures
CU15	Preparation of Sampling Kits
EX15	Toxicity Compound Leaching Procedure (TCLP) and Synthetic Precipitation Leaching Procedure (SPLP)
EX30	Liquid Extraction Procedures: Continuous Liquid-Liquid & Separatory Funnel
EX40	Sonication Procedures
EX42	Waste Dilution Extraction
EX45	Extraction of Chlorinated Herbicides in Water, Soils, and Wastes
FD05	Field Sampling Procedures
GE01	Measurement of Analytes Using Konelab Autoanalyzer
GE10	Heat of Combustion BTU/LB
GE105	Total Sulfur and Total Halogens
GE113	Inorganic Disinfection Byproducts by Ion Chromatography
GE114	Perchlorate by Ion Chromatography
GE115	Anions by Ion Chromatography
GE132	Sulfite
GE133	Total Residual Chlorine by Iodometric Titration
GE140	Flashpoint and Ignitability
GE157	Oil and Grease and Petroleum Hydrocarbons by Gravimetry
GE160	Methylene Blue Active Substances (MBAS)
GE165	Total Recoverable Phenolics
GE187	Organic Halides: Adsorbable (AOX) & Total (TOX)
GE189	UV - Absorbing Organic Constituents (UV-254)
GE190	Solid / Residue Determinations
GE191	pH Determination
GE192	Extractable Organic Halides (EOX)
GE193	Measurement of Analytes using PC Titrate Analyzer
GE194	Dissolved Oxygen: Azide Modification
GE195	Chemical Oxygen Demand (Hach Method)
GE196	Density and Specific Gravity
GE197	Color
GE198	Free Liquids by Paint Filter Liquids Test

SOP Reference	Title
GE199	Acidity
GE20	Block Digestion for the Determination of Total Kjeldahl Nitrogen and Total Phosphorus
GE200	Total Organic Carbon in Soils and Sediments
GE201	Total Hardness as CaCO3 by Titrimetric EDTA
GE202	Biochemical Oxygen Demand (BOD) and Carbonaceous Biochemical Oxygen Demand (CBOD)
GE204	Carbon Content in Water: Total Carbon (TC), Total Organic Carbon (TOC), and Total Inorganic Carbon
GE205	Odor
GE206	Turbidity
GE207	Total Cyanide: Preparation and Analysis
GE40	Total and Amenable Cyanide: Autoanalyzer Procedure
GE43	Midi Distillation of Water and Soils for the Determination of Cyanide
GE47	Thiocyanate
GE85	Sulfide: Titrimetric Preparation and Analysis
LC70	Carbamate Pesticides by HPLC
LC71	Glyphosate by HPLC
LC72	Diquat and Paraquat by HPLC
MB01	Total & Fecal Coliforms: Membrane Filter Technique
MB03	Enzyme Substrate Coliform Test: Colilert P/A and Colilert QT
MB04	Heterotrophic Plate Count
ME100	Mercury Preparation and Analysis
ME101	Sample Preparation Procedures for ICP and ICPMS
ME102	Elements by ICP
ME103	Elements by ICPMS
ME21	Digestion Procedures for Hexavalent Chromuim
ME28	Mercury Preparation and Analysis
ME50	Liquid Preparation Procedures for ICP and ICP/MS
ME51	Soil Preparation Procedures for ICP & ICP/MS
ME70	Elements by ICP
ME74	Elements by ICP-MS
PM01	Project Management
QA01	Document Control Program
QA02	Data Generation and Review
QA03	Client Inquiries and Complaint Resolution
QA05	Preventive and Corrective Action Procedures
QA06	Training Procedures

SOP Reference	Title
QA07	Determination and Verification of Detection and Reporting Limits (RLs, MDLs, and IDLs)
QA08	Evaluation of Chromatographic Data
QA10	Validation of New Analytical Capabilities and Instrumentation
QA12	Laboratory Certification Program
QA14	Handling, Storage, and Disposal of Restricted Foreign and Domestic Soil Samples
QA15	Homogenization, Compositing, and Segregation of Samples
QA16	Evaluation of Calibration Curves
QA17	Evaluation of Batch QC Data
SG45	Organochlorine Pesticides and Polychlorinated Biphenyls (PCBs) by GC/ECD
SG46	Organochlorine Pesticides and Polychlorinated Biphenyls (PCBs) by GC/ECD
SG50	Organo-Phosphorus Pesticides by Gas Chromatography
SG60	Microextractables by GC/ECD
SG62	Haloacetic Acids by Gas Chromatography
SG65	Chlorinated Herbicides
SG70	Diesel Range Organics (DRO), Oil Range Organics (ORO), & Petroleum Product Identification by GC/FID
SM02	Semivolatile Organic Compounds in Drinking Water by GC/MS
SM07	Polychlorinated Biphenyls (PCBs) by GC/MS
SM30	Endothall by GC/MS
SM31	Chlorinated Phenolics in Watewater by in-Situ Acetylation and GC/MS
SM33	Semivolatile Compounds by GC/MS
VG15	Gasoline Range Organics by GC/FID
VG40	Solvents by Direct Aqueous Injection (DAI) Using GC/FID
VG60	Dissolved Gases in Water
VM05	Volatile Compounds by GC/MS
VM15	Volatile Compounds in Drinking Water by GC/MS
VM20	Volatile Compounds by GC/MS
VM21	Preparation, Screening, and Storage of Volatile Samples
VM31	Acetates in the Pharmaceutical Industry by GC/MS

SECTION 3. INTRODUCTION (NELAC 5.1 - 5.3)

3.1 INTRODUCTION AND COMPLIANCE REFERENCES

TestAmerica Savannah's Quality Assurance Manual (QAM) is a document prepared to define the overall policies, organization objectives and functional responsibilities for achieving TestAmerica's data quality goals. The laboratory maintains a local perspective in its scope of services and client relations and maintains a national perspective in terms of quality.

The QAM has been prepared to assure compliance with the 2003 National Environmental Laboratory Accreditation Conference (NELAC) standards and ISO/IEC Guide 17025 (2005). In addition, the policies and procedures outlined in this manual are compliant with TestAmerica's Corporate Quality Management Plan (CQMP) and the various accreditation and certification programs listed in Appendix 3. The CQMP provides a summary of TestAmerica's quality and data integrity system. It contains requirements and general guidelines under which all TestAmerica facilities shall conduct their operations.

The QAM has been prepared to be consistent with the requirements of the following documents:

- EPA 600/4-88/039, *Methods for the Determination of Organic Compounds in Drinking Water,* EPA, Revised July 1991.
- EPA 600/R-95/131, *Methods for the Determination of Organic Compounds in Drinking Water,* Supplement III, EPA, August 1995.
- EPA 600/4-79-019, *Handbook for Analytical Quality Control in Water and Wastewater Laboratories,* EPA, March 1979.
- *Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IV, January 2008.*
- U.S. Department of Defense, Quality Systems Manual for Environmental Laboratories, Version 4.1, April 2009.
- Federal Register, 40 CFR Parts 136, 141, 172, 173, 178, 179 and 261.
- *Statement of Work for Inorganics & Organics Analysis, SOM and ISM, current versions, USEPA Contract Laboratory Program Multi-media, Multi-concentration.*
- APHA, *Standard Methods for the Examination of Water and Wastewater,* 18th Edition, 19th, 20th, 21st, and On-Line Edition.

3.2 TERMS AND DEFINITIONS

A Quality Assurance Program is a company-wide system designed to ensure that data produced by the laboratory conforms to the standards set by state and/or federal regulations. The program functions at the management level through company goals and management policies, and at the analytical level through Standard Operating Procedures (SOPs) and quality control. The TestAmerica program is designed to minimize systematic error, encourage constructive, documented problem solving, and provide a framework for continuous improvement within the organization.

Refer to Appendix 2 for the Glossary/Acronyms.

3.3 SCOPE / FIELDS OF TESTING

The laboratory analyzes a broad range of environmental and industrial samples every month. Sample matrices include drinking water, wastewater, hazardous waste, waste oils, and soils. The Quality Assurance Program contains specific procedures and methods to test samples of differing matrices for chemical, physical and biological parameters. The Program also contains guidelines on maintaining documentation of analytical processes, reviewing results, servicing clients and tracking samples through the laboratory. The technical and service requirements of all requests to provide analyses are thoroughly evaluated before commitments are made to accept the work. Measurements are made using published reference methods or methods developed and validated by the laboratory.

The methods covered by this manual include the most frequently requested methodologies needed to provide analytical services in the United States and its territories. The specific list of test methods used by the laboratory can be found on TotalAccess. The approach of this manual is to define the minimum level of quality assurance and quality control necessary to meet requirements. All methods performed by the laboratory shall meet these criteria as appropriate. In some instances, quality assurance project plans (QAPPs), project specific data quality objectives (DQOs) or local regulations may require criteria other than those contained in this manual. In these cases, the laboratory will abide by the requested criteria following review and acceptance of the requirements by Laboratory Management. In some cases, QAPPs and DQOs may specify less stringent requirements. The Laboratory Director and the QA Manager must determine if it is in the lab's best interest to follow the less stringent requirements.

3.4 MANAGEMENT OF THE MANUAL

3.4.1 Review Process

This manual is reviewed annually by senior laboratory management to assure that it reflects current practices and meets the requirements of the laboratory's clients and regulators as well as the CQMP. Occasionally, the manual may need changes in order to meet new or changing regulations and operations. The QA Manager will review the changes in the normal course of business and incorporate changes into revised sections of the document. All updates will be reviewed by the senior laboratory management staff. The laboratory updates and approves such changes according to our Document Control & Updating procedures (refer to SOP No. SA-QA-01: *Document Control Program*).

SECTION 4. ORGANIZATION AND MANAGEMENT (NELAC 5.4.1)

4.1 OVERVIEW

TestAmerica Savannah is a local operating unit of TestAmerica Laboratories, Inc.. The organizational structure, responsibilities and authorities of the corporate staff of TestAmerica Laboratories, Inc. are presented in the CQMP. The laboratory has day-to-day independent operational authority overseen by corporate officers (e.g., President, Chief Operating Officer, Corporate Quality Assurance, etc.). The laboratory operational and support staff work under the direction of the Laboratory Director. The organizational structure for both Corporate and TestAmerica Savannah is presented in Figure 4-1.

4.2 ROLES AND RESPONSIBILITIES

In order for the Quality Assurance Program to function properly, all members of the staff must clearly understand and meet their individual responsibilities as they relate to the quality program. The following descriptions briefly define each role in its relationship to the Quality Assurance Program.

4.2.1 Quality Assurance Program

The responsibility for quality lies with every employee of the laboratory. All employees have access to the QAM, are trained to this manual, and are responsible for upholding the standards therein. Each person carries out his/her daily tasks in a manner consistent with the goals and in accordance with the procedures in this manual and the laboratory's SOPs. Role descriptions for Corporate personnel are defined in the CQMP. This manual is specific to the operations of TestAmerica's Savannah laboratory.

4.2.1.1 Quality Assurance (QA) Manager

The QA Manager has responsibility and authority to ensure the continuous implementation of the quality system based on ISO 17025 and NELAC. The QA Manager is independent of production; reports directly to the Laboratory Director; and has access to Corporate QA for advice and resources. The QA Manager is able to evaluate data objectively and perform assessments without outside (i.e., managerial) influence. The QA Manager directs the activities of the QA Department to accomplish specific responsibilities, which include, but are not limited to:

- Ensuring communication and monitoring standards of performance to ensure that systems are in place to produce the level of quality as defined in this document.
- Notifying laboratory management of deficiencies in the quality system and ensuring corrective action is taken. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs are temporarily suspended following the procedures outlined in Section 12.
- Evaluation of the thoroughness and effectiveness of training.
- Compliance with the IEC/ISO 17025 Standard

4.2.1.2 Technical Manager/Director

Specific responsibilities include, but are not limited to, the following:

- Evaluates and implements new instrumentation, technology, and methods

- Reviews and edits Standard Operating Procedures in conjunction with QA Manager
- Evaluates technical Non-Conformances and Corrective Actions
- Assists in instrument and method trouble-shooting and maintenance
- Reviews data and evaluates trends
- Participates in reviewing, editing, and updating of QA Manual in conjunction with QA Manager
- Compliance with the IEC/ISO 17025 Standard

4.2.1.3 Laboratory Director

Specific responsibilities include, but are not limited to, the following:

- Directs and provides guidance to Laboratory Manager and Project Managers
- Develops and maintains company-client relationships
- Reviews proposals
- Supervises project management
- Interviews and hires technical and administrative personnel
- Other administrative and budgetary functions

4.2.1.4 Operations/Laboratory Manager

Specific responsibilities include, but are not limited to, the following:

- Coordinates all production activities
- Works with Project Managers to ensure project objectives are met
- Provides guidance to Department Managerss
- Interviews and hires laboratory personnel
- Establishes production priorities and coordinates day-to-day operation of the laboratory

4.2.1.5 Compliance Officer/Environmental Health and Safety Manager

Specific responsibilities include, but are not limited to, the following:

- Provides technical assistance in complying with corporate policies concerning safety, waste, and shipping
- Assists Laboratory Director, Laboratory Manager, and Project Managers in developing appropriate safety precautions for new projects
- Monitors collection and disposal of chemical wastes
- Ensures employees comply with safety and waste disposal plans

4.2.1.6 Department Manager/Supervisor

Specific responsibilities include, but are not limited to, the following:

- Organizes workflow in the department
- Assures adequate inventory of reagents and equipment
- Ensures effective maintenance and repair of instrumentation
- Investigates and evaluates new methodology and equipment
- Ensures proper training is conducted
- Reviews data, assures quality objectives are met for each project, and approves results

4.2.1.7 Analyst/Chemist

Specific responsibilities include, but are not limited to, the following:

- Performs preparation and/or analysis of samples using approved procedures

- Calculates, checks, and reports data in accordance with approved SOP and the Laboratory Quality Manual
- Performs instrument maintenance and maintains instrument logs
- Maintains proper documentation of all analytical steps

4.2.1.8 Lab Technician

Specific responsibilities include, but are not limited to, the following:

- Assists analysts in sample preparation and data collection
- Performs routine checks for data quality objectives - surrogate recoveries, LCS/MS recoveries, initial evaluation of dilutions, internal standards areas, and method blanks
- Assists analysts in maintaining traceability of standards and samples
- Assists analysts in preparing samples, extracts, or digests for analysis
- Checks samples for proper preservation and maintains department sample receipt and chain-of-custody logs

4.2.1.9 Client Services Director

Specific responsibilities include, but are not limited to, the following:

- Coordinates marketing efforts with General Manager, Laboratory Director, Project Managers, and laboratory marketing group
- Supervises Project Managers
- Coordinates proposal and contract review and response process
- Responds to client inquiries

4.2.1.10 Project Manager

Specific responsibilities include, but are not limited to, the following:

- Serves as primary contact with client on individual job tasks
- Prepares work plans; schedules manpower allocations
- Initiates all procurement for each project
- Provides day-to-day coordination of the project team
- Coordinates financial and contractual aspects of the projects
- Provides formatting and technical review of all reports
- Provides day-to-day communication with the client
- Exercises final review and approval on all reports and invoices for the project
- Responds to post project inquiries

4.2.1.11 Custody Supervisor

Specific responsibilities include, but are not limited to, the following:

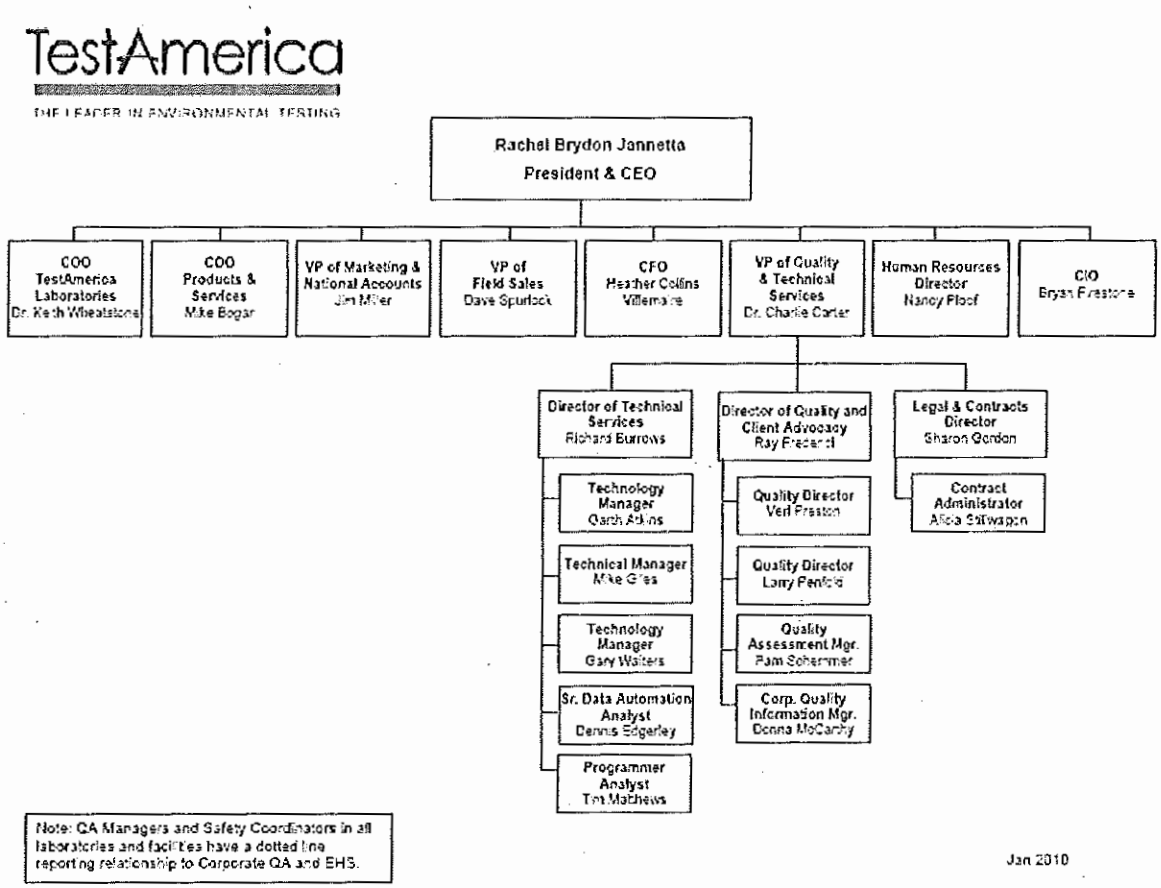
- Schedules bottle orders and supervises bottle prep staff
- Supervises sample custody staff
- Coordinates with Project Managers and Field/Sampling Supervisor on scheduling field sampling efforts
- Identifies and documents custody discrepancies and notifies Project Managers about custody problems

4.3 DEPUTIES

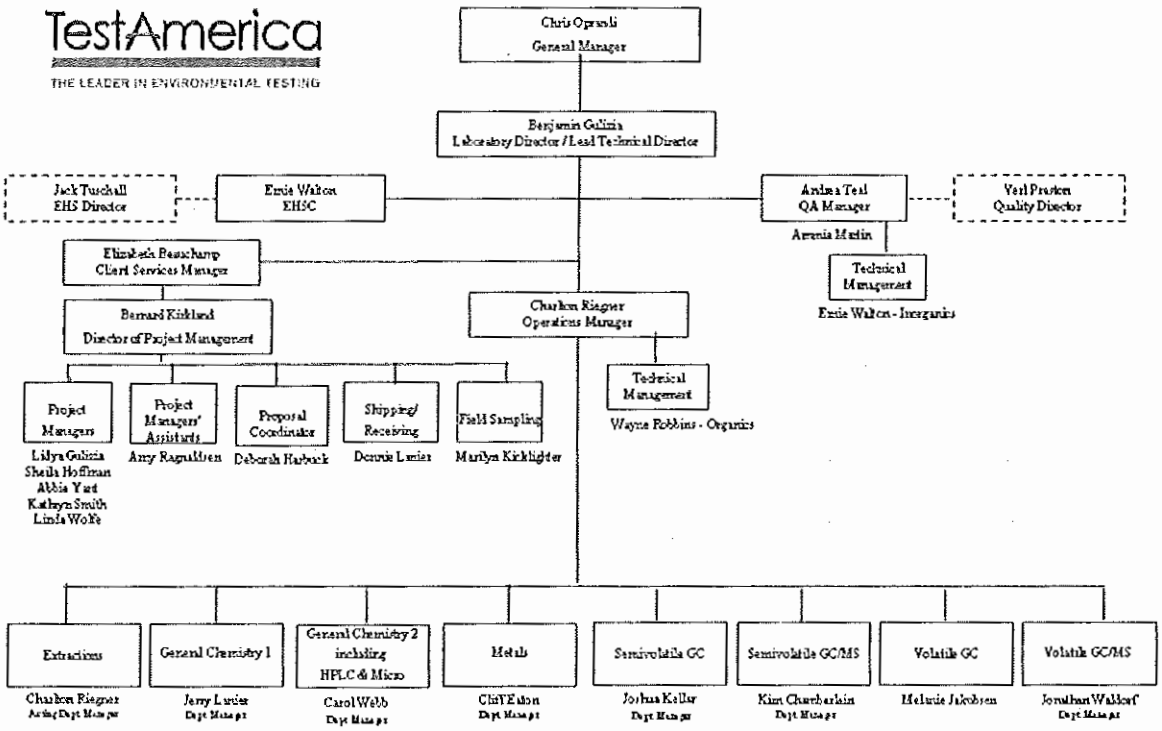
The following table defines who assumes the responsibilities of key personnel in their absence:

Key Personnel	Deputy
Laboratory Director	Client Services Director
QA Manager	Laboratory Director
Operations Manager	Laboratory Director
Technical Director/Manager	Laboratory Director
EHS Coordinator	Operations Manager

Figure 4-1. Corporate and Laboratory Organization Charts



Savannah Laboratory Organization



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SECTION 5. QUALITY SYSTEM (NELAC 5.4.2)

5.1 QUALITY POLICY STATEMENT

It is TestAmerica's Policy to:

- Provide data of known quality to its clients by adhering to approved methodologies, regulatory requirements and the QA/QC protocols including the NELAC and IEC/ISO 17025 Standards.
- Effectively manage all aspects of the laboratory and business operations by the highest ethical standards.
- Continually improve systems and provide support to quality improvement efforts in laboratory, administrative and managerial activities. TestAmerica recognizes that the implementation of a quality assurance program requires management's commitment and support as well as the involvement of the entire staff.
- Provide clients with the highest level of professionalism and the best service practices in the industry.

Every staff member at the laboratory plays an integral part in quality assurance and is held responsible and accountable for the quality of their work. It is, therefore, required that all laboratory personnel are trained and agree to comply with applicable procedures and requirements established by this document.

5.2 ETHICS AND DATA INTEGRITY

TestAmerica is committed to ensuring the integrity of its data and meeting the quality needs of its clients. The elements of TestAmerica's Ethics and Data Integrity Program include:

- An Ethics Policy (Corporate Policy No. CA-L-P-001) and Employee Ethics Statements.
- Ethics and Compliance Officers (ECOs).
- A Training Program.
- Self-governance through disciplinary action for violations.
- A Confidential mechanism for anonymously reporting alleged misconduct and a means for conducting internal investigations of all alleged misconduct. (Corporate SOP No. CA-L-S-001.)
- Procedures and guidance for recalling data if necessary (Corporate SOP No. CA-L-S-001).
- Effective external and internal monitoring system that includes procedures for internal audits (Section 15).
- Produce results, which are accurate and include QA/QC information that meets client pre-defined Data Quality Objectives (DQOs).
- Present services in a confidential, honest and forthright manner.
- Provide employees with guidelines and an understanding of the Ethical and Quality Standards of our Industry.

- Operate our facilities in a manner that protects the environment and the health and safety of employees and the public.
- Obey all pertinent federal, state and local laws and regulations and encourage other members of our industry to do the same.
- Educate clients as to the extent and kinds of services available.
- Assert competency only for work for which adequate personnel and equipment are available and for which adequate preparation has been made.
- Promote the status of environmental laboratories, their employees, and the value of services rendered by them.

5.3 QUALITY SYSTEM DOCUMENTATION

The laboratory's Quality System is communicated through a variety of documents.

- Quality Assurance Manual – Each laboratory has a lab specific quality assurance manual.
- Corporate SOPs and Policies - Corporate SOPs and Policies are developed for use by all relevant laboratories. They are incorporated into the laboratory's normal SOP distribution, training and tracking system. Corporate SOPs may be general or technical.
- Work Instructions - A subset of procedural steps, tasks or forms associated with an operation of a management system (e.g., checklists, preformatted bench sheets, forms).
- Laboratory SOPs – General and Technical
- Corporate Quality Policy Memorandums

5.3.1 Order of Precedence

In the event of a conflict or discrepancy between policies, the order of precedence is as follows:

- Corporate Quality Policy Memorandum
- Corporate Quality Management Plan (CQMP)
- Corporate SOPs and Policies
- Laboratory Quality Assurance Manual (QAM)
- Laboratory SOPs and Policies
- Other (Work Instructions (WI), memos, flow charts, etc.)

Note: The laboratory has the responsibility and authority to operate in compliance with regulatory requirements of the jurisdiction in which the work is performed. Where the CQMP conflicts with those regulatory requirements, the regulatory requirements of the jurisdiction shall hold primacy. The laboratory's QAM shall take precedence over the CQMP in those cases.

5.4 QA/QC OBJECTIVES FOR THE MEASUREMENT OF DATA

Quality Assurance (QA) and Quality Control (QC) are activities undertaken to achieve the goal of producing data that accurately characterize the sites or materials that have been sampled.

Quality Assurance is generally understood to be more comprehensive than Quality Control. Quality Assurance can be defined as the integrated system of activities that ensures that a product or service meets defined standards.

Quality Control is generally understood to be limited to the analyses of samples and to be synonymous with the term *"analytical quality control"*. QC refers to the routine application of statistically based procedures to evaluate and control the accuracy of results from analytical measurements. The QC program includes procedures for estimating and controlling precision and bias and for determining reporting limits.

Request for Proposals (RFPs) and Quality Assurance Project Plans (QAPP) provide a mechanism for the client and the laboratory to discuss the data quality objectives in order to ensure that analytical services closely correspond to client needs. The client is responsible for developing the QAPP. In order to ensure the ability of the laboratory to meet the Data Quality Objectives (DQOs) specified in the QAPP, clients are advised to allow time for the laboratory to review the QAPP before being finalized. Additionally, the laboratory will provide support to the client for developing the sections of the QAPP that concern laboratory activities.

Historically, laboratories have described their QC objectives in terms of precision, accuracy, representativeness, comparability, completeness, selectivity and sensitivity (PARCCSS).

5.4.1 Precision

The laboratory objective for precision is to meet the performance for precision demonstrated for the methods on similar samples and to meet data quality objectives of the EPA and/or other regulatory programs. Precision is defined as the degree of reproducibility of measurements under a given set of analytical conditions (exclusive of field sampling variability). Precision is documented on the basis of replicate analysis, usually duplicate or matrix spike (MS) duplicate samples.

5.4.2 Accuracy

The laboratory objective for accuracy is to meet the performance for accuracy demonstrated for the methods on similar samples and to meet data quality objectives of the EPA and/or other regulatory programs. Accuracy is defined as the degree of bias in a measurement system. Accuracy may be documented through the use of laboratory control samples (LCS) and/or matrix spiked (MS). A statement of accuracy is expressed as an interval of acceptance recovery about the mean recovery.

5.4.3 Representativeness

The laboratory objective for representativeness is to provide data which is representative of the sampled medium. Representativeness is defined as the degree to which data represent a characteristic of a population or set of samples and is a measurement of both analytical and field sampling precision. The representativeness of the analytical data is a function of the procedures used in procuring and processing the samples. The representativeness can be documented by the relative percent difference between separately procured, but otherwise identical samples or sample aliquots.

The representativeness of the data from the sampling sites depends on both the sampling procedures and the analytical procedures. The laboratory may provide guidance to the client regarding proper sampling and handling methods in order to assure the integrity of the samples.

5.4.4 Comparability

The comparability objective is to provide analytical data for which the accuracy, precision, representativeness and reporting limit statistics are similar to these quality indicators generated by other laboratories for similar samples, and data generated by the laboratory over time.

The comparability objective is documented by inter-laboratory studies carried out by regulatory agencies or carried out for specific projects or contracts, by comparison of periodically generated statements of accuracy, precision and reporting limits with those of other laboratories.

5.4.5 Completeness

The completeness objective for data is 90% (or as specified by a particular project), expressed as the ratio of the valid data to the total data over the course of the project. Data will be considered valid if they are adequate for their intended use. Data usability will be defined in a QAPP, project scope or regulatory requirement. Data validation is the process for reviewing data to determine its usability and completeness. If the completeness objective is not met, actions will be taken internally and with the data user to improve performance. This may take the form of an audit to evaluate the methodology and procedures as possible sources for the difficulty or may result in a recommendation to use a different method.

5.4.6 Selectivity

Selectivity is defined as the capability of a test method or instrument to respond to a target substance or constituent in the presence of non-target substances. Target analytes are separated from non-target constituents and subsequently identified/detected through one or more of the following, depending on the analytical method: extractions (separation), digestions (separation), interelement corrections (separation), use of matrix modifiers (separation), specific retention times (separation and identification), confirmations with different columns or detectors (separation and identification), specific wavelengths (identification), specific mass spectra (identification), specific electrodes (separation and identification), etc..

5.4.7 Sensitivity

Sensitivity refers to the amount of analyte necessary to produce a detector response that can be reliably detected (Method Detection Limit) or quantified (Reporting Limit).

5.5 CRITERIA FOR QUALITY INDICATORS

The laboratory maintains a Method Limit Groups (MLGs) in the Laboratory Information Management System (LIMS) that summarize the precision and accuracy acceptability limits for performed analyses. This summary includes an effective date which is updated each time new limits are generated and are managed by the laboratory's QA department. Unless otherwise

noted, limits within these tables are laboratory generated. Some acceptability limits are derived from US EPA methods when they are required. Where US EPA method limits are not required, the laboratory has developed limits from evaluation of data from similar matrices. Criteria for development of control limits is contained in SOP SA-QA-17: *Evaluation of Batch QC Data.*

5.6 STATISTICAL QUALITY CONTROL

Statistically-derived precision and accuracy limits are required by selected methods (such as SW-846) and programs. The laboratory routinely utilizes statistically-derived limits to evaluate method performance and determine when corrective action is appropriate. The analysts are instructed to use the current limits in the laboratory (dated and approved by the QA Manager) and entered into the Laboratory Information Management System (LIMS). The Quality Assurance department maintains an archive of all limits used within the laboratory and stores these values in LIMS. If a method defines the QC limits, the method limits are used.

If a method requires the generation of historical limits, the lab develops such limits from recent data in the QC database of the LIMS following the guidelines described in Section 24. All calculations and limits are documented and dated when approved and effective. On occasion, a client requests contract-specified limits for a specific project.

Surrogate recoveries are determined for a specific time period as defined above. The resulting ranges are entered in LIMS.

Current QC limits are entered and maintained in the LIMS analyte database. As sample results and the related QC are entered into LIMS, the sample QC values are compared with the limits in LIMS to determine if they are within the acceptable range. The analyst then evaluates if the sample needs to be rerun or re-extracted/rerun or if a comment should be added to the report explaining the reason for the QC outlier.

5.6.1 QC Charts

Control charting is a useful tool and is performed to assess analyte recoveries over time to evaluate trends. Control charting must be performed periodically (recommended annually) in accordance with SOP SA-QA-17: *Evaluation of Batch QC Data.*

5.7 QUALITY SYSTEM METRICS

In addition to the QC parameters discussed above, the entire Quality System is evaluated on a monthly basis through the use of specific metrics (refer to Section 16). These metrics are used to drive continuous improvement in the laboratory's Quality System.

SECTION 6. DOCUMENT CONTROL (NELAC 5.4.3)

6.1 OVERVIEW

The QA Department is responsible for the control of documents used in the laboratory to ensure that approved, up-to-date documents are in circulation and out-of-date (obsolete) documents are archived or destroyed. The following documents, at a minimum, must be controlled:

- Laboratory Quality Assurance Manual
- Laboratory Standard Operating Procedures (SOP)
- Laboratory Policies
- Work Instructions and Forms
- Corporate Policies and Procedures distributed outside the intranet

Corporate Quality posts Corporate Manuals, SOPs, Policies, Work Instructions, White Papers and Training Materials on the company intranet site. These Corporate documents are only considered controlled when they are read on the intranet site. Printed copies are considered uncontrolled unless the laboratory physically distributes them as controlled documents. A detailed description of the procedure for issuing, authorizing, controlling, distributing, and archiving Corporate documents is found in Corporate SOP No. CW-Q-S-001, Corporate Document Control and Archiving. The laboratory's internal document control procedure is defined in SOP SA-QA-01: *Document Control Program.*

The laboratory QA Department also maintains access to various references and document sources integral to the operation of the laboratory. This includes reference methods and regulations. Instrument manuals (hard or electronic copies) are also maintained by the laboratory.

The laboratory maintains control of records for raw analytical data and supporting records such as audit reports and responses, logbooks, standard logs, training files, MDL studies, Proficiency Testing (PT) studies, certifications and related correspondence, and corrective action reports. Raw analytical data consists of bound logbooks, instrument printouts, any other notes, magnetic media, electronic data and final reports.

6.2 DOCUMENT APPROVAL AND ISSUE

The pertinent elements of a document control system for each document include a unique document title and number, the number of pages of the item, the effective date, revision number and the laboratory's name. The QA personnel are responsible for the maintenance of this system.

Controlled documents are authorized by the QA Department. In order to develop a new document, a manager submits an electronic draft to the QA Department for suggestions and approval before use. Upon approval, QA personnel add the identifying version information to the document and retain the official document on file. The official document is provided to all applicable operational units (may include electronic access). Controlled documents are identified as such and records of their distribution are kept by the QA Department. Document control may be achieved by either electronic or hardcopy distribution.

The QA Department maintains a list of the official versions of controlled documents.

Quality System Policies and Procedures will be reviewed annually at a minimum and revised as appropriate. Changes to documents occur when a procedural change warrants.

6.3 PROCEDURES FOR DOCUMENT CONTROL POLICY

For changes to the QA Manual and SOPs, refer to SOP SA-QA-01: *Document Control Program.*

Uncontrolled copies must not be used within the laboratory. Previous revisions and back-up data are stored by the QA department.

Electronic copies of current documents (including QA Manuals, SOPs, Forms, Work Instructions, etc.) are maintained by the QA Department distributed electronically via the QA Navigator.

6.4 OBSOLETE DOCUMENTS

All invalid or obsolete documents are removed, or otherwise prevented from unintended use. At least one copy of the obsolete document is archived according to SOP SA-QA-01: *Document Control Program.*

SECTION 7. SERVICE TO THE CLIENT (NELAC 5.4.7)

7.1 OVERVIEW

The laboratory has established procedures for the review of work requests and contracts, oral or written. The procedures include evaluation of the laboratory's capability and resources to meet the contract's requirements within the requested time period. All requirements, including the methods to be used, must be adequately defined, documented and understood. For many environmental sampling and analysis programs, testing design is site or program specific and does not necessarily "fit" into a standard laboratory service or product. It is the laboratory's intent to provide both standard and customized environmental laboratory services to our clients.

A thorough review of technical and QC requirements contained in contracts is performed to ensure project success. The appropriateness of requested methods, and the lab's capability to perform them must be established. Projects, proposals and contracts are reviewed for adequately defined requirements and the laboratory's capability to meet those requirements. Alternate test methods that are capable of meeting the clients' requirements may be proposed by the lab. A review of the lab's capability to analyze non-routine analytes is also part of this review process.

All projects, proposals and contracts are reviewed for the client's requirements in terms of compound lists, test methodology requested, sensitivity (detection and reporting levels), accuracy, and precision requirements (% Recovery and RPD). The reviewer ensures that the laboratory's test methods are suitable to achieve these regulatory and client requirements and that the laboratory holds the appropriate certifications and approvals to perform the work. The laboratory and any potential subcontract laboratories must be certified, as required, for all proposed tests.

The laboratory must determine if it has the necessary physical, personnel and information resources to meet the contract, and if the personnel have the expertise needed to perform the testing requested. Each proposal is checked for its impact on the capacity of the laboratory's equipment and personnel. As part of the review, the proposed turnaround time will be checked for feasibility.

Electronic or hard copy deliverable requirements are evaluated against the laboratory's capacity for production of the documentation.

If the laboratory cannot provide all services but intends to subcontract such services, whether to another TestAmerica facility or to an outside firm, this will be documented and discussed with the client prior to contract approval. (Refer to Section 8 for Subcontracting Procedures.)

The laboratory informs the client of the results of the review if it indicates any potential conflict, deficiency, lack of accreditation, or inability of the lab to complete the work satisfactorily. Any discrepancy between the client's requirements and the laboratory's capability to meet those requirements is resolved in writing before acceptance of the contract. It is necessary that the contract be acceptable to both the laboratory and the client. Amendments initiated by the client and/or TestAmerica, are documented in writing.

All contracts, QAPPs, Sampling and Analysis Plans (SAPs), contract amendments, and documented communications become part of the project record.

The same contract review process used for the initial review is repeated when there are amendments to the original contract by the client, and the participating personnel are informed of the changes.

7.2 REVIEW SEQUENCE AND KEY PERSONNEL

Appropriate personnel will review the work request at each stage of evaluation.

For routine projects and other simple tasks, a review by the Project Manager (PM) is considered adequate. The PM confirms that the laboratory has any required certifications, that it can meet the clients' data quality and reporting requirements and that the lab has the capacity to meet the clients turn around needs.

For new, complex or large projects, the proposed contract is given to the National Account Director, who will decide which lab will receive the work based on the scope of work and other requirements, including certification, testing methodology, and available capacity to perform the work. The contract review process is outlined in TestAmerica's Corporate SOP No. CA-L-P-002: Contract Compliance Policy.

This review encompasses all facets of the operation. The scope of work is distributed to the appropriate personnel, as needed based on scope of contract, to evaluate all of the requirements shown above. The Project Manager then submits the final proposal to the client.

In the event that one of the designated personnel is not available to review the contract, his or her back-up will fulfill the review requirements.

The Legal & Contracts Director and the local Proposal Coordinator maintain copies of all signed contracts.

7.3 DOCUMENTATION

Appropriate records are maintained for every contract or work request. All stages of the contract review process are documented and include records of any significant changes. These records are maintained by the Proposal Coordinator.

Records are maintained of pertinent discussions with a client relating to the client's requirements or the results of the work during the period of execution of the contract. The PM keeps a phone log of conversations with the client.

7.3.1 Project-Specific Quality Planning

Communication of contract specific technical and QC criteria is an essential activity in ensuring the success of site specific testing programs. To achieve this goal, the laboratory assigns a PM to each client. It is the PM's responsibility to ensure that project-specific technical and QC requirements are effectively evaluated and communicated to the laboratory personnel before

and during the project. QA department involvement may be needed to assist in the evaluation of custom QC requirements.

PMs are the primary client contact and they ensure resources are available to meet project requirements. Although PMs do not have direct reports or staff in production, they coordinate opportunities and work with laboratory management and supervisory staff to ensure available resources are sufficient to perform work for the client's project. Project management is positioned between the client and laboratory resources.

Prior to work on a new project, the dissemination of project information and/or project opening meetings may occur to discuss schedules and unique aspects of the project. Items to be discussed may include the project technical profile, turnaround times, holding times, methods, analyte lists, reporting limits, deliverables, sample hazards, or other special requirements. The PM introduces new projects to the laboratory staff through project kick-off meetings or to the supervisory staff during production meetings. These meetings provide direction to the laboratory staff in order to maximize production and client satisfaction, while maintaining quality. In addition, project notes may be associated with each Project in LIMS as a reminder upon sample receipt and analytical processing.

During the project, any change that may occur within an active project is agreed upon between the client/regulatory agency and the PM/laboratory. These changes (e.g., use of a non-standard method or modification of a method) and approvals must be documented prior to implementation. Documentation pertains to any document, e.g., letter, e-mail, variance, contract addendum, which has been signed by both parties.

Such changes are also communicated to the laboratory during production meetings. Such changes are updated to the project notes and are introduced to the managers at these meetings. The laboratory staff is then introduced to the modified requirements via the PM or the individual laboratory Department Manager.

The laboratory strongly encourages client visits to the laboratory and for formal/informal information sharing session with employees in order to effectively communicate ongoing client needs as well as project specific details for customized testing programs.

7.4 SPECIAL SERVICES

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. It is the laboratory's goal to meet all client requirements in addition to statutory and regulatory requirements. The laboratory has procedures to ensure confidentiality to clients (Section 15 and 25).

Note: IEC/ISO 17025 and NELAC 2003 state that a laboratory "shall afford clients or their representatives cooperation to clarify the client's request". This topic is discussed in Section 7.

The laboratory's standard procedures for reporting data are described in Section 25. Special services are also available and provided upon request. These services include:

- Reasonable access for our clients or their representatives to the relevant areas of the laboratory for the witnessing of tests performed for the client.

- Assist client-specified third party data validators as specified in the client's contract.
- Supplemental information pertaining to the analysis of their samples. Note: An additional charge may apply for additional data/information that was not requested prior to the time of sample analysis or previously agreed upon.

7.5 CLIENT COMMUNICATION

Project managers are the primary communication link to the clients. They shall inform their clients of any delays in project completion as well as any non-conformances in either sample receipt or sample analysis. Project management will maintain ongoing client communication throughout the entire client project.

Technical Managers, Department Managers, and the QA Manager are available to discuss any technical questions or concerns that the client may have.

7.6 REPORTING

The laboratory works with our clients to produce any special communication reports required by the contract.

7.7 CLIENT SURVEYS

The laboratory assesses both positive and negative client feedback. The results are used to improve overall laboratory quality and client service. TestAmerica's Sales and Marketing teams periodically develops lab and client specific surveys to assess client satisfaction.

SECTION 8. SUBCONTRACTING OF TESTS (NELAC 5.4.5)

8.1 OVERVIEW

For the purpose of this quality manual, the phrase subcontract laboratory refers to a laboratory external to the TestAmerica laboratories. The phrase "work sharing" refers to internal transfers of samples between the TestAmerica laboratories. The term outsourcing refers to the act of subcontracting tests.

When contracting with our clients, the laboratory makes commitments regarding the services to be performed and the data quality for the results to be generated. When the need arises to outsource testing for our clients because project scope, changes in laboratory capabilities, capacity or unforeseen circumstances, we must be assured that the subcontractors or work sharing laboratories understand the requirements and will meet the same commitments we have made to the client. Refer to TestAmerica's Corporate SOPs on Subcontracting Procedures (CA-L-S-002) and the Work Sharing Process (CA-C-S-001).

When outsourcing analytical services, the laboratory will assure, to the extent necessary, that the subcontract or work sharing laboratory maintains a program consistent with the requirements of this document, the requirements specified in NELAC/ISO 17025 and/or the client's Quality Assurance Project Plan (QAPP). All QC guidelines specific to the client's analytical program are transmitted to the subcontractor and agreed upon before sending the samples to the subcontract facility. Additionally, work requiring accreditation will be placed with an appropriately accredited laboratory. The laboratory performing the subcontracted work will be identified in the final report, as will non-NELAC accredited work where required.

For projects requiring adherence to the DOD QSM, the subcontractor laboratories used must have an established and documented laboratory quality system that complies with DOD QSM requirements. The subcontractor laboratory must receive project-specific approval from the DOD client before any samples are analyzed.

The DOD QSM has 5 specific requirements for subcontracting:

1. Subcontractor laboratories must have an established laboratory quality system that complies with the QSM.
2. Subcontractor laboratories must be approved by the specific DOD component laboratory approval process.
3. Subcontractor laboratories must demonstrate the ability to generate acceptable results from the analysis of PT samples, subject to availability, using each applicable method, in the specified matrix, and provide appropriate documentation to the DOD client.
4. Subcontractor laboratories must receive project-specific approval from the DOD client before any samples are analyzed.
5. Subcontractor laboratories are subject to project-specific, on-site assessments by the DOD client or their designated representatives.

Project Managers (PMs) for the Export Lab are responsible for obtaining client approval prior to outsourcing any samples. The laboratory will advise the client of a subcontract or work sharing arrangement in writing and when possible approval from the client shall be retained in the project folder.

Note: In addition to the client, some regulating agencies, such as the US Army Corps of Engineers and the USDA, require notification prior to placing such work.

8.2 QUALIFYING AND MONITORING SUBCONTRACTORS

Whenever a PM becomes aware of a client requirement or laboratory need where samples must be outsourced to another laboratory, the other laboratory(s) shall be selected based on the following:

- The first priority is to attempt to place the work in a qualified TestAmerica laboratory;
- Firms specified by the client for the task (Documentation that a subcontractor was designated by the client must be maintained with the project file. This documentation can be as simple as placing a copy of an e-mail from the client in the project folder);
- Firms listed as pre-qualified and currently under a subcontract with TestAmerica. A listing of all approved subcontracting laboratories and supporting documentation is available on the TestAmerica intranet site. Verify necessary accreditation, where applicable, (e.g., on the subcontractor's NELAC, A2LA accreditation or State Certification).
- Firms identified in accordance with the company's Small Business Subcontracting program as small, women-owned, veteran-owned and/or minority-owned businesses;
- NELAC or A2LA accredited laboratories.
- In addition, the firm must hold the appropriate certification to perform the work required.

All TestAmerica laboratories are pre-qualified for work sharing provided they hold the appropriate accreditations, can adhere to the project/program requirements, and the client approved sending samples to that laboratory. The client must provide acknowledgement that the samples can be sent to that facility (an e-mail is sufficient documentation or if acknowledgement is verbal, the date, time, and name of person providing acknowledgement must be documented). The originating laboratory is responsible for communicating all technical, quality, and deliverable requirements as well as other contract needs. (Corporate SOP No. CA-C-S-001, Work Sharing Process).

When the potential sub-contract laboratory has not been previously approved, PMs may nominate a laboratory as a subcontractor based on need. The decision to nominate a laboratory must be approved by the Laboratory Director. The Laboratory Director requests that the QA Manager begin the process of approving the subcontract laboratory as outlined in Corporate SOP No. CA-L-S-002, Subcontracting Procedures. The client must provide acknowledgement that the samples can be sent to that facility (an e-mail is sufficient documentation or if acknowledgement is verbal, the date, time, and name of person providing acknowledgement must be documented).

8.2.1 Once the appropriate accreditation and legal information is received by the laboratory, it is evaluated for acceptability (where applicable) and forwarded to Corporate Contracts for formal contracting with the laboratory. They will add the lab to the approved list on the intranet site along with the associate documentation and notify the finance group for JD Edwards.

8.2.2 The client will assume responsibility for the quality of the data generated from the use of a subcontractor they have requested the lab to use. The qualified subcontractors on the intranet site are known to meet minimal standards. TestAmerica does not certify laboratories. The subcontractor is on our approved list and can only be recommended to the extent that we would use them.

8.2.3 The status and performance of qualified subcontractors will be monitored periodically by the Corporate Contracts and/or Quality Departments. Any problems identified will be brought to the attention of TestAmerica's Corporate Finance or Corporate Quality personnel.

- Complaints shall be investigated. Documentation of the complaint, investigation and corrective action will be maintained in the subcontractor's file on the intranet site. Complaints are posted using the Vendor Performance Report.
- Information shall be updated on the intranet when new information is received from the subcontracted laboratories.
- Subcontractors in good standing will be retained on the intranet listing. The QA Manager will notify all TestAmerica laboratories, Corporate Quality and Corporate Contracts if any laboratory requires removal from the intranet site. This notification will be posted on the intranet site and e-mailed to all Lab Directors/Managers, QA Managers and Sales Personnel.

8.3 OVERSIGHT AND REPORTING

The PM must request that the selected subcontractor be presented with a subcontract, if one is not already executed between the laboratory and the subcontractor. The subcontract must include terms which flow down the requirements of our clients, either in the subcontract itself or through the mechanism of work orders relating to individual projects. A standard subcontract and the Lab Subcontractor Vendor Package (posted on the intranet) can be used to accomplish this, and the Legal & Contracts Director can tailor the document or assist with negotiations, if needed. The PM responsible for the project must advise and obtain client consent to the subcontract as appropriate, and provide the scope of work to ensure that the proper requirements are made a part of the subcontract and are made known to the subcontractor.

Prior to sending samples to the subcontracted laboratory, the PM confirms their certification status to determine if it is current and scope-inclusive. For TestAmerica laboratories, certifications can be viewed on the company's TotalAccess Database.

The Sample Control department is responsible for ensuring compliance with QA requirements and applicable shipping regulations when shipping samples to a subcontracted laboratory.

All subcontracted samples must be accompanied by a Chain of Custody (COC). A copy of the original COC sent by the client must be included with all samples subbed within TestAmerica.

Through communication with the subcontracted laboratory, the PM monitors the status of the subcontracted analyses, facilitates successful execution of the work, and ensures the timeliness and completeness of the analytical report.

Non-NELAC accredited work must be identified in the subcontractor's report as appropriate. If NELAC accreditation is not required, the report does not need to include this information.

Reports submitted from subcontractor laboratories are not altered and are included in their original form in the final project report. This clearly identifies the data as being produced by a subcontractor facility. If subcontract laboratory data is incorporated into the laboratories EDD (i.e., imported), the report must explicitly indicate which lab produced the data for which methods and samples.

Note: The results submitted by a TestAmerica work sharing laboratory may be transferred electronically and the results reported by the TestAmerica work sharing lab are identified on the final report. The report must explicitly indicate which lab produced the data for which methods and samples. The final report must include a copy of the completed COC for all work sharing reports.

8.4 CONTINGENCY PLANNING

The Laboratory Director may waive the full qualification of a subcontractor process temporarily to meet emergency needs. In the event this provision is utilized, the QA Manager will be required to verify certifications. The comprehensive approval process must then be initiated within 30 calendar days of subcontracting.

SECTION 9. PURCHASING SERVICES AND SUPPLIES (NELAC 5.4.6)

9.1 OVERVIEW

Evaluation and selection of suppliers and vendors is performed, in part, on the basis of the quality of their products, their ability to meet the demand for their products on a continuous and short term basis, the overall quality of their services, their past history, and competitive pricing. This is achieved through evaluation of objective evidence of quality furnished by the supplier, which can include certificates of analysis, recommendations, and proof of historical compliance with similar programs for other clients. To ensure that quality critical consumables and equipment conform to specified requirements, which may affect quality, all purchases from specific vendors are approved by a member of the supervisory or management staff. Capital expenditures are made in accordance with TestAmerica's Corporate Controlled Purchases Procedure, SOP No. CW-F-S-007.

Contracts will be signed in accordance with TestAmerica's Corporate Authorization Matrix Policy, Policy No. CW-F-P-002. Request for Proposals (RFP's) will be issued where more information is required from the potential vendors than just price. Process details are available in TestAmerica's Corporate Procurement and Contracts Policy (Policy No. CW-F-P-004). RFP's allow TestAmerica to determine if a vendor is capable of meeting requirements such as supplying all of the TestAmerica facilities, meeting required quality standards and adhering to necessary ethical and environmental standards. The RFP process also allows potential vendors to outline any additional capabilities they may offer.

9.2 GLASSWARE

Glassware used for volumetric measurements must be Class A or verified for accuracy according to laboratory procedure. Pyrex (or equivalent) glass should be used where possible. For safety purposes, thick-wall glassware should be used where available.

9.3 REAGENTS, STANDARDS & SUPPLIES

Purchasing guidelines for equipment and reagents must meet the requirements of the specific method and testing procedures for which they are being purchased. Solvents and acids are pre-tested in accordance with TestAmerica's Corporate SOP on Solvent & Acid Lot Testing & Approval, SOP No. CA-Q-S-001.

9.3.1 Purchasing

Chemical reagents, solvents, glassware, and general supplies are ordered as needed to maintain sufficient quantities on hand. Materials used in the analytical process must be of a known quality. The wide variety of materials and reagents available makes it advisable to specify recommendations for the name, brand, and grade of materials to be used in any determination. This information is contained in the method SOP.

9.3.2 Receiving

It is the responsibility of the Shipping and Receiving Department to receive the shipment. Once the ordered reagents or materials are received, the analyst and/or Department Manager

compare the information on the label or packaging to the original order to ensure that the purchase meets the quality level specified. Material Safety Data Sheets (MSDSs) are available online through the Company's intranet website. Anyone may review these for relevant information on the safe handling and emergency precautions of on-site chemicals.

9.3.3 Specifications

All methods in use in the laboratory specify the grade of reagent that must be used in the procedure. If the quality of the reagent is not specified, it may be assumed that it is not significant in that procedure and, therefore, any grade reagent may be used. It is the responsibility of the analyst to check the procedure carefully for the suitability of grade of reagent.

Chemicals must not be used past the manufacturer's expiration date and must not be used past the expiration time noted in a method SOP. If expiration dates are not provided, the laboratory may contact the manufacturer to determine an expiration date.

The laboratory assumes a five year expiration date on inorganic dry chemicals unless noted otherwise by the manufacturer or by the reference source method. Chemicals should not be used past the manufacturer's or SOPs expiration date unless 'verified' (refer to item 3 listed below).

- An expiration date can not be extended if the dry chemical is discolored or appears otherwise physically degraded, the dry chemical must be discarded.
- Expiration dates can be extended if the dry chemical is found to be satisfactory based on acceptable performance of quality control samples (Continuing Calibration Verification (CCV), Blanks, Laboratory Control Sample (LCS), etc.).
- If the dry chemical is used for the preparation of standards, the expiration dates can be extended 6 months if the dry chemical is compared to an unexpired independent source in performing the method and the performance of the dry chemical is found to be satisfactory. The comparison must show that the dry chemical meets CCV limits. The comparison studies are maintained on-file in the QA Department.

Wherever possible, standards must be traceable to national or international standards of measurement or to national or international reference materials. Records to that effect are available to the user.

Compressed gases in use are checked for pressure and secure positioning daily. The minimum total pressure must be 500psig or the tank must be replaced. The quality of the gases must meet method or manufacturer specification or be of a grade that does not cause any analytical interference.

Water used in the preparation of standards or reagents must have a specific conductivity of less than 1-mmho/cm (or specific resistivity of greater than 1.0 megaohm-cm) at 25°C. The specific conductivity is checked and recorded daily. If the water's specific conductivity is greater than the specified limit, the Facility Manager and appropriate Department Managers/Supervisors must be notified immediately in order to notify all departments, decide on cessation (based on intended use) of activities, and make arrangements for correction.

The laboratory may purchase reagent grade (or other similar quality) water for use in the laboratory. This water must be certified "clean" by the supplier for all target analytes or otherwise verified by the laboratory prior to use. This verification is documented.

Standard lots are verified before first time use if the laboratory switches manufacturers or has historically had a problem with the type of standard.

Purchased VOA vials must be certified clean and the certificates must be maintained. If uncertified VOA vials are purchased, all lots must be verified clean prior to use. This verification must be maintained.

Records of manufacturer's certification and traceability statements are maintained in electronically.

9.3.4 Storage

Reagent and chemical storage is important from the aspects of both integrity and safety. Light-sensitive reagents may be stored in brown-glass containers. Storage conditions are per the Corporate Environmental Health & Safety Manual (Corp. Doc. No. CW-E-M-001) and method SOPs or manufacturer instructions.

9.4 PURCHASE OF EQUIPMENT/INSTRUMENTS/SOFTWARE

When a new piece of equipment is needed, either for additional capacity or for replacing inoperable equipment, the analyst or supervisor makes a supply request to the Technical Director and/or the Laboratory Director. If they agree with the request, the procedures outlined in TestAmerica's Corporate Policy No. CA-T-P-001, Qualified Products List, are followed. A decision is made as to which piece of equipment can best satisfy the requirements. The appropriate written requests are completed and purchasing places the order.

Upon receipt of a new or used piece of equipment, an identification name is assigned and added to the equipment list. IT must also be notified so that they can synchronize the instrument for back-ups. Its capability is assessed to determine if it is adequate or not for the specific application. For instruments, a calibration curve is generated, followed by MDLs, Demonstration of Capabilities (DOCs), and other relevant criteria (refer to Section 19). For software, its operation must be deemed reliable and evidence of instrument verification must be retained by the QA Department. Software certificates supplied by the vendors are filed with the LIMS Administrator. The manufacturer's operation manual is retained in the QA Library.

9.5 SERVICES

Service to analytical instruments (except analytical balances) is performed on an as needed basis. Routine preventative maintenance is discussed in Section 20. The need for service is determined by analysts and/or Department Managers. The service providers that perform the services are approved by the Operations Manager.

9.6 SUPPLIERS

TestAmerica selects vendors through a competitive proposal / bid process, strategic business alliances or negotiated vendor partnerships (contracts). This process is defined in the Corporate Finance documents on Vendor Selection (SOP No. CW-F-S-018) and Procurement & Contracts Policy (Policy No. CW-F-P-004). The level of control used in the selection process is dependent on the anticipated spending amount and the potential impact on TestAmerica business. Vendors that provide test and measuring equipment, solvents, standards, certified containers, instrument related service contracts or subcontract laboratory services shall be subject to more rigorous controls than vendors that provide off-the-shelf items of defined quality that meet the end use requirements. The JD Edwards purchasing system includes all suppliers/vendors that have been approved for use.

Evaluation of suppliers is accomplished by ensuring the supplier ships the product or material ordered and that the material is of the appropriate quality. This is documented by signing off on packing slips or other supply receipt documents. The purchasing documents contain the data that adequately describe the services and supplies ordered.

Any issues of vendor performance are to be reported immediately by the laboratory staff to the Corporate Purchasing Group by completing a Vendor Performance Report.

The Corporate Purchasing Group will work through the appropriate channels to gather the information required to clearly identify the problem and will contact the vendor to report the problem and to make any necessary arrangements for exchange, return authorization, credit, etc.

As deemed appropriate, the Vendor Performance Reports will be summarized and reviewed to determine corrective action necessary, or service improvements required by vendors

The laboratory has access to a listing of all approved suppliers of critical consumables, supplies and services. This information is provided through the JD Edwards purchasing system.

9.6.1 New Vendor Procedure

TestAmerica employees who wish to request the addition of a new vendor must complete a JD Edwards Vendor Add Request Form. (JD Edwards is the laboratory's purchasing software platform.)

New vendors are evaluated based upon criteria appropriate to the products or services provided as well as their ability to provide those products and services at a competitive cost. Vendors are also evaluated to determine if there are ethical reasons or potential conflicts of interest with TestAmerica employees that would make it prohibitive to do business with them as well as their financial stability. The QA Department and/or the Technology Director are consulted with vendor and product selection that have an impact on quality.

SECTION 10. COMPLAINTS (NELAC 5.4.8)

10.1 OVERVIEW

The laboratory considers an effective client complaint handling processes to be of significant business and strategic value. Listening to and documenting client concerns captures 'client knowledge' that enables our operations to continually improve processes and client satisfaction. An effective client complaint handling process also provides assurance to the data user that the laboratory will stand behind its data, service obligations and products.

A client complaint is any expression of dissatisfaction with any aspect of our business services (e.g., communications, responsiveness, data, reports, invoicing and other functions) expressed by any party, whether received verbally or in written form. Client inquiries, complaints or noted discrepancies are documented, communicated to management, and addressed promptly and thoroughly.

The laboratory has procedures for addressing both external and internal complaints with the goal of providing satisfactory resolution to complaints in a timely and professional manner.

The nature of the complaint is identified, documented and investigated, and an appropriate action is determined and taken. In cases where a client complaint indicates that an established policy or procedure was not followed, the QA Department must evaluate whether a special audit must be conducted to assist in resolving the issue. A written confirmation or letter to the client, outlining the issue and response taken is recommended as part of the overall action taken.

The process of complaint resolution and documentation utilizes the procedures outlined in Section 12 (Corrective Actions) and is documented following SOP SA-QA-03: *Client Inquiries and Complaint Resolution.*

10.2 EXTERNAL COMPLAINTS

An employee that receives a complaint initiates the complaint resolution process by first documenting the complaint according to SOP SA-QA-03.

Complaints fall into two categories: correctable and non-correctable. An example of a correctable complaint would be one where a report re-issue would resolve the complaint. An example of a non-correctable complaint would be one where a client complains that their data was repeatedly late. Non-correctable complaints should be reviewed for preventive action measures to reduce the likelihood of future occurrence and mitigation of client impact.

The general steps in the complaint handling process are:

- Receiving and Documenting Complaints
- Complaint Investigation and Service Recovery
- Process Improvement

The laboratory shall inform the initiator of the complaint of the results of the investigation and the corrective action taken, if any.

10.3 INTERNAL COMPLAINTS

Internal complaints include, but are not limited to: errors and non-conformances, training issues, internal audit findings, and deviations from methods. Corrective actions may be initiated by any staff member who observes a nonconformance and shall follow the procedures outlined in Section 12. In addition, Corporate Management, Sales and Marketing and IT may initiate a complaint by contacting the laboratory or through the corrective action system described in Section 12.

10.4 MANAGEMENT REVIEW

The number and nature of client complaints is reported by the QA Manager to the laboratory and QA Director in the QA Monthly Report. Monitoring and addressing the overall level and nature of client complaints and the effectiveness of the solutions is part of the Annual Management Review (Section 16).

SECTION 11. CONTROL OF NON-CONFORMING WORK (NELAC 5.4.9)

11.1 OVERVIEW

When data discrepancies are discovered or deviations and departures from laboratory SOPs, policies and/or client requests have occurred, corrective action is taken immediately. First, the laboratory evaluates the significance of the nonconforming work. Then, a corrective action plan is initiated based on the outcome of the evaluation. If it is determined that the nonconforming work is an isolated incident, the plan could be as simple as adding a qualifier to the final results and/or making a notation in the case narrative. If it is determined that the nonconforming work is a systematic or improper practices issue, the corrective action plan could include a more in depth investigation and a possible suspension of an analytical method. In all cases, the actions taken are documented using the laboratory's corrective action system (refer to Section 12).

Due to the frequently unique nature of environmental samples, sometimes departures from documented policies and procedures are needed. When an analyst encounters such a situation, the problem is presented to the supervisor for resolution. The supervisor may elect to discuss it with the Technical Director or have a representative contact the client to decide on a logical course of action. Once an approach is agreed upon, the analyst documents it using the laboratory's corrective action system described in Section 12. This information can then be supplied to the client in the form of a footnote or a case narrative with the report.

Project Management may encounter situations where a client requests that a special procedure be applied to a sample that is not standard lab practice. Based on a technical evaluation, the lab may accept or reject the request based on technical or ethical merit. Such a request would need to be approved by laboratory management and documented in the project files. Deviations to standard operating procedures must be noted in the final report.

11.2 RESPONSIBILITIES AND AUTHORITIES

TestAmerica's Corporate SOP entitled *Internal Investigation of Potential Data Discrepancies and Determination for Data Recall* (SOP No. CA-L-S-001) outlines the general procedures for the reporting and investigation of data discrepancies and alleged incidents of misconduct or violations of TestAmerica's data integrity policies as well as the policies and procedures related to the determination of the potential need to recall data.

Under certain circumstances, laboratory management may authorize departures from documented procedures or policies. The departures may be a result of procedural changes due to the nature of the sample; a one-time procedure for a client; QC failures with insufficient sample to reanalyze, etc. In most cases, the client will be informed of the departure prior to the reporting of the data. Any departures must be well documented using the laboratory's corrective action procedures. This information may also be documented in logbooks and/or data review checklists as appropriate. Any impacted data must be referenced in a case narrative and/or flagged with an appropriate data qualifier.

Any misrepresentation or possible misrepresentation of analytical data discovered by any laboratory staff member must be reported to facility Senior Management within 24 hours. The Senior Management staff is comprised_of the Laboratory Director, the QA Manager, and the Department Managers. The reporting of issues involving alleged violations of the company's

Data Integrity or Manual Integration procedures must be conveyed to an Ethics and Compliance Officer (ECO), Director of Quality & Client Advocacy and the laboratory's Quality Director within 24 hours of discovery.

Whether an inaccurate result was reported due to calculation or quantitation errors, data entry errors, improper practices, or failure to follow SOPs, the data must be evaluated to determine the possible effect.

The Laboratory Director, QA Manager, ECOs, Corporate Quality, the COO, General Managers and the Quality Directors have the authority and responsibility to halt work, withhold final reports, or suspend an analysis for due cause as well as authorize the resumption of work.

11.3 EVALUATION OF SIGNIFICANCE AND ACTIONS TAKEN

For each nonconforming issue reported, an evaluation of its significance and the level of management involvement needed is made. This includes reviewing its impact on the final data, whether or not it is an isolated or systematic issue, and how it relates to any special client requirements.

TestAmerica's Corporate Data Investigation & Recall Procedure (SOP No. CA-L-S-001) distinguishes between situations when it would be appropriate for laboratory management to make the decision on the need for client notification (written or verbal) and data recall (report revision) and when the decision must be made with the assistance of the ECO's and Corporate Management. Laboratory level decisions are documented and approved using the laboratory's standard nonconformance/corrective action reporting in lieu of the data recall determination form contained in TestAmerica's Corporate SOP No. CA-L-S-001.

11.4 PREVENTION OF NONCONFORMING WORK

If it is determined that the nonconforming work could recur, further corrective actions must be made following the laboratory's corrective action system. On a monthly basis, the QA Department initiates an evaluation of non-conformances to determine if any nonconforming work has been repeated multiple times. If so, the laboratory's corrective action process may be followed.

11.5 METHOD SUSPENSION/RESTRICTION (STOP WORK PROCEDURES)

In some cases, it may be necessary to suspend/restrict the use of a method or target compound which constitutes significant risk and/or liability to the laboratory. Suspension/restriction procedures can be initiated by any of the persons noted in Section 11.2, Paragraph 5.

Prior to suspension/restriction, confidentiality will be respected, and the problem with the required corrective and preventive action will be stated in writing and presented to the Laboratory Director.

The Laboratory Director shall arrange for the appropriate personnel to meet with the QA Manager as needed. This meeting shall be held to confirm that there is a problem, that suspension/restriction of the method is required and will be concluded with a discussion of the steps necessary to bring the method/target or test fully back on line. In some cases, that may

not be necessary if all appropriate personnel have already agreed there is a problem and there is agreement on the steps needed to bring the method, target or test fully back on line.

The QA Manager will also initiate a corrective action report as described in Section 12 if one has not already been started. A copy of any meeting notes and agreed upon steps should be faxed or e-mailed by the laboratory to the appropriate General Manager and member of Corporate QA. This fax/e-mail acts as notification of the incident.

After suspension/restriction, the lab will hold all reports to clients pending review. No faxing, mailing or distributing through electronic means may occur. The report must not be posted for viewing on the internet. It is the responsibility of the Laboratory Director to hold all reporting and to notify all relevant laboratory personnel regarding the suspension/restriction (e.g., Project Management, Log-in, etc...). Clients will NOT generally be notified at this time. Analysis may proceed in some instances depending on the non-conformance issue.

Within 72 hours, the QA Manager will determine if compliance is now met and reports can be released, OR determine the plan of action to bring work into compliance, and release work. A team, with all principals involved (Laboratory Director, Technical Director, QA Manager, Department Manager) can devise a start-up plan to cover all steps from client notification through compliance and release of reports. Project Management, and the Directors of Client Services and Sales and Marketing must be notified if clients must be notified or if the suspension/restriction affects the laboratory's ability to accept work. The QA Manager must approve start-up or elimination of any restrictions after all corrective action is complete. This approval is given by final signature on the completed corrective action report.

SECTION 12. CORRECTIVE ACTION (NELAC 5.4.10)

12.1 OVERVIEW

A major component of TestAmerica's Quality Assurance (QA) Program is the problem investigation and feedback mechanism designed to keep the laboratory staff informed on quality related issues and to provide insight to problem resolution. When nonconforming work or departures from policies and procedures in the quality system or technical operations are identified, the corrective action procedure provides a systematic approach to assess the issues, restore the laboratory's system integrity, and prevent reoccurrence. Corrective actions are documented using Non-Conformance Memos (NCM) and Corrective Action Reports (CAR) (refer to Figure 12-1).

12.2 GENERAL

Problems within the quality system or within analytical operations may be discovered in a variety of ways, such as QC sample failures, internal or external audits, proficiency testing (PT) performance, client complaints, staff observation, etc.

The purpose of a corrective action system is to:

- Identify non-conformance events and assign responsibility(s) for investigating.
- Resolve non-conformance events and assign responsibility for any required corrective action.
- Identify Systematic Problems before they become serious.
- Identify and track client complaints and provide resolution.

12.2.1 Non-Conformance Memo (NCM) - is used to document the following types of corrective actions:

- Deviations from an established procedure or SOP
- QC outside of limits (non-matrix related)

12.2.2 Corrective Action Report (CAR) - is used to document the following types of corrective actions:

- Issues found while reviewing NCMs that warrant further investigation
- Internal and External Audit Findings
- Unacceptable PT results
- Systematic Reporting / Calculation Errors

12.3 CLOSED LOOP CORRECTIVE ACTION PROCESS

Any employee in the company can initiate a corrective action. There are four main components to a closed-loop corrective action process once an issue has been identified: Cause Analysis, Selection and Implementation of Corrective Actions (both short and long term), Monitoring of the Corrective Actions, and Follow-up.

12.3.1 Cause Analysis

- Upon discovery of a non-conformance event, the event must be defined and documented. An CAR must be initiated, someone is assigned to investigate the issue and the event is investigated for cause. Table 12-1 provides some general guidelines on determining responsibility for assessment.
- The cause analysis step is the key to the process as a long term corrective action cannot be determined until the cause is determined.
- If the cause is not readily obvious, the QA Manager is consulted.

12.3.2 Selection and Implementation of Corrective Actions

- Where corrective action is needed, the laboratory shall identify potential corrective actions. The action(s) most likely to eliminate the problem and prevent recurrence are selected and implemented. Responsibility for implementation is assigned.
- Corrective actions shall be to a degree appropriate to the magnitude of the problem identified through the cause analysis.
- Whatever corrective action is determined to be appropriate, the laboratory shall document and implement the changes. The CAR is used for this documentation.

12.3.3 Root Cause Analysis

Root Cause Analysis is a class of problem solving (investigative) methods aimed at identifying the basic or causal factor(s) that underlie variation in performance or the occurrence of a significant failure. The root cause may be buried under seemingly innocuous events, many steps preceding the perceived failure. At first glance, the immediate response is typically directed at a symptom and not the cause. Typically, root cause analysis would be best with three or more incidents to triangulate a weakness.

Systematically analyze and document the Root Causes of the more significant problems that are reported. Identify, track, and implement the corrective actions required to reduce the likelihood of recurrence of significant incidents. Trend the Root Cause data from these incidents to identify Root Causes that, when corrected, can lead to dramatic improvements in performance by eliminating entire classes of problems.

Identify the one event associated with problem and ask why this event occurred. Brainstorm the root causes of failures by asking why events occurred or conditions existed; and then why the cause occurred 5 consecutive times until you get to the root cause. For each of these sub events or causes, ask why it occurred. Repeat the process for the other events associated with the incident.

Root cause analysis does not mean the investigation is over. Look at technique, or other systems outside the normal indicators. Often creative thinking will find root causes that ordinarily would be missed, and continue to plague the laboratory or operation.

12.3.4 Monitoring of the Corrective Actions

- The Department Manager and QA Manager are responsible to ensure that the corrective action taken was effective.

- Ineffective actions are documented and re-evaluated until acceptable resolution is achieved. Department Managers are accountable to the Laboratory Director to ensure final acceptable resolution is achieved and documented appropriately.
- Each CAR is entered into the CAR Task Items in Outlook for tracking purposes.
- The QA Manager reviews monthly CARs for trends. Highlights are included in the QA monthly report (refer to Section 16). If a significant trend develops that adversely affects quality, an audit of the area is performed and corrective action implemented.
- Any out-of-control situations that are not addressed acceptably at the laboratory level may be reported to the Corporate Quality Director by the QA Manager, indicating the nature of the out-of-control situation and problems encountered in solving the situation.

12.3.5 Follow-up Audits

- Follow-up audits may be initiated by the QA Manager and shall be performed as soon as possible when the identification of a nonconformance casts doubt on the laboratory's compliance with its own policies and procedures, or on its compliance with state or federal requirements.
- These audits often follow the implementation of the corrective actions to verify effectiveness. An additional audit would only be necessary when a critical issue or risk to business is discovered.

(Also refer to Section 15.1.4, Special Audits.)

12.4 TECHNICAL CORRECTIVE ACTIONS

In addition to providing acceptance criteria and specific protocols for technical corrective actions in the analytical SOPs, the laboratory has general procedures to be followed to determine when departures from the documented policies and procedures and quality control have occurred (refer to Section 11). The documentation of these procedures is through the use of an NCR.

Table 12-1 includes examples of general technical corrective actions. For specific criteria and corrective actions, SOP SA-QA-17: *Evaluation of Batch QC Data* and the analytical SOPs.

Table 12-1 provides some general guidelines for identifying the individual(s) responsible for assessing each QC type and initiating corrective action. The table also provides general guidance on how a data set should be treated if associated QC measurements are unacceptable. Specific procedures are included in analytical SOPs, Work Instructions, QAM Sections 19 and 20. All corrective actions are reviewed monthly, at a minimum, by the QA Manager, and highlights are included in the QA monthly report.

To the extent possible, samples shall be reported only if all quality control measures are acceptable. If the deficiency does not impair the usability of the results, data will be reported with an appropriate data qualifier and/or the deficiency will be noted in the case narrative. Where sample results may be impaired, the Project Manager is notified by an NCR and appropriate corrective action (e.g., reanalysis) is taken and documented.

12.5 BASIC CORRECTIONS

When mistakes occur in records, each mistake shall be crossed-out, [not obliterated (e.g. no white-out)], and the correct value entered alongside. All such corrections shall be initialed (or signed) and dated by the person making the correction. In the case of records stored electronically, the original "uncorrected" file must be maintained intact and a second "corrected" file is created.

This same process applies to adding additional information to a record. All additions made later than the initial must also be initialed (or signed) and dated.

When corrections are due to reasons other than obvious transcription errors, the reason for the corrections (or additions) shall also be documented.

Figure 12-1.
Example - Corrective Action Report
Audits

1	**Summary of Problem / Finding:** CAR Due Date to agency:
2a	**Root Cause Analysis / Investigation / Explanation:** *<<Note: Root Cause Analysis should involve multiple layers of questioning >>* *Example:* *- Why was this audit deficiency cited?* *- What weaknesses are indicated by this deficiency?* *- What Quality Systems mechanisms are in place that should have prevented this deficiency from occurring?* *- What changes are needed to existing Quality Systems mechanisms to prevent this deficiency from recurring?* *- What, if any, new Quality System mechanisms are needed to prevent this deficiency from recurring?* *- Is this issue acute or chronic?* *- Are other departments affected by this issue?* *- Etc.*
2b	**Corrective Action(s) Needed:** *<<Based on the Root Cause Analysis outlined above, what action items need to be completed to:* *1) correct this deficiency, and* *2) prevent its recurrence?>>* 1. Assigned Party: Due Date: 2. Assigned Party: Due Date: 3. Assigned Party: Due Date: 4. Assigned Party: Due Date: 5. Assigned Party: Due Date:
3a	**Corrective Action Taken:** *<<These items should correspond to the Corrective Actions Needed, as outlined in Section 2b.>>* 1. 2. 3.

	4. 5.
3b	**Corrective Action Documentation:** *<<These items should correspond to the Corrective Actions Needed, as outlined in Section 2b.>>* Corrective Action Documentation attached here: 1. 2. 3. 4. 5.
3c	**Agency Comments:** *<<To be completed by QA Department. If separate CAR letter was issued to agency, attach here.>>* Laboratory Response sent to agency on: 08/14/09, attached here. Audit Finding Response Status: - Awaiting agency response - Accepted by agency - Subsequent laboratory response/supporting documentation needed *<<Note: If subsequent response or supporting documentation is needed, enter information in Section 4, and re-assign.>>*
4	**Subsequent Information / Documentation Requests:** Assigned to: Due Date: Documentation attached here:
5	**Additional Close-out / Follow-up Comments:** A) This finding pertains to an isolated and/or anomalous event No further action or follow-up is needed to close out this item Initial / Date: B) An additional routine follow-up assessment is required to evaluate the effectiveness of the corrective action taken. Follow-up Assigned To: Due Date: Documentation Needed: Items used to assess effectiveness/sustainability of corrective action: *<<Include AD batch numbers, attach example logbook pages, etc., as applicable.>>*

	Choose One: a) Corrective action has been implemented and is effective. b) Similar problems have been noted. The corrective action has not been effective. Additional action is required. Initial / Date: C) This item needs to be added to the Internal Audit Checklist for reassessment at a later date. D) This audit-specific finding has been addressed. However, this finding may be present in other sections of the laboratory and could precipitate other Action Items and/or Investigation. A formal CAR is needed to address. New CAR Number: Issue:

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CARs

1a	**Summary of Problem:**
1b	**Hypothesis / Non-Conformance Event:** *<<Identify suspected non-conformance event(s) leading up to this problem.>>*
2a	**Root Cause Summary:** *<<True root cause analysis should involve multiple layers of questioning>>* *Examples:* *- Why did this problem occur?* *- What weaknesses are indicated by this problem?* *- What Quality Systems mechanisms are in place that should have prevented this problem from occurring?* *- Is this issue acute or chronic?* *- Are changes needed to existing SOPs to correct this problem and prevent its recurrence?* *- Are other departments affected by this issue?*
2b	**Summary of Items Reviewed / Evaluated to Assess Impact:** *<<List any items reviewed during this investigation.>>*
3a	**Corrective Action Plan (CAP):** *<<Based on the Root Cause Analysis outlined above, what action items need to be completed to correct this deficiency, and prevent its recurrence.>>* *Examples:* *- Identify impacted Jobs* *- Revise results/reports* *- Initiate formal Data Recall* *- Revise SOP* *- Re-train staff* 1. 2. 3. 4. 5.

3b	**Action Items Needed:** *<<These items should correspond to the Corrective Action Plan, as outlined in Section 3a.>>* 1. Assigned to: Due Date: Status: 2. Assigned to: Due Date: Status: 3. Assigned to: Due Date: Status: 4. Assigned to: Due Date: Status: 5. Assigned to: Due Date: Status:
3c	**Supporting Documentation:** *<<These items should correspond to the Corrective Action Plan, as outlined in Section 3a.>>* Corrective Action Documentation attached here: 1. 2. 3. 4. 5.
4	**Additional Close-out / Follow-up Comments:** A) This finding pertains to an isolated and/or anomalous event. No further action or follow-up is needed to close out this item. B) A routine follow-up assessment is required to evaluate the effectiveness of corrective action taken. Follow-up Assigned To: Due Date: Documentation Needed: Items used to assess effectiveness/sustainability of corrective action: *<<Include AD batch numbers, attach example logbook pages, etc., as applicable.>>*

	Corrective action has been implemented and is effective. Initial / Date: C) This item needs to be added to the Internal Audit Checklist for reassessment at a later date.

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PTs

The following results were scored unacceptable for:

PT Study: _____ **SDG:** _____ **Job Number:** _____

Copy of PT Study Results:

Analyte	Method	Reported Value	Assigned Value	Acceptance Limits

Investigation Completed By: _____

ASSESSMENT ITEMS	Yes	No	Not Assessed	Not Applicable	Comment(s)
Sample Preparation					
Preparation Method					
Analyst					
AD Batch					
Was the sample prepared according to the vendor's instructions?					
Was the sample prepared according to the SOP?					

Was the sample prepared within the prescribed holding time? (Note: Holding time for PT samples begins once the vial is opened, unless stated otherwise.) Were the standards and reagents used in the preparation batch valid?(e.g., traceable, unexpired, prepared properly, approved lot, etc.)					
Was the sample preparation information entered correctly on the batch sheet and/or in LIMS? (i.e., no transcription errors)					
Sample Analysis					
Analytical Method					
Analyst					
Instrument					
AD Batch					
Was the sample analyzed according to the vendor's instructions? Was the sample analyzed according to the SOP?					
Was the sample analyzed within the prescribed holding time? (Note: Holding time for PT samples begins once the vial is opened, unless stated otherwise.)					
Were the standards and reagents used in the analytical batch valid? (e.g., traceable, unexpired, prepared properly, approved lot, verified with 2nd source, etc.)					
Was the calibration curve appropriate and valid? (e.g., # of points, dispersion, low level standard acceptable, curve type appropriate, meets criteria, etc.)					
Data Evaluation and Reporting					
Was the analyte properly identified? (e.g., integration, resolution, quantitation, pattern recognition, spectra, etc.)					
Does the value reported fall within the instrument calibration range? (e.g., no J-value, E-value, etc.)					

Was the associated preparatory QC within limits? (e.g., method blank, LCS, MS/MSD, etc.)					
Was the associated analytical QC within limits? (ICV, CCV, instrument blank, PEVAL, tune, etc.)					
Does the RL support the spiked concentration of the PT sample?					
Where applicable, was there a correlation between the results of the primary and confirmation column/detector (i.e., <40% RPD)?					
If a dilution and/or re-analysis was performed, do these results support the reported result?					
Was the sample analysis information entered correctly on the batch sheet and/or in LIMS? (i.e., no transcription errors)					
Was the final result calculated properly?					
Is the reported result within the concentration ranges supplied by the PT Provider?					
Is the reported result above the PTRL?					
If multiple methods were reported for this analyte, do the results concur? (e.g., 200.7 vs. 6010, 625 vs. 8270, 300 vs. 353.2, 508 vs. 525.2, etc.)					
Training Assessment					
Does the preparation technician have the applicable SOP training on-file with the QA Department?					
Does the preparation technician have DOCs on-file with the QA Department?					
Does the analyst have the applicable SOP training on-file with the QA Department?					
Does the analyst have DOCs on-file with the QA Department?					
Miscellaneous					

Generate a Control Chart for the timeframe affected. Are the recoveries consistently within expected ranges for this analyte? (i.e., no noticeable trend in % recoveries for this analyte that would adversely affect the reported result.) If the result is biased-high, has it been determined that contamination was not a problem?					
Have common sources of contamination, degradation, and interference been eliminated as the cause for failure? (e.g., common lab contaminants, endrin/DDT breakdown components, co-eluters, CH_3Br/CH_3Cl formation, etc.)					
If there is sufficient sample remaining, reprepare and/or reanalyze. Does this reanalysis meet the PT acceptance criteria?					
Were situations requiring corrective action at the time of preparation or analysis properly resolved prior to reporting the result?					

If the answer to all of the preceding questions was "YES", complete the section below:

ASSESSMENT ITEMS	Yes	No	Not Assessed	Not Applicable	Comment(s)
Based on this investigative process, does the data support the reported value for this analyte? (i.e., no definitive source of error could be found)					
Does a blind QC Sample need to be procured to verify corrective action is sustainable?					
Does a remedial PT need to be procured?					

Remedial PT Information:

PT Study: **SDG:** **Job Number:**

Copy of Remedial PT Study Results:

Comments:

If the answer to any of the preceding questions was "NO", complete the section below:

ASSESSMENT ITEMS	Yes	No	Not Assessed	Not Applicable	Comment(s)
Has the problem been identified?					
Has the problem been corrected?					
Does a blind QC Sample need to be procured to verify corrective action is sustainable?					
Are there additional corrective actions that need to be taken as a result of this investigation? (e.g. SOP revision, re-training, form/template revision, etc.)					
Does a remedial PT need to be procured?					

Remedial PT Information:

PT Study: _____ **SDG:** _____ **Job Number:** _____

Copy of Remedial PT Study Results:

Comments: _____

Additonal Comments and/or Summary: _____

Followup Information and Dates:

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Table 12-1.

General Corrective Action Procedures

QC Activity ***(Individual Responsible for Initiation/Assessment)***	**Acceptance Criteria**	**Recommended Corrective Action**
Instrument Blank *(Analyst)*	- Criteria in analytical SOP	- Prepare and analyze another blank. - If same response, determine cause of contamination: reagents, environment, instrument equipment failure, etc.
Initial Calibration Standards *(Analyst)*	- Criteria in analytical SOP	- Reanalyze standards. - If still unacceptable, remake standards and recalibrate instrument.
Initial Calibration Verification (Second Source ICV) *(Analyst)*	- Criteria within analytical SOP	- Remake and reanalyze standard. - If still unacceptable, then remake calibration standards or use new primary standards and recalibrate instrument.
Continuing Calibration Verification (CCV) *(Analyst)*	- Criteria within analytical SOP	- Reanalyze standard. - If still unacceptable, then recalibrate and rerun affected samples.
Matrix Spike / Matrix Spike Duplicate (MS/MSD) *(Analyst)*	- Criteria in LIMS MLGs	- If matrix interferences are present, evaluate the LCS. - If the LCS is within acceptable limits the batch is acceptable.
Laboratory Control Sample (LCS) *(Analyst)*	- Criteria in LIMS MLGs and SOP SA-QA-17	- Batch must be re-prepared and re-analyzed.
Surrogates *(Analyst)*	- Criteria in LIMS MLGs	- Individual sample must be repeated, unless obvious matrix interference is noted.
Method Blank *(Analyst)*	<1/2RL	- Reanalyze blank. - Determine source of contamination. - Re-prepare/re-analyze batch.

SECTION 13. PREVENTIVE ACTION (NELAC 5.4.11)

13.1 OVERVIEW

The laboratory's preventive action programs improve, or eliminate potential causes of nonconforming product and/or nonconformance to the quality system. This preventive action process is a proactive continuous process improvement activity that can be initiated through feedback from clients, employees, business providers, and affiliates. The QA Department has the overall responsibility to ensure that the preventive action process is in place, and that relevant information on actions is submitted for management review.

Dedicating resources to an effective preventive action system emphasizes the laboratory's commitment to its Quality Program. It is beneficial to identify and address negative trends before they develop into complaints, problems and corrective actions. Additionally, customer service and satisfaction can be improved through continuous improvements to laboratory systems.

Opportunities for improvement may be discovered during management reviews, the QA Metrics Report, internal or external audits, proficiency testing performance, client complaints, staff observation, etc.

The monthly QA Metrics Report shows performance indicators in all areas of the quality system. These areas include revised reports, corrective actions, audit findings, internal auditing and data authenticity audits, client complaints, PT samples, holding time violations, SOPs, ethics training, etc. These metrics are used to help evaluate quality system performance on an ongoing basis and provide a tool for identifying areas for improvement.

The laboratory's corrective action process is integral to implementation of preventive actions. A critical piece of the corrective action process is the implementation of actions to prevent further occurrence of a non-compliance event. Historical review of corrective action provides a valuable mechanism for identifying preventive action opportunities.

13.1.1 The following elements are part of a preventive action system:

- Identification of an opportunity for preventive action.
- Process for the preventive action.
- Define the measurements of the effectiveness of the process once undertaken.
- Execution of the preventive action.
- Evaluation of the plan using the defined measurements.
- Verification of the effectiveness of the preventive action.
- Close-Out by documenting any permanent changes to the Quality System as a result of the Preventive Action. Documentation of Preventive Action is incorporated into the monthly QA reports, corrective action process and management review.

13.1.2 Any Preventive Actions undertaken or attempted shall be taken into account during the Annual Management Review (Section 16). A highly detailed recap is not required; a simple

recount of success and failure within the preventive action program will provide management a measure for evaluation.

SECTION 14. CONTROL OF RECORDS (NELAC 5.4.12)

The laboratory maintains a record system appropriate to its needs and that complies with applicable standards or regulations as required. The system produces unequivocal, accurate records that document all laboratory activities. The laboratory retains all original observations, calculations and derived data, calibration records and a copy of the analytical report for a minimum of five years after it has been issued.

14.1 OVERVIEW

The laboratory has established procedures for identification, collection, indexing, access, filing, storage, maintenance and disposal of quality and technical records. A record index is listed in Table 14-1. Quality records are maintained by the Quality Assurance (QA) Manager in the QA Database, which is backed up as part of the regular network backup. Technical records are maintained by the laboratory departments in the Data Archival folder on the G-drive and are backed up as part of the regular network backup. Records are of two types; either electronic or hard copy paper formats depending on whether the record is computer- or hand-generated (some records may be in both formats).

Table 14-1. Record Index[1]

Technical Records	QA Records	Project Records	Electronic Records
Retention: 5 years	**Retention:** 5 years	**Retention:** 5 years	**Retention:** 5 years
Examples: - Raw Data - Laboratory Notebooks - Certificates of Analysis - Analytical Sequences	**Examples:** - Audit Responses - Training Records - Agency Certificates - Management Reviews	**Examples:** - QAPPs - Contracts - RFPs - Correspondence	**Examples:** - Technical Records - QA Records - Project Records - Laboratory Backups - LIMS Records

* Exceptions listed in Table 14-2.

14.1.1 All records are stored and retained in such a way that they are secure and readily retrievable at the laboratory facility that provides a suitable environment to prevent damage or deterioration and to prevent loss. All records shall be protected against fire, theft, loss, environmental deterioration, and vermin. In the case of electronic records, electronic or magnetic sources, storage media are protected from deterioration caused by magnetic fields and/or electronic deterioration.

Access to the data is limited to laboratory and company employees. Logs are maintained to note removal and return of records. Records are maintained for a minimum of five years unless otherwise specified by a client or regulatory requirement.

For raw data and project records, record retention shall be calculated from the date the project report is issued. For other records, such as Controlled Documents, QA, or Administrative Records, the retention time is calculated from the date the record is formally retired. Records related to the programs listed in Table 14-2 have lengthier retention requirements and are subject to the requirements in Section 14.1.3.

14.1.2 Programs with Longer Retention Requirements

Some regulatory programs have longer record retention requirements than the standard record retention time. These are detailed in Table 14-2 with their retention requirements. In these cases, the longer retention requirement is enacted. If special instructions exist such that client data cannot be destroyed prior to notification of the client, the container or box containing that data is marked as to who to contact for authorization prior to destroying the data.

Table 14-2. Special Record Retention Requirements

Program	[1]Retention Requirement
Drinking Water (All States)	10 years (project records)
Drinking Water (Lead and Copper Rule)	12 years (project records)
Commonwealth of MA (All environmental data 310 CMR 42.14)	10 years
Louisiana – All	10 years
Michigan Department of Environmental Quality (all environmental data)	10 years
Navy Facilities Engineering Service Center (NFESC)	10 years
NY Potable Water (NYCRR Part 55-2)	10 years

[1]Note: Extended retention requirements must be noted with the archive documents or addressed in facility-specific records retention procedures.

14.1.3 The laboratory has procedures to protect and back-up records stored electronically and to prevent unauthorized access to or amendment of these records. All analytical data is maintained as hard copy or in a secure readable electronic format. For analytical reports that are maintained as copies in PDF format, refer to Section 19.14.1 for more information. Electronic records are maintained in the Data Archival Folder on the G-drive, or in another applicable drive (such as Q-drive or I-drive). Refer to SOP SA-QA-01: *Document Control Program* for specific information on the archival, storage, and back-up of records.

14.1.4 The record keeping system allows for historical reconstruction of all laboratory activities that produced the analytical data as well as rapid recovery of historical data. The history of the sample from when the laboratory took possession of the samples must be readily understood through the documentation. This shall include inter-laboratory transfers of samples and/or extracts.

- The records include the identity of personnel involved in sampling, sample receipt,

preparation, or testing. All analytical work contains the initials (at least) of the personnel involved. The laboratory's copy of the COC is stored electronically in the LIMS. The chain of custody would indicate the name of the sampler.

- All information relating to the laboratory facilities equipment, analytical test methods, and related laboratory activities, such as sample receipt, sample preparation, or data verification are documented.

- The record keeping system facilitates the retrieval of all working files and archived records for inspection and verification purposes (e.g., set format for naming electronic files, set format for what is included with a given analytical data set, etc. as per SOP SA-QA-01: *Document Control Program*. Instrument data is stored sequentially by instrument. A given day's analyses are maintained in the order of the analysis. Run logs are maintained for each instrument. Where an analysis is performed without an instrument, bound logbooks or bench sheets, or spreadsheets are used to record and file data. Standard and reagent information is recorded in the LIMS for each method.

- Changes to hardcopy records shall follow the procedures outlined in Section 12 and 19. Changes to electronic records in LIMS or instrument data are recorded in audit trails.

- The reason for a signature or initials on a document is clearly indicated in the records such as "sampled by," "prepared by," "reviewed by", or "analyzed by".

- All generated data except those that are generated by automated data collection systems, are recorded directly, promptly and legibly in permanent dark ink.

- Hard copy data may be scanned into PDF format for record storage as long as the scanning process can be verified in order to ensure that no data is lost and the data files and storage media must be tested to verify the laboratory's ability to retrieve the information prior to the destruction of the hard copy that was scanned.

- Also refer to Section 19.14.1 'Computer and Electronic Data Related Requirements'.

14.2 TECHNICAL AND ANALYTICAL RECORDS

14.2.1 The laboratory retains records of original observations, derived data and sufficient information to establish an audit trail, calibration records, staff records and a copy of each analytical report issued, for a minimum of five years unless otherwise specified by a client or regulatory requirement. The records for each analysis shall contain sufficient information to enable the analysis to be repeated under conditions as close as possible to the original. The records shall include the identity of laboratory personnel responsible for the sampling, performance of each analysis and reviewing results.

14.2.2 Observations, data and calculations are recorded real-time and are identifiable to the specific task.

14.2.3 Changes to hardcopy records shall follow the procedures outlined in Section 12 and 19. Changes to electronic records in LIMS or instrument data are recorded in audit trails.

The essential information to be associated with analysis, such as strip charts, tabular printouts, computer data files, analytical notebooks, and run logs, include:

- laboratory sample ID code;
- Date of analysis; Time of Analysis is also required if the holding time is seventy-two (72) hours or less, or when time critical steps are included in the analysis (e.g., drying times, incubations, etc.); instrumental analyses have the date and time of analysis recorded as part of their general operations. Where a time critical step exists in an analysis, location for such a time is included as part of the documentation in a specific logbook or on a benchsheet.
- Instrumentation identification and instrument operating conditions/parameters. Operating conditions/parameters are typically recorded in instrument maintenance logs where available.
- analysis type;
- all manual calculations and manual integrations;
- analyst's or operator's initials/signature;
- sample preparation including cleanup, separation protocols, incubation periods or subculture, ID codes, volumes, weights, instrument printouts, meter readings, calculations, reagents;
- test results;
- standard and reagent origin, receipt, preparation, and use;
- calibration criteria, frequency and acceptance criteria;
- data and statistical calculations, review, confirmation, interpretation, assessment and reporting conventions;
- quality control protocols and assessment;
- electronic data security, software documentation and verification, software and hardware audits, backups, and records of any changes to automated data entries; and
- Method performance criteria including expected quality control requirements. These are indicated both in the LIMS and on specific analytical report formats.

14.3 LABORATORY SUPPORT ACTIVITIES

In addition to documenting all the above-mentioned activities, the following are retained QA records and project records (previous discussions in this section relate where and how these data are stored):

- all original raw data, whether hard copy or electronic, for calibrations, samples and quality control measures, including analysts' work sheets and data output records (chromatograms, strip charts, and other instrument response readout records);
- a written description or reference to the specific test method used which includes a description of the specific computational steps used to translate parametric observations into a reportable analytical value;
- copies of final reports;

- archived SOPs;
- correspondence relating to laboratory activities for a specific project;
- all corrective action reports, audits and audit responses;
- proficiency test results and raw data; and
- results of data review, verification, and crosschecking procedures

14.3.1 Sample Handling Records

Records of all procedures to which a sample is subjected while in the possession of the laboratory are maintained. These include but are not limited to records pertaining to:

- sample preservation including appropriateness of sample container and compliance with holding time requirement;
- sample identification, receipt, acceptance or rejection and login;
- sample storage and tracking including shipping receipts, sample transmittal / COC forms; and
- procedures for the receipt and retention of samples, including all provisions necessary to protect the integrity of samples.

14.4 ADMINISTRATIVE RECORDS

The laboratory also maintains the administrative records in either electronic or hard copy form. Refer to Table 14-1.

14.5 RECORDS MANAGEMENT, STORAGE AND DISPOSAL

All records (including those pertaining to test equipment), certificates and reports are safely stored, held secure and in confidence to the client. Certification related records are available upon request.

All information necessary for the historical reconstruction of data is maintained by the laboratory. Records that are stored only on electronic media must be supported by the hardware and software necessary for their retrieval.

Records that are stored or generated by computers or personal computers have hard copy, write-protected backup copies, or an electronic audit trail controlling access.

The laboratory has a record management system (i.e., document control) for control of laboratory notebooks, instrument logbooks, standards logbooks, and records for data reduction, validation, storage and reporting. Laboratory notebooks are issued on a per analysis basis, and are numbered sequentially. All data are recorded sequentially within a series of sequential notebooks. Bench sheets are filed sequentially. Standards are maintained in the LIMS. Records are considered archived when noted as such in the records management system.

14.5.1 Transfer of Ownership

In the event that the laboratory transfers ownership or goes out of business, the laboratory shall ensure that the records are maintained or transferred according to client's instructions. Upon ownership transfer, record retention requirements shall be addressed in the ownership transfer agreement and the responsibility for maintaining archives is clearly established. In addition, in cases of bankruptcy, appropriate regulatory and state legal requirements concerning laboratory records must be followed. In the event of the closure of the laboratory, all records will revert to the control of the corporate headquarters. Should the entire company cease to exist, as much notice as possible will be given to clients and the accrediting bodies who have worked with the laboratory during the previous 5 years of such action.

14.5.2 Records Disposal

Records are removed from the archive and destroyed after 5 years unless otherwise specified by a client or regulatory requirement. On a project specific or program basis, clients may need to be notified prior to record destruction. Records are destroyed in a manner that ensures their confidentiality such as shredding, mutilation or incineration. (Refer to Tables 14-1 and 14-2).

Electronic copies of records must be destroyed by erasure or physically damaging off-line storage media so no records can be read.

If a third party records management company is hired to dispose of records, a "Certificate of Destruction" is required.

SECTION 15. AUDITS (NELAC 5.4.13)

15.1 INTERNAL AUDITS

Internal audits are performed to verify that laboratory operations comply with the requirements of the lab's quality system and with the external quality programs under which the laboratory operates. Audits are planned and organized by the QA staff. Personnel conducting the audits should be independent of the area being evaluated. Auditors will have sufficient authority, access to work areas, and organizational freedom necessary to observe all activities affecting quality and to report the assessments to laboratory management and when requested to corporate management.

Audits are conducted and documented as described in the TestAmerica Corporate SOP on performing Internal Audits, SOP No. CA-Q-S-004. The types and frequency of routine internal audits are shown in Table 15-1. Special or ad hoc assessments may be conducted as needed under the direction of the QA staff.

Table 15-1. Types of Internal Audits and Frequency

Description	Performed by	Frequency
Quality Systems	QA Department or Designee	All areas of the laboratory annually
QA Technical Audits - Evaluate raw data versus final reports - Analyst integrity - Data authenticity	QA Department or Designee	All methods within a 2-year period, with at least 15% of methods every quarter
SOP Method Compliance	Technical Director	- All SOPs within a 2-year period - All new analysts or new analyst/methods within 3 months of IDOC
Special	QA Department or Designee	Surveillance or spot checks performed as needed
Performance Testing	Analysts with QA oversight	Two successful per year for each NELAC field of testing or as dictated by regulatory requirements

15.1.1 Annual Quality Systems Audit

An annual quality systems audit is required to ensure compliance to analytical methods and SOPs, the laboratory's Data Integrity and Ethics Policies, NELAC quality systems, client and state requirements, and the effectiveness of the internal controls of the analytical process, including but not limited to data review, quality controls, preventive action and corrective action. The completeness of earlier corrective actions is assessed. The audit is divided into modules for each operating or support area of the lab, and each module is comprehensive for a given area. The area audits may be done on a rotating schedule throughout the year to ensure

adequate coverage of all areas. This schedule may change as situations in the laboratory warrant.

15.1.2 QA Technical Audits

QA technical audits are based on client projects, associated sample delivery groups, and the methods performed. Reported results are compared to raw data to verify the authenticity of results. The validity of calibrations and QC results are compared to data qualifiers, footnotes, and case narratives. Documentation is assessed by examining run logs and records of manual integrations. Manual calculations are checked. Where possible, MintMiner is used to identify unusual manipulations of the data deserving closer scrutiny. QA technical audits will include all methods within a two-year period.

15.1.3 SOP Method Compliance

Compliance of all SOPs with the source methods and compliance of the operational groups with the SOPs will be assessed by the Technical Director at least every two years. The work of each newly hired analyst is assessed within 3 months of working independently, (e.g., completion of method IDOC). In addition, as analysts add methods to their capabilities, (new IDOC) reviews of the analyst work products will be performed within 3 months of completing the documented training.

15.1.4 Special Audits

Special audits are conducted on an as needed basis, generally as a follow up to specific issues such as client complaints, corrective actions, PT results, data audits, system audits, validation comments, regulatory audits or suspected ethical improprieties. Special audits are focused on a specific issue, and report format, distribution, and timeframes are designed to address the nature of the issue.

15.1.5 Performance Testing

The laboratory participates semi-annually in performance audits conducted through the analysis of PT samples provided by a third party. The laboratory generally participates in the following types of PT studies: Drinking Water, Nonpotable Water, and Soil.

It is TestAmerica's policy that PT samples be treated as typical samples in the production process. Furthermore, where PT samples present special or unique problems, in the regular production process they may need to be treated differently, as would any special or unique request submitted by any client. The QA Manager must be consulted and in agreement with any decisions made to treat a PT sample differently due to some special circumstance.

Written responses to unacceptable PT results are required. In some cases it may be necessary for blind QC samples to be submitted to the laboratory to show a return to control.

15.2 EXTERNAL AUDITS

External audits are performed when certifying agencies or clients conduct on-site inspections or submit performance testing samples for analysis. It is TestAmerica's policy to cooperate fully with regulatory authorities and clients. The laboratory makes every effort to provide the auditors with access to personnel, documentation, and assistance. Laboratory supervisors are responsible for providing corrective actions to the QA Manager who coordinates the response for any deficiencies discovered during an external audit. Audit responses are due in the time allotted by the client or agency performing the audit. A copy of the audit report and the labs corrective action plan will be forwarded to Corporate Quality.

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. The client may only view data and systems related directly to the client's work. All efforts are made to keep other client information confidential.

15.2.1 Confidential Business Information (CBI) Considerations

During on-site audits, auditors may come into possession of information claimed as business confidential. A business confidentiality claim is defined as "a claim or allegation that business information is entitled to confidential treatment for reasons of business confidentiality or a request for a determination that such information is entitled to such treatment." When information is claimed as business confidential, the laboratory must place on (or attach to) the information at the time it is submitted to the auditor, a cover sheet, stamped or typed legend or other suitable form of notice, employing language such as "trade secret", "proprietary" or "company confidential". Confidential portions of documents otherwise non-confidential must be clearly identified. CBI may be purged of references to client identity by the responsible laboratory official at the time of removal from the laboratory. However, sample identifiers may not be obscured from the information. Additional information regarding CBI can be found in within the 2003 NELAC standards.

15.3 AUDIT FINDINGS

Audit findings are documented using the corrective action process and database. The laboratory's corrective action responses for both types of audits may include action plans that could not be completed within a predefined timeframe. In these instances, a completion date must be set and agreed to by operations management and the QA Manager.

Developing and implementing corrective actions to findings is the responsibility of the Department Manager where the finding originated. Findings that are not corrected by specified due dates are reported monthly to management in the QA monthly report. When requested, a copy of the audit report and the labs corrective action plan will be forwarded to Corporate Quality.

If any audit finding casts doubt on the effectiveness of the operations or on the correctness or validity of the laboratory's test results, the laboratory shall take timely corrective action, and shall notify clients in writing if the investigations show that the laboratory results have been affected. Once corrective action is implemented, a follow-up audit is scheduled to ensure that the problem has been corrected.

Clients must be notified promptly in writing, of any event such as the identification of defective measuring or test equipment that casts doubt on the validity of results given in any test report or amendment to a test report. The investigation must begin within 24-hours of discovery of the problem and all efforts are made to notify the client within two weeks after the completion of the investigation.

SECTION 16. MANAGEMENT REVIEWS (NELAC 5.4.14)

16.1 QUALITY ASSURANCE REPORT

A comprehensive QA Report shall be prepared each month by the laboratory's QA Department and forwarded to the Laboratory Director, their Quality Director, as well as the General Manager. All aspects of the QA system are reviewed to evaluate the suitability of policies and procedures. During the course of the year, the Laboratory Director, General Manager or Corporate QA may request that additional information be added to the report.

On a monthly basis, Corporate QA compiles information from all the monthly laboratory reports. The Corporate Quality Directors prepare a report that includes a compilation of all metrics and notable information and concerns regarding the QA programs within the laboratories. The report also includes a listing of new regulations that may potentially impact the laboratories. This report is presented to the Senior Management Team and General Managers.

16.2 ANNUAL MANAGEMENT REVIEW

The senior lab management team conducts a review annually of its quality systems and LIMS to ensure its continuing suitability and effectiveness in meeting client and regulatory requirements and to introduce any necessary changes or improvements. It will also provide a platform for defining quality goals and objectives. The LIMS review consists of examining any audits, complaints or concerns that have been raised through the year that are related to the LIMS. The laboratory will summarize any critical findings that can not be solved by the lab and report them to Corporate IT.

This management systems review (Corporate SOP No. CA-Q-S-008 and Work Instruction No. CA-Q-WI-020) uses information generated during the preceding year to assess the "big picture" by ensuring that routine actions taken and reviewed on a monthly basis are not components of larger systematic concerns. The monthly review should keep the quality systems current and effective, therefore, the annual review is a formal senior management process to review specific existing documentation. Significant issues from the following documentation are compiled or summarized by the QA Manager prior to the review meeting:

- Matters arising from the previous annual review.
- Prior Monthly QA Reports issues.
- Laboratory QA Metrics.
- Review of report reissue requests.
- Review of client feedback and complaints.
- Issues arising from any prior management or staff meetings.
- Minutes from prior senior lab management meetings. Issues that may be raised from these meetings include:
    - Adequacy of staff, equipment and facility resources.
    - Adequacy of policies and procedures.
    - Future plans for resources and testing capability and capacity.

- The annual internal double blind PT program sample performance (if performed),
- Compliance to the Ethics Policy and Data Integrity Plan. Including any evidence/incidents of inappropriate actions or vulnerabilities related to data Integrity.

A report is generated by the QA Manager and management. The report is distributed to the appropriate General Manager and the Quality Director. The report includes, but is not limited to:

- The date of the review and the names and titles of participants.
- A reference to the existing data quality related documents and topics that were reviewed.
- Quality system or operational changes or improvements that will be made as a result of the review [e.g., an implementation schedule including assigned responsibilities for the changes (Action Table)].

Changes to the quality systems requiring update to the laboratory QA Manual shall be included in the next revision of the QA Manual.

16.3 POTENTIAL INTEGRITY RELATED MANAGERIAL REVIEWS

Potential integrity issues (data or business related) must be handled and reviewed in a confidential manner until such time as a follow-up evaluation, full investigation, or other appropriate actions have been completed and issues clarified. TestAmerica's Corporate Data Investigation/Recall SOP shall be followed (SOP No. CA-L-S-001). All investigations that result in finding of inappropriate activity are documented and include any disciplinary actions involved, corrective actions taken, and all appropriate notifications of clients.

TestAmerica's COO, VP of Client & Technical Services, General Managers and Quality Directors receive a monthly report from the Director of Quality & Client Advocacy summarizing any current data integrity or data recall investigations. The General Manager's are also made aware of progress on these issues for their specific labs.

SECTION 17. PERSONNEL (NELAC 5.5.2)

17.1 OVERVIEW

The laboratory's management believes that its highly qualified and professional staff is the single most important aspect in assuring a high level of data quality and service. The staff consists of professionals and support personnel as outlined in the organization chart in Figure 4-1.

All personnel must demonstrate competence in the areas where they have responsibility. Any staff that is undergoing training shall have appropriate supervision until they have demonstrated their ability to perform their job function on their own. Staff shall be qualified for their tasks based on appropriate education, training, experience and/or demonstrated skills as required.

The laboratory employs sufficient personnel with the necessary education, training, technical knowledge and experience for their assigned responsibilities.

All personnel are responsible for complying with all QA/QC requirements that pertain to the laboratory and their area of responsibility. Each staff member must have a combination of experience and education to adequately demonstrate a specific knowledge of their particular area of responsibility. Technical staff must also have a general knowledge of lab operations, test methods, QA/QC procedures and records management.

Laboratory management is responsible for formulating goals for lab staff with respect to education, training and skills and ensuring that the laboratory has a policy and procedures for identifying training needs and providing training of personnel. The training shall be relevant to the present and anticipated responsibilities of the lab staff.

The laboratory only uses personnel that are employed by or under contract to, the laboratory. Contracted personnel, when used, must meet competency standards of the laboratory and work in accordance to the laboratory's quality system.

17.2 EDUCATION AND EXPERIENCE REQUIREMENTS FOR TECHNICAL PERSONNEL

The laboratory makes every effort to hire analytical staffs that possess a college degree (AA, BA, BS) in an applied science with some chemistry in the curriculum. Exceptions can be made based upon the individual's experience and ability. Selection of qualified candidates for laboratory employment begins with documentation of minimum education, training, and experience prerequisites needed to perform the prescribed task. Minimum education and training requirements for TestAmerica employees are outlined in job descriptions and are generally summarized for analytical staff in the table below.

The laboratory maintains job descriptions for all personnel who manage, perform or verify work affecting the quality of the environmental testing the laboratory performs. Job Descriptions are located on the TestAmerica intranet site's Human Resources web-page (Also see Section 4 for position descriptions/responsibilities).

Experience and specialized training are occasionally accepted in lieu of a college degree (basic lab skills such as using a balance, colony counting, aseptic or quantitation techniques, etc., are also considered).

As a general rule for analytical staff:

Specialty	Education	Experience
Extractions, Digestions, some electrode methods (pH, DO, Redox, etc.), or Titrimetric and Gravimetric Analyses	H.S. Diploma	On the job training (OJT)
CVAA, Single component or short list Chromatography (e.g., Fuels, BTEX-GC, IC	A college degree in an applied science or 2 years of college and at least 1 year of college chemistry	Or 2 years prior analytical experience is required
ICP, ICPMS, Long List or complex chromatography (e.g., Pesticides, PCB, Herbicides, HPLC, etc.), GCMS	A college degree in an applied science or 2 years of college chemistry	Or 5 years of prior analytical experience
Spectra Interpretation	A college degree in an applied science or 2 years of college chemistry	And 2 years relevant experience Or 5 years of prior analytical experience
Technical Directors/Department Managers – General	Bachelors Degree in an applied science or engineering with 24 semester hours in chemistry An advanced (MS, PhD.) degree may substitute for one year of experience	And 2 years experience in environmental analysis of representative analytes for which they will oversee
Technical Director – **Wet Chem** only (no advanced instrumentation)	Associates degree in an applied science or engineering or 2 years of college with 16 semester hours in chemistry	And 2 years relevant experience

Specialty	Education	Experience
Technical Director - Microbiology	Bachelors degree in applied science with at least 16 semester hours in general microbiology and biology An advanced (MS, PhD.) degree may substitute for one year of experience	And 2 years of relevant experience

When an analyst does not meet these requirements, they can perform a task under the direct supervision of a qualified analyst, peer reviewer or Department Manager, and are considered an analyst in training. The person supervising an analyst in training is accountable for the quality of the analytical data and must review and approve data and associated corrective actions.

17.3 TRAINING

The laboratory is committed to furthering the professional and technical development of employees at all levels.

Orientation to the laboratory's policies and procedures, in-house method training, and employee attendance at outside training courses and conferences all contribute toward employee proficiency.

Below are examples of various areas of required employee training:

Required Training	Time Frame	Employee Type
Environmental Health & Safety	Prior to lab work	All
Ethics (New Hires)	1 week of hire	All
Ethics (Comprehensive)	90 days of hire	All
Data Integrity	30 days of hire	Technical and PMs
Quality Assurance	90 days of hire	All
Ethics (Comprehensive Refresher)	Annually	All
Initial Demonstration of Capability (IDOC)	Prior to unsupervised method performance	Technical

The laboratory maintains records of relevant authorization/competence, education, professional qualifications, training, skills and experience of technical personnel (including contracted

personnel) as well as the date that approval/authorization was given. These records are kept on file at the laboratory. Also refer to "Demonstration of Capability" in Section 19.

The training of technical staff is kept up to date by:

- Each employee must have documentation in their training file that they have read, understood and agreed to follow the most recent version of the laboratory QA Manual and SOPs in their area of responsibility. This documentation is updated as SOPs are updated.
- Documentation from any training courses or workshops on specific equipment, analytical techniques or other relevant topics are maintained in their training file.
- Documentation of proficiency (refer to Section 19).
- An Ethics Agreement signed by each staff member (renewed each year) and evidence of annual ethics training.
- A Confidentiality Agreement signed by each staff member signed at the time of employment.
- Human Resources maintains documentation and attestation forms on employment status & records; benefit programs; timekeeping/payroll; and employee conduct (e.g., ethics). This information is maintained in the employee's secured personnel file.

Evidence of successful training could include such items as:

- Adequate documentation of training within operational areas, including one-on-one technical training for individual technologies, and particularly for people cross-trained.
- Analysts knowledge to refer to QA Manual for quality issues.
- Analysts following SOPs, i.e., practice matches SOPs.
- Analysts regularly communicate to supervisors and QA if SOPs need revision, rather than waiting for auditors to find problems.

Further details of the laboratory's training program are described in the SOP SA-QA-06: *Training Procedures.*

17.4 DATA INTEGRITY AND ETHICS TRAINING PROGRAM

Establishing and maintaining a high ethical standard is an important element of a Quality System. Ethics and data integrity training is integral to the success of TestAmerica and is provided for each employee at TestAmerica. It is a formal part of the initial employee orientation within 1 week of hire followed by technical data integrity training within 30 days, comprehensive training within 90 days, and an annual refresher for all employees. Senior management at each facility performs the ethics training for their staff.

In order to ensure that all personnel understand the importance TestAmerica places on maintaining high ethical standards at all times; TestAmerica has established a Corporate Ethics Policy (Policy No. CA-L-P-001) and an Ethics Statement. All initial and annual training is documented by signature on the signed Ethics Statement demonstrating that the employee has participated in the training and understands their obligations related to ethical behavior and data integrity.

Violations of this Ethics Policy will not be tolerated. Employees who violate this policy will be subject to disciplinary actions up to and including termination. Criminal violations may also be referred to the Government for prosecution. In addition, such actions could jeopardize TestAmerica's ability to do work on Government contracts, and for that reason, TestAmerica has a Zero Tolerance approach to such violations.

Employees are trained as to the legal and environmental repercussions that result from data misrepresentation. Key topics covered in the presentation include:

- Organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting.
- Ethics Policy
- How and when to report ethical/data integrity issues. Confidential reporting.
- Record keeping.
- Discussion regarding data integrity procedures.
- Specific examples of breaches of ethical behavior (e.g. peak shaving, altering data or computer clocks, improper macros, etc., accepting/offering kickbacks, illegal accounting practices, unfair competition/collusion)
- Internal monitoring. Investigations and data recalls.
- Consequences for infractions including potential for immediate termination, debarment, or criminal prosecution.
- Importance of proper written narration / data qualification by the analyst and project manager with respect to those cases where the data may still be usable but are in one sense or another partially deficient.

Additionally, a data integrity hotline (1-800-736-9407) is maintained by TestAmerica and administered by the Corporate Quality Department.

SECTION 18. ACCOMMODATIONS AND ENVIRONMENTAL CONDITIONS (NELAC 5.5.3)

18.1 OVERVIEW

The laboratory is a 55,000 ft^2 secure laboratory facility with controlled access and designed to accommodate an efficient workflow and to provide a safe and comfortable work environment for employees. All visitors sign in and are escorted by laboratory personnel. Access is controlled by various measures.

The laboratory is equipped with structural safety features. Each employee is familiar with the location, use, and capabilities of general and specialized safety features associated with their workplace. The laboratory provides and requires the use of protective equipment including safety glasses, protective clothing, gloves, etc., OSHA and other regulatory agency guidelines regarding required amounts of bench and fume hood space, lighting, ventilation (temperature and humidity controlled), access, and safety equipment are met or exceeded.

Traffic flow through sample preparation and analysis areas is minimized to reduce the likelihood of contamination. Adequate floor space and bench top area is provided to allow unencumbered sample preparation and analysis space. Sufficient space is also provided for storage of reagents and media, glassware, and portable equipment. Ample space is also provided for refrigerated sample storage before analysis and archival storage of samples after analysis. Laboratory HVAC and deionized water systems are designed to minimize potential trace contaminants.

The laboratory is separated into specific areas for sample receiving, sample preparation, volatile organic sample analysis, non-volatile organic sample analysis, inorganic sample analysis, microbiological sample analysis, and administrative functions.

18.2 ENVIRONMENT

Laboratory accommodation, test areas, energy sources, lighting are adequate to facilitate proper performance of tests. The facility is equipped with heating, ventilation, and air conditioning (HVAC) systems appropriate to the needs of environmental testing performed at this laboratory.

The environment in which these activities are undertaken does not invalidate the results or adversely affect the required accuracy of any measurements.

The laboratory provides for the effective monitoring, control and recording of environmental conditions that may affect the results of environmental tests as required by the relevant specifications, methods, and procedures.

When any of the method or regulatory required environmental conditions change to a point where they may adversely affect test results, analytical testing will be discontinued until the environmental conditions are returned to the required levels.

Environmental conditions of the facility housing the computer network and LIMS are regulated to protect against raw data loss.

18.3 WORK AREAS

There is effective separation between neighboring areas when the activities therein are incompatible with each other. Examples include:

- Microbiological culture handling and sample incubation areas.
- Volatile organic chemical handling areas, including sample preparation and waste disposal, and volatile organic chemical analysis areas.

Access to and use of all areas affecting the quality of analytical testing is defined and controlled by secure access to the laboratory building as described below in the Building Security section.

Adequate measures are taken to ensure good housekeeping in the laboratory and to ensure that any contamination does not adversely affect data quality. These measures include regular cleaning to control dirt and dust within the laboratory. Work areas are available to ensure an unencumbered work area. Work areas include:

- Access and entryways to the laboratory.
- Sample receipt areas.
- Sample storage areas.
- Chemical and waste storage areas.
- Data handling and storage areas.
- Sample processing areas.
- Sample analysis areas.

18.4 FLOOR PLAN

A floor plan can be found in Appendix 1.

18.5 BUILDING SECURITY

Building keys are distributed to employees as necessary.

Visitors to the laboratory sign in and out in a visitor's logbook. A visitor is defined as any person who visits the laboratory who is not an employee of the laboratory. In addition to signing into the laboratory, the Environmental, Health and Safety Manual contains requirements for visitors and vendors. There are specific safety forms that must be reviewed and signed. Visitors (with the exception of company employees) are escorted by laboratory personnel at all times, or the location of the visitor is noted in the visitor's logbook.

SECTION 19. TEST METHODS AND METHOD VALIDATION (NELAC 5.5.4)

19.1 OVERVIEW

The laboratory uses methods that are appropriate to meet our clients' requirements and that are within the scope of the laboratory's capabilities. These include sampling, handling, transport, storage and preparation of samples, and, where appropriate, an estimation of the measurement of uncertainty as well as statistical techniques for analysis of environmental data.

Instructions are available in the laboratory for the operation of equipment as well as for the handling and preparation of samples. All instructions, Standard Operating Procedures (SOPs), reference methods and manuals relevant to the working of the laboratory are readily available to all staff. Deviations from published methods are documented (with justification) in the laboratory's approved SOPs. SOPs are submitted to clients for review at their request. Significant deviations from published methods require client approval and regulatory approval where applicable.

19.2 STANDARD OPERATING PROCEDURES (SOPS)

The laboratory maintains SOPs that accurately reflect all phases of the laboratory such as assessing data integrity, corrective actions, handling customer complaints as well as all analytical methods and sampling procedures. The method SOPs are derived from the most recently promulgated/approved, published methods and are specifically adapted to the laboratory facility. Modifications or clarifications to published methods are clearly noted in the SOPs. All SOPs are controlled in the laboratory.

- All SOPs contain a revision number, effective date, and appropriate approval signatures. Controlled copies are available to all staff.
- Procedures for writing an SOP are incorporated by reference to TestAmerica's Corporate SOP entitled 'Writing a Standard Operating Procedure', No. CW-Q-S-002 or the laboratory's SOP SA-QA-01: *Document Control.*
- SOPs are reviewed at a minimum of every 2 years (annually for Drinking Water and DoD SOPs), and where necessary, revised to ensure continuing suitability and compliance with applicable requirements.

19.3 LABORATORY METHODS MANUAL

For each test method, the laboratory shall have available the published referenced method as well as the laboratory developed SOP.

Note: If more stringent standards or requirements are included in a mandated test method or regulation than those specified in this manual, the laboratory shall demonstrate that such requirements are met. If it is not clear which requirements are more stringent, the standard from the method or regulation is to be followed. Any exceptions or deviations from the referenced methods or regulations are noted in the specific analytical SOP.

The laboratory maintains an SOP Index for both technical and non-technical SOPs. Technical SOPs are maintained to describe a specific test method. Non-technical SOPs are maintained to describe functions and processes not related to a specific test method.

19.4 SELECTION OF METHODS

Since numerous methods and analytical techniques are available, continued communication between the client and laboratory is imperative to assure the correct methods are utilized. Once client methodology requirements are established, this and other pertinent information is summarized by the Project Manager. These mechanisms ensure that the proper analytical methods are applied when the samples arrive for log-in. For non-routine analytical services (e.g., special matrices, non-routine compound lists), the method of choice is selected based on client needs and available technology. The methods selected should be capable of measuring the specific parameter of interest, in the concentration range of interest, and with the required precision and accuracy.

19.4.1 Sources of Methods

Routine analytical services are performed using standard EPA-approved methodology. In some cases, modification of standard approved methods may be necessary to provide accurate analyses of particularly complex matrices. When the use of specific methods for sample analysis is mandated through project or regulatory requirements, only those methods shall be used.

When clients do not specify the method to be used or methods are not required, the methods used will be clearly validated and documented in an SOP and available to clients and/or the end user of the data.

The analytical methods used by the laboratory are those currently accepted and approved by the U. S. EPA and the state or territory from which the samples were collected. Reference methods include:

- *Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act, and Appendix A-C; 40 CFR Part 136, USEPA Office of Water. Revised as of July 1, 1995, Appendix A to Part 136 - Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater (EPA 600 Series)*
- *Methods for Chemical Analysis of Water and Wastes, EPA 600 (4-79-020), 1983.*
- *Methods for the Determination of Inorganic Substances in Environmental Samples, EPA-600/R-93/100, August 1993.*
- *Methods for the Determination of Metals in Environmental Samples, EPA/600/4-91/010, June 1991. Supplement I: EPA-600/R-94/111, May 1994.*
- *Methods for the Determination of Organic Compounds in Drinking Water, EPA-600/4-88-039, December 1988, Revised, July 1991, Supplement I, EPA-600-4-90-020, July 1990, Supplement II, EPA-600/R-92-129, August 1992. Supplement III EPA/600/R-95/131 - August 1995 (EPA 500 Series) (EPA 500 Series methods)*
- *Technical Notes on Drinking Water Methods, EPA-600/R94-173, October 1994*
- *Statement of Work for Inorganics & Organics Analysis, SOM and ISM, current versions, USEPA Contract Laboratory Program Multi-media, Multi-concentration.*
- *Standard Methods for the Examination of Water and Wastewater, 18th/19th /20th/ on-line edition; Eaton, A.D. Clesceri, L.S. Greenberg, A.E. Eds; American Water Works Association, Water Pollution Control Federation, American Public Health Association: Washington, D.C.*

- *Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IV, January 2008.*
- *Manual for the Certification of Laboratories Analyzing Drinking Water (EPA 815-R-05-004, January 2005)*
- *Code of Federal Regulations (CFR) 40, Parts 136, 141, 172, 173, 178, 179 and 261*

The laboratory reviews updated versions to all the aforementioned references for adaptation based upon capabilities, instrumentation, etc., and implements them as appropriate. As such, the laboratory strives to perform only the latest versions of each approved method as regulations allow or require.

Other reference procedures for non-routine analyses may include methods established by specific states (e.g., Underground Storage Tank methods), ASTM or equipment manufacturers. Sample type, source, and the governing regulatory agency requiring the analysis will determine the method utilized.

The laboratory shall inform the client when a method proposed by the client may be inappropriate or out of date. After the client has been informed, and they wish to proceed contrary to the laboratory's recommendation, it will be documented.

19.4.2 Demonstration of Capability

Before the laboratory may institute a new method and begin reporting results, the laboratory shall confirm that it can properly operate the method. In general, this demonstration does not test the performance of the method in real world samples, but in an applicable and available clean matrix sample. If the method is for the testing of analytes that are not conducive to spiking, demonstration of capability may be performed on quality control samples.

A demonstration of capability (DOC, Lab SOP SA-QA-06: *Training Procedures*) is performed whenever there is a change in instrument type (e.g., new instrumentation), method or personnel.

The initial demonstration of capability must be thoroughly documented and approved by the Technical Director and QA Manager prior to independently analyzing client samples. All associated documentation must be retained in accordance with the laboratories archiving procedures.

The laboratory must have an approved SOP, demonstrate satisfactory performance, and conduct an MDL study (when applicable). There may be other requirements as stated within the published method or regulations (i.e., retention time window study).

Note: In some instances, a situation may arise where a client requests that an unusual analyte be reported using a method where this analyte is not normally reported. If the analyte is being reported for regulatory purposes, the method must meet all procedures outlined within this QA Manual (SOP, MDL, and Demonstration of Capability). If the client states that the

information is not for regulatory purposes, the result may be reported as long as the following criteria are met:

- The instrument is calibrated for the analyte to be reported using the criteria for the method and ICV/CCV criteria are met (unless an ICV/CCV is not required by the method or criteria are per project DQOs).
- The laboratory's nominal or default reporting limit (RL) is equal to the quantitation limit (QL), must be at or above the lowest non-zero standard in the calibration curve and must be reliably determined. Project RLs are client specified reporting levels which may be higher than the QL. Results reported below the QL must be qualified as estimated values. Also see Section 19.6.1.3, Relationship of Limit of Detection (LOD) to Quantitation Limit (QL).
- The client request is documented and the lab informs the client of its procedure for working with unusual compounds. The final report must be footnoted to indicate the reporting limit was based on the low standard of the calibration curve.

19.4.3 Initial Demonstration of Capability (IDOC) Procedures

Refer to SOP SA-QA-06: *Training Procedures* for information on performing Initial Demonstrations of Capability (IDOC)

A certification statement (refer to Figure 19-1 shall be used to document the completion of each initial demonstration of capability. A copy of the certification is archived in the analyst's training folder.

19.5 LABORATORY DEVELOPED METHODS AND NON-STANDARD METHODS

Any new method developed by the laboratory must be fully defined in an SOP and validated by qualified personnel with adequate resources to perform the method. Method specifications and the relation to client requirements must be clearly conveyed to the client if the method is a non-standard method (not a published or routinely accepted method). The client must also be in agreement to the use of the non-standard method.

19.6 VALIDATION OF METHODS

Validation is the confirmation by examination and the provision of objective evidence that the particular requirements for a specific intended use are fulfilled.

All non-standard methods, laboratory designed/developed methods, standard methods used outside of their scope, and major modifications to published methods must be validated to confirm they are fit for their intended use. The validation will be as extensive as necessary to meet the needs of the given application. The results are documented with the validation procedure used and contain a statement as to the fitness for use.

19.6.1 Method Validation and Verification Activities for All New Methods

While method validation can take various courses, the following activities can be required as part of method validation. Method validation records are designated QC records and are archived accordingly.

19.6.1.1 Determination of Method Selectivity

Method selectivity is the demonstrated ability to discriminate the analyte(s) of interest from other compounds in the specific matrix or matrices from other analytes or interference. In some cases to achieve the required selectivity for an analyte, a confirmation analysis is required as part of the method.

19.6.1.2 Determination of Method Sensitivity

Sensitivity can be both estimated and demonstrated. Whether a study is required to estimate sensitivity depends on the level of method development required when applying a particular measurement system to a specific set of samples. Where estimations and/or demonstrations of sensitivity are required by regulation or client agreement, such as the procedure in 40 CFR Part 136 Appendix B, under the Clean Water Act, these shall be followed.

19.6.1.3 Relationship of Limit of Detection (LOD) to the Quantitation Limit (QL)

An important characteristic of expression of sensitivity is the difference in the LOD and the QL. The LOD is the minimum level at which the presence of an analyte can be reliably concluded. The QL is the minimum concentration of analyte that can be quantitatively determined with acceptable precision and bias. For most instrumental measurement systems, there is a region where semi-quantitative data is generated around the LOD (both above and below the estimated MDL or LOD) and below the QL. In this region, detection of an analyte may be confirmed but quantification of the analyte is unreliable within the accuracy and precision guidelines of the measurement system. When an analyte is detected below the QL, and the presence of the analyte is confirmed by meeting the qualitative identification criteria for the analyte, the analyte can be reliably reported, but the amount of the analyte can only be estimated. If data is to be reported in this region, it must be done so with a qualification that denotes the semi-quantitative nature of the result.

19.6.1.4 Determination of Interferences

A determination that the method is free from interferences in a blank matrix is performed.

19.6.1.5 Determination of Range

Where appropriate to the method, the quantitation range is determined by comparison of the response of an analyte in a curve to established or targeted criteria. Generally the upper quantitation limit is defined by highest acceptable calibration concentration. The lower quantitation limit or QL cannot be lower than the lowest non-zero calibration level, and can be constrained by required levels of bias and precision.

19.6.1.6 Determination of Accuracy and Precision

Accuracy and precision studies are generally performed using replicate analyses, with a resulting percent recovery and measure of reproducibility (standard deviation, relative standard deviation) calculated and measured against a set of target criteria.

19.6.1.7 Documentation of Method

The method is formally documented in an SOP. If the method is a minor modification of a standard laboratory method that is already documented in an SOP, an SOP Attachment describing the specific differences in the new method is acceptable in place of a separate SOP.

19.6.1.8 Continued Demonstration of Method Performance

Continued demonstration of Method Performance is addressed in the SOP. Continued demonstration of method performance is generally accomplished by batch specific QC samples such as LCS, method blanks or PT samples.

19.7 METHOD DETECTION LIMITS (MDL)/ LIMITS OF DETECTION (LOD)

Method detection limits (MDL) are initially determined in accordance with 40 CFR Part 136, Appendix B or alternatively by other technically acceptable practices that have been accepted by regulators. MDL is also sometimes referred to as Limit of Detection (LOD). The MDL theoretically represents the concentration level for each analyte within a method at which the analyst is 99% confident that the true value is not zero. The MDL is determined for each analyte initially during the method validation process and updated as required in the analytical methods, whenever there is a significant change in the procedure or equipment, or based on project specific requirements. Generally, the analyst prepares at least seven replicates of solution spiked at one to five times the estimated method detection limit (most often at the lowest standard in the calibration curve) into the applicable matrix with all the analytes of interest. Each of these aliquots is extracted (including any applicable clean-up procedures) and analyzed in the same manner as the samples. Where possible, the seven replicates should be analyzed over 2-4 days to provide a more realistic MDL.

Refer to the Corporate SOP No. CA-Q-S-006 or the laboratory's SOP No. SA-QA-07: Determination and Verification of Detection and Reporting Limits (RLs, MDLs, and IDLs) for details on the laboratory's MDL process.

19.8 INSTRUMENT DETECTION LIMITS (IDL)

The IDL is sometimes used to assess the reasonableness of the MDLs or in some cases required by the analytical method or program requirements. IDLs are most used in metals analyses but may be useful in demonstration of instrument performance in other areas.

IDLs are calculated to determine an instrument's sensitivity independent of any preparation method. IDLs are calculated either using 7 replicate spike analyses, like MDL but without sample preparation, or by the analysis of 10 instrument blanks and calculating 3 x the absolute value of the standard deviation.

If IDL is > than the MDL, it may be used as the reported MDL.

19.9 VERIFICATION OF DETECTION AND REPORTING LIMITS

Once the MDL is determined, it must be verified on each instrument used for the given method. TestAmerica defines the DoD QSM Detection Limit (DL) as being equal to the MDL. TestAmerica also defines the DoD QSM Limit of Detection (LOD) as being equal to the lowest

concentration standard that successfully verifies the MDL, also referred to as the MDLV standard. MDL and MDLV standards are extracted/digested and analyzed through the entire analytical process. The MDL and MDLV determinations do not apply to methods that are not readily spiked (e.g. pH, turbidity, etc.) or where the lab does not report to the MDL. If the MDLV standard is not successful, then the laboratory will redevelop their MDL. Initial and quarterly verification is required for all methods listed in the laboratory's DoD ELAP Scope of Accreditation. Refer to the laboratory SOP SA-QA-07 for further details.

The laboratory quantitation limit is equivalent to the DoD Limit of Quantitation (LOQ), which is at a concentration equal to or greater than the lowest non-zero calibration standard. The DoD QSM requires the laboratory to perform an initial characterization of the bias and precision at the LOQ and quarterly LOQ verifications thereafter. If the quarterly verification results are not consistent with three-standard deviation confidence limits established initially, then the bias and precision will be reevaluated and clients contacted for any on-going projects. For DoD projects, TestAmerica makes a distinction between the Reporting Limit (RL) and the LOQ. The RL is a level at or above the LOQ that is used for specific project reporting purposes, as agreed to between the laboratory and the client. The RL cannot be lower than the LOQ concentration, but may be higher.

19.10 RETENTION TIME WINDOWS

Most organic analyses and some inorganic analyses use chromatography techniques for qualitative and quantitative determinations. For every chromatography analysis or as specific in the reference method, each analyte will have a specific time of elution from the column to the detector. This is known as the analyte's retention time. The variance in the expected time of elution is defined as the retention time window. As the key to analyte identification in chromatography, retention time windows must be established on every column for every analyte used for that method. These records are maintained on-file and are available for review. Complete details are available in the laboratory SOPs.

19.11 EVALUATION OF SELECTIVITY

The laboratory evaluates selectivity by following the checks within the applicable analytical methods, which include mass spectral tuning, second column confirmation, ICP interelement interference checks, chromatography retention time windows, and sample blanks.

19.12 ESTIMATION OF UNCERTAINTY OF MEASUREMENT

19.12.1 Uncertainty is "a parameter associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand" (as defined by the International Vocabulary of Basic and General Terms in Metrology, ISO Geneva, 1993, ISBN 92-67-10175-1). Knowledge of the uncertainty of a measurement provides additional confidence in a result's validity. Its value accounts for all the factors which could possibly affect the result, such as adequacy of analyte definition, sampling, matrix effects and interferences, climatic conditions, variances in weights, volumes, and standards, analytical procedure, and random variation. Some national accreditation organizations require the use of an "expanded uncertainty": the range within which the value of the measurand is believed to lie within at least a 95% confidence level with the coverage factor k=2.

19.12.2 Uncertainty is not error. Error is a single value, the difference between the true result and the measured result. On environmental samples, the true result is never known. The measurement is the sum of the unknown true value and the unknown error. Unknown error is a combination of systematic error, or bias, and random error. Bias varies predictably, constantly, and independently from the number of measurements. Random error is unpredictable, assumed to be Gaussian in distribution, and reducible by increasing the number of measurements.

19.12.3 The minimum uncertainty associated with results generated by the laboratory can be determined by using the Laboratory Control Sample (LCS) accuracy range for a given analyte. The LCS limits are used to assess the performance of the measurement system since they take into consideration all of the laboratory variables associated with a given test over time (except for variability associated with the sampling and the variability due to matrix effects). The percent recovery of the LCS is compared either to the method-required LCS accuracy limits or to the statistical, historical, in-house LCS accuracy limits.

19.12.4 To calculate the uncertainty for the specific result reported, multiply the result by the decimal of the lower end of the LCS range percent value for the lower end of the uncertainty range, and multiply the result by the decimal of the upper end of the LCS range percent value for the upper end of the uncertainty range. These calculated values represent a 99%-certain range for the reported result. As an example, suppose that the result reported is 1.0 mg/l, and the LCS percent recovery range is 50 to 150%. The uncertainty range would be 0.5 to 1.5 mg/l, which could also be written as 1.0 +/- 0.5 mg/l.

Refer to SOP SA-QA-17: *Evaluation of Batch QC Data* for more information on this topic.

19.12.5 In the case where a well recognized test method specifies limits to the values of major sources of uncertainty of measurement (e.g., 524.2, 525, etc.) and specifies the form of presentation of calculated results, no further discussion of uncertainty is required.

19.13 SAMPLE REANALYSIS GUIDELINES

Because there is a certain level of uncertainty with any analytical measurement, a sample reanalysis may result in either a higher or lower value from an initial sample analysis. There are also variables that may be present (e.g., sample homogeneity, analyte precipitation over time, etc.) that may affect the results of a reanalysis. Based on the above comments, the laboratory will reanalyze samples at a client's request with the following caveats. (Note: Client specific Contractual Terms & Conditions for reanalysis protocols may supersede the following items.)

- Homogenous samples: If a reanalysis agrees with the original result to within the RPD limits for MS/MSD or Duplicate analyses, or within $\pm$ 1 reporting limit for samples $\leq$ 5x the reporting limit, the original analysis will be reported. At the client's request, both results may be reported on the same report but not on two separate reports.

- If the reanalysis does not agree (as defined above) with the original result, then the laboratory will investigate the discrepancy and reanalyze the sample a third time for confirmation if sufficient sample is available.

- Any potential charges related to reanalysis are discussed in the contract terms and conditions or discussed at the time of the request. The client will typically be charged for reanalysis unless it is determined that the lab was in error.

- Due to the potential for increased variability, reanalysis may not be applicable to Non-homogenous, Encore, and Sodium Bisulfate preserved samples.

19.14 CONTROL OF DATA

The laboratory has policies and procedures in place to ensure the authenticity, integrity, and accuracy of the analytical data generated by the laboratory.

19.14.1 Computer and Electronic Data Related Requirements

The three basic objectives of our computer security procedures and policies are shown below. The laboratory is currently running the TestAmerica LIMS System (TALS) which is a custom in-house developed LIMS system that has been highly customized to meet the needs of the laboratory. It is referred to as LIMS for the remainder of this section. The LIMS utilizes Microsoft SQL Server which is an industry standard relational database platform. It is referred to as Database for the remainder of this section.

19.14.1.1 Maintain the Database Integrity: Assurance that data is reliable and accurate through data verification (review) procedures, password-protecting access, anti-virus protection, data change requirements, as well as an internal LIMS permissions procedure.

- LIMS Database Integrity is achieved through data input validation, internal user controls, and data change requirements.
- Spreadsheets and other software developed in-house must be verified with documentation through hand calculations prior to use.

19.14.1.2 Ensure Information Availability: Protection against loss of information or service is ensured through scheduled back-ups, stable file server network architecture, secure storage of media, line filter, Uninterruptible Power Supply (UPS), and maintaining older versions of software as revisions are implemented.

19.14.1.3 Maintain Confidentiality: Ensure data confidentiality through physical access controls when electronically transmitting data.

19.14.2 Data Reduction

The complexity of the data reduction depends on the analytical method and the number of discrete operations involved (e.g., extractions, dilutions, instrument readings and concentrations). The analyst calculates the final results from the raw data or uses appropriate computer programs to assist in the calculation of final reportable values.

For manual data entry, e.g., Wet Chemistry, the data is reduced by the analyst and then verified by the Department Manager or alternate analyst prior to approving the data in LIMS.

Manual integration of peaks will be documented and reviewed and the raw data will be flagged in accordance with the TestAmerica Corporate SOP No. CA-Q-S-002, *Acceptable Manual Integration Practices* and SOP SA-QA-08: *Evaluation of Chromatographic Data.*

Analytical results are reduced to appropriate concentration units specified by the analytical method, taking into account factors such as dilution, sample weight or volume, etc. Blank correction will be applied only when required by the method or per manufacturer's indication; otherwise, it should not be performed. Calculations are independently verified by appropriate laboratory staff. Calculations and data reduction steps for various methods are summarized in the respective analytical SOPs or program requirements.

19.14.2.1 All raw data is retained in the laboratory benchsheets, computer file (if appropriate), and/or runlog. All criteria pertinent to the method are recorded. The documentation is recorded at the time observations or calculations are made and is initialed and dated such that each person involved is readily identified.

19.14.2.2 In general, concentration results are reported in milligrams per liter (mg/l) or micrograms per liter (µg/l) for liquids and milligrams per kilogram (mg/kg) or micrograms per kilogram (µg/kg) for solids. For values greater than 10,000 mg/l, results can be reported in percent, i.e., 10,000 mg/l = 1%. Units are defined in each lab SOP.

19.14.2.3 In general, results are reported to 2 significant figures on the final report.

19.14.2.4 For those methods that do not have an instrument printout or an instrumental output compatible with the LIMS, the raw results and dilution factors are entered directly into LIMS by the analyst, and the software calculates the final result for the analytical report.

19.14.2.5 The laboratory strives to import data directly from instruments or calculation spreadsheets to ensure that the reported data are free from transcription and calculation errors. For those analyses with an instrumental output compatible with the LIMS, the raw results and dilution factors are transferred into LIMS electronically. Electronic data from instruments are saved electronically in a daily folder on the system (Target or instrument computer). For instruments that print out calibrations and concentrations, the data are retained with the data file. The data file is stored in a monthly folder on the public access G-drive. Periodically, these files are transferred to the server and, eventually, to a tape file.

19.14.3 Logbook / Worksheet Use Guidelines

Logbooks and worksheets are filled out 'real time' and have enough information on them to trace the events of the applicable analysis/task. (e.g. calibrations, standards, analyst, sample ID, date, time on short holding time tests, temperatures when applicable, calculations are traceable, etc.)

- Corrections are made following the procedures outlined in Section 12.
- Logbooks are controlled by the QA department. A record is maintained of all logbooks in the lab.

- Unused portions of pages must be "Z"'d out, signed and dated.
- Worksheets are created with the approval of the Technical Director/QA Manager at the facility. The QA Department controls all worksheets following the procedures in Section 6.

19.14.4 Review / Verification Procedures

Data review procedures are outlined in the analytical SOPs and SOP SA-QA-02: *Data Generation and Review* and ensure that data reported are free from calculation and transcription errors and that QC parameters have been reviewed and evaluated before data is reported. The laboratory also has an SOP discussing Manual Integrations to ensure the authenticity of the data (SOP SA-QA-08). The general review concepts are discussed below; more specific information can be found in the SOPs.

19.14.4.1 The data review process at TestAmerica Savannah starts at the Sample Control level. Sample Control personnel review chain-of-custody forms and input the sample information into the LIMS. The Project Management Assistant reviews the transaction of the chain-of-custody forms and inputs the required analyses. The Project Managers perform final review of the chain-of-custody forms and enterred information.

19.14.4.2 The next level of data review occurs with the analysts. As results are generated, analysts review their work to ensure that the results generated meet QC requirements. The analysts transfer the data into the LIMS. To ensure data compliance, another analyst/supervisor performs a second level of review. Second level review is accomplished by checking reported results against raw data and evaluating the results for accuracy. During the second level review, blanks, initial and continuing calibrations, laboratory control samples, sample data, qualifiers, manual integrations, and spike information are evaluated. Issues that deem further review include the following:

- QC data are outside the specified control limits for accuracy and precision
- Reviewed sample data does not match with reported results
- Unusual detection limit changes are observed
- Samples have unusually high results
- Samples exceed a known regulatory limit
- Raw data indicates some type of contamination or poor technique
- Inconsistent peak integration is observed
- Transcription errors are identified
- Results are outside of calibration range

19.14.4.3 Unacceptable analytical results may require reanalysis of the samples. Problems may be brought to the attention of the Laboratory Director, Project Manager, Quality Assurance Director/Manager, Technical Manager, or Supervisor for further investigation, if needed. Corrective action is initiated whenever necessary.

19.14.4.4 As a final review prior to the release of the report, the Project Manager reviews the results for appropriateness and completeness. This review and approval ensures that client requirements have been met and that the final report has been properly completed. The process includes, but is not limited to, verifying that chemical

relationships are evaluated, COC is followed, cover letters/narratives are present, data qualifiers are appropriate, and project-specific requirements are met. The following are some examples of chemical relationships that can be reviewed (if data is available):

- Total Results are ≥ Dissolved results (e.g. metals)
- Total Solids (TS) ≥ Total Dissolved Solids (TDS) or Total Suspended Solids (TSS)
- TKN ≥ Ammonia
- Total Phosphorus ≥ Orthophosphate
- COD ≥ TOC
- Total cyanide ≥ Amenable Cyanide
- TDS ≥ individual anions

19.14.4.5 Any project that requires a data package is subject to a tertiary data review for transcription errors and acceptable quality control requirements. The Project Manager then signs the final report and sends to the client.

19.14.4.6 A visual summary of the flow of samples and information through the laboratory, as well as data review and validation, is presented in Figure 19-2.

19.14.5 Manual Integrations

Computerized data systems provide the analyst with the ability to re-integrate raw instrument data in order to optimize the interpretation of the data. Though manual integration of data is an invaluable tool for resolving variations in instrument performance and some sample matrix problems, when used improperly, this technique would make unacceptable data appear to meet quality control acceptance limits. Improper re-integrations lead to legally indefensible data, a poor reputation, or possible laboratory decertification. Because guidelines for re-integration of data are not provided in the methods and most methods were written prior to widespread implementation of computerized data systems, the laboratory trains all analytical staff on proper manual integration techniques using TestAmerica's Corporate SOP (CA-Q-S-002) as the guideline for our internal SOP No. SA-QA-08, entitled *Evaluation of Chromatographic Data.*

19.14.5.1 The analyst must adjust baseline or the area of a peak in some situations, for example when two compounds are not adequately resolved or when a peak shoulder needs to be separated from the peak of interest. The analyst must use professional judgment and common sense to determine when manual integrating is required. Analysts are encouraged to ask for assistance from a senior analyst or manager when in doubt.

19.14.5.2 Analysts shall not increase or decrease peak areas to for the sole purpose of achieving acceptable QC recoveries that would have otherwise been unacceptable. The intentional recording or reporting of incorrect information (or the intentional omission of correct information) is against company principals and policy and is grounds for immediate termination.

19.14.5.3 Client samples, performance evaluation samples, and quality control samples are all treated equally when determining whether or not a peak area or baseline should be manually adjusted.

19.14.5.4 All manual integrations receive a second level review. Manual integrations must be indicated on an expanded scale "after" chromatograms such that the integration performed can be easily evaluated during data review. Expanded scale "before" chromatograms are also required for all manual integrations on QC parameters (calibrations, calibration verifications, laboratory control samples, internal standards, surrogates, etc.) unless the laboratory has another documented corporate approved procedure in place that can demonstrate an active process for detection and deterrence of improper integration practices.

Figure 19-1. Example - Demonstration of Capability Documentation

TRAINING DOCUMENTATION FORM
DEMONSTRATION OF CAPABILITY

Laboratory Name: TestAmerica Savannah
Address: 5102 LaRoche Avenue
Savannah, GA 31404

Date Completed: _____

Analyst Name: _____

Prep Analyst Name (s): _____

Analytical Test Method: _____

Prep Method: _____

Matrix: ☐ Soil ☐ Aqueous ☐ Other

Analytical SOP Document Control Number: _____

Prep SOP Document Control Number: _____

Analyte, Class of Analytes, or Measured Parameters: _____

If PT Study is used as DOC, list the PT Number: _____

We, the undersigned, CERTIFY that:

1. The analysts identified above, using the cited test method(s), which is in use at this facility for the analyses of samples under the National Environmental Laboratory Accreditation Program and/or other state and federal programs have completed the Demonstration of Capability.
2. The test method(s) was performed by the analyst(s) identified on this certification.
3. A copy of test method(s) and laboratory-specific SOPs are available for all personnel on-site.
4. The data associated with the demonstration of capability are true, accurate, complete and self-explanatory.
5. All raw data necessary to reconstruct and validate these analyses have been retained at the facility. The associated information is organized and available for review.

Technical Director's Name	Signature	Date
Quality Assurance Officer's Name	Signature	Date

FQA049:08.13.07.6

TestAmerica
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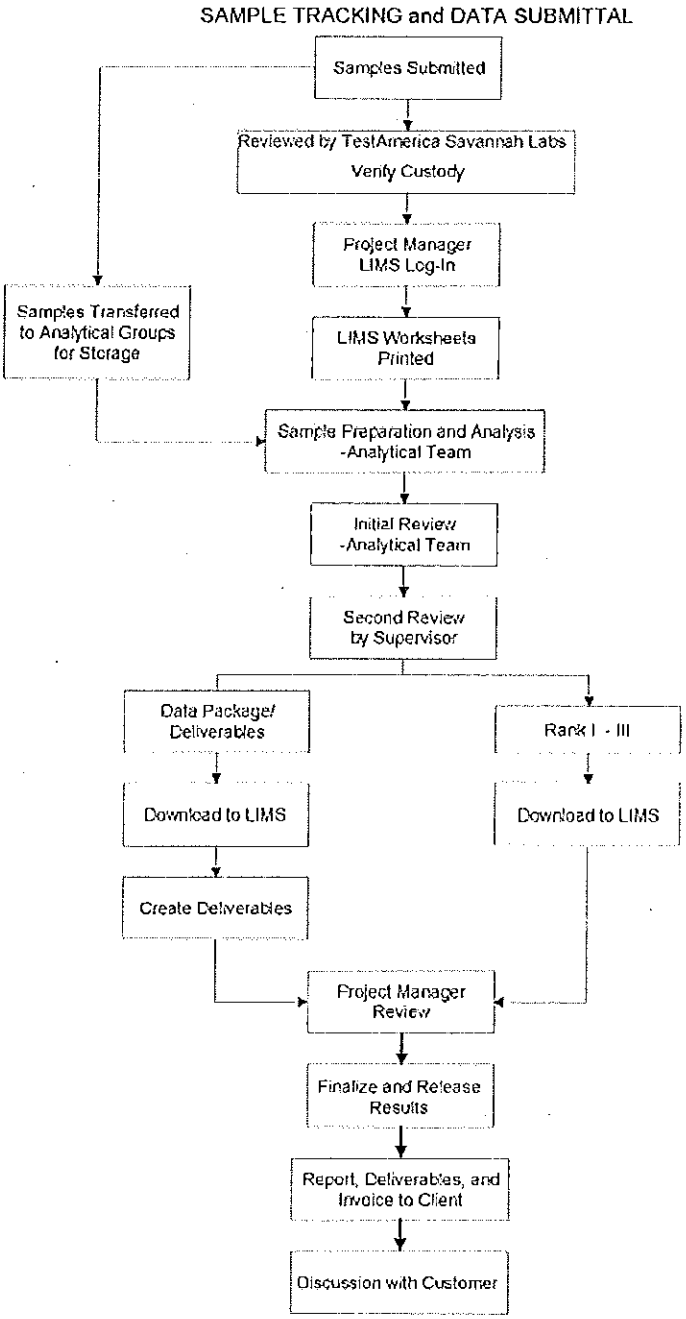
Figure 19-2. Example: Work Flow



SECTION 20. EQUIPMENT (AND CALIBRATIONS) (NELAC 5.5.5)

20.1 OVERVIEW

The laboratory purchases the most technically advanced analytical instrumentation for sample analyses. Instrumentation is purchased on the basis of accuracy, dependability, efficiency and sensitivity. Each laboratory is furnished with all items of sampling, preparation, analytical testing and measurement equipment necessary to correctly perform the tests for which the laboratory has capabilities. Each piece of equipment is capable of achieving the required accuracy and complies with specifications relevant to the method being performed. Before being placed into use, the equipment (including sampling equipment) is calibrated and checked to establish that it meets its intended specification. The calibration routines for analytical instruments establish the range of quantitation. Calibration procedures are specified in laboratory SOPs. A list of laboratory instrumentation is presented in Table 20-1.

Equipment is only operated by authorized and trained personnel. Manufacturer's instructions for equipment use are readily accessible to all appropriate laboratory personnel.

20.2 PREVENTIVE MAINTENANCE

The laboratory follows a well-defined maintenance program to ensure proper equipment operation and to prevent the failure of laboratory equipment or instrumentation during use. This program of preventive maintenance helps to avoid delays due to instrument failure.

Routine preventive maintenance procedures and frequency, such as cleaning and replacements, should be performed according to the procedures outlined in the manufacturer's manual. Qualified personnel must also perform maintenance when there is evidence of degradation of peak resolution, a shift in the calibration curve, loss of sensitivity, or failure to continually meet one of the quality control criteria.

The analytical SOPs list examples of scheduled routine maintenance. It is the responsibility of each Department Manager to ensure that instrument maintenance logs are kept for all equipment in his/her department. Preventative maintenance procedures are also outlined in analytical SOPs or instrument manuals. (Note: For some equipment, the log used to monitor performance may also serve as the maintenance log. Multiple pieces of equipment may share the same log as long as it is clear as to which instrument is associated with an entry.)

Instrument maintenance logs are controlled and are used to document instrument problems, instrument repair and maintenance activities. Maintenance logs shall be kept for all major pieces of equipment. Instrument maintenance logs may also be used to specify instrument parameters.

- Documentation must include all major maintenance activities such as contracted preventive maintenance and service and in-house activities such as the replacement of electrical components, lamps, tubing, valves, columns, detectors, cleaning and adjustments.
- Each entry in the instrument log includes the Analyst's initials, the date, a detailed description of the problem (or maintenance needed/scheduled), a detailed explanation of the solution or maintenance performed, and a verification that the equipment is functioning properly (state what was used to determine a return to control. e.g. CCV run on *'date'* was acceptable, or

instrument recalibrated on 'date' with acceptable verification, etc.) must also be documented in the instrument records.

- When maintenance or repair is performed by an outside agency, service receipts detailing the service performed can be affixed into the logbooks adjacent to pages describing the maintenance performed.

If an instrument requires repair (subjected to overloading or mishandling, gives suspect results, or otherwise has shown to be defective or outside of specified limits) it shall be taken out of operation and tagged as out-of-service or otherwise isolated until such a time as the repairs have been made and the instrument can be demonstrated as operational by calibration and/or verification or other test to demonstrate acceptable performance. The laboratory shall examine the effect of this defect on previous analyses.

In the event of equipment malfunction that cannot be resolved, service shall be obtained from the instrument vendor manufacturer, or qualified service technician, if such a service can be tendered. If on-site service is unavailable, arrangements shall be made to have the instrument shipped back to the manufacturer for repair. Back up instruments, which have been approved, for the analysis shall perform the analysis normally carried out by the malfunctioning instrument. If the back up is not available and the analysis cannot be carried out within the needed timeframe, the samples shall be subcontracted.

If an instrument is sent out for service or transferred to another facility, it must be recalibrated and verified (including new initial MDL study) prior to return to lab operations.

20.3 SUPPORT EQUIPMENT

This section applies to all devices that may not be the actual test instrument, but are necessary to support laboratory operations. These include but are not limited to: balances, ovens, refrigerators, freezers, incubators, water baths, temperature measuring devices, and volumetric dispensing devices if quantitative results are dependent on their accuracy, as in standard preparation and dispensing or dilution into a specified volume. All raw data records associated with the support equipment are retained to document instrument performance.

20.3.1 Weights and Balances

The accuracy of the balances used in the laboratory is checked every working day, before use. All balances are placed on stable counter tops.

Each balance is checked prior to initial serviceable use with at least two certified ASTM type 1 weights spanning its range of use (weights that have been calibrated to ASTM type 1 weights may also be used for daily verification). ASTM type 1 weights used only for calibration of other weights (and no other purpose) are inspected for corrosion, damage or nicks at least annually and if no damage is observed, they are calibrated at least every 5 years by an outside calibration laboratory. Any weights (including ASTM Type 1) used for daily balance checks or other purposes are recalibrated/recertified annually to NIST standards (this may be done internally if laboratory maintains "calibration only" ASTM type 1 weights).

All balances are serviced annually by a qualified service representative, who supplies the laboratory with a certificate that identifies traceability of the calibration to the NIST standards.

All of this information is recorded in logs, and the recalibration/recertification certificates are kept on file.

20.3.2 pH, Conductivity, and Turbidity Meters

The pH meters used in the laboratory are accurate to ± 0.1 pH units, and have a scale readability of at least 0.05 pH units. The meters automatically compensate for the temperature, and are calibrated with at least two working range buffer solutions before each use.

Conductivity meters are also calibrated before each use with a known standard to demonstrate the meters do not exceed an error of 1% or one umhos/cm.

Turbidity meters are also calibrated before each use. All of this information is documented in logs.

Consult pH and Conductivity, and Turbidity SOPs for further information.

20.3.3 Thermometers

All thermometers are calibrated on an annual basis with a NIST-traceable thermometer. IR thermometers, digital probes and thermocouples are calibrated quarterly.

The NIST thermometer is recalibrated at a minimum of every five years (unless thermometer has been exposed to temperature extremes or apparent separation of internal liquid) by an approved outside service and the provided certificate of traceability is kept on file. The NIST thermometer(s) have increments of 1 degree (0.5 degree or less increments are required for drinking water microbiological laboratories), and have ranges applicable to method and certification requirements. The NIST traceable thermometer is used for no other purpose than to calibrate other thermometers.

All of this information is documented electronically. Monitoring method-specific temperatures, including incubators, heating blocks, water baths, and ovens, is documented in equipment-specific logbooks or LIMS sample batches. More information on this subject can be found in SOP SA-AN-100: *Laboratory Support Equipment (Verification and Use).*

20.3.4 Refrigerators/Freezer Units, Waterbaths, Ovens and Incubators

The temperatures of all refrigerator units and freezers used for sample and standard storage are monitored each working day – including weekends and holidays (i.e., 7 days a week).

Ovens, waterbaths and incubators are monitored on days of use.

All of this equipment has a unique identification number, and is assigned a unique thermometer for monitoring.

Sample storage refrigerator temperatures are kept between > 0°C and ≤ 6 °C.

Specific temperature settings/ranges for other refrigerators, ovens waterbaths, and incubators can be found in method specific SOPs.

All of this information is documented in Daily Temperature Logbooks and procedure-specific logbooks.

20.3.5 Autopipettors, Dilutors, and Syringes

Mechanical volumetric dispensing devices including burettes (except Class A Glassware) are given unique identification numbers and the delivery volumes are verified gravimetrically or volumetrically, at a minimum, on a quarterly basis.

Glass micro-syringes are considered the same as Class A glassware provided they are purchased with a manufacturer's certificate attesting to their accuracy. Micro-syringes are routinely purchased from Hamilton Company. The laboratory keeps on file an "Accuracy and Precision Statement of Conformance" from Hamilton attesting established accuracy.

Any device not regularly verified can not be used for any quantitative measurements.

More information on this subject can be found in SOP SA-AN-100: *Laboratory Support Equipment (Verification and Use).*

20.3.6 Autoclaves

TestAmerica Savannah uses an autoclave to sterilize biological contaminants.

A maximum registering thermometer documents the sterilization temperature of the autoclave with each use. Temperature sensitive tape is also used each cycle to indicate the contents have been processed. A biological indicator is processed monthly to determine sterilization has been effective.

The following data is documented in an equipment-specific logbook with each cycle: date, contents, maximum temperature, pressure, sterilization time, total time, and analyst's initials.

The pressure and the temperature device of the autoclave are verified yearly by an approved outside service technician and the provided certificate of traceability is kept on file. The timing device is checked quarterly against a stopwatch and adjusted accordingly. All maintenance is recorded in an equipment-specific logbook.

20.4 INSTRUMENT CALIBRATIONS

Calibration of analytical instrumentation is essential to the production of quality data. Strict calibration procedures are followed for each method. These procedures are designed to determine and document the method detection limits, the working range of the analytical instrumentation and any fluctuations that may occur from day to day.

Sufficient raw data records are retained to allow an outside party to reconstruct all facets of the initial calibration. Records contain, but are not limited to, the following: calibration date, method, instrument, analyst(s) initials or signatures, analysis date, analytes, concentration, response,

type of calibration (Avg RF, curve, or other calculations that may be used to reduce instrument responses to concentration.)

Sample results must be quantitated from the initial calibration and may not be quantitated from any continuing instrument calibration verification unless otherwise required by regulation, method or program.

If the initial calibration results are outside of the acceptance criteria, corrective action is performed and any affected samples are reanalyzed if possible. If the reanalysis is not possible, any data associated with an unacceptable initial calibration will be reported with appropriate data qualifiers (refer to Section 12).

Note: Instruments are calibrated initially and as needed after that and at least annually.

20.4.1 CALIBRATION STANDARDS

Calibration standards are prepared using the procedures indicated in the Reagents and Standards section of the determinative method SOP.

Standards for instrument calibration are obtained from a variety of sources. All standards are traceable to national or international standards of measurement, or to national or international standard reference materials.

The lowest concentration calibration standard that is analyzed during an initial calibration must be at or below the stated reporting limit for the method based on the final volume of extract (or sample).

The other concentrations define the working range of the instrument/method or correspond to the expected range of concentrations found in actual samples that are also within the working range of the instrument/method. Results of samples not bracketed by initial instrument calibration standards (within calibration range to 3 significant figures) must be reported as having less certainty, e.g., defined qualifiers or flags (additional information may be included in the case narrative). The exception to these rules is ICP methods or other methods where the referenced method does not specify two or more standards.

All initial calibrations are verified with a standard obtained from a second source and traceable to a national standard, when available (or vendor certified different lot if a second source is not available). For unique situations, such as EPA 1653 analysis where no other source or lot is available, a standard made by a different analyst at a different time or a different preparation would be considered a second source. This verification occurs immediately after the calibration curve has been analyzed, and before the analysis of any samples.

20.4.1.1 Calibration Verification

The calibration relationship established during the initial calibration must be verified initially and at least daily as specified in the laboratory method SOPs in accordance with the referenced analytical methods and NELAC (2003) standard, Section 5.5.5.10. The process of calibration verification applies to both external standard and internal standard calibration techniques, as well as to linear and non-linear calibration models. Initial calibration verification is with a

standard source secondary (second source standard) to the calibration standards, but continuing calibration verifications may use the same source standards as the calibration curve.

Note: The process of calibration verification referred to here is fundamentally different from the approach called "calibration" in some methods. As described in those methods, the calibration factors or response factors calculated during calibration are used to update the calibration factors or response factors used for sample quantitation. This approach, while employed in other EPA programs, amounts to a daily single-point calibration

All target analytes and surrogates, including those reported as non-detects, must be included in periodic calibration verifications for purposes of retention time confirmation and to demonstrate that calibration verification criteria are being met, i. e., RPD, per NELAC (2003) Standard, Section 5.5.5.10.

All samples must be bracketed by periodic analyses of standards that meet the QC acceptance criteria (e.g., calibration and retention time). The frequency is found in the determinative methods or SOPs.

Note: If an internal standard calibration is being used then bracketing standards are not required, only daily verifications are needed. The results from these verification standards must meet the calibration verification criteria and the retention time criteria (if applicable).

Generally, the initial calibrations must be verified at the beginning of each 12-hour analytical shift during which samples are analyzed. (Some methods may specify more or less frequent verifications). The 12-hour analytical shift begins with the injection of the calibration verification standard (or the MS tuning standard in MS methods). The shift ends after the completion of the analysis of the last sample, QC, or standard that can be injected within 12 hours of the beginning of the shift.

A continuing instrument calibration verification (CCV) must be repeated at the beginning and, for methods that have quantitation by external calibration models, at the end of each analytical batch. Some methods have more frequent CCV requirements. See specific SOPs. Most Inorganic methods require the CCV to be analyzed after ever 10 samples or injections, including matrix or batch QC samples.

20.4.1.2 Verification of Linear and Non-Linear Calibrations

Calibration verification for calibrations involves the calculation of the percent drift or the percent difference of the instrument response between the initial calibration and each subsequent analysis of the verification standard. (These calculations are available in the laboratory method SOPs. Verification standards are evaluated based on the % Difference from the average CF or RF of the initial calibration or based on % Drift or % Recovery if a linear or quadratic curve is used.

Regardless of whether a linear or non-linear calibration model is used, if initial verification criterion is not met, then no sample analyses may take place until the calibration has been verified or a new initial calibration is performed that meets the specifications listed in the method SOPs. If the calibration cannot be verified after the analysis of a single verification standard, then adjust the instrument operating conditions and/or perform instrument maintenance, and

analyze another aliquot of the verification standard. If the calibration cannot be verified with the second standard, then a new initial calibration is performed.

- When the acceptance criteria for the calibration verification are exceeded high, i.e., high bias, and there are associated samples that are non-detects, then those non-detects may be reported. Otherwise, the samples affected by the unacceptable calibration verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted.

- When the acceptance criteria for the calibration verification are exceeded low, i.e., low bias, those sample results may be reported if they exceed a maximum regulatory limit/decision level. Otherwise, the samples affected by the unacceptable verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted. Alternatively, a reporting limit standard may be analyzed to demonstrate that the laboratory can still support non-detects at their reporting limit.

20.5 TENTATIVELY IDENTIFIED COMPOUNDS (TICS) – GC/MS ANALYSIS

For samples containing components not associated with the calibration standards, a library search may be made for the purpose of tentative identification. The necessity to perform this type of identification will be determined by the purpose of the analyses being conducted. Data system library search routines should not use normalization routines that would misrepresent the library or unknown spectra when compared to each other.

Note: If the TIC compound is not part of the client target analyte list but is calibrated by the laboratory and is both qualitatively and/or quantitatively identifiable, it should not be reported as a TIC. If the compound is reported on the same form as true TICs, it should be qualified and/or narrated that the reported compound is qualitatively and quantitatively (if verification in control) reported compared to a known standard that is in control (where applicable).

For example, the RCRA permit or waste delisting requirements may require the reporting of non-target analytes. Only after visual comparison of sample spectra with the nearest library searches may the analyst assign a tentative identification.

20.6 GC/MS TUNING

Prior to any GCMS analytical sequence, including calibration, the instrument parameters for the tune and subsequent sample analyses within that sequence must be set.

Prior to tuning/auto-tuning the mass spec, the parameters may be adjusted within the specifications set by the manufacturer or the analytical method. These generally don't need any adjustment but it may be required based on the current instrument performance. If the tune verification does not pass it may be necessary to clean the source or perform additional maintenance. Any maintenance is documented in the maintenance log.

Table 20-1. Example: Instrumentation List

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Savannah Instrument List

Instrument Type	Manufacturer	Model Number	Serial Number	Year Put Into Service	Condition When Received
ICP	Thermo Jarrell Ash (D)	61E Trace	507990	1999	New
ICP	Varian (E)	730-ES	IP07 12M054	2008	New
ICP/MS	Agilent (A)	Agilent 7500C G3155A	JP 10300403	2002	New
ICP/MS	Agilent (B)	Agilent 7500CE G3272A	JP 14101289	2005	New
Mercury Analyzer	Mercury Cold Vapor Unit	Leeman HYDRA AA	2039	2003	New
GC/MS Semivolatiles	Hewlett-Packard (D)	5973/6890	US82311451	1999	New
GC/MS Semivolatiles	Hewlett-Packard (E)	5973/6890	US82311455	1999	New
GC/MS Semivolatiles	Hewlett-Packard (F)	5973/6890	US44647039	2004	New
GC/MS Semivolatiles	Hewlett-Packard (G)	5973/6890	US82311571	1999	New
GC/MS Semivolatiles	Hewlett-Packard (K)	5973/6890	CN10524062	2005	New
GC/MS Semivolatiles	Hewlett-Packard (N)	5973/6890	US72010580	1998	New
GC/MS Semivolatiles	Hewlett-Packard (R – DW)	5973/6890N	21842170	2002	New
GC/MS Semivolatiles	Hewlett-Packard (T)	5973/6890	US33246115	2003	New
GC/MS Semivolatiles	Agilent (W – DW)	5975/6890N	US10608004	2006	New
GC/MS Semivolatiles	Hewlett-Packard (X – DW)	5975/6890N	CN10608061	2006	New
GC/MS Semivolatiles	Agilent (Y)	5975/7980A	US80838915	2008	New
GC/MS Volatiles	Hewlett-Packard (A)	5973/6890	US82311453	2000	New
GC/MS Volatiles	Hewlett-Packard (A-screener)	5972/5890 II	3336A50555	1992	New
GC/MS Volatiles	Hewlett-Packard (B)	5973/6890	US82311452	2000	New
GC/MS Volatiles	Hewlett-Packard (L)	5972/5890 II	3306A00159	1994	New
GC/MS Volatiles	Hewlett-Packard (M)	5972/5890 II	3251A00054	1992	New
GC/MS Volatiles	Hewlett-Packard (O)	5973/6890	US7200579	1993	New
GC/MS Volatiles	Hewlett-Packard (P)	5973/6890	US0039011	2000	New
GC/MS Volatiles	Hewlett-Packard (S – DW)	5973/6890	US21843181	2002	New
GC/MS Volatiles	Agilent (U – DW)	5973/6890	US52441057	2005	New
Ion Chromatograph	Dionex (F)	DX-500	02020190	2002	New
Ion Chromatograph	Dionex (G)	ICS-2000	05101132	2005	New
Ion Chromatograph	Dionex (H)	ICS-2000	06080799	2006	New
GC Semivolatiles	Hewlett-Packard (J – DW)	6890	US00033184	2000	New
GC Semivolatiles	Hewlett-Packard (K – DW)	6890	US10223085	2002	New
GC Semivolatiles	Hewlett-Packard (L-screener)	5890 II Plus	3033A31398	2000	Used
GC Semivolatiles	Hewlett-Packard (M – DW)	5890 II Plus	3336A51190	1993	New
GC Semivolatiles	Agilent (O)	6890N	US10543005	2005	New

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TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Savannah Instrument List

Instrument Type	Manufacturer	Model Number	Serial Number	Year Put Into Service	Condition When Received
GC Semivolatiles	Agilent (Q)	6890N	CN10521056	2005	New
GC Semivolatiles	Hewlett-Packard (S – DW)	6890 Plus	US00024188	2000	New
GC Semivolatiles	Hewlett-Packard (X – DW)	6890N	CN10406086	2003	New
GC Semivolatiles	Agilent (Y – DW)	6890N	CN10528081	2005	New
GC Volatiles	Agilent (G)	6890 (FID)	14921	2007	New
GC Volatiles	Agilent (U)	6890 (FID)	US10439011	2005	New
GC Volatiles	Agilent (V)	6890 (PID)	CN10619098	2006	New
GC Volatiles	Agilent (W)	6890 (FID)	CN10603131	2006	New
Liquid Chromatography	Hewlett-Packard (J)	1100	JP63205060	2002	New
Liquid Chromatography	Hewlett-Packard (K)	1100	JP73016069	2002	New
Liquid Chromatography	Hewlett-Packard (M)	1050	3118A00905	2008	Used
Liquid Chromatography	Hewlett-Packard (N)	1100	JP73019052	2008	Used
Microbiology	Fisher Scientific (Microscope 1)	Stereomaster Microscope 1256214	C0909-0714-001	2009	New
General Chemistry	GENESYS	10UV	2G2E1410011	2002	New
General Chemistry	Hach (TURB1)	2100 AN	950400000487	1995	New
General Chemistry	Lachet Quickchem	8000	A83000-1070	1997	New
General Chemistry	Milton Roy Spectronic (SPC1)	301	3802235017	1991	New
General Chemistry	Shimadzu	TOC-V CPN	H51404335036 CS	2006	New
General Chemistry	OI Solids	OI Solids	D110705896	2000	New
General Chemistry	Mitsubishi	TOX-10E	75C20047	1998	New
General Chemistry	Euroglass	ETS-1200	2001.068	2000	Used
General Chemistry	Mitsubishi	TOX-100	A7M42015	2005	New
General Chemistry	BOD AssayPlus	Version 3.0	270F6XB334	2006	New
General Chemistry	PCTitrate	Version 3.0	270G6XB370	2006	New
General Chemistry	Konelab20 (1)	Konelab20	M4218134	2000	New
General Chemistry	Konelab (2)	Konelab20	M3118114	2001	New

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SECTION 21. MEASUREMENT TRACEABILITY (NELAC 5.5.6)

21.1 OVERVIEW

Traceability of measurements shall be assured using a system of documentation, calibration, and analysis of reference standards. Laboratory equipment that are peripheral to analysis and whose calibration is not necessarily documented in a test method analysis or by analysis of a reference standard shall be subject to ongoing certifications of accuracy. At a minimum, these must include procedures for checking specifications of ancillary equipment: balances, thermometers, temperature, water systems, automatic pipettes and other volumetric measuring devices. (Refer to Section 20.3). With the exception of Class A Glassware (including glass microliter syringes that have a certificate of accuracy), quarterly accuracy checks are performed for all mechanical volumetric devices. Wherever possible, subsidiary or peripheral equipment is checked against standard equipment or standards that are traceable to national or international standards. Class A Glassware should be routinely inspected for chips, acid etching or deformity. If the Class A glassware is suspect, the accuracy of the glassware will be assessed prior to use.

21.2 NIST-TRACEABLE WEIGHTS AND THERMOMETERS

Reference standards of measurement shall be used for calibration only and for no other purpose, unless it can be shown that their performance as reference standards would not be invalidated.

For NIST-traceable weights and thermometers, the laboratory requires that all calibrations be conducted by a calibration laboratory accredited by A2LA, NVLAP (National Voluntary Laboratory Accreditation Program), APLAC (Asia-Pacific Laboratory Accreditation Cooperation), or EA (European Cooperation for Accreditation). A certificate and scope of accreditation is kept on file at the laboratory.

Calibration laboratory's policy for achieving measurement traceability is defined and includes the subsequent elements of uncertainty. The calibration report or certificate contains a traceability statement, the conditions under which the calibrations were made in the context of any potential influence, a compliance statement with an identified metrological specification and the pertinent clauses, a clearly identified record of the quantities and functional test results before and after re-calibration, and no recommendation on the calibration interval. Opinions and interpretations of results are presented along with the basis upon which they were made and identified as such. All calibration reports are filed in the QA Department.

An external certified service engineer services laboratory balances on an annual basis. This service is documented on each balance with a signed and dated certification sticker. Balance calibrations are checked each day of use. All mercury thermometers are calibrated annually against a traceable reference thermometer. Temperature readings of ovens, refrigerators, and incubators are checked on each day of use.

21.3 REFERENCE STANDARDS / MATERIALS

Reference standards/materials, where commercially available, are traceable to certified reference materials. Commercially prepared standard materials are purchased from vendors

accredited by A2LA and/or NVLAP with an accompanying Certificate of Analysis that documents the standard purity. If a standard cannot be purchased from a vendor that supplies a Certificate of Analysis, the purity of the standard is documented by analysis. The receipt of all reference standards must be documented. Reference standards are labeled with a unique Standard Identification Number and expiration date. All documentation received with the reference standard is retained as a QC record and references the Standard Identification Number.

All reference, primary and working standards/materials, whether commercially purchased or laboratory prepared, must be checked regularly to ensure that the variability of the standard or material from the 'true' value does not exceed method requirements. The accuracy of calibration standards is checked by comparison with a standard from a second source. In cases where a second standard manufacturer is not available, a vendor certified different lot is acceptable for use as a second source. For unique situations, such as EPA 1653 analysis where no other source or lot is available, a standard made by a different analyst would be considered a second source. The appropriate Quality Control (QC) criteria for specific standards are defined in laboratory SOPs. In most cases, the analysis of an Initial Calibration Verification (ICV) or LCS (where there is no sample preparation) is used as the second source confirmation. These checks are generally performed as an integral part of the analysis method (e.g. calibration checks, laboratory control samples).

All standards and materials must be stored and handled according to method or manufacturer's requirements in order to prevent contamination or deterioration. Refer to the Corporate Environmental Health & Safety Manual or laboratory SOPs. For safety requirements, please refer to method SOPs and the laboratory Environmental Health and Safety Manual.

21.4 DOCUMENTATION AND LABELING OF STANDARDS, REAGENTS, AND REFERENCE MATERIALS

Reagents must be at a minimum the purity required in the test method. The date of reagent receipt and the expiration date are documented. The lots for most of the common solvents and acids are tested for acceptability prior to company wide purchase. [Refer to TestAmerica's Corporate SOP (CA-Q-S-001), Solvent and Acid Lot Testing and Approval.]

All manufacturer or vendor supplied Certificate of Analysis or Purity must be retained, stored appropriately, and readily available for use and inspection. These records are maintained electronically. Records must be kept of the date of receipt and date of expiration of standards, reagents and reference materials. In addition, records of preparation of laboratory standards, reagents, and reference materials must be retained, stored appropriately, and be readily available for use and inspection. For detailed information on documentation and labeling, please refer to method specific SOPs.

Commercial materials purchased for preparation of calibration solutions, spike solutions, etc.., are usually accompanied with an assay certificate or the purity is noted on the label. If the assay purity is 96% or better, the weight provided by the vendor may be used without correction. If the assay purity is less than 96% a correction will be made to concentrations applied to solutions prepared from the stock commercial material.

21.4.1 All standards, reagents, and reference materials must be labeled in an unambiguous manner. Standards are logged into the laboratory's LIMS system, and are assigned a unique

identification number. The following information is typically recorded in the electronic database within the LIMS.

- Standard ID
- Description of Standard
- Department
- Preparer's name
- Final volume and number of vials prepared
- Solvent type and lot number
- Preparation Date
- Expiration Date
- Standard source type (stock or daughter)
- Parent standard ID (if applicable)
- Parent Standard Analyte Concentration (if applicable)
- Parent Standard Amount used (if applicable)
- Component Analytes
- Final concentration of each analyte
- Comment box (text field)

Records are maintained electronically for standard and reference material preparation. These records show the traceability to purchased stocks or neat compounds. These records also include method of preparation, date of preparation, expiration date and preparer's name or initials. Preparation procedures are provided in the Method SOPs.

21.4.2 All standards, reagents, and reference materials must be clearly labeled with a minimum of the following information:

- Expiration Date (include prep date for reagents)
- LIMS Standard ID
- Special Health/Safety warnings if applicable

21.4.3 In addition, the following information may be helpful:

- Date of receipt for commercially purchased items or date of preparation for laboratory prepared items
- Date opened (for multi-use containers, if applicable)
- Description of standard (if different from manufacturer's label or if standard was prepared in the laboratory)
- Concentration (if applicable)
- Initials of analyst preparing standard or opening container

All containers of prepared reagents must include a preparation date, expiration date and an ID number to trace back to preparation.

Procedures for preparation of reagents can be found in the Method SOPs.

Standard ID numbers must be traceable through associated logbooks, worksheets and raw data.

All reagents and standards must be stored in accordance to the following priority: 1) with the manufacturer's recommendations; 2) with requirements in the specific analytical methods as specified in the laboratory SOP.

SECTION 22. SAMPLING (NELAC 5.5.7)

22.1 OVERVIEW

TestAmerica Savannah provides some sampling services. Sampling procedures are described in SOP SA-FD-05: *Field Sampling Procedures.*

22.2 SAMPLING CONTAINERS

The laboratory offers clean sampling containers for use by clients. These containers are obtained from reputable container manufacturers and meet EPA specifications as required. Any certificates of cleanliness that are provided by the supplier are maintained at the laboratory.

22.2.1 Preservatives

Upon request, preservatives are provided to the client in pre-cleaned sampling containers. In some cases containers may be purchased pre-preserved from the container supplier. Whether prepared by the laboratory or bought pre-preserved, the grades of the preservatives are at a minimum:

- Hydrochloric Acid – Reagent ACS (Certified VOA Free) or equivalent
- Methanol – Purge and Trap grade
- Nitric Acid – Instra-Analyzed or equivalent
- Sodium Bisulfate – ACS Grade or equivalent
- Sodium Hydroxide – Instra-Analyzed or equivalent
- Sulfuric Acid – Instra-Analyzed or equivalent
- Sodium Thiosulfate – ACS Grade or equivalent

22.3 DEFINITION OF HOLDING TIME

The date and time of sampling documented on the COC form establishes the day and time zero. As a general rule, when the maximum allowable holding time is expressed in "days" (e.g., 14 days, 28 days), the holding time is based on calendar day measured. Holding times expressed in "hours" (e.g., 6 hours, 24 hours, etc.) are measured from date and time zero. The first day of holding time ends twenty-four hours after sampling. Holding times for analysis include any necessary reanalysis.

22.4 SAMPLING CONTAINERS, PRESERVATION REQUIREMENTS, HOLDING TIMES

The preservation and holding time criteria specified in the laboratory SOPs are derived from the source documents for the methods. If method required holding times or preservation requirements are not met, the reports will be qualified using a flag, footnote or case narrative. As soon as possible or "ASAP" is an EPA designation for tests for which rapid analysis is advised, but for which neither EPA nor the laboratory have a basis for a holding time.

22.5 SAMPLE ALIQUOTS / SUBSAMPLING

Taking a representative sub-sample from a container is necessary to ensure that the analytical results are representative of the sample collected in the field. The size of the sample container,

the quantity of sample fitted within the container, and the homogeneity of the sample need consideration when sub-sampling for sample preparation. It is the laboratory's responsibility to take a representative subsample or aliquot of the sample provided for analysis.

Analysts should handle each sample as if it is potentially dangerous. At a minimum, safety glasses, gloves, and lab coats must be worn when preparing aliquots for analysis.

Guidelines on taking sample aliquots & subsampling are located SOP SA-QA-15: *Homogenization, Compositing, and Segregation of Samples.*

SECTION 23. HANDLING OF SAMPLES (NELAC 5.5.8)

Sample management procedures at the laboratory ensure that sample integrity and custody are maintained and documented from sampling/receipt through disposal.

23.1 CHAIN OF CUSTODY (COC)

The COC form is the written documented history of any sample and is initiated when bottles are sent to the field, or at the time of sampling. This form is completed by the sampling personnel and accompanies the samples to the laboratory where it is received and stored under the laboratory's custody. The purpose of the COC form is to provide a legal written record of the handling of samples from the time of collection until they are received at the laboratory. It also serves as the primary written request for analyses from the client to the laboratory. The COC form acts as a purchase order for analytical services when no other contractual agreement is in effect. An example of a COC form may be found in Figure 23-1.

23.1.1 Field Documentation

The information the sampler needs to provide at the time of sampling on the container label is:

- Sample identification
- Date and time
- Preservative

During the sampling process, the COC form is completed and must be legible (see Figure 23-1). This form includes information such as:

- Client name, address, phone number and fax number (if available)
- Project name and/or number
- The sample identification
- Date, time and location of sampling
- Sample collectors name
- The matrix description
- The container description
- The total number of each type of container
- Preservatives used
- Analysis requested
- Requested turnaround time (TAT)
- Any special instructions
- Purchase Order number or billing information (e.g. quote number) if available
- The date and time that each person received or relinquished the sample(s), including their signed name.

The samples are stored in a cooler with ice, as applicable, and remain solely in the possession of the client's field technician until the samples are delivered to the laboratory. The sample collector must assure that each container is in his/her physical possession or in his/her view at

all times, or stored in such a place and manner to preclude tampering. The field technician relinquishes the samples in writing on the COC form to the sample control personnel at the laboratory or to a TestAmerica courier. Samples are only considered to be received by lab when personnel at the laboratory have physical contact with the samples.

Note: Independent couriers are not required to sign the COC form. The COC is usually kept in the sealed sample cooler. The receipt from the courier is stored in log-in by date; it lists all receipts each date.

23.1.2 Legal / Evidentiary Chain-of-Custody

If samples are identified for legal/evidentiary purposes on the COC, login will complete the custody seal retain the shipping record with the COC, and initiate an internal COC for laboratory use by analysts and a sample disposal record.

23.2 SAMPLE RECEIPT

Samples are received at the laboratory by designated sample receiving personnel and a unique laboratory project identification number is assigned. Each sample container shall be assigned a unique sample identification number that is cross-referenced to the client identification number such that traceability of test samples is unambiguous and documented. Each sample container is affixed with a durable sample identification label. Sample acceptance, receipt, tracking and storage procedures are summarized in the following sections.

Additional information on the sample receipt process is given in SOP SA-CU-01: *Sample Receipt Procedures.*

23.2.1 Laboratory Receipt

When samples arrive at the laboratory, sample receiving personnel inspect the coolers and samples. The integrity of each sample must be determined by comparing sample labels or tags with the COC and by visual checks of the container for possible damage. Any non-conformance, irregularity, or compromised sample receipt must be documented on the Sample Receipt Checklist in LIMS and brought to the immediate attention of the client. The COC, shipping documents, documentation of any non-conformance, irregularity, or compromised sample receipt, record of client contact, and resulting instructions become part of the project record.

23.2.1.1 Unique Sample Identification

All samples that are processed through the laboratory receive a unique sample identification to ensure that there can be no confusion regarding the identity of such samples at anytime. This system includes identification for all samples, subsamples and subsequent extracts and/or digestates.

The laboratory assigns a unique identification (e.g., Sample ID) code to each sample container received at the laboratory. This Primary ID is made up of the following information (consisting of 4 components):

Example: 680 - 9608 - A - 1

Location ID (3-digit # for your lab) | Login ID | Container Occurrence | Sample Number

The above example states that TestAmerica Savannah is the laboratory (Location ID 680). The Login ID is 9608 (unique to a particular client/job occurrence). The container code indicates it is the first container ("A") of Sample #1.

If the primary container goes through a prep step that creates a "new" container, then the new container is considered secondary and gets another ID. An example of this being a client sample in a 1-Liter amber bottle is sent through a Liquid/Liquid Extraction and an extraction vial is created from this step. The vial would be a SECONDARY container. The secondary ID has 5 components.

Example: 680 - 9608 - A - 1 - A ←——— Secondary Container Occurrence

Example: 680-9608-A-1-A, would indicate the PRIMARY container listed above that went through a step that created the 1st occurrence of a Secondary container.

With this system, a client sample can literally be tracked throughout the laboratory in every step from receipt to disposal.

23.3 SAMPLE ACCEPTANCE POLICY

The laboratory has a written sample acceptance policy (Figure 23-2) that clearly outlines the circumstances under which samples shall be accepted or rejected. These include:

- a COC filled out completely;
- samples must be properly labeled;
- proper sample containers with adequate volume for the analysis (Sampling Guide) and necessary QC;
- samples must be preserved according to the requirements of the requested analytical method (Sampling Guide);
- sample holding times must be adhered to;
- the Project Manager will be notified if any sample is received in damaged condition.

Data from samples which do not meet these criteria are flagged and the nature of the variation from policy is defined. A copy of the sample acceptance policy is provided to each client prior to shipment of samples.

23.3.1 After inspecting the samples, the sample receiving personnel sign and date the COC form, make any necessary notes of the samples' conditions and route them to the appropriate refrigerators or storage locations.

23.3.2 Any deviations from these checks that question the suitability of the sample for analysis, or incomplete documentation as to the tests required will be resolved by consultation

with the client. If the sample acceptance policy criteria are not met, the laboratory shall either:

- Retain all correspondence and/or records of communications with the client regarding the disposition of rejected samples, or
- Fully document any decision to proceed with sample analysis that does not meet sample acceptance criteria.

23.4 SAMPLE STORAGE

In order to avoid deterioration, contamination or damage to a sample during storage and handling, from the time of receipt until all analyses are complete, samples are stored in storage locations (e.g. freezers, refrigerators, etc.) suitable for the sample matrix. In addition, samples to be analyzed for volatile organic parameters are stored in storage locations designated for volatile organic parameters only. Samples are never to be stored with reagents, standards or materials that may create contamination.

To ensure the integrity of the samples during storage, storage blanks are maintained in the volatile sample refrigerators and analyzed every week.

Analysts technicians retrieve the sample container allocated to their analysis from the designated refrigerator, prepare or analyze the sample, and return the remaining sample to the refrigerator from which it originally came. All samples are scanned into and out of the refrigerator using the LIMS sample custody program. Empty containers are scanned into the LIMS sample custody program as empty and are properly disposed of. All samples are kept for at least 30 days after the report is sent out, which meets or exceeds most sample holding times. After this time, the samples are properly disposed of in accordance with the Corporate Safety Manual.

Access to the laboratory is controlled such that sample storage need not be locked at all times unless a project specifically demands it. Samples are accessible to laboratory personnel only. Visitors to the laboratory are prohibited from entering the refrigerator and laboratory areas unless accompanied by an employee of TestAmerica.

23.5 HAZARDOUS SAMPLES AND FOREIGN SOILS

Upon receipt, foreign soil samples are marked with a fluorescent green "FOREIGN SOIL" label prior to distributing to the analytical departments. Once the sample is received by the department, it is stored in a "FOREIGN SOIL ONLY" box segregated from other samples. Non-hazardous foreign soil samples are sent out for incineration by a USDA-approved waste disposal facility. RCRA hazardous foreign soil samples are heat treated at the laboratory. After heat treatment normal disposal procedures are followed. Refer to SOP SA-QA-14: *Handling, Storage, and Disposal of Restricted Foreign and Domestic Soil Samples* and the Environmental Health and Safety Manual for additional information on disposal of hazardous samples. If not classified as hazardous, foreign soil samples are sent out for incineration by a USDA-approved waste disposal facility.

To minimize exposure to personnel and to avoid potential accidents, hazardous and/or high concentration samples may be segregated from regular samples. All hazardous samples are either returned to the client or disposed of appropriately through a hazardous waste disposal firm that lab-packs all hazardous samples and removes them from the laboratory.

23.6 SAMPLE SHIPPING

In the event that the laboratory needs to ship samples, the samples are placed in a cooler with enough ice to ensure the samples remain just above freezing and at or below 6.0°C during transit. The samples are carefully surrounded by packing material to avoid breakage (yet maintain appropriate temperature). A trip blank is enclosed for those samples requiring water/solid volatile organic analyses (see Note). The chain-of-custody form is signed by the sample control technician and attached to the shipping paperwork. Samples are generally shipped overnight express or hand-delivered by a TestAmerica courier to maintain sample integrity. All personnel involved with shipping and receiving samples must be trained to maintain the proper chain-of-custody documentation and to keep the samples intact and on ice. The Environmental, Health and Safety Manual contains additional shipping requirements.

Note: If a client does not request trip blank analysis on the COC or other paperwork, the laboratory will not analyze the trip blanks that were supplied. However, in the interest of good client service, the laboratory will advise the client at the time of sample receipt that it was noted that they did not request analysis of the trip blank; and that the laboratory is providing the notification to verify that they are not inadvertently omitting a key part of regulatory compliance testing.

23.7 SAMPLE DISPOSAL

Samples should be retained for a minimum of 30 days after the project report is sent, however, provisions may be made for earlier disposal of samples once the holding time is exceeded. Some samples are required to be held for longer periods based on regulatory or client requirements (e.g., 60 days after project report is sent). The laboratory must follow the longer sample retention requirements where required by regulation or client agreement. Several possibilities for sample disposal exist: the sample may be consumed completely during analysis, the sample may be returned to the customer or location of sampling for disposal, or the sample may be disposed of in accordance with the laboratory's waste disposal procedures (outlined in the Savannah Addendum to the Corporate Safety Manual. All procedures in the laboratory Environmental, Health and Safety Manual are followed during disposal. Samples are normally maintained in the laboratory no longer than three months from receipt unless otherwise requested. Unused portions of samples found or suspected to be hazardous according to state or federal guidelines may be returned to the client upon completion of the analytical work.

If a sample is part of a known litigation, the affected legal authority, sample data user, and/or submitter of the sample must participate in the decision about the sample's disposal. All documentation and correspondence concerning the disposal decision process must be kept on file. Pertinent information includes the date of disposal, nature of disposal (such as sample depletion, hazardous waste facility disposal, return to client), names of individuals who conducted the arrangements and physically completed the task. The laboratory will remove or deface sample labels prior to disposal unless this is accomplished through the disposal method (e.g., samples are incinerated). A Waste Disposal Record should be completed.

Figure 23-1. Example: Chain of Custody (COC)

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

TestAmerica

TestAmerica Savannah
5102 LaRoche Avenue
Savannah, GA 31404
Phone: (912) 354-7858
Fax: (912) 352-0165

REQUIRED ANALYSES

SAMPLE DATE	SAMPLE TIME	SAMPLE IDENTIFICATION	NUMBER OF CONTAINERS SUBMITTED	REMARKS

RELINQUISHED BY	DATE	TIME	RELINQUISHED BY	DATE	TIME	RELINQUISHED BY	DATE	TIME
RECEIVED BY	DATE	TIME	RECEIVED BY	DATE	TIME	RECEIVED BY	DATE	TIME

LABORATORY USE ONLY

RECEIVED FOR LABORATORY BY	DATE	TIME	CUSTODY INTACT YES NO	CUSTODY SEAL NO	SAVANNAH LOG NO	LABORATORY REMARKS

FCU052.01 02.03.2

Figure 23-2. Example: Sample Acceptance Policy

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Sample Acceptance Policy

All samples will be evaluated against the criteria listed below. Samples which do not meet the criteria listed below will be qualified using the LIMS NCM Program and/or Sample Receipt Checklist.

1) Samples must arrive in good condition with a Chain-of-Custody filled out completely.

2) Samples must be properly labeled.

3) Samples must be in proper containers with adequate volume for the analysis.

4) Samples must be preserved according to the requirements of the requested analytical test method. Most analytical methods require chilling samples to 4°C. These criteria are met if the samples are chilled to below 6°C and above freezing. For methods with other temperature criteria (e.g. some bacteriological methods require ≤ 8°C), the samples must arrive within ± 2°C of the required temperature or within the method specified range.

   Note: Samples that are hand delivered to the laboratory immediately after collection may not have had time to cool sufficiently. In this case the samples will be considered acceptable as long as there is evidence that the chilling process has begun (arrival on ice).

5) Samples must be submitted with proper chemical preservation (pH) as required by the analytical test method.

6) Samples must be dechlorinated as required by the analytical test method.

7) Samples must be prepared and analyzed with the holding times defined in the analytical test method.

8) Samples submitted for Volatiles analyses must be submitted without headspace.

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Figure 23-3. Example: Cooler Receipt Form

Login Sample Receipt Check List

Client: TestAmerica Laboratories, Inc. Job Number:

SDG Number:

Login Number: **List Source:**

Creator:

List Number:

Question	T / F / NA	Comment
Radioactivity either was not measured or, if measured, is at or below background		
The cooler's custody seal, if present, is intact.		
The cooler or samples do not appear to have been compromised or tampered with.		
Samples were received on ice.		
Cooler Temperature is acceptable.		
Cooler Temperature is recorded.		
COC is present.		
COC is filled out in ink and legible		
COC is filled out with all pertinent information.		
There are no discrepancies between the sample IDs on the containers and the COC.		
Samples are received within Holding Time.		
Sample containers have legible labels.		
Containers are not broken or leaking.		
Sample collection date/times are provided.		
Appropriate sample containers are used.		
Sample bottles are completely filled.		
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs		
VOA sample vials do not have headspace or bubble is <6mm (1/4") in diameter.		
If necessary, staff have been informed of any short hold time or quick TAT needs		
Multiphasic samples are not present.		
Samples do not require splitting or compositing.		
Is the Field Sampler's name present on COC?		
Sample Preservation Verified		

TestAmerica Savannah

SECTION 24. ASSURING THE QUALITY OF TEST RESULTS (NELAC 5.5.9)

24.1 OVERVIEW

In order to assure our clients of the validity of their data, the laboratory continuously evaluates the quality of the analytical process. The analytical process is controlled not only by instrument calibration as discussed in Section 20, but also by routine process quality control measurements (e.g. Blanks, Laboratory Control Samples (LCS), Matrix Spikes (MS), duplicates (Dup), surrogates, Internal Standards (ISTD)). These quality control checks are performed as required by the method or regulations to assess precision and accuracy. In addition to the routine process quality control samples, Proficiency Testing (PT) Samples (concentrations unknown to laboratory) are analyzed to help ensure laboratory performance.

24.2 CONTROLS

Sample preparation or pre-treatment is commonly required before analysis. Typical preparation steps include homogenization, grinding, solvent extraction, sonication, acid digestion, distillation, reflux, evaporation, drying, and ashing. During these pre-treatment steps, samples are arranged into discreet manageable groups referred to as preparation (prep) batches. Prep batches provide a means to control variability in sample treatment. Control samples are added to each prep batch to monitor method performance and are processed through the entire analytical procedure with investigative/field samples.

24.3 NEGATIVE CONTROLS

Table 24-1. – Negative Controls

Control Type	Details
Method Blank (MB)	Used to assess preparation and analysis for possible contamination during the preparation and processing steps.
	The specific frequency of use for method blanks during the analytical sequence is defined in the specific standard operating procedure for each analysis. Generally it is 1 for each batch of samples; not to exceed 20 environmental samples.
	The method blank is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (e.g., Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The method blank goes through all of the steps of the process (including as necessary: filtration, clean-ups, etc.).
Calibration Blanks	Prepared and analyzed along with calibration standards where applicable. They are prepared using the same reagents that are used to prepare the standards. In some analyses the calibration blank may be included in the calibration curve.

Table 24-1. – Negative Controls

Control Type	Details
Instrument Blanks	Blank reagents or reagent water that may be processed during an analytical sequence in order to assess contamination in the analytical system. In general, instrument blanks are used to differentiate between contamination caused by the analytical system and that caused by the sample handling or sample prep process. Instrument blanks may also be inserted throughout the analytical sequence to minimize the effect of carryover from samples with high analyte content.
Trip Blank[1]	Required to be submitted by the client with each shipment of samples requiring aqueous and solid volatiles analyses. Additionally, trip blanks may be prepared and analyzed for volatile analysis of air samples, when required by the client. A trip blank may be purchased (certified clean) or is prepared by the laboratory by filling a clean container with pure deionized water that has been purged to remove any volatile compounds. Appropriate preservatives are also added to the container. The trip blank is sent with the bottle order and is intended to reflect the environment that the containers are subjected to throughout shipping and handling and help identify possible sources if contamination is found. The field sampler returns the trip blank in the cooler with the field samples.
Field Blanks[1]	Sometimes used for specific projects by the field samplers. A field blank prepared in the field by filling a clean container with pure reagent water and appropriate preservative, if any, for the specific sampling activity being undertaken. (EPA OSWER)
Equipment Blanks[1]	Sometimes created in the field for specific projects. An equipment blank is a sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures. (NELAC)
Holding Blanks	Also referred to as refrigerator or freezer blanks, or storage blanks. Used to monitor the sample storage units for volatile organic compounds during the storage of VOA samples in the laboratory

[1] When known, these field QC samples should not be selected for matrix QC as it does not provide information on the behavior of the target compounds in the field samples. Usually, the client sample ID will provide information to identify the field blanks with labels such as "FB", "EB", or "TB."

Evaluation criteria and corrective action for these controls are defined in the specific standard operating procedure for each analysis.

24.3.1 <u>Negative Controls for Microbiological Methods</u> – Microbiological Methods utilize a variety of negative controls throughout the process to ensure that false positive results are not obtained. These controls are critical to the validity of the microbiological analyses. Some of these negative controls are:

Table 24-2. Negative Controls for Microbiology

Control Type	Details
Sterility Checks (Media)	Analyzed for each lot of pre-prepared media, ready-to-use media and for each batch of medium prepared by the laboratory.
Filtration Blanks	Analyzed at the beginning and end for each sterilized filtration unit used in a filtration series. For pre-sterilized single use funnels a sterility check is performed on at least one funnel per lot.
Sterility checks (Sample Containers)	Performed on at least one container per lot of purchased, pre-sterilized containers. If containers are prepared and sterilized by the laboratory, one container per sterilization batch is checked. Container sterility checks are performed using non-selective growth media.
Sterility Checks (Dilution Water)	Performed on each batch of dilution water prepared by the laboratory and on each batch of pre-prepared dilution water. All checks are performed using non-selective growth media.
Sterility Checks (Filters)	Performed on at least one filter from each new lot of membrane filters using non-selective growth media.

Negative culture controls demonstrate that a media does not support the growth of non-target organisms and ensures that there is not an atypical positive reaction from the target organisms. Prior to the first use of the media, each lot of pre-prepared selective media or batch of laboratory prepared selective media is analyzed with at least one known negative culture control as appropriate to the method.

24.4 POSITIVE CONTROLS

Control samples (e.g., QC indicators) are analyzed with each batch of samples to evaluate data based upon (1) Method Performance (Laboratory Control Sample (LCS) or Blank Spike (BS)), which entails both the preparation and measurement steps; and (2) Matrix Effects (Matrix Spike (MS) or Sample Duplicate (MD, Dup), which evaluates field sampling accuracy, precision, representativeness, interferences, and the effect of the matrix on the method performed. Each regulatory program and each method within those programs specify the control samples that are prepared and/or analyzed with a specific batch

Note that frequency of control samples vary with specific regulatory, methodology and project specific criteria. Complete details on method control samples are as listed in each analytical SOP.

24.4.1 Method Performance Control - Laboratory Control Sample (LCS)

The LCS measures the accuracy of the method in a blank matrix and assesses method performance independent of potential field sample matrix affects in a laboratory batch.

The LCS is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (for example: Reagent water, Ottawa sand, glass beads, etc.) and is

processed along with and under the same conditions as the associated samples. The LCS is spiked with verified known amounts of analytes or is made of a material containing known and verified amounts of analytes, taken through all preparation and analysis steps along with the field samples. Where there is no preparation taken for an analysis (such as in aqueous volatiles), or when all samples and standards undergo the same preparation and analysis process (such as Phosphorus), a calibration verification standard may be reported as the LCS.

Certified pre-made reference material purchased from a NIST/A2LA accredited vendor may also be used for the LCS when the material represents the sample matrix or the analyte is not easily spiked (e.g. solid matrix LCS for metals, TDS, etc.).

The specific frequency of use for LCS during the analytical sequence is defined in the specific standard operating procedure for each analysis. It is generally 1 for each batch of samples; not to exceed 20 environmental samples.

If the mandated or requested test method, or project requirements, do not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample (and Matrix Spike) where applicable (e.g. no spike of pH). However, in cases where the components interfere with accurate assessment (such as simultaneously spiking chlordane, toxaphene and PCBs in Method 608), or the test method has an extremely long list of components or components are incompatible, at a minimum, a representative number of the listed components (see below) shall be used to control the test method. The selected components of each spiking mix shall represent all chemistries, elution patterns and masses, permit specified analytes and other client requested components. However, the laboratory shall ensure that all reported components are used in the spike mixture within a two-year time period.

- For methods that have 1-10 target analytes, spike all components.
- For methods that include 11-20 target analytes, spike at least 10 or 80%, whichever is greater.
- For methods with more than 20 target analytes, spike at least 16 components.
- Exception: Due to analyte incompatibility in pesticides, Toxaphene and Chlordane are only spiked at client request based on specific project needs.
- Exception: Due to analyte incompatibility between the various PCB aroclors, Aroclors 1016 and 1260 are used for spiking as they cover the range of all of the aroclors. Specific aroclors may be used by request on a project specific basis.

24.4.2 Positive Controls for Microbiological Methods

- Each lot of pre-prepared media (including chromofluorogenic reagent) and each batch of laboratory prepared media is tested with a pure culture of known positive reaction.
- In addition, every analytical batch also contains a pure culture of known positive reaction.
- A pure culture of known negative reaction is also tested with each analytical batch to ensure specificity of the procedure.

24.5 SAMPLE MATRIX CONTROLS

Table 24-3. Sample Matrix Control

Control Type	Details	
Matrix Spikes (MS)	Use	Used to assess the effect sample matrix of the spiked sample has on the precision and accuracy of the results generated by the method used;
	Typical Frequency [1]	At a minimum, with each matrix-specific batch of samples processed, an MS is carried through the complete analytical procedure. Unless specified by the client, samples used for spiking are randomly selected and rotated between different client projects.If the mandated or requested test method does not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample and Matrix Spike. Refer to the method SOP for complete details
	Description	A sample fortified with a known amount of the test analyte(s).
Surrogate	Use	Measures method performance to sample matrix (organics only).
	Typical Frequency [1]	Added to all samples, standards, and blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. The recovery of the surrogates is compared to the acceptance limits for the specific method. Poor surrogate recovery may indicate a problem with sample composition and shall be reported, with data qualifiers, to the client whose sample produced poor recovery.
	Description	Similar to matrix spikes except the analytes are compounds with properties that mimic the analyte of interest and are unlikely to be found in environment samples.
Duplicates [2]	Use	For a measure of analytical precision, with each matrix-specific batch of samples processed, a matrix duplicate (MD or Dup) sample, matrix spike duplicate (MSD), or LCS duplicate (LCSD) is carried through the complete analytical procedure.
	Typical Frequency [1]	Duplicate samples are usually analyzed with methods that do not require matrix spike analysis.
	Description	Performed by analyzing two aliquots of the same field sample independently or an additional LCS.
Internal Standards	Use	Spiked into all environmental and quality control samples (including the initial calibration standards) to monitor the qualitative aspect of organic and some inorganic analytical measurements.
	Typical Frequency [1]	All organic and ICP methods as required by the analytical method.
	Description	Used to correct for matrix effects and to help troubleshoot variability in analytical response and are assessed after data acquisition. Possible sources of poor internal standard response are sample matrix, poor analytical technique or instrument performance.

[1] See the specific analytical SOP for type and frequency of sample matrix control samples.
[2] LCSD's are normally not performed except when regulatory agencies or client specifications require them. The recoveries for the spiked duplicate samples must meet the same laboratory established recovery limits as the accuracy QC samples. If an LCSD is analyzed both the LCS and LCSD must meet the same recovery criteria and be included in the final report. The precision measurement is reported as "Relative Percent Difference" (RPD). Poor precision between duplicates (except LCS/LCSD) may indicate non-homogeneous matrix or sampling.

24.6 ACCEPTANCE CRITERIA (CONTROL LIMITS)

As mandated by the test method and regulation, each individual analyte in the LCS, MS, or Surrogate Spike is evaluated against the control limits published in the test method. Where there are no established acceptance criteria, the laboratory calculates in-house control limits with the use of control charts or, in some cases, utilizes client project specific control limits. When this occurs, the regulatory or project limits will supersede the laboratory's in-house limits.

Note: For methods, analytes and matrices with very limited data (e.g., unusual matrices not analyzed often), interim limits are established using available data or by analogy to similar methods or matrices.

Once control limits have been established, they are verified, reviewed, and updated if necessary (recommended on an annual basis) unless the method requires more frequent updating. Control limits are established per method (as opposed to per instrument) regardless of the number of instruments utilized.

Laboratory generated % Recovery acceptance (control) limits are generally established by taking $\pm$ 3 Standard Deviations (99% confidence level) from the average recovery of a minimum of 20-30 data points (more points are preferred).

- Regardless of the calculated limit, the limit should be no tighter than the Calibration Verification (ICV/CCV). (Unless the analytical method specifies a tighter limit.)

- In-house limits cannot be any wider than those mandated in a regulated analytical method. Client or contract required control limits are evaluated against the laboratory's statistically derived control limits to determine if the data quality objectives (DQOs) can be achieved. If laboratory control limits are not consistent with DQOs, then alternatives must be considered, such as method improvements or use of an alternate analytical method.

- For routine analytes that are not classified as poor performers, the lowest acceptable recovery limit will be 10% (the analyte must be detectable and identifiable).

- If either the high or low end of the control limit changes by $\leq$ 5% from previous, the control chart is visually inspected and, using professional judgment, they may be left unchanged if there is no affect on laboratory ability to meet the existing limits.

24.6.1 The lab must be able to generate a current listing of their control limits and track when the updates are performed. In addition, the laboratory must be able to recreate historical control limits.

The QA Department generates a Method Limit Group (MLG) in the LIMS that contains tables that summarize the precision and accuracy acceptability limits for analyses performed at TestAmerica Savannah. The MLG includes an effective date and is updated each time new limits are generated and entered. Unless otherwise noted, limits within these tables are laboratory generated. The LIMS maintains an archive of all limits used within the laboratory.

24.6.2 A LCS that is within the acceptance criteria establishes that the analytical system is in control and is used to validate the process. Samples that are analyzed with an LCS with recoveries outside of the acceptance limits may be determined as out of control and should be reanalyzed if possible. If reanalysis is not possible, then the results for all affected analytes for samples within the same batch must be qualified when reported. The internal corrective action process (see Section 12) is also initiated if an LCS exceeds the acceptance limits. Sample results may be qualified and reported without reanalysis if:

- The analyte results are below the reporting limit and the LCS is above the upper control limit.
- If the analytical results are above the relevant regulatory limit and the LCS is below the lower control limit.
- If there are an allowable number of Marginal Exceedances (ME):

<11 analytes	0 marginal exceedances are allowed.
11 – 30 Analytes	1 marginal exceedance is allowed
31-50 Analytes	2 marginal exceedances are allowed
51-70 Analytes	3 marginal exceedances are allowed
71-90 Analytes	4 marginal exceedances are allowed
> 90 Analytes	5 marginal exceedances are allowed

Marginal exceedances are recovery exceedances between 3 SD and 4 SD from the mean recovery limit (NELAC).

Marginal exceedances should be random. If the same analyte exceeds the LCS control limit repeatedly, it is an indication of a systematic problem. The source of the error must be located and corrective action taken.

Though marginal exceedances may be allowed, the data must still be qualified to indicate it is outside of the normal limits.

24.6.3 If the MS/MSDs do not meet acceptance limits, the MS/MSD and the associated spiked sample is reported with a qualifier for those analytes that do not meet limits. If obvious preparation errors are suspected, or if requested by the client, unacceptable MS/MSDs are reprocessed and reanalyzed to prove matrix interference. A more detailed discussion of acceptance criteria and corrective action can be found in the lab's method SOPs and in Section 12.

24.6.4 If a surrogate standard falls outside the acceptance limits, if there is not obvious chromatographic matrix interference, reanalyze the sample to confirm a possible matrix effect. If the recoveries confirm or there was obvious chromatographic interference, results are

reported from the original analysis and a qualifier is added. If the reanalysis meets surrogate recovery criteria, the second run is reported (or both are reported if requested by the client).

24.7 ADDITIONAL PROCEDURES TO ASSURE QUALITY CONTROL

The laboratory has written and approved method SOPs to assure the accuracy of the test method including calibration (see Section 20), use of certified reference materials (see Section 21) and use of PT samples (see Section 15).

A discussion regarding MDLs, Limit of Detection (LOD) and Limit of Quantitation (LOQ) can be found in Section 19.

- Use of formulae to reduce data is discussed in the method SOPs and in Section 20.
- Selection of appropriate reagents and standards is included in Section 9 and 21.
- A discussion on selectivity of the test is included in Section 5.
- Constant and consistent test conditions are discussed in Section 18.
- The laboratories sample acceptance policy is included in Section 23.

SECTION 25. REPORTING RESULTS (NELAC 5.5.10)

25.1 OVERVIEW

The results of each test are reported accurately, clearly, unambiguously, and objectively in accordance with State and Federal regulations as well as client requirements. Analytical results are issued in a format that is intended to satisfy customer and laboratory accreditation requirements as well as provide the end user with the information needed to properly evaluate the results. Where there is conflict between client requests and laboratory ethics or regulatory requirements, the laboratory's ethical and legal requirements are paramount, and the laboratory will work with the client during project set up to develop an acceptable solution. Refer to Section 7.

A variety of report formats are available to meet specific needs.

In cases where a client asks for simplified reports, there must be a written request from the client. There still must be enough information that would show any analyses that were out of conformance (QC out of limits) and there should be a reference to a full report that is made available to the client. Review of reported data is included in Section 19.

25.2 TEST REPORTS

Analytical results are reported in a format that is satisfactory to the client and meets all requirements of applicable accrediting authorities and agencies. A variety of report formats are available to meet specific needs. The report is reviewed and signed by the appropriate Project Manager. At a minimum, the standard laboratory report shall contain the following information:

25.2.1 A report title (e.g. Analytical Report) with a "Result" column header.

25.2.2 Each report cover page includes the laboratory name, address and telephone number.

25.2.3 A unique identification of the report (e.g. Job number) and on each page an identification in order to ensure the page is recognized as part of the report and a clear identification of the end.

Note: Page numbers of report are represented as page # of ##. Where the first number is the page number and the second is the total number of pages.

25.2.4 A copy of the chain of custody (COC).

- Any COCs involved with Subcontracting are included.

25.2.5 The name and address of client and a project name/number, if applicable.

25.2.6 Client project manager or other contact

25.2.7 Description and unambiguous identification of the tested sample(s) including the client identification code.

25.2.8 Date of receipt of sample, date and time of collection, and date(s) of test preparation and performance, and time of preparation or analysis if the required holding time for either activity is less than or equal to 72 hours.

25.2.9 Date reported or date of revision, if applicable.

25.2.10 Method of analysis including method code (EPA, Standard Methods, etc).

25.2.11 Reporting limits.

25.2.12 Method detection limits (if requested)

25.2.13 Definition of Data qualifiers and reporting acronyms (e.g. ND).

25.2.14 Sample results.

25.2.15 QC data consisting of method blank, surrogate, LCS, and MS/MSD recoveries and control limits.

25.2.16 Condition of samples at receipt including temperature. This may be accomplished in a narrative or by attaching sample login sheets (Refer to Sec. 25.2.4 – Item 3 regarding additional addenda).

25.2.17 A statement to the effect that the results relate only to the items tested and the sample as received by the laboratory.

25.2.18 A statement that the report shall not be reproduced except in full, without prior express written approval by the laboratory.

25.2.19 A signature and title of the person(s) accepting responsibility for the content of the report and date of issue. Signatories are appointed by the Lab Director.

25.2.20 When NELAC accreditation is required, the lab shall certify that the test results meet all requirements of NELAC or provide reasons and/or justification if they do not.

25.2.21 Where applicable, a narrative to the report that explains the issue(s) and corrective action(s) taken in the event that a specific accreditation or certification requirement was not met.

25.2.22 When soil samples are analyzed, a specific identification as to whether soils are reported on a "wet weight" or "dry weight" basis.

25.2.23 Appropriate laboratory certification number for the state of origin of the sample, if applicable.

25.2.24 If only part of the report is provided to the client (client requests some results before all of it is complete), it must be clearly indicated on the report (e.g., partial report, or preliminary report). A complete and final report must be sent once all of the work has been completed.

25.2.25 Any non-TestAmerica subcontracted analysis results are provided as a separate report on the official letterhead of the subcontractor. All TestAmerica subcontracting is clearly identified on the report as to which laboratory performed a specific analysis.

Note: Refer to the Corporate SOP on Electronic Reporting and Signature Policy (No. CA-I-P-002) for details on internally applying electronic signatures of approval.

25.3 REPORTING LEVEL OR REPORT TYPE

The laboratory offers four levels of quality control reporting. Each level, in addition to its own specific requirements, contains all the information provided in the preceding level. The packages provide the following information in addition to the information described above:

- Level I is a report with the features described in Section 25.2 above.
- Level II is a Level I report plus summary information, including QC results.
- Level III contains all the information supplied in Level II, but presented on the CLP-like summary forms, and relevant calibration information. No raw data is provided.
- Level IV is the same as Level III with the addition of all raw supporting data.

In addition to the various levels of QC packaging, the laboratory also provides reports in diskette deliverable form. Initial reports may be provided to clients by facsimile. All faxed reports are followed by hardcopy. Procedures used to ensure client confidentiality are outlined in Section 25.6.

25.3.1 Electronic Data Deliverables (EDDs)

EDDs are routinely offered as part of TestAmerica's services. TestAmerica Savannah offers a variety of EDD formats including including Environmental Resources Program Information Management System (ERPIMS), Automated Data Review (ADR), Locus Focus (EIM), EQUIS ESBasic, Environmental Quality Information Systems (EQUIS), Staged Electronic Data Deliverable (SEDD), EPA Region V EDD (EDMAN), and Terrabase.

EDD specifications are submitted to the IT department by the Project Manager for review and undergo the contract review process. Once the facility has committed to providing data in a specific electronic format, the coding of the format may need to be performed. This coding is documented and validated. The validation of the code is retained by the IT staff coding the EDD.

EDDs shall be subject to a review to ensure their accuracy and completeness. If EDD generation is automated, review may be reduced to periodic screening if the laboratory can demonstrate that it can routinely generate that EDD without errors. Any revisions to the EDD format must be reviewed until it is demonstrated that it can routinely be generated without errors. If the EDD can be reproduced accurately and if all subsequent EDDs can be produced error-free, each EDD does not necessarily require a review.

25.4 SUPPLEMENTAL INFORMATION FOR TEST

The lab identifies any unacceptable QC analyses or any other unusual circumstances or observations such as environmental conditions and any non-standard conditions that may have affected the quality of a result. This is typically in the form of a footnote or a qualifier and/or a narrative explaining the discrepancy in the front of the report.

Numeric results with values outside of the calibration range, either high or low are qualified as 'estimated'.

Where quality system requirements are not met, a statement of compliance/non-compliance with requirements and/or specifications is required, including identification of test results derived from any sample that did not meet NELAC sample acceptance requirements such as improper container, holding time, or temperature.

Where applicable, a statement on the estimated uncertainty of measurements; information on uncertainty is needed when a client's instructions so require.

Opinions and Interpretations - The test report contains objective information, and generally does not contain subjective information such as opinions and interpretations. If such information is required by the client, the Laboratory Director will determine if a response can be prepared. If so, the Laboratory Director will designate the appropriate member of the management team to prepare a response. The response will be fully documented, and reviewed by the Laboratory Director, before release to the client. There may be additional fees charged to the client at this time, as this is a non-routine function of the laboratory.

When opinions or interpretations are included in the report, the laboratory provides an explanation as to the basis upon which the opinions and interpretations have been made. Opinions and interpretations are clearly noted as such and where applicable, a comment should be added suggesting that the client verify the opinion or interpretation with their regulator.

25.5 ENVIRONMENTAL TESTING OBTAINED FROM SUBCONTRACTORS

If the laboratory is not able to provide the client the requested analysis, the samples would be subcontracted following the procedures outlined in the Corporate SOP on Subcontracting (SOP # CA-L-S-002).

Data reported from analyses performed by a subcontractor laboratory are clearly identified as such on the analytical report provided to the client. Results from a subcontract laboratory outside of TestAmerica are reported to the client on the subcontract laboratory's original report stationary and the report includes any accompanying documentation.

25.6 CLIENT CONFIDENTIALITY

In situations involving the transmission of environmental test results by telephone, facsimile or other electronic means, client confidentiality must be maintained.

TestAmerica will not intentionally divulge to any person (other than the Client or any other person designated by the Client in writing) any information regarding the services provided by TestAmerica or any information disclosed to TestAmerica by the Client. Furthermore, information known to be potentially endangering to national security or an entity's proprietary rights will not be released.

Note: This shall not apply to the extent that the information is required to be disclosed by TestAmerica under the compulsion of legal process. TestAmerica will, to the extent feasible, provide reasonable notice to the client before disclosing the information.

Note: Authorized representatives of an accrediting authority are permitted to make copies of any analyses or records relevant to the accreditation process, and copies may be removed from the laboratory for purposes of assessment.

25.6.1 Report deliverable formats are discussed with each new client. If a client requests that reports be faxed or e-mailed, the reports are faxed with a cover sheet or e-mailed with the following note that includes a confidentiality statement similar to the following:

This material is intended only for the use of the individual(s) or entity to whom it is addressed and may contain information that is privileged and confidential. It is our policy that facsimiles are intended for and should be used for business purposes only. If you are not the intended recipient, or the employee or agent responsible for delivering this material to the intended recipient, you are hereby notified that any dissemination, distribution or copying of this facsimile is strictly prohibited. If you have received this communication in error, please notify the sender. Thank you for your professional consideration and cooperation.

25.7 FORMAT OF REPORTS

The format of reports is designed to accommodate each type of environmental test carried out and to minimize the possibility of misunderstanding or misuse.

25.8 AMENDMENTS TO TEST REPORTS

Corrections, additions, or deletions to reports are only made when justification arises through supplemental documentation. Justification is documented using the laboratory's corrective action system (refer to Section 12).

The revised report is retained in the LIMS, as is the original report. The revised report is stored in the project files under the sample number followed by "Rev#" where # is the number of the report revision.

When the report is re-issued, the revision number is placed on the cover/signature page of the report or at the top of the narrative page. A brief explanation of reason for the re-issue and a reference back to the last final report generated may be included.

25.9 POLICIES ON CLIENT REQUESTS FOR AMENDMENTS

25.9.1 Policy on Data Omissions or Reporting Limit Increases

Fundamentally, our policy is simply to not omit previously reported results (including data qualifiers) or to not raise reporting limits and report sample results as ND. This policy has few exceptions. Exceptions are:

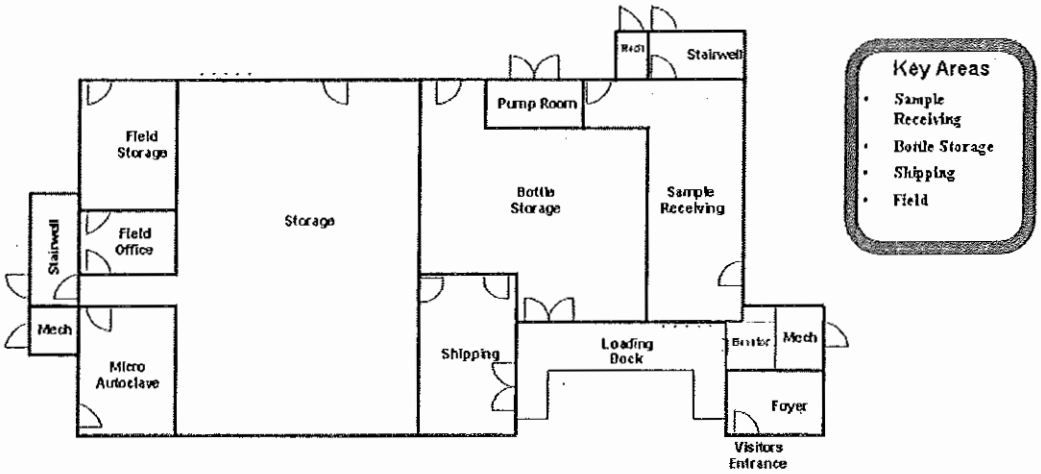
- Laboratory error.
- Sample identification is indeterminate (confusion between COC and sample labels).
- An incorrect analysis (not analyte) was requested (e.g., COC lists 8315 but client wanted 8310). A written request for the change is required.
- Incorrect limits reported based on regulatory requirements.
- The requested change has absolutely *no possible* impact on the interpretation of the analytical results and there is *no possibility* of the change being interpreted as misrepresentation by anyone inside or outside of our company.

25.9.2 Multiple Reports

TestAmerica does not issue multiple reports for the same work order where there is different information on each report (this does not refer to copies of the same report) unless required to meet regulatory needs and approved by QA.

Appendix 1. Laboratory Floor Plan

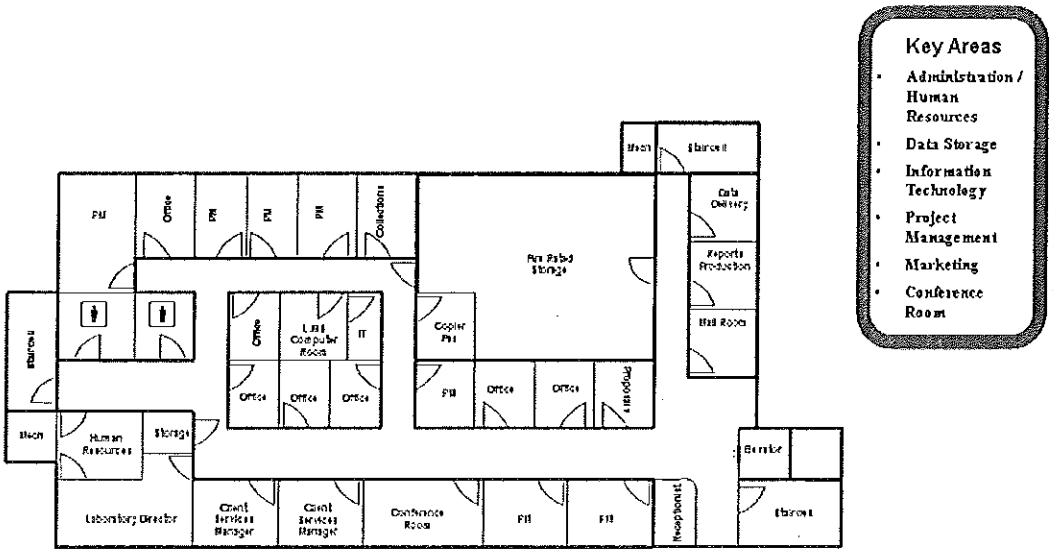
Floor Plan of Savannah



BUILDING 2 FIRST FLOOR
8, 400 Square Feet

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

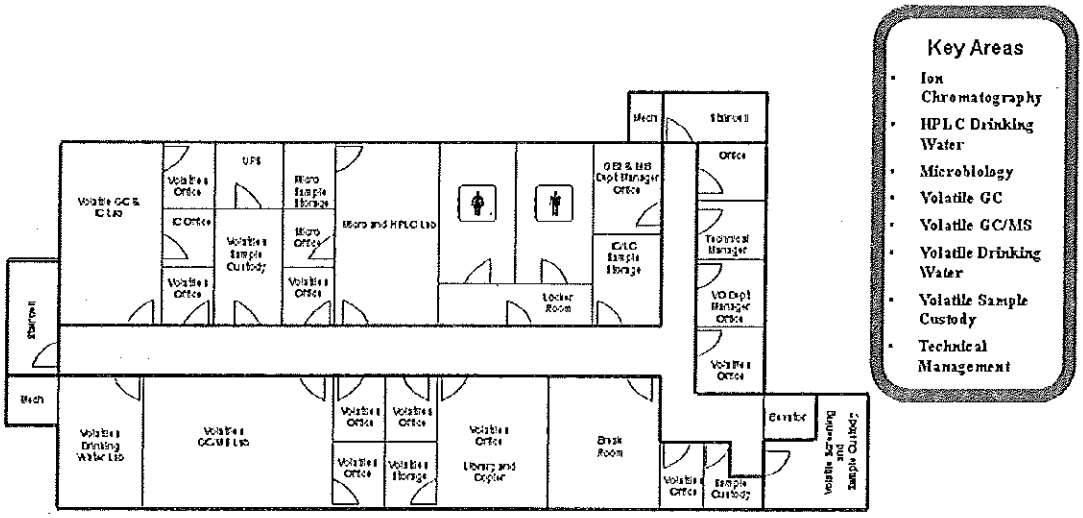
Floor Plan of Savannah



BUILDING 2 SECOND FLOOR
8,400 Square Feet

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

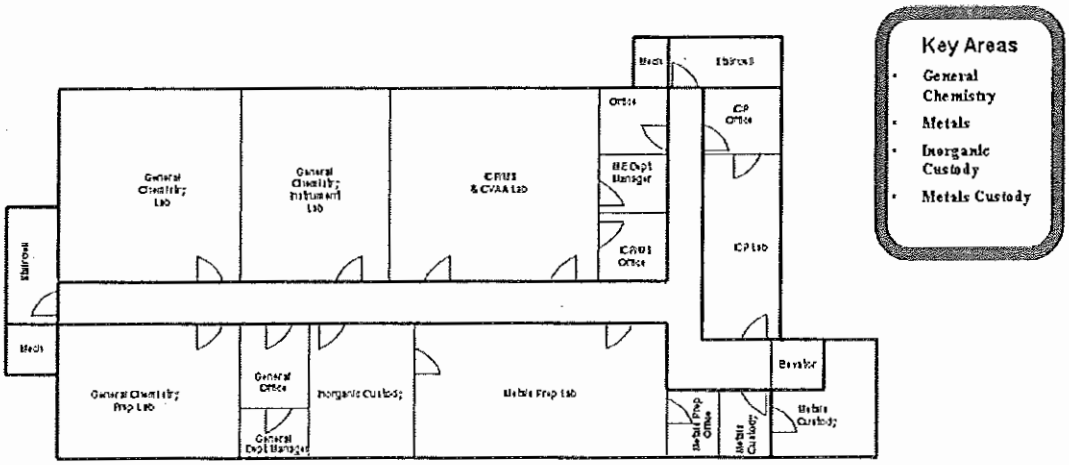
Floor Plan of Savannah



BUILDING 2 THIRD FLOOR
8,400 Square Feet

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

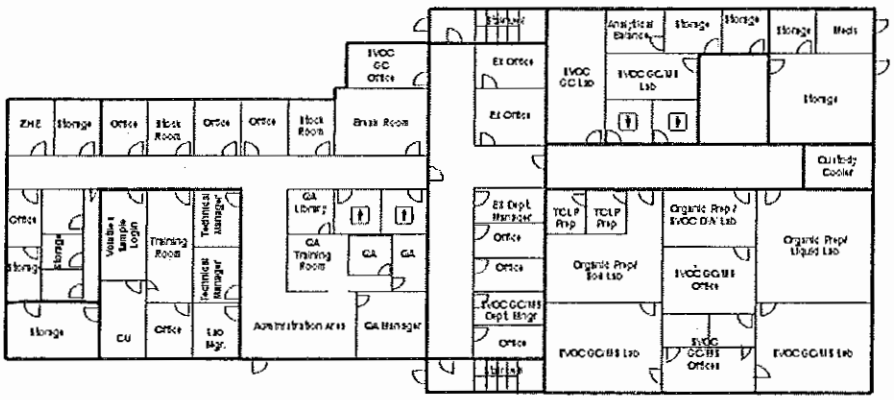
Floor Plan of Savannah



BUILDING 2 FOURTH FLOOR
8,400 Square Feet

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Floor Plan of TestAmerica Savannah



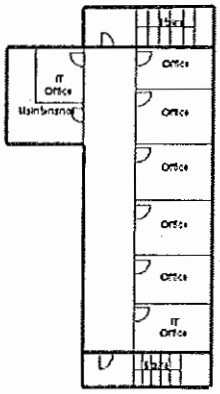
BUILDING 1 FIRST FLOOR
16,600 Square Feet

Key Areas

- Lab Management
- Organic Prep / Extractions
- Quality Assurance
- Semivolatile GC
- Semivolatile GC Drinking Water
- Semivolatile GC/MS
- Semivolatile GC/MS Drinking Water
- Technical Management
- Training Center

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Floor Plan of Savannah



BUILDING 1 SECOND FLOOR
2,200 Square Feet

Key Areas
- IT
- Maintenance

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Appendix 2. Glossary/Acronyms

Glossary:

Acceptance Criteria:
Specified limits placed on characteristics of an item, process, or service defined in requirement documents. (ASQC)

Accreditation:
The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory. In the context of the National Environmental Laboratory Accreditation Program (NELAP), this process is a voluntary one. (NELAC)

Accrediting Authority:
The Territorial, State, or Federal Agency having responsibility and accountability for environmental laboratory accreditation and which grants accreditation (NELAC) [1.5.2.3]

Accuracy:
The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator. (QAMS)

Aliquot:
A representative portion of the sample, standard, or reagent.

Analyst:
The designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality. (NELAC)
Analyte:
The element, molecule, or compound that is being measured in a given procedure. Also referred to as a parameter.

Analytical Method:
Defines the sample preparation and instrumentation procedures that must be performed to determine the quantity of analyte in a sample.

Analytical Sequence:
The order in which calibration standards, verification standards, QC items, and samples are analyzed.

Analytical Spike:
Addition of a known concentration of analyte to an aliquot of sample after the preparation steps have been performed.

Anion:
A negatively charged ion.

Anomaly:
Anomalous situations that are out of the ordinary but are not necessarily a method deviation and are not definitive enough to require a CAR are documented in the Non-Conformance Module. The use of the grand mean exception would require initiation of an Anomaly NCM.

Aromatic:
Relating to the six-carbon-ring configuration of benzene and its derivatives.

Assessment:
The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its systems to defined criteria (to the standards and requirements of NELAC). (NELAC)

Assessment Criteria:
The measures established by NELAC and applied in establishing the extent to which an applicant is in conformance with NELAC requirements. (NELAC)

Assessment Team:
The group of people authorized to perform the on-site inspection and proficiency testing data evaluation required to establish whether an applicant meets the criteria for NELAP accreditation. (NELAC)

Assessor:
One who performs on-site assessments of accrediting authorities and laboratories' capability and capacity for meeting NELAC requirements by examining the records and other physical evidence for each one of the tests for which accreditation has been requested. (NELAC)

Audit:
A systematic evaluation to determine the conformance to quantitative and qualitative specifications of some operational function or activity. (EPA-QAD)

Background Correction:
A technique to compensate for variable background contribution to the instrument signal and the determination of trace metals.

Batch:
Environmental samples which are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A preparation batch is composed of one to 20 environmental samples of the same matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours. An analytical batch is composed of prepared environmental samples (extracts, digestates or concentrates) and /or those samples not requiring preparation, which are analyzed together as a group using the same calibration curve or factor. An analytical batch can include samples originating from various environmental matrices and can exceed 20 samples. (NELAC Quality Systems Committee)

Blank:
A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results. (ASQC)

Blind Sample:
A sample for analysis with a composition known to the submitter. The analyst/laboratory may know the identity of the sample but not its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process.

Calibration:
To determine, by measurement or comparison with a standard, the correct value of each scale reading on a meter, instrument, or other device. The levels of the applied calibration standard should bracket the range of planned or expected sample measurements. (NELAC)

Calibration Check Compounds (CCC):
Term used in conjunction with SW-846, Method 8260 and 8270 to refer to the compounds in which the percent RSD is evaluated against method-prescribed criteria to decide the validity of a calibration.

Calibration Curve:
The graphical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response. (NELAC)

Calibration Method:
A defined technical procedure for performing a calibration. (NELAC)

Calibration Standard:
A substance or reference material used to calibrate an instrument (QAMS)

Certified Reference Material (CRM):
A reference material one or more of whose property values are certified by a technically valid procedure, accompanied by or traceable to a certificate or other documentation which is issued by a certifying body. (ISO Guide 30–2.2)

Chain of Custody:
An unbroken trail of accountability that ensures the physical security of samples and includes the signatures of all who handle the samples. (NELAC) [5.12.4]

Cation:
A positively charged ion.

Chemical Analysis:
Any of a variety of laboratory methods used to evaluate the concentrations of compounds and elements present in an environmental sample.

Clean Air Act:
The enabling legislation in 42 U>S>C> 7401 et seq., Public Law 91-604, 84 Stat. 1676 Pub. L. 95-95, 91 Stat., 685 and Pub. L. 95-190, 91 Stat., 1399, as amended, empowering EPA to promulgate air quality standards, monitor and enforce them. (NELAC)

Client Complaint:
A complaint is a situation where dissatisfaction is expressed with the service provided by the laboratory.

Composite Sample:
Portions of material collected from more than one spatial location or at different times that are blended and submitted for chemical analyses. Composite samples can provide data representative of a large area with relatively few samples. However, the resulting data are less accurate with regard to the concentrations of contaminants detected in a specific location, because they represent average values.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA/SUPERFUND):
The enabling legislation in 42 U.S.C. 9601-9675 et seq., as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), 42 U.S.C. 9601 et seq., to eliminate the health and environmental threats posed by hazardous waste sites. (NELAC)

Compromised Samples:
Those samples which are improperly sampled, insufficiently documented (chain of custody and other sample records and/or labels), improperly preserved, collected in improper containers, or exceeding holding times when delivered to a laboratory. Under normal conditions, compromised samples are not analyzed. If emergency situation require analysis, the results must be appropriately qualified. (NELAC)

Concentration:
The mass of analyte per unit mass or volume of sample. Common units of concentration for environmental analyses are microgram per liter or kilogram (ug/L or ug/kg) and milligrams per liter or kilogram (mg/L or mg/kg).

Confidence interval:
For normally distributed (random) data, the intervals where 68%, 95%, and 99% of the data fall. 68% of the data should fall within 1 standard deviation of the mean, 95% of the data should fall within 2 standard deviations of the mean, and 99% of the data should fall within 3 standard deviations of the mean.

Confidential Business Information (CBI):
Information that an organization designates as having the potential of providing a competitor with inappropriate insight into its management, operation or products. NELAC and its representatives agree to safeguarding identified CBI and to maintain all information identified as such in full confidentiality.

Confirmation:
Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to:

Second column confirmation
Alternate wavelength
Derivatization
Mass spectral interpretation
Alternative detectors or
Additional Cleanup procedures
(NELAC)

Conformance:

An affirmative indication or judgement that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements. (ANSI/ASQC E4-1994)

Continuing Calibration Verification (CCV) Standard:
A mid-concentration analytical standard run periodically to verify the calibration of the analytical instrument. Also known as continuing calibration check (CCC).

Contract Laboratory Program (CLP):
A nationwide laboratory network established by the USEPA, structured to provide legally defensible analytical results to support USEPA enforcement actions or other requirements of the use community. The CLP incorporates a level of quality assurance appropriately designed for the intended usage of the data.

Control Limits:
Accuracy or precision ranges that determine whether the experimentally determined results are in control. If the results are within the acceptance ranges, the results are said to be in control; if the results are outside the limits, they are said to be out-of–control.

Corrective Action:
The action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence. (ISO 8402)

Corrective Action Report (CAR):
The CAR form is used in situations where a recurring problem or breakdown in systems is observed and warrants a more thorough investigation than a single-event NCR. CARs may be initiated from: a specific nonconformance situation (NCM), an observed trend or frequency of events that warrant corrective action, an audit finding, etc.

Correlation Coefficient:
A number (r), which indicates the degree of dependence between two variables (concentration and response). The more dependent the variables are, the closer the value is to one. This value is used to evaluate the straightness of a line, (the linearity of the instrument).

Data Audit:
A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality (i.e., that they meet specified acceptance criteria). (NELAC)

Data Reduction:
The process of transforming raw data by arithmetic or statistical calculations, standard curves, concentration factors, etc., and collation into a more useable form. (EPA-QAD)

Data Validation:
An evaluation of laboratory data quality based on a review of the data deliverables. This process involves procedures verifying instrument calibration, calibration verification, and other method-specific performance criterion.

Deficiency:
An unauthorized deviation from acceptable procedures or practices, or a defect in an item. (ASQC)

Demonstration of Capability (DOC):
Procedure to establish the ability to generate acceptable accuracy and precision. This is done initially upon starting a new method and then continues each year the method is performed.

Detection Limit:
The lowest concentration or amount of the target analyte that can be identified, measured, and reported with confidence that the analyte concentration is not a false positive value. See Method Detection Limit. (NELAC)

Direct Aqueous Injection (DAI):
A technique in which an aliquot of the aqueous sample or aqueous leachate is injected directly into the gas chromatograph with no prior sample preparation.

Disposal:
Final placement or destruction of wastes. Disposal may be accomplished through the use of landfills, treatment processes, etc.

Document Control:
The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly, and controlled to ensure use of the correct version at the location where the prescribed activity if performed. (ASQC)

Duplicate Analyses:
The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory. (EPA-QAD)

E. coli:
Bacteria giving a positive total coliform response and possessing the enzyme B-glucuronidase, which cleaves the fluorogenic substrate MUG, resulting in the release of a fluorescent product when viewed under long-wavelength UV light.

Environmental Detection Limit (EDL):
The smallest level at which a radionuclide in an environmental medium can be unambiguously distinguished for a given confidence interval using a particular combination of sampling and measurement procedures, sample size, analytical detection limit, and processing procedure. The EDL shall be specified for the 0.95 or greater confidence interval. The EDL shall be established initially and verified annually for each test method and sample matrix. (NELAC Radioanalysis Subcommittee)

Equipment Blank:
Sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures. (NELAC)

External Standard Calibration:
Calibrations for methods that do not utilize internal standards to compensate for changes in instrument conditions.

Extractable Organics:
Semivolatiles (base/neutral and acid extractable compounds) and pesticide/polychlorinated biphenyl compounds that can be partitioned into an organic solvent from the sample matrix and are amenable to gas chromatography (GC).

Fecal Coliforms:
A subset of total coliforms that grow and ferment lactose at an elevated incubation temperature (44.5°C) and are also referred to as thermotolerant coliforms. Fecal coliforms produce colonies that appear in various shades of blue, domes and glistening, ranging in size from pinpoints to several millimeters. This group consists of mostly E. Coli (EC) but also includes some other enterics. Fecal coliforms are a more specific indicator organism for contamination. This type of bacteria is associated with the fecal material of warm-blooded animals.

Federal Insecticide, Fungicide and Rodenticide Act (FIFRA):
The enabling legislation under 7 U.S.C. 135 et seq., as amended, that empowers the EPA to register insecticides, fungicides, and rodenticides. (NELAC)

Federal Water Pollution Control Act (Clean Water Act, CWA):
The enabling legislation under 33 U.S.C. 1251 et seq., Public Law 92-50086 Stat 816, that empowers EPA to set discharge limitations, write discharge permits, monitor, and bring enforcement action for non-compliance. (NELAC)

Field Blank:
Blank prepared in the field by filing a clean container with pure de-ionized water and appropriate preservative, if any, for the specific sampling activity being undertaken (EPA OSWER)

Field Control Samples:
General term assigned to field-generated replicates (duplicates/splits/spikes), blanks, background/upgradient samples, etc.

Field Duplicate Sample:
Independent sample collected at approximately the same time and place, using the same methods as another sample. The duplicate and original sample are containerized, handled, and analyzed in an identical manner.

Field of Testing:
NELAC's approach to accrediting laboratories by program, method and analyte. Laboratories requesting accreditation for a program-method-analyte combination or for an up-dated/improved method are required to submit to only that portion of the accreditation process not previously addressed (see NELAC, section 1.9ff). (NELAC)

Filtrate:
A filtered liquid.

Filtration:
The physical removal of solid particles from a liquid wastestream by passing the liquid across a filter medium, which serves as a barrier to the solid material.

Finding:

An assessment conclusion that identifies a condition having a significant effect on an item or activity. As assessment finding is normally a deficiency and is normally accompanied by specific examples of the observed condition. (NELAC)

Gas Chromatography/Mass Spectroscopy (GC/MS):
Two distinct analytical techniques used to separate and identify organic compounds: the GC is used for the separating portion and the MS is used as the detection portion of an analysis. Both techniques are typically performed by a single instrument.

Good Laboratory Practices (GLP):
Formal regulations for performing basic laboratory operations outlined in 40 CFR Part 160 and 40 CFR Part 729.

Heavy Metals:
In reference to environmental sampling, typically identified as the following trace inorganics: cadmium, lead, mercury, silver, etc. (all metals of health concern). Heavy metals can cause biological damage if consumed at low concentrations and tend to accumulate in the food chain.

Heterotrophic Bacteria:
A large group of bacteria that obtain energy by oxidizing organic matter. Coliform bacteria are a subset of this group.

Holding Times (Maximum Allowable Holding Times):
The maximum times that samples may be held prior to analyses and still be considered valid or not compromised. (40 CFR Part 136)

Homogeneous:
The quality of uniform composition.

Initial Calibration Verification (ICV):
A mid-concentration analytical standard run immediately after the calibration to verify the calibration of the analytical instrument. Also known as initial calibration check (ICC).

Inorganic Chemicals:
Chemical substances of mineral origin, not of basically carbon structure.

Inquiry:
A question or request for information about the service provided by the laboratory.

Inspection:
An activity such as measuring, examining, testing, or gauging one or more characteristics of an entity and comparing the results with specified requirements in order to establish whether conformance is achieved for each characteristic. (ANSI/ASQC E4-1994)

Instrument Blank:
A blank matrix that is the same as the processed sample matrix (i.e. extract, digestate, condensate) and introduced onto the instrument for analysis.

Instrument Detection Limit (IDL):
The minimum amount of a substance that can be measured on a specific instrument, with a specified degree of confidence that the amount is greater than zero. The IDL is associated with

the instrumental portion of a specific method only, and sample preparation steps are not considered in its derivation. An IDL value, by definition, has an uncertainty of ±100%. The IDL thus represents a range where qualitative detection occurs on a specific instrument. Quantitative results are not produced in this range.

Instrument Performance Check Solution (IPC):
A solution of one or more method analytes, surrogates, or other test substances used to evaluate the performance of the instrument system with respect to a defined set of criteria.

Intermediate or Secondary Stock Standard:
A solution made from two or more stock standards. A secondary standard may also be a certified solution purchased from a vendor as a mixture of several target analytes. Also known as a source reagent in LIMS if purchased and an intermediate reagent if prepared in the lab.

Internal Standard:
A known amount of standard added to a test portion of a sample and carried through the entire measurement process as a reference for evaluating and controlling the precision and bias of the applied analytical test method. (NELAC)

Internal Standard Calibration:
Calibrations for methods that utilize internal standards to compensate for changes in instrument conditions.

Instrument Blank:
A clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination. (EPA-QAD)

Instrument Response:
Instrument response is normally expressed as either peak area or peak height however it may also reflect a numerical representation of some type of count on a detector (e.g. Photomultiplier tube, or Diode array detector) and is used in this document to represent all types.

Job number:
A sequential number that is assigned to each client's samples upon receipt into the laboratory. This log number provides the primary means of associating the samples to the client.

Laboratory:
A defined facility performing environmental analyses in a controlled and scientific manner. (NELAC)

Laboratory Control Sample (however named, such as laboratory fortified blank, spiked blank, or QC check sample):
A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes, taken through all preparation and analysis steps. Where there is no preparation taken for an analysis (such as in aqueous volatiles), or when all samples and standards undergo the same preparation and analysis process (such as Phosphorus), there is no LCS. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

An LCS shall be prepared at a minimum of 1 per batch of 20 or less samples per matrix type per sample extraction or preparation method except for analytes for which spiking solutions are not available such as total suspended solids, total dissolved solids, total volatile solids, total solids, pH, color, odor, temperature, dissolved oxygen or turbidity. The results of these samples shall be used to determine batch acceptance.

Note: NELAC standards allow a matrix spike to be used in place of this control as long as the acceptance criteria are as stringent as for the LCS. (NELAC)

Laboratory Duplicate:
Aliquots of a sample taken from the same container under laboratory conditions and processed and analyzed independently. (NELAC)

Laboratory Fortified Blank (LFB):
An aliquot of reagent water to which known quantities of the method analytes are added in the laboratory. The LFB is analyzed exactly like a sample, and its purpose is to determine whether the methodology is in control, and whether the laboratory is capable of making accurate and precise measurements at the required method detection limit. The percent recovery (accuracy) result for the LFB must fall within the limits listed in the LIMS. Also referred to as a laboratory control standard (LCS).

Laboratory Fortified Sample Matrix (LFM):
An aliquot of an environmental sample to which known quantities of the method analytes are added in the laboratory. The LFM is analyzed exactly like a sample, and its purpose is to determine whether the sample matrix contributes bias to the analytical results. The background concentrations of the analytes in the sample matrix must be determined in a separate aliquot and the measured values in the LFM corrected for background concentrations. The percent recovery (accuracy) result for the LFM must fall within the limits listed in the LIMS. Also referred to as a matrix spike (MS).

Laboratory Fortified Sample Matrix Duplicate (LFMD):
A replicate laboratory fortified sample matrix.

Laboratory Performance Check Solution (LPC):
A solution of selected method analytes used to evaluate the performance of the instrumental system with respect to a defined set of method criteria.

Laboratory Quality Manual (LQM):
A document stating the quality policy, quality system and quality practices of the laboratory. The LQM may include by reference other documentation relating to the laboratory's quality system. Also referred to as the Quality Assurance Manual (QAM) or Quality Assurance Plan (QAP).

Laboratory Reagent Blank (LRB):
An aliquot of reagent water that is treated exactly as a sample including exposure to all glassware, equipment, solvents, reagents, internal standards, and surrogates that are used with other samples. The LRB is used to determine if method analytes or other interferences are present in the laboratory environment, the reagents, or the apparatus. Also referred to as a method blank (MB).

Leachate:

The liquid portion of a sample that passes through a 0.6μm filter in the initial evaluation of the percent solids, or the liquid that passes through a 0.6μm filter after the sample has been subjected to the TCLP. The liquid produced by subjecting the sample to the SPLP method.

Least Squares Regression (1st Order Curve):
The least squares regression is a mathematical calculation of a straight line over two axes. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The regression calculation will generate a correlation coefficient (r) that is a measure of the "goodness of fit" of the regression line to the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r must be greater than or equal to 0.99 for organics and 0.995 for inorganics.

Limit of Detection (LOD):
An estimate of the minimum amount of a substance that an analytical process can reliably detect. An LOD is analyte- and matrix-specific and may be laboratory dependent. (Analytical Chemistry, 55, p.2217, December 1983, modified) See also Method Detection Limit.

Liquid phase:
The portion of the sample that passes through the 0.6-0.8□m filter when subjected to a pressure of 50psi during the TCLP or SPLP process.

Manager (however named):
The individual designed as being responsible for the overall operation, all personnel, and the physical plant of the environmental laboratory. A supervisor may report to the manager. In some cases, the supervisor and the manager may be the same individual. (NELAC)

Mass Spectrometry (MS):
A detection instrument that differentiates compounds by their differences in mass, or mass fragments. The basic components of the MS are the ion source and lenses, the mass filter (quadrapoles), and the electron multiplier. The ion source and lenses create the ions and propel them on a consistent path to the quadrapoles. The quadrapoles filter the ions that are produced in the source, allowing them to continue to the electron multiplier, where the ions are collected and the signal sent to the data sytem.

Mass Spectra:
A graphical representation of the abundance of the mass ions produced when a compound is detected by mass spectrometry. The mass spectrum is essentially a fingerprint of the compound and along with the retention time of the compound provides excellent qualitative information about the presence of the compound.

Matrix:
The component or substrate that contains the analyte of interest. For purposes of batch and QC requirement determinations, the following matrix distinctions shall be used:

> Aqueous: Any aqueous sample excluded from the definition of Drinking Water matrix or Saline/Estuarine source. Includes surface water, groundwater, effluents, and TCLP or other extracts.
>
> Drinking Water: any aqueous sample that has been designated as a potable or potential potable water source.

Saline/Estuarine: any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake.

Non-aqueous Liquid: any organic liquid with <15% settleable solids.

Biological Tissue: any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.

Solids: includes soils, sediments, sludges, and other matrices with >15% settleable solids.

Chemical Waste: a product or by-product of an industrial process that results in a matrix not previously defined.

Air: whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbant tube, impinger solution, filter, or other device. (NELAC)

Matrix Duplicate (MD):
Duplicate aliquot of a sample processed and analyzed independently; under the same laboratory conditions; also referred to as Sample Duplicate; Laboratory Duplicate.

Matrix Spike (spiked sample or fortified sample):
Prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.
Matrix spikes shall be performed at a frequency of one in 20 samples per matrix type per sample extraction or preparation method except for analytes for which spiking solutions are not available such as, total suspended solids, total dissolved solids, total volatile solids, total solids, pH, color, odor, temperature, dissolved oxygen or turbidity. The selected sample(s) shall be rotated among client samples so that various matrix problems may be noted and/or addressed. Poor performance in a matrix spike may indicate a problem with the sample composition and shall be reported to the client whose sample was used for the spike. (QAMS)

Matrix Spike Duplicate (spiked sample or fortified sample duplicate):
A second replicate matrix spike is prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte.

Matrix spike duplicates or laboratory duplicates shall be analyzed at a minimum of 1 in 20 samples per matrix type per sample extraction or preparation method. The laboratory shall document their procedure to select the use of an appropriate type of duplicate. The selected sample(s) shall be rotated among client samples so that various matrix problems may be noted and/or addressed. Poor performance in the duplicates may indicate a problem with the sample composition and shall be reported to the client whose sample was used for the duplicate. (QAMS)

Method Blank:
A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target

analytes or interferences are present at concentrations that impact the analytical results for sample analyses. (NELAC)

Method Detection Limit:
The minimum concentration of a substance (an analyte) that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. (40 CFR Part 136, Appendix B)
The MDL is defined as:

$$MDL = SD \otimes t(0.99)$$

SD = standard deviation of the replicates
t(0.99) = Student's t-Value at the 99% confidence level for number of replicates

Most Probable Number (MPN):
An estimate of the mean density of coliforms in a sample based on certain probability formulas.

National Environmental Laboratory Accreditation Conference (NELAC):
A voluntary organization of State and Federal environmental officials and interest groups purposed primarily to establish mutually acceptable standards for accrediting environmental laboratories. A subset of NELAP. (NELAC)

National Environmental Laboratory Accreditation Program (NELAP):
The overall National Environmental Laboratory Accreditation Program of which NELAC is a part. (NELAC)

Neat standard:
A pure compound, element, or salt that contains the target analyte. The purity, usually expressed as a percent, of the neat standard must be known. Also known as a source reagent in LIMS.

Negative Control:
Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results. (NELAC)

NELAC Standards:
The plan of procedures for consistently evaluating and documenting the ability of laboratories performing environmental measurements to meet nationally defined standards established by the National Environmental Laboratory Accreditation Conference. (NELAC)

Non-conformance:
Any occurrence that prevents the lab from delivering data that is compliant with the control criteria published (or incorporated by reference) in an applicable QA plan. The Non-conformance Module is used to document nonconformance conditions and to specify the necessary action(s) taken to correct the specific problem.
Organic:
Referring to or derived from living organisms; any compound containing carbon.

Parts Per Billion (ppb):
One part of analyte per billion parts of sample. For aqueous samples, a ppb is equivalent to ug/L; for soils, ug/kg.

Parts Per Million (ppm):
One part of analyte per million parts of sample. For aqueous samples, a ppm is equivalent to mg/L; for soils, mg/kg.

Peak Gaussian Factor (PGF):
A means to measure peak symmetry and monitoring retention time drift over time. Critically evaluate peak in the instrument performance check sample, and calculate the PGF as follows,

$$PGF = \frac{1.83 \otimes W(1/2)}{W(1/10)}$$

where:
W(1/2) is the peak width at half height
W(1/10) is the peak width at tenth height

Percent Recovery:
Percent recovery is used to assess accuracy and is calculated:

where:
Cexperimental = experimentally determined concentration
Cknown = known or theoretical concentration

Percent Solids:

$$\%REC = \frac{C\exp erimental}{Cknown} \otimes 100$$

The proportion of solid in a soil sample determined by drying an aliquot of the sample.

Performance Audit:
The routine comparison of independently obtained qualitative and quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory. (NELAC)

Performance Based Measurement System (PBMS):
A set of processes wherein the data quality needs, mandates or limitations of a program or project are specified and serve as criteria for selecting appropriate test methods to meet those needs in a cost-effective manner. (NELAC)

pH:
A numerical designation of relative acidity or basicity (Alkalinity). A pH of 7 indicates neutrality; lower values indicate increasing acidity; high values indicate increasing alkalinity.

Precision:
The agreement between two or more experimentally determined results. Precision is routinely expressed as the relative percent difference between two results. Precision is not routinely used as a measurement to determine if the analysis is in control but may be required for certain programs and agencies.

Positive Control:

Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects. (NELAC)

Post-Digestion Spike:
Addition of a known concentration of analyte to an aliquot of sample after the preparation steps have been performed.

Preservation:
Refrigeration and or reagents added at the time of sample collection to maintain the chemical, physical and/or biological integrity of the sample. Methods used to retard degradation of chemical analytes within samples by inhibiting decomposition by biological action, chemical reactions, and reducing sorption effects. Methods include limiting headspace, chemical, acid, or base addition, protection from light, cooling, etc.

Precision:
The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms. (NELAC)

Preservation:
Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical and/or biological integrity of the sample. (NELAC)

Preventive Action:
The pro-active process of noting and correcting a potential problem before it happens due to a weakness in a system, method, or procedure.

Procedural Standard Calibration:
A calibration method where aqueous calibration standards are prepared and processed (e.g., purged, extracted, and/or derivatized) in exactly the same manner as a sample. All steps in the process from addition of sampling preservatives through instrumental analyses are included in the calibration. Using procedural standard calibration compensates for any inefficiency in the processing procedure.

Proficiency Testing:
A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source. (NELAC) [2.1]

Proficiency Testing Program:
The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results and the collective demographics and results summary of all participating laboratories. (NELAC)

Proficiency Test Sample (PT):
A sample, the composition of which is unknown to the analyst and is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance criteria. (QAMS)

Quality Assurance:

An integrated system of activities involving planning, quality control, quality assessment, reporting and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence. (QAMS)

Quality Assurance [Project] Plan (QAPP):
A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved. (EAP-QAD)

Quality Control:
The overall system of technical activities which purpose is to measure and control the quality of a product or service so that it meets the needs of users. (QAMS)

Quality Control Sample:
An uncontaminated sample matrix spiked with known amounts of analytes from a source independent from the calibration standards. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system. (EPA-QAD)

Quality Manual:
A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users. (NELAC)

Quality System:
A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC (ANSI/ASQC-E-41994)

Quantitation Limit (QL):
The lowest point at which a substance can be quantitatively measured with a specified degree of confidence using a specific method. The QL can be based on the MDL, and is generally calculated as 3-5 times the MDL, however, there are analytical techniques and methods where this relationship is not applicable. Also referred to as Practical Quantitation Level (PQL) or Reporting Limit (RL).

Quantitation Limits:
The maximum or minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be quantified with the confidence level required by the data user. (NELAC)

Range:
The difference between the minimum and the maximum of a set of values. (EPA-QAD)

Raw Data:
Any original information from a measurement activity or study recorded in laboratory notebooks, worksheets, records, memoranda, notes, or exact copies thereof and that are necessary for the reconstruction and evaluation of the report of the activity or study. Raw data may include photography, microfilm or microfiche copies, computer printouts, magnetic/optical media, including dictated observations, and recorded data from automated instruments. Reports

specifying inclusion of "raw data" do not need all of the above included, but sufficient information to create the reported data.

Reagent:
A material that is used in a process or analysis but is not directly related to the measured analyte concentration.

Reagent Blank (method reagent blank):
A sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and of the involved analytical steps. (QAMS)

Reference Material:
A material or substance one or more properties of which are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. (ISO Guide 30-2.1)

Reference Method:
A method of known and documented accuracy and precision issued by an organization recognized as competent to do so. (NELAC)

Reference Standard:
A standard, generally of the highest metrological quality available at a given location, from which measurements made at that location are derived. (VIM-6.0-8)

Regulatory Threshold Limit:
The concentration of analyte in the TCLP leachate at which the sample is deemed hazardous.

Relative Percent Difference:
The relative percent difference is calculated between the concentrations of two spikes or sample duplicates:

Where:
C_1 = concentration of the sample or spike
C_2 = concentration of the sample duplicate or spike duplicate

Replicate Analyses:
The measurements of the variable of interest performed identically on two or more sub-samples of the same sample within a short time interval. (NELAC)

Reporting Limit (RL):
Defines the lowest concentration that can be reported with reasonable certainty that the result falls within the laboratories' accuracy and precision limits. Also referred to as the practical

$$\%RPD = \left| \frac{(C1 - C2)}{\frac{C1 + C2}{2}} \right| \otimes 100$$

quantitation limit or PQL, the RL is usually defined as the lowest point in the calibration curve or the sample equivalent concentration of the lowest point in the calibration curve.

Representativeness:

A qualitative measure of the extent to which a sample(s) acquired from a medium describes the chemical characteristics of that medium.

Requirement:
Denotes a mandatory specification; often designated by the term "shall". (NELAC)

Resolution:
Also known as separation, or percent resolution. The separation between peaks on a chromatogram, calculated by dividing the depth of the valley between the peaks by the peak height of the smallest peak being resolved, and multiplied by 100.

Resource Conservation and Recovery Act (RCRA):
The enabling legislation under 42 USC 321 et seq. (1976), that gives EPA the authority to control hazardous waste from the "cradle-to-grave", including its generation, transportation, treatment, storage, and disposal. (NELAC)

Safe Drinking Water Act (SDWA):
The enabling legislation, 42 USC 300f et seq. (1974), (Public Law 93-523), that requires the EPA to protect the quality of drinking water in the U.S. by setting maximum allowable contaminant levels, monitoring, and enforcing violations. (NELAC)

Sample:
A portion of material collected for chemical analyses. Note that a sample is identified by a unique sample number and that the term and the number may apply to multiple sample containers, if a single sample is submitted for a variety of chemical analyses.

Sample Duplicate:
Two samples taken from and representative of the same population and carried through all steps of the sampling and analytical procedures in an identical manner. Duplicate samples are used to assess variance of the total method including sampling and analysis. (EPA-QAD)

Sampling and Analysis Plan (SAP):
A formal document describing the detailed sampling and analysis procedures for a specific project.

Second Order Polynomial Curve (Quadratic): The 2nd order curves are a mathematical calculation of a slightly curved line over two axis. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The 2nd order regression will generate a coefficient of determination (COD or r^2) that is a measure of the "goodness of fit" of the quadratic curvature the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r^2 must be greater than or equal to 0.99.

Secondary or Intermediate Stock Standard:
A solution made from two or more stock standards. A secondary standard may also be a certified solution purchased from a vendor as a mixture of several target analytes. Also known as a source reagent in LIMS if purchased and an intermediate reagent if prepared in the lab.

Selectivity:
(Analytical chemistry) the capability of a test method or instrument to respond to a target substance of constituent in the presence of non-target substances. (EPA-QAD)

Semivolatile Organics:
Compounds that are amenable to analysis by extraction of the sample with an organic solvent. The term semivolatile organic is used synonymously with base/neutral/acid (BNA) compounds.

Sensitivity:
The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. (NELAC)

Solvent:
The organic liquid used to extract the compounds of interest out of the sample matrix. The solvent is also used to dissolve (put into solution) standards. In general, the solvent used to prepare the standards is also used to extract the samples. A good rule of thumb is that "like dissolves like", that is, a solvent must be similar in chemical structure to the compound that is being extracted or being dissolved. For most organic extractions, the solvent should also not be miscible (dissolves in all proportions) with water.

Spike:
A known mass of target analyte added to a blank, sample or sub-sample; used to determine recovery efficiency or for other quality control purposes.

If the mandated or requested test method does not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample and Matrix Spike. However, in cases where the components interfere with accurate assessment (such as simultaneously spiking chlordane, toxaphene and PCBs in Method 608), the test method has an extremely long list of components or components are incompatible, a representative number (at a minimum 10%) of the listed components may be used to control the test method. The selected components of each spiking mix shall represent all chemistries, elution patterns and masses permit specified analytes and other client requested components. However, the laboratory shall ensure that all reported components are used in the spike mixture within a two-year time period. (NELAC)

Standard:
The document describing the elements of laboratory accreditation that has been developed and established within the consensus principles of NELAC and meets the approval requirements of NELAC procedures and policies. (ASQC)

Standard Operating Procedures (SOPs):
A written document which details the method of an operation, analysis, or action whose techniques and procedures are thoroughly prescribed and which is accepted as the method for performing certain routine or repetitive tasks. (QAMS)

Standardized Reference Material (SRM):
A certified reference material produced by the U.S. National Institute of Standards and Technology or other equivalent organization and characterized for absolute content, independent of analytical method. (EPA-QAD)

Stock standard:
A solution made from one or more neat standards. The stock standard will usually have a high concentration, usually higher than 1000mg/L (1000ug/mL). This standard can also be purchased from a certified vendor. Also known as a source reagent in LIMS.

Storage Blank:
A blank matrix stored with field samples of a similar matrix.

Supervisor (however named):
The individual(s) designated as being responsible for a particular area or category of scientific analysis. This responsibility includes direct day-to-day supervision of technical employees, supply and instrument adequacy and upkeep, quality assurance/quality control duties, and ascertaining that technical employees have the required balance of education, training and experience to perform the required analyses. (NELAC)

Surrogate:
A substance with properties that mimic the analyte of interest. It is unlikely to be found in environment samples and is added to them for quality control purposes.

Surrogate compounds must be added to all samples, standards, and blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. Poor surrogate recovery may indicate a problem with sample composition and shall be reported to the client whose sample produced poor recovery. (QAMS)

Suspended Metals:
The concentration of metals determined in the portion of a sample that is retained on a 0.45-µm filter. (The concentration of suspended metals may also be calculated from the difference between the total metals sample results minus the dissolved metals sample results.)

Systems Audit (also Technical Systems Audit):
A thorough, systematic, qualitative on-site assessment of the facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a total measurement system. (EPA-QAD)

System Performance Check Compounds (SPCCs):
Term used in conjunction with SW-846, Method 8260 and 8270, to refer to the compounds in which the response factor (RF) is evaluated against method-prescribed criteria to decide the validity of a calibration.

Target Analyte List (TAL):
Refers to the Contract Lab Program (CLP) list of inorganic analytes that includes metals and cyanide. May also refer to any general list of inorganic target analytes.

Target Compound List (TCL):
Refers to the Contract Lab Program (CLP) list of organic compounds that includes volatiles (GC/MS), semivolatiles (GC/MS), and pesticides and PCBs (GC/EC). May also refer to any general list of organic target compounds.

Technical Director:
Individuals(s) who has overall responsibility for the technical operation of the environmental testing laboratory. (NELAC)

Test:
A technical operation that consists of the determination of one or more characteristics or performance of a given product, material, equipment, organism, physical phenomenon, process,

or service according to a specified procedure. The result of a test is normally recorded in a document sometimes called a test report or a test certificate. (ISO/IEC Guide 2-12.1, amended)

Test Method:
An adoption of a scientific technique for a specific measurement problem, as documented in a laboratory SOP. (NELAC)

Total Coliforms:
Gram-negative, facultative anaerobic rod-shaped enteric bacteria that ferment lactose to produce colonies with a metallic sheen (yellow to green) when viewed under a fluorescent lamp or acid and gas within 48 hours incubated at 35°C. All bacteria possessing the enzyme B-D-galactosidase, which cleaves the chromogenic substrate ONPG, resulting in release of a chromogen that produces a color change in the sample. They are used as an indicator of contamination in samples although some total coliform bacteria are found naturally in environmental samples. This type of bacteria is commonly found in the intestines of humans.

Total Metals:
Concentration of metals determined in an unfiltered water sample which is preserved (acidified) in the field, transported to the laboratory, and then follows a rigorous digestion.

Total Recoverable Metals:
Concentration of metals in an unfiltered water sample which is preserved (acidified) in the field and transported to the lab, which then performs the digestion with hot dilute mineral acid. This preparation method is typically utilized for drinking water samples and TCLP extracts.

Toxic Substances Control Act (TSCA):
The enabling legislation in 15 USC 2601 et seq., (1976) that provides for testing, regulating, and screening all chemicals produced or imported into the United States for possible toxic effects prior to commercial manufacture. (NELAC)

Traceability:
The property of a result of a measurement whereby it can be related to appropriate standards, generally international or national standards, through an unbroken chain of comparisons. (VIM-6.12)

Trip Blank:
Samples prepared by adding clean, analyte-free water to sample containers for analysis for volatile organics. Preservatives are added to the blank, and the containers are sealed prior to the sampling trip. Trip blanks are transported with empty sample containers to the site of work and remain sealed until analyzed with collected environmental samples. Trip blanks permit evaluation of contamination generated from sample containers or occurring during the shipping and laboratory storage process.

Tune:
To adjust the parameters of the mass spectrometer in order to meet the mass calibration criteria.

Uncertainty:
A parameter associated with the result of a measurement that characterizes the dispersion of the value that could reasonably be attributed to the measured value.

United States Environmental Protection Agency (EPA):
The Federal governmental agency with responsibility for protecting public health and safeguarding and improving the natural environment (i.e., the air, water, and land) upon which human life depends. (US-EPA)

Validation:
The process of substantiating specified performance criteria. (EPA-QAD)

Verification:
Confirmation by examination and provision of evidence that specified requirements have been met. (NELAC)

NOTE: In connection with the management of measuring equipment, verification provides a means for checking that the deviations between values indicated by a measuring instrument and corresponding known values of a measured quantity are consistently smaller than the maximum allowable error defined in a standard, regulation or specification peculiar to the management of the measuring equipment.
The result of verification leads to a decision either to restore in service, to perform adjustment, to repair, to downgrade, or to declare obsolete. In all cases, it is required that a written trace of the verification performed shall be kept on the measuring instrument's individual record.

Volatile Organic Compound (VOC):
An organic compound that is amenable to purge and trap analysis. In general, VOC have low boiling pints (<200°C), high vapor pressures (tend to evaporate easily as low temperatures), and have low molecular weight (generally less than 300 amu).

Work Cell:
A well-defined group of analysts that together perform the method analysis. The members of the group and their specific functions within the work cell must be fully documented. (NELAC)

Working Standard:
The standard that is analyzed on the instrument or using the analytical procedure. Also known as an intermediate reagent in LIMS.

Acronyms:

ACRONYM	DEFINTION
A2LA	American Association for Laboratory Accreditation
AA	Atomic Absorption
AFCEE	Air Force Center for Environmental Excellence
AL	Action Level
ASTM	American Society for Testing and Materials
BFB	Bromofluorobenzene
bgs	Below Ground Surface
BNA	Base, Neutral, Acids (Semivolatile Organics)
BOD	Biochemical Oxygen Demand
BS	Blank Spike
BSD	Blank Spike Duplicate
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
BTU	British Thermal Unit
CA	Corrective Action
CAA	Clean Air Act
CAR	Corrective Action Report
CBOD	Carbonaceous Biochemical Oxygen Demand
CCB	Continuing Calibration Blank
CCC	Calibration Check Compounds
CCV	Continuing Calibration Verification
CDC	Continuing Demonstration of Capability
CDOC	Continuing Demonstration of Capability
CDQO	Chemical Data Quality Objective
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act

ACRONYM	DEFINTION
MRF*	Method Request Form
MRL	Method Reporting Limit
MS	Mass Spectrometer
MS	Matrix Spike
MS/MS	Tandem Mass Spectrometry
MSA	Method of Standard Additions
MSD	Matrix Spike Duplicate
MSDS	Material Safety Data Sheet
MW	Monitoring Well
NBS	National Bureau of Standards
NCASI	National Counsel for Air and Stream Improvement, Inc.
NCM*	Non-Conformance Module
NCR	Non-Conformance Report
NELAC	National Environmental Laboratory Accreditation Conference
NELAP	National Environmental Laboratory Accreditation Program
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
nm	Nanometer
NPD	Nitrogen – Phosphorus Detector
NPDES	National Pollutant Discharge Elimination System
NPW	Non-Potable Water
ORO	Oil Range Organics
OSHA	Occupational Safety and Health Administration
OSTR*	Outstanding SOP Training Report

ACRONYM	DEFINTION
CF	Calibration Factor
CFR	Code of Federal Regulations
CLLE	Continuous Liquid-Liquid Extraction
CLP	Contract Laboratory Program
COA	Certificate of Analysis
COC	Chain of Custody
COD	Chemical Oxygen Demand
CRDL	Contract Required Detection Limit
CRF	Change Request Form
CRQL	Contract Required Quantitation Limit
CSM*	Corporate Safety Manual
CU	Custody
CVAA	Cold Vapor Atomic Absorption
CWA	Clean Water Act
DAI	Direct Aqueous Injection
DFTPP	Decafluorotriphenylphosphate
DM	Department Manager
DO	Dissolved Oxygen
DOC	Demonstration of Capability
DOD	Department of Defense
DOD QSM	Department of Defense Quality Systems Manual
DOE	Department of Energy
DOT	Department of Transportation
DQO	Data Quality Objective
DRO	Diesel Range Organics
DU	Duplicate
DUP	Duplicate
DW	Drinking Water
ECD	Electron Capture Detector
EDD	Electronic Data Deliverable
EDQM	Environmental Data Quality Management
EHS	Environmental Health and Safety
EHSD	Environmental Health and Safety Director

ACRONYM	DEFINTION
PAH	Polynuclear Aromatic Hydrocarbon
PARCC	Precision, Accuracy, Representativeness, Comparability, and Completeness
PCB	Polychlorinated Biphenyl
PDA	Photodiode Array
PDS	Post Digestion Spike
PE	Performance Evaluation
PGF	Peak Gaussian Factor
PID	Photoionization Detector
PM	Project Manager
PNA	Polynuclear Aromatic Hydrocarbon
PP	Project Plan
ppb	Parts Per Billion
PPE	Personnel Protective Equipment
PPL	Priority Pollutant List
ppm	Parts Per Million
ppq	Part Per Quadrillion
ppt	Parts Per Trillion
PQL	Practical Quantitation Limit
PRG	Preliminary Remediation Goals
PT	Proficiency Test
PTFE	Polytetrafluoroethylene
PVC	Polyvinyl Chloride
PW	Potable Water
PWS	Public Water System
QA	Quality Assurance
QAM	Quality Assurance Manager
QAM	Quality Assurance Manual
QAMP	Quality Assurance Management Plan
QAN*	Quality Assurance Navigator
QAP	Quality Assurance Plan
QAPjP	Quality Assurance Project Specific Plan
QAPP	Quality Assurance Project Plan
QAS	Quality Assurance Specialist

ACRONYM	DEFINTION
ELCD	Electrolytic Conductivity Detector
EPA	U.S. Environmental Protection Agency
ERPIMS	Environmental Resources Program Information Management System
eV	Electron Volt
FID	Flame Ionization Detector
FPD	Flame Photometric Detector
GALP	Good Automated Laboratory Practices
GC	Gas Chromatograph or Gas Chromatography
GC/MS	Gas Chromatograph/Mass Spectrometer
GE	General
GFAA	Graphite Furnace Atomic Absorption
GLP	Good Laboratory Practices
GPC	Gel Permeation Column (Gel Permeation Chromatography)
GRO	Gasoline Range Organics
HAA	Haloacetic Acids
HAPS	Hazardous Air Pollutants
HAZMAT	Hazardous Materials
HDPE	High Density Polyethylene
HECD	Electrolytic Conductivity Detector
HPLC	High Performance Liquid Chromatography
HRGC/HRMS	High Resolution Gas Chromatography/Hugh Resolution Mass Spectrometry
HT	Holding Time
HTRW	Hazardous, Toxic, and Radioactive Waste
HTV	Holding Time Violation
IC	Ion Chromatography
IC/EC	Ion Chromatography/Electric Conductivity
IC/MS	Ion Chromatography/Mass Spectrometer
ICAP	Inductively Coupled Argon Plasma Emission Spectroscopy

ACRONYM	DEFINTION
QC	Quality Control
QCS	Quality Control Sample
QCSR	Quality Assurance Summary Report
QL	Quantitation Limit
QMP	Quality Management Plan
QSM	Quality Systems Manual
RCRA	Resource Conservation Recovery Act
RF	Response Factor
RI	Remedial Investigation
RL	Reporting Limit
RPD	Relative Percent Difference
RRF	Relative Response Factor
RRT	Relative Retention Time
RSD	Relative Standard Deviation
RT	Retention Time
RTW	Retention Time Window
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SD	Standard Deviation
SD	Sample Dilution
SD	Sample Duplicate
SDG	Sample Delivery Group
SDWA	Safe Drinking Water Act
SG	Semi Volatile Gas Chromatography
SIM	Selected Ion Monitoring
SM	Semi Volatile Mass Chromatography
SOC	Synthetic Organic Compound
SOP	Standard Operating Procedure

ACRONYM	DEFINTION
ICB	Initial Calibration Blank
ICCS	Interference Calibration Check Sample
ICOC	Internal Chain of Custody
ICP	Inductively Coupled Argon Plasma Emission Spectroscopy
ICP/MS	Inductively Coupled Plasma/Mass Spectrometer
ICS	Interference Check Sample
ICV	Initial Calibration Verification
IDC	Initial Demonstration of Capability
IDL	Instrument Detection Limit
IDOC	Initial Demonstration of Capability
IH	Industrial Hygiene
IPC	Instrument Performance Check Standard
IR	Infrared Radiation
IS	Internal Standard
ISO	International Standards Organization
ISTD	Internal Standard
LC	Liquid Chromatography
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LFB	Laboratory Fortified Blank
LFM	Laboratory Fortified Matrix
LFMD	Laboratory Fortified Matrix Duplicate
LIMS	Laboratory Information Management System
LM	Laboratory Manager
LOD	Limit of Detection
LOQ	Limit of Quantitation
LPC	Laboratory Performance Check
LQM	Laboratory Quality Manual
LRB	Laboratory Reagent Blank
LUFT	Leaking Underground Fuel Tank
LUST	Leaking Underground Storage Tank

ACRONYM	DEFINTION
SOW	Scope of Work Statement of Work
SPCC	System Performance Check Compound
SPE	Solid Phase Extraction
SPLP	Synthetic Precipitation Leaching Procedure
SR	Shipping and Receiving
SRM	Standard Reference Material
SS	Suspended Solids
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
SVOC	Semi Volatile Organic Compound
SW-846	Solid Waste Analytical Protocols
TAL	Target Analyte List
TAT	Turn-Around-Time
TCL	Target Compound List
TCLP	Toxicity Characteristic Leachate Procedure
TDS	Total Dissolved Solids
TEPH	Total Extractable Petroleum Hydrocarbons
THM	Trihalomethanes
TIC	Tentatively Identified Compound
TKN	Total Kjeldahl Nitrogen
TM	Technical Manager
TOC	Total Organic Carbon
TOX	Total Organic Halides
TPH	Total Petroleum Hydrocarbons
TRPH	Total Recoverable Petroleum Hydrocarbons
TS	Total Solids
TSD	Thermionic Specific Detector
TSS	Total Suspended Solids
TVPH	Total Volatile Petroleum Hydrocarbons
TVS	Total Volatile Solids
UCL	Upper Confidence Level

ACRONYM	DEFINTION
MB	Method Blank
MB	Microbiology
MBAS	Methylene Blue Active Substances
MCL	Maximum Contaminant Level
MCT	Maximum Conductivity Threshold
MD	Matrix Duplicate
MDL	Method Detection Limit
ME	Metals
µg/L	Microgram per Liter
mg/L	Milligram per Liter
MLG*	Method Limit Group
µm	Micrometer
MPN	Most Probable Number

ACRONYM	DEFINTION
UCMR	Unregulated Contaminant Monitoring Rule
US EPA	United States Environmental Protection Agency
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USGS	United States Geological Service
UST	Underground Storage Tank
UV	Ultraviolet
VG	Volatile Gas Chromatography
VM	Volatile Mass Chromatography
VOA	Volatile Organic Analysis / Volatile Organic Analyte
VOC	Volatile Organic Compound
ZHE	Zero Headspace Extraction

Appendix 3. Laboratory Certifications, Accreditations, Validations

TestAmerica Savannah maintains certifications, accreditations, certifications, and validations with numerous state and national entities. Programs vary but may include on-site audits, reciprocal agreements with another entity, performance testing evaluations, review of the QA Manual, Standard Operating Procedures, Method Detection Limits, training records, etc. At the time of this QA Manual revision, the laboratory has accreditation/certification/licensing with the following organizations:

Organization	Certification Number or Laboratory ID Number
A2LA (DoD ELAP)	0399-01
A2LA (ISO/IEC 17025)	0399-01
Alabama	41450
Arizona	AZ0741
Arkansas	88-0692
Arkansas (SDWA)	N/A
California	3217CA
Colorado	N/A
Connecticut	PH-0161
Delaware	N/A
Florida	E87052
Georgia (SDWA)	803
Georgia	N/A
Georgia (Micro)	803
Guam	09-005r
Hawaii	N/A
Illinois	200022
Indiana	N/A
Iowa	353
Kansas	E-10322
Kentucky (UST)	18
Kentucky	90084
Louisiana	30690
Louisiana (SDWA)	LA100015
Maine	GA0006
Maryland	250

Organization	Certification Number or Laboratory ID Number
Massachusetts	M-GA006
Michigan	9925
Mississippi	N/A
Montana	CERT0081
Nebraska	TestAmerica-Savannah
Nevada	GA6
New Jersey	GA769
New Mexico	N/A
New York	10842
North Carolina (SDWA)	13701
North Carolina	269
Oklahoma	9984
Pennsylvania	68-00474
Puerto Rico	GA00006
Rhode Island	LAO00244
South Carolina	98001
Tennessee	TN02961
Texas	T104704185-08-TX
USDA	SAV 3-04
Vermont	87052
Virginia	302
Washington	C1794
West Virginia	94
West Virginia (SDWA)	9950C
Wisconsin	999819810
Wyoming	8TMS-Q

The certificates and parameter lists (which may differ) for each organization may be found on the corporate web site, the laboratory's public server, the final report review table, and in the following offices: QA, marketing, and project management.

Laboratory SOPs

MERCURY PREPARATION AND ANALYSIS

(Methods: EPA 245.1, EPA 7470A, EPA 7471A, EPA 7471B, and SM3112B)

Approvals (Signature/Date):

November 22, 2010
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November 29, 2010
Benjamin Gulizia — Date
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December 7, 2010
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January 20, 2011
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1.0 Scope and Application

This SOP gives the procedures for the determination of mercury by cold vapor atomic absorption spectrophotometry (CVAA). The routine matrices performed by this procedure are waters and soils; however, this procedure may be adapted to accommodate other matrices as outlined in Section 16.1.

The reporting limits (RL), the method detection limits (MDL), and the accuracy and precision criteria associated with this procedure are provided in the LIMS Method Limit Groups (MLGs).

This SOP was written by and for TestAmerica's Savannah laboratory.

2.0 Summary of Method

This procedure is based on the absorption of characteristic radiation at 253.7nm by mercury vapor. After digestion, to convert all forms of mercury to the same oxidation state, the mercury ions are reduced to mercury by the addition of stannous chloride and aerated from solution after passing through a mixing coil. The mixture passes through a gas/liquid separator and through a drying tube. The vapor is passed through a flow cell positioned in the light path of an atomic absorption spectrophotometer. Mercury concentration is measured as a function of absorbance.

This SOP is based on the following methods: EPA 7470A (liquids), EPA 7471A (solids), EPA 7471B (solids), SM3112B, and EPA 245.1.

3.0 Definitions

Refer to the Glossary Section of the *Quality Assurance Manual* (QAM) for a complete listing of applicable definitions and acronyms.

4.0 Interferences

4.1 Procedural Interferences

4.1.1 Interferences may be caused by contaminants in solvents, reagents, glassware, and other sample processing apparatus and can make identification and/or quantification of the target analytes difficult.

4.1.2 All sample collection containers are single-use disposable containers which limits the potential for contamination. All non-disposable labware must be scrupulously cleaned in accordance with the posted Labware Cleaning Instructions to ensure it is free from contaminants and does not contribute artifacts.

4.1.3 High purity reagents and solvents are used to help minimize interference problems. Hydrochloric acid, nitric acid, and sulfuric acid must be verified prior to use in accordance with the TestAmerica Solvent Lot Testing Program.

4.1.4 Instrument and/or method blanks are routinely used to demonstrate all reagents and apparatus are free from interferences under the conditions of the analysis.

4.2 Matrix Interferences

4.2.1 Matrix interferences may be caused by contaminants that are co-extracted from the sample matrix. The sample may require cleanup or dilution prior to analysis to reduce or eliminate the interferences.

4.2.2 Interfering contamination may occur when a sample containing low concentrations of analytes is analyzed immediately following a sample containing relatively high concentrations of analytes. As such, samples known to be clean should be analyzed first. To prevent carryover into subsequent samples, analysis of reagent blanks may be needed after the analysis of a sample containing high concentrations of analytes.

4.2.3 Potassium permanganate is added to eliminate the possibility of interference from sulfide and certain organic compounds.

4.2.4 High levels of residual chlorine (such as those produced when seawaters, brines, and industrial effluents high in chlorides are digested) are known to interfere with this analysis. Addition of extra potassium permanganate may be needed during the digestion of samples containing chloride. Also, the samples are not capped tightly during digestion so that excess chlorine can escape.

4.2.5 Interferences have been reported for waters containing sulfide, chloride, copper and tellurium. Organic compounds which have broad band UV absorbance (around 253.7 nm) are confirmed interferences. The concentration levels for interferants are difficult to define. This suggests that quality control procedures must be strictly followed.

4.2.6 Volatile materials (e.g., chlorine) which absorb at 253.7 nm will cause a positive interference. In order to remove any interfering volatile materials, the dead air space in the digestion vessel should be purged before addition of stannous chloride solution.

5.0 Safety

Employees must abide by the policies and procedures in the TestAmerica Environmental Health and Safety Manual (EHSM), the TestAmerica Savannah Addendum to the EHSM, and this document.

This procedure may involve hazardous materials, operations, and equipment. This SOP does not purport to address all of the safety problems associated with its use. It is the responsibility of the user to follow appropriate safety, waste disposal, and health practices under the assumption that all samples and reagents are potentially hazardous.

The analyst must protect himself/herself from exposure to the sample matrix. Many of the samples that are tested may contain hazardous chemical compounds or biological organisms. The analyst must, at a minimum, wear protective clothing (lab coat), eye protection (safety glasses or face shield), disposable latex or nitrile gloves, and closed-toe, nonabsorbent shoes when handling samples.

5.1 Specific Safety Concerns or Requirements

Nitric and hydrochloric acids are extremely hazardous as oxidizers, corrosives, poisons, and are reactive. Inhalation of the vapors can cause coughing, choking, irritation of the nose, throat, and respiratory tract, breathing difficulties, and lead to pneumonia and pulmonary edema. Contact with the skin can cause severe burns, redness, and pain. Nitric acid can cause deep ulcers, and staining of the skin to a yellow or yellow-brown color. These acid vapors are irritating and can cause damage to the eyes. Contact with the eyes can cause permanent damage.

Sulfuric acid is a strong oxidizer and is a corrosive. It will react violently when combined with organic compounds, possibly producing fire. Inhalation can cause irritation of the nose, throat, mucus membranes, and upper respiratory tract. Contact with the eyes can cause blurred vision, redness, pain, and even blindness.

Samples that contain high concentrations of carbonates or organic matter, or samples that are at elevated pH can react violently when acids are added. Acids must be added to samples under a hood to avoid splash/splatter hazards and/or possibly toxic vapors that will be given off when the samples are acidified.

The making of aqua regia can produce toxic fumes and heat. This procedure must be performed under a fume hood.

The exhaust of the mercury analyzer must be vented or trapped so that mercury vapors do not enter the laboratory.

The preparation of the samples for mercury analysis uses a water bath with a temperature of ~95°C. The water and the steam produced can cause burns to unprotected skin. Employees must use appropriate PPE when working with sample digestions.

Mercury compounds are highly toxic if swallowed, inhaled, or absorbed through the skin. Analyses should be conducted in a laboratory exhaust hood. The analyst should use chemical resistant gloves when handling concentrated mercury standards.

The acidification of samples containing reactive materials may result in the release of toxic gases, such as cyanides or sulfides. Acidification of samples should be done in a fume hood.

5.2 Primary Materials Used

The following is a list of the materials used in this procedure, which have a serious or significant hazard rating, and a summary of the primary hazards listed in their MSDS.

NOTE: This list does not include all materials used in the procedure. A complete list of materials used in this procedure can be found in the Reagents and Standards Section and the Equipment and Supplies Section of this SOP

Employees must review the information in the MSDS for each material before using it for the first time or when there are major changes to the MSDS. Electronic copies of MSDS can be found using the "MSDS" link on the Oasis homepage, on the EH&S webpage on Oasis, and on the QA Navigator.

Material	Hazards	Exposure Limit[1]	Signs and Symptoms of Exposure
Sulfuric Acid[2]	Corrosive Oxidizer Dehydrator Poison	1mg/m^3 TWA	Inhalation produces damaging effects on the mucous membranes and upper respiratory tract. Symptoms may include irritation of the nose and throat, and labored breathing. Symptoms of redness, pain, and severe burn can occur. Contact can cause blurred vision, redness, pain and severe tissue burns. Can cause blindness.
Nitric Acid[2]	Corrosive Oxidizer Poison	2ppm TWA 4ppm STEL	Nitric acid is extremely hazardous; it is corrosive, reactive, an oxidizer, and a poison. Inhalation of vapors can cause breathing difficulties and lead to pneumonia and pulmonary edema, which may be fatal. Other symptoms may include coughing, choking, and irritation of the nose, throat, and respiratory tract. Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and stain skin a yellow or yellow-brown color. Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
Hydrochloric Acid[2]	Corrosive Poison	5ppm - Ceiling	Inhalation of vapors can cause coughing, choking, inflammation of the nose, throat, and upper respiratory tract, and in severe cases, pulmonary edema, circulatory failure, and death. Can cause redness, pain, and severe skin burns. Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
Potassium Permanganate	Oxidizer	5mg/m^3 for Mn Compounds	Causes irritation to the respiratory tract. Symptoms may include coughing, shortness of breath. Dry crystals and concentrated solutions are caustic, causing redness, pain, severe burns, brown stains in the contact area and possible hardening of outer skin layer. Diluted solutions are only mildly irritating to the skin. Eye contact with crystals (dusts) and concentrated solutions causes severe irritation, redness, and blurred vision and can cause severe damage, possibly permanent.

Material	Hazards	Exposure Limit[1]	Signs and Symptoms of Exposure
Potassium Persulfate	Oxidizer	None	Causes irritation to the respiratory tract. Symptoms may include coughing, shortness of breath. Causes irritation to skin and eyes. Symptoms include redness, itching, and pain. May cause dermatitis, burns, and moderate skin necrosis.
[1]Exposure limit refers to the OSHA regulatory exposure limit.			
[2]Always add acid to water to prevent violent reactions.			

6.0 Equipment and Supplies

6.1 Equipment and Instrumentation

Top-loading Balance – Verify in accordance with SOP SA-AN-100: *Laboratory Support Equipment: Verification and Use*

Thermometers – Verify in accordance with SOP SA-AN-100: *Laboratory Support Equipment: Verification and Use*

Water bath or heating block capable of maintaining temperatures of 30 ± 3°C, 80 ± 3°C, and 95 ± 3°C

Leeman Hydra AA or other suitable automated mercury analyzer

Mercury Hollow Cathode Lamp

Absorption Cell

Nitrogen or argon gas supply and appropriate fittings

Air Pump

Pump (Aeration) tubing of appropriate sizes for use on the Hydra AA

Drying Tube – Purchased pre-packed from Leeman Labs

6.2 Analytical Data System / Software / Hardware

The Leeman software is used on a Windows-based PC to schedule and acquire data. The raw data from the Hg Analyzer is manually checked for validity by a minimum of 2 analysts. Raw instrument data are uploaded to the laboratory's LIMS (i.e., TALS) via the Environmental Information Systems Corporation Metals Analytical Review and Reporting System (MARRS) program. Additionally, any quality control failures are flagged in TALS, as appropriate.

6.3 Lab Supplies

Volumetric Containers – various sizes; Class A, where applicable. Verify in accordance with SOP SA-AN-100: *Laboratory Support Equipment: Verification and Use*

Mechanical Pipettes – various sizes. Verify in accordance with SOP SA-AN-100: *Laboratory Support Equipment: Verification and Use*

Disposable Graduated Pipettes – various sizes. Verify in accordance with SOP SA-AN-100: *Laboratory Support Equipment: Verification and Use*

Test tubes of the two sizes to fit the Hydra AA autosampler

Digestion glassware – 4oz flint digestion vessels

Digestion vials – 50mL and 100mL. Verify in accordance with SOP SA-AN-100: *Laboratory Support Equipment: Verification and Use*

pH paper

Detergent – Liquinox, used for washing non-disposable labware.

6.4 Sample Collection Containers

All sample collection containers are single-use disposable containers which limits the potential for contamination.

The routine sample collection containers supplied by the laboratory are:

Waters or Field-Filtered Dissolved Mercury Samples:
250mL plastic, nitric acid – purchased with Certificate of Analysis attesting to purity.

Soil Samples:
8oz plastic soil jar, unpreserved – purchased with Certificate of Analysis attesting to purity.

Wipe Samples:
40mL VOA vial, Acetic acid in water, pH 4.93 +/- 0.05 – purchased with Certificate of Analysis attesting to purity.

Leachate Samples (originally aqueous):
1L amber glass, unpreserved – purchased with Certificate of Analysis attesting to purity.

Leachate Samples (originally solid):
16oz glass soil jar, unpreserved – purchased with Certificate of Analysis attesting to purity.

Lab-Filtered Dissolved Mercury Samples
250mL plastic, unpreserved – purchased with Certificate of Analysis attesting to purity.

7.0 Reagents and Standards

The standards and reagents listed are those in use at the time this SOP was updated. Other standard and reagent stocks, vendors, and concentrations may be used provided

they are fully documented and in compliance with method requirements.

7.1 Expiration Dates

Expiration dates (time from initial use or receipt to final use) for standard and reagent materials must be set according to the guidance in this SOP. Note: These are maximum expiration dates and are not to be considered an absolute guarantee of standard or reagent quality. Sound judgment must be used when deciding whether to use a standard or reagent. If there is doubt about the quality of a standard or reagent material, a new material must be obtained or the standard or reagent material verified. Data quality must not be compromised to extend a standard's life – i.e., when in doubt, throw it out.

The expiration date of any standard or reagent must not exceed the expiration date of the standard or reagent that was used to prepare it; that is, the "children may not outlive the parents".

7.2 Reagents

Reagents must be prepared and documented in accordance with SOP SA-AN-041: *Reagent and Standard Materials Procedures.*

Hydrochloric acid, nitric acid, and sulfuric acid must be verified prior to use in accordance with the TestAmerica Solvent Lot Testing Program.

7.2.1 Blank Matrix – Teflon Chips, Ottawa Sand, or other suitable matrix. Used for the preparation of soil QC samples.

7.2.2 Laboratory Reagent Water – ASTM Type II

7.2.3 Nitric Acid (HNO_3), concentrated, reagent grade – stable under ordinary conditions of use and storage
Storage: Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Store away from sunlight, heat, water, and incompatible materials.
Expiration:
Unopened: Manufacturer's expiration date
Opened: 5 years from date opened

7.2.4 Hydrochloric Acid (HCl), concentrated-reagent grade – stable under ordinary conditions of use and storage
Storage: Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Store away from sunlight, heat, water, and incompatible materials.
Expiration:
Unopened: Manufacturer's expiration date.
Opened: 5 years from date opened

7.2.5 Aqua Regia: Prepare immediately before use by carefully adding three volumes of concentrated HCl to one volume of concentrated HNO_3. This reagent needs to be carefully prepared under a fume hood due to vapors that are produced. Properly dispose of any unused volume.

For greater stability 1:1 aqua regia may be prepared. To 4 volumes of reagent water, carefully add 3 volumes of concentrated HCl and 1 volume of concentrated HNO3. Store

this reagent away from incompatibles, combustibles, organics, and other readily oxidizable materials. This reagent will be stable for up to 3 months.

7.2.6 Potassium permanganate ($KMnO_4$), mercury free – stable under ordinary conditions of use and storage.
Storage: Store in a tightly closed container in a cool, dry, ventilated area. Keep away from heat and avoid storage on wood floors. Store away from incompatibles, combustibles, organics and other readily oxidizable materials.
Expiration:
Unopened: Manufacturer's expiration date
Opened: 5 years from date opened

7.2.7 Potassium permanganate, mercury-free, 5% solution (w/v) – Dissolve 50g of $KMnO_4$ in 1000mL of reagent water. Stable under ordinary conditions of use and storage.
Storage: Store in a tightly closed container in a cool, dry, ventilated area. Keep away from heat and avoid storage on wood floors. Store away from incompatibles, combustibles, organics and other readily oxidizable materials.
Expiration: 1 year from date prepared

7.2.8 Sodium Chloride (NaCl) – stable under ordinary conditions of use and storage.
Storage: Store in a tightly closed container in a cool, dry, ventilated area.
Expiration:
Unopened: Manufacturer's expiration date
Opened: 5 years from date opened

7.2.9 Hydroxylamine Sulfate ($(NH_2OH)\cdot 2H_2O$) – stable under ordinary conditions of use and storage.
Storage: Store in a tightly closed container in a cool, dry, ventilated area. Store away from incompatible materials.
Expiration:
Unopened: Manufacturer's expiration date
Opened: 5 years from date opened

7.2.10 Sodium chloride hydroxylamine sulfate solution – Dissolve 120g NaCl and 120g hydroxylamine sulfate in reagent water in a 1-L volumetric flask and dilute to volume. Stable under ordinary conditions of use and storage.
Storage: Store in a tightly closed container in a cool, dry, ventilated area. Store away from incompatible materials.
Expiration: 1 year from date prepared

7.2.11 Potassium persulfate ($K_2S_2O_8$) – stable under ordinary conditions of use and storage.
Storage: Store in a tightly closed container in a cool, dry, ventilated area. Keep away from heat and avoid storage on wood floors. Store away from incompatibles, combustibles, organics and other readily oxidizable materials.
Expiration:
Unopened: Manufacturer's expiration date
Opened: 5 years from date opened

7.2.12 Potassium persulfate, 5% solution (w/v) – Dissolve 50g potassium persulfate in 1000mL reagent water. Stable under ordinary conditions of use and storage.
Storage: Store in a tightly closed container in a cool, dry, ventilated area. Keep away from

heat and avoid storage on wood floors. Store away from incompatibles, combustibles, organics and other readily oxidizable materials.
Expiration: 1 year from date prepared

7.2.13 Rinse Water, 5% HCl / 1%HNO_3 – to a clean 2-L bottle, add 1-L of reagent water. Carefully add 100mL of concentrated hydrochloric acid. Carefully add 20mL of concentrated nitric acid. Dilute to a final volume of 2L. Other volumes may be utilized providing the reagent proportions remain the same. Stable under ordinary conditions of use and storage.
Storage: Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Store away from sunlight, heat, water, and incompatible materials.
Expiration: 1 year from date prepared

7.2.14 Stannous chloride ($SnCl_2.2H_2O$) – reagent grade, suitable for mercury determination. Stable if stored in tightly closed containers.
Storage: Store in a tightly closed container in a cool, dry, ventilated area. Keep away from incompatible materials. It will absorb air and form the insoluble oxychloride.
Expiration:
Unopened: Manufacturer's expiration date
Opened: 5 years from date opened

7.2.15 Stannous chloride ($SnCl_2 \cdot 2H_2O$) solution – to a clean 2-L volumetric flask, add 100g of stannous chloride. Add approximately 400mL of reagent water. Carefully add 500mL of concentrated hydrochloric acid. Add a stirring bar, and stir on a stir plate until the stannous chloride is dissolved. Remove the stirring bar and dilute to volume with reagent water. Stable under ordinary conditions of use and storage.
Storage: Store in a tightly closed container in a cool, dry, ventilated area. Keep away from incompatible materials.
Expiration: 1 year from date prepared

7.2.16 Sulfuric Acid (H_2SO_4), concentrated reagent grade – stable under ordinary conditions of use and storage.
Storage: Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Store away from sunlight, heat, water, and incompatible materials.
Expiration:
Unopened: Manufacturer's expiration date
Opened: 5 years from date opened

7.2.17 Nitric Acid (HNO_3), 1:1 – Slowly add 250mL of concentrated nitric acid to 250mL of laboratory reagent water in a 1-L beaker. Mix well and transfer to a tightly closed container.
Storage: Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Store away from sunlight, heat, water, and incompatible materials.
Expiration: 2 years from date prepared

7.3 Standards

Standards must be prepared and documented in accordance with SOP SA-AN-041: *Reagent and Standard Materials Procedures.* Certificates of analysis or purity must be received with all purchased standards, and scanned and filed in the Data Archival Folder on the G-drive.

7.3.1 Hg Stock Standard, 1000mg/L – currently purchased from SPEX.
Storage: Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Store away from sunlight, heat, water, and incompatible materials.
Expiration: Stable under ordinary conditions of use and storage up to the manufacturer's expiration date.

7.3.2 Second Source Hg Stock Standard, 1000mg/L – currently purchased from Baker.
Storage: Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Store away from sunlight, heat, water, and incompatible materials.
Expiration: Stable under ordinary conditions of use and storage up to the manufacturer's expiration date.

7.3.3 Calibration standards

7.3.3.1 Mercury Intermediate Standard, 500ug/L – Add 0.050mL of the purchased 1000mg/L Hg Stock Standard and 2.5mL of nitric acid to about 50mL of reagent water in a 100-mL volumetric flask and dilute to volume with reagent water.
Storage: Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Store away from sunlight, heat, water, and incompatible materials.
Expiration: Stable under ordinary conditions of use and storage for up to 28 days. The expiration date cannot exceed the expiration of any of the components.

7.3.3.2 Mercury Calibration Standards – Transfer 0.0, 0.02, 0.04, 0.1, 0.3, and 0.5mL portions of the Mercury Intermediate Standard to a series of 125-mL glass bottles. Add reagent water from a graduated cylinder to each bottle to make a final volume of 50mL. (This results in calibration standard concentrations of 0.0, 0.2, 0.4, 1.0, 3.0, and 5.0ug/L mercury.) Mix well. Add 2.5mL of concentrated H_2SO_4, 1.25mL of concentrated HNO_3, and 7.5mL of $KMnO_4$ solution and let stand at least 15 minutes. Add 4mL of potassium persulfate and heat for ~2 hours in a water bath at 95°C+/- 3°C. Cool and add 3mL of sodium chloride-hydroxylamine sulfate solution to reduce the excess permanganate. The standards are now ready for analysis. Larger volumes of standards may be digested as needed as long as reagent ratios are kept the same.
Storage: Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Store away from sunlight, heat, water, and incompatible materials.
Expiration: Stable under ordinary conditions of use and storage for up to 28 days. The expiration date cannot exceed the expiration date of any of the components.

7.3.4 Initial Calibration Verification Standards (also used as QCS and IPC standards)

7.3.4.1 Second Source Intermediate Standard, 1.0mg/L – Add 0.1mL of the 1000mg/L Second Source Hg Stock Standard, and 2.5mL of nitric acid to about 50mL of reagent water in a 100mL volumetric flask and dilute to volume with reagent water.
Storage: Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Store away from sunlight, heat, water, and incompatible materials.
Expiration: Stable under ordinary conditions of use and storage for up to 28 days. The expiration date cannot exceed the expiration date of any of the components.

7.3.4.2 Second Source Initial Calibration Verification (ICV) Standard, 3.0ug/L – Add 0.15mL of the 1.0mg/L Second Source Intermediate Standard to a 125mL glass bottle. Add enough reagent water from a graduated cylinder to give a final volume of 50mL. The ICV is now

ready to be digested. Other final volumes may be used as long as the reagent ratios are kept the same.
Storage: Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Store away from sunlight, heat, water, and incompatible materials.
Expiration: Stable under ordinary conditions of use and storage for up to 28 days. The expiration date cannot exceed the expiration date of any of the components.

7.3.5 QC Standards

7.3.5.1 Analytical Spike Standard, 73.26ug/L – Using a graduated cylinder, add 20mL of the 500ug/L Hg Intermediate Standard, and 5.0mL of nitric acid to about 50mL of reagent water and dilute to 136.5mL final volume with reagent water. Note: Since this standard is not digested the volume has been adjusted to compensate for the dilution that the other standards and samples undergo during the digestions.

8.0 Sample Collection, Preservation, Shipment, and Storage

8.1 Aqueous Samples

8.1.1 Total Mercury

Aqueous samples are routinely collected in 250mL plastic containers containing 3mL of a 1:3 nitric acid preservative. The preservative should be sufficient to achieve a sample pH of less than 2.

Although no temperature preservation is required, samples are routinely iced at the time of collection at 4°C (less than 6°C but not frozen). Samples are stored at room temperature until the time of digestion. Samples must be digested and analyzed within 28 days of sample collection. Digestates are stored at room temperature until the time of analysis.

NCMs must be initiated for samples collected in improper containers and containing improper or insufficient preservatives.

8.1.2 Dissolved Mercury

Aqueous samples for dissolved metals are routinely filtered at the time of sampling and collected in 250mL plastic containers containing 3mL of a 1:3 nitric acid preservative. The preservative should be sufficient to achieve a sample pH of less than 2.

Although no temperature preservation is required, samples are routinely iced at the time of collection at 4°C (less than 6°C but not frozen). Samples are stored at room temperature until the time of digestion. Samples must be digested and analyzed within 28 days of sample collection. Digestates are stored at room temperature until the time of analysis.

Note: If the sample is to be filtered in the laboratory, the sample must be collected in 250mL plastic container with no preservatives. The sample must be stored at 4°C (less than 6°C but not frozen) until filtered. Once filtered, the laboratory will add nitric acid to obtain a pH of less than 2.

NCMs must be initiated for samples collected in improper containers and containing improper or insufficient preservatives.

8.1.3 Preservation Checks – pH Verification

For each sample, prior to sample preparation,
- Place a piece of pH paper in a disposable medicine cup.
- Pour a few drops of sample into the medicine cup and note the color change of the pH paper.
- If the pH is outside the range of less than 2, initiate a Nonconformance Memo. Adjust the sample pH to less than 2 using 1:1 nitric acid.
- Mix well and hold for 24 hours. If pH is still greater than 2 repeat the process.

Note: To avoid cross-contamination, use a separate medicine cup and piece of pH paper per sample. Do not dip the pH paper into the sample container. The pH paper dye may bleed into the sample and affect sample results.

8.2 Soil Samples

Soil samples are routinely collected in 8oz plastic soil containers.

Samples must be iced at the time of collection and maintained at 4°C (less than 6°C but not frozen) until the time of digestion. Samples must be digested and analyzed within 28 days of collection. Digestates are stored at room temperature until the time of analysis.

9.0 Quality Control

SOP SA-QA-17: *Evaluation of Batch QC Data* and the SOP Summary in Attachment 3 provide requirements for evaluating QC data.

9.1 Batch QC

9.1.1 EPA 245.1 – Drinking Water

A digestion batch consists of up to 20 environmental samples and the associated QC items extracted together within a 24 hour period.

The laboratory's default minimum QC items performed for each digestion batch are: a method blank, a laboratory control sample (LCS), a low-level LCS (LLCS), a matrix spike (MS) to be performed on a minimum of 10% of samples or one per batch – whichever is greater, and a matrix spike duplicate (MSD).

This frequency equates to the following:

- For a batch of 10 or fewer samples, the minimum QC items are a method blank, an LCS, an LLCS, 1 matrix spike, and 1 matrix spike duplicate (MSD).
- For a batch of 11-20 samples, the minimum QC items are a method blank, an LCS, an LLCS, 1 matrix spike (from sample 1-10), another matrix spike (from sample 11-20), and a matrix spike duplicate (MSD).

9.1.2 EPA 245.1 – Clean Water Act

A digestion batch consists of up to 20 environmental samples and the associated QC items extracted together within a 24 hour period.

The laboratory's default minimum QC items performed for each digestion batch are: a method blank and a laboratory control sample (LCS), a matrix spike (MS) to be performed on a minimum of 10% of samples or one per batch – whichever is greater, and a matrix spike duplicate (MSD).

This frequency equates to the following:

- For a batch of 10 or fewer samples, the minimum QC items are a method blank, an LCS, 1 matrix spike, and 1 matrix spike duplicate.
- For a batch of 11-20 samples, the minimum QC items are a method blank, an LCS, 1 matrix spike (from sample 1-10), another matrix spike (from sample 11-20), and a matrix spike duplicate.

9.1.3 EPA 7470A, EPA 7471A, EPA 7471B, and SM3112B

A digestion batch consists of up to 20 environmental samples and the associated QC items. The laboratory's default minimum QC items performed for each digestion batch are: a method blank, a laboratory control sample (LCS), a matrix spike (MS), and a matrix spike duplicate (MSD).

The routine container supplied for this method is a 250mL (water) or 8oz (soil) container. 50mL or 1g is required for digestion. Reduced sample initial volumes or weights may be necessary to achieve the required batch QC frequency; however, the minimum digestion amount to be used is 10mL or 0.2g.

Note: Spike amounts must be adjusted to compensate for these reduced initial volumes or weights. Since final volumes are not easily reduced, elevated reporting limits will be provided when reduced initial volumes and weights are used

9.1.4 If there is insufficient sample volume to perform the required matrix spike(s), the LCS must be prepared in duplicate (i.e., LCS/LCSD). An NCM must be initiated on all affected samples to denote this situation. Insufficient sample volume or weight is defined as receiving less than a total of 50mL or 1g.

Note: If an LCS and LCSD are performed, both QC items must be evaluated and reported. Acceptable recoveries (as well as %RPD) for both LCS and LCSD are required.

9.1.5 Batch QC must meet the criteria given in Attachment 3 of this SOP.

9.2 <u>Instrument QC</u>

9.2.1 Initial Calibration (ICAL)

The instrument must be calibrated in accordance with SOP SA-QA-16: *Evaluation of Calibration Curves.* This SOP provides requirements for establishing the calibration curve and gives the applicable formulas.

Instrument calibration is performed by analyzing a series of known standards. The calibration curve must consist of a minimum of 5 standards and a blank. The lowest level calibration standard must be at or below the reporting limit, and the remaining standards will define the working range of the analytical system.

The initial calibration standard concentrations currently in use in the laboratory are as follows:

Standard Level	Concentration (ug/L)
1	0.0
2	0.2
3	0.4
4	1.0
5	3.0
6	5.0

Refer to Section 7.3 for the standard preparation instructions. Other standard concentrations may be used provided they support the reporting limit and are fully documented in accordance with SOP SA-AN-041.

The correlation coefficient (r) of the regression curve must be greater than 0.995 for the initial calibration curve to be acceptable.

9.2.2 Second Source Initial Calibration Verification (ICV)

The calibration curve must be verified initially – prior to any sample analyses – in accordance with SOP SA-QA-16 with a standard obtained from a second source.

For EPA 245.1, the ICV must be within 5% of the true value to be acceptable. For EPA 7470A, EPA 7471A, EPA 7471B, and SM3112B, the ICV must be within 10% of the true value to be acceptable.

Note: The ICV is utilized to satisfy the EPA 245.1 requirement to analyze a QCS and IPC.

The initial calibration verification standard concentration currently in use in the laboratory is equivalent to level 5 of the ICAL. Refer to Section 7.3 for the standard preparation instructions. Another standard concentration may be used provided it is mid-level and fully documented in accordance with SOP SA-AN-041.

9.2.3 Initial Calibration Blank (ICB) / Continuing Calibration Blank (CCB)

The instrument must be shown to be free from contamination by the analysis of calibration blanks. Initial calibration blanks are analyzed immediately following the ICV. Continuing calibration blanks are analyzed immediately following each CCV.

The absolute value of the initial and continuing calibration blanks must be <½RL to be acceptable.

9.2.4 Continuing Calibration Verification

The initial calibration curve must be verified initially and after every 10 samples with a mid-level standard.

For SM3112B, the initial CCV must be within 5% of the true value and ongoing CCVs must be within 10% of the true value to be acceptable. For EPA 245.1, all CCVs must be within 10% of the true value to be acceptable. For EPA 7470A, EPA 7471A, and EPA 7471B, all CCVs must be within 20% of the true value to be acceptable.

The continuing calibration verification standard concentration currently in use in the laboratory is equivalent to the 3.0 ug/L standard of the ICAL. Refer to Section 7.3 for the standard preparation instructions. Another standard concentration may be used provided it is mid-level and fully documented in accordance with SOP SA-AN-041.

Note: The CCV is utilized to satisfy the EPA 245.1 requirement to analyze an IPC.

9.2.5 Reporting Limit Standard

SM3112B and certain project plans require the analysis of a reporting limit standard. If required, the reporting limit standard must be analyzed daily after the ICB, to verify the accuracy of the calibration curve at the reporting limit. The limits of recovery for the RL standard are 50-150%.

9.2.6 Quality Control Standard (QCS)

EPA 245.1 requires a second source QCS to be performed quarterly, at a minimum. The QCS must recover within 10% to be acceptable.

The laboratory uses the ICV to satisfy this QCS requirement.

9.2.7 Instrument Performance Check (IPC)

EPA 245.1 requires an IPC to be performed daily, after each calibration and after every tenth sample. The initial IPC must recover within 5% to be acceptable. Subsequent IPCs must recover within 10% to be acceptable.

The laboratory uses the ICV to satisfy the initial IPC requirement and the CCV to satisfy any subsequent IPC requirements.

9.2.8 Method of Standard Additions

Two identical aliquots of the sample digest, V_x, are taken. One aliquot is spiked with a known concentration, C_s. The second aliquot is analyzed un-spiked (the small volume of standard added to the spiked sample should be disregarded). The absorbance of both aliquots is measured and the sample concentration, C_x, is calculated as follows:

$$C_x = \frac{S_2 V_s C_s}{(S_1 - S_2) V_x}$$

Where:

S_1 = absorbance of the spiked aliquot
S_2 = absorbance of the un-spiked aliquot

The method of standard additions (MSA) must not be applied to samples analyzed at a dilution which produce a significant negative absorbance. The first point in the MSA (the un-spiked sample) should be greater than or equal to zero absorbance or the magnitude of the negative response should not exceed the reporting limit. Use good judgment when evaluating data where the absorbances are negative. The digestate should be diluted and reanalyzed to determine the extent of the matrix interferences.

9.2.9 Analytical Spike (Post Digestion Spike, PDS)

If the MS/MSD is not acceptable, an analytical spike (post digestion spike) must be prepared and analyzed on the sample used as the MS/MSD to determine if matrix interferences are present in the sample matrix. If the post digestion spike does not meet 85-115% recovery, proceed as outlined in the table below:

Result of Post Digestion Spikes	Corrective Action
Within 85-115% limits	None. PDS is acceptable.
>115% recovery	Repeat analysis. Remake spiking solutions, re-spike, and reanalyze. Reanalyze un-spiked sample.
<85% recovery but >50% recovery	Analyze all associated samples by single point method of standard addition and quantify by using MSA. Or qualify all associated samples on report. If sample concentration is less than the IDL, respike (to check for a spiking error), reanalyze, and re-evaluate.
<50% recovery	Dilute digestate and repeat spike. Perform the PDS procedure on all associated samples.

The >50% recovery of the post digestion spike is a benchmark below which samples may be biased high.

Note: If the sample used for MS/MSD exceeds 4x the spiking level, then the post digestion spike is not required.

Note: The post digestion spike must not be applied to samples which produce a significant negative absorbance. The analyst must use good judgment when evaluating data where the absorbances are negative.

9.3 Corrective Action for Out-of-Control Data

When the quality control parameters do not meet the criteria set forth in this SOP, corrective action must be taken in accordance with SOP SA-QA-05: *Preventive and Corrective Action Procedures* the QC Summary Table in Attachment 3. SOP SA-QA-05 provides contingencies for out-of-control data and gives guidance for exceptionally permitting departures from approved policies and procedures. Nonconformance Memos must be initiated to document all instances where QC criteria are not met and all departures from approved policies and procedures.

10.0 Procedure

10.1 Sample Preparation

Remove the samples from the refrigerator, if refrigeration is required, and allow them to come to room temperature.

Soil samples must be homogenized prior to preparation in accordance with SOP SA-QA-15: *Compositing, Homogenization, and Segregation of Samples.*

10.1.1 Water Samples

10.1.1.1 Mix the sample thoroughly. Verify the sample pH as instructed in Section 8.1.3 and adjust as needed.

Note: If the pH is greater than 2 the sample must be held for 24 hours after pH adjustment and the pH re-verified.

10.1.1.2 Using a 50mL digestion vial, add 50mL of sample or an aliquot of sample diluted to 50mL to a 125-mL glass bottle.

10.1.1.3 Add 1.25mL HNO_3, 2.5mL H_2SO_4, and 7.5mL of $KMnO_4$ solution to each sample. Shake well after each addition. Be sure the purple color of $KMnO_4$ persists for at least 15 minutes. If not, add 7.5mL of $KMnO_4$ solution up to three additional times.

Note: Equal quantities of $KMnO_4$ must be added to the LCS and MB.

10.1.1.4 Add 4mL of potassium persulfate to each sample, cap, shake well, loosen cap, and place the samples in a water bath or block digestion apparatus at 95 ± 3°C for at least 2 hours.

10.1.1.5 Remove the samples and allow them to cool. Add 3mL of sodium chloride-hydroxylamine sulfate solution to each bottle to neutralize excess $KMnO_4$. This should give a final volume of 68.25mL.

Note: If a different final volume is obtained (due to additional $KMnO_4$ or other reason) a dilution factor must be calculated in order to correct the final result.

10.1.2 Soil Samples

10.1.2.1 Homogenize the sample thoroughly. Weigh between 0.50-0.60g wet weight of sample into a 125mL glass bottle.

10.1.2.2 Add 5.0mL DI water and 5.0mL aqua regia. Heat for at least 2 minutes in a water bath or digestion block at 95°C± 3°C.

Note: 10mL of 1:1 aqua regia may be utilized for this step.

10.1.2.3 Allow the samples to cool to room temperature and add 20mL DI water and 15mL $KMnO_4$ solution to sample, cap, shake well, loosen cap, and place the samples in a water bath or block digestion apparatus at 95 ± 3°C for at least 30 minutes.

Be sure the purple color of $KMnO_4$ persists for at least 15 minutes prior to placing samples in the water bath or block digestion apparatus. If not, add 7.5mL of $KMnO_4$ solution up to two additional times.

Note: Equal quantities of $KMnO_4$ must be added to the LCS and MB.

10.1.2.4 Allow the samples to cool to room temperature. Add 6mL of sodium chloride-hydroxylamine sulfate solution to each bottle to neutralize excess $KMnO_4$. Add 17mL DI water, cap, and shake well. This should give a final volume of 68mL.

Note: If additional volume(s) of $KMnO_4$ were added, compensate for the addition(s) by adding less DI water so that the final volume will remain constant.

10.2 Batch QC Sample Preparation

10.2.1 Water Samples

10.2.1.1 Method Blank – Add 50mL of reagent water to a 125mL glass bottle. Prepare in accordance with Section 10.1.1.

Note: The method blank must be prepared using the same volume of each reagent as used for the field samples. If additional $KMnO_4$ was added to any of the field samples an equal volume must be added to the method blank.

10.2.1.2 Laboratory Control Samples (LCS/LCSD) – Add 0.25mL of the 500ug/L Hg Intermediate Standard to a 125mL glass bottle. Using a disposable digestion vial, add 50mL reagent water. Prepare in accordance with Section 10.1.1.

Note: The LCS must be prepared using the same volume of each reagent as used for the field samples. If additional $KMnO_4$ was added to any of the field samples an equal volume must be added to the LCS.

10.2.1.3 Matrix Spikes (MS/MSD) – Add 50mL of the sample selected for the batch matrix spike to a 125mL glass bottle. Add 0.1mL of the 500ug/L Hg Intermediate Standard to the sample. Prepare in accordance with Section 10.1.1.

Note: For EPA 245.1 Clean Water Act, EPA 7470A, EPA 7471A, and EPA 7471B the matrix spike must be prepared in duplicate.

10.2.1.4 Low Level Laboratory Control Sample (LLCS) – Add 50mL of reagent water to a 125-mL glass bottle. Add 0.02mL of the 500ug/L Hg Intermediate Standard to the sample. Prepare in accordance with Section 10.1.1. Refer to Section 7.3.3.2 for additional information. (This is the same solution as the low level calibration standard, 0.2 ug/L.)

Note: The LCS must be prepared using the same volume of each reagent as used for the field samples. If additional $KMnO_4$ was added to any of the field samples an equal volume must be added to the LCS.

Note: The LLCS is only required for EPA 245.1 drinking water samples.

10.2.2 Soil Samples

10.2.2.1 Method Blank – Weigh out 0.5g of blank matrix and add to a 125mL glass bottle. Prepare in accordance with Section 10.1.2 for soils.

Note: The method blank must be prepared using the same volume of each reagent as used for the field samples. If additional $KMnO_4$ was added to any of the field samples an equal volume must be added to the method blank.

10.2.2.2 Laboratory Control Samples (LCS/LCSD) – Weigh out 0.5g of blank matrix and add to a 125mL glass bottle. Add 0.25mL of the 500ug/L Hg Intermediate Standard. Prepare in accordance with Section 10.1.2 for soil samples.

Note: The LCS must be prepared using the same volume of each reagent as used for the field samples. If additional $KMnO_4$ was added to any of the field samples an equal volume must be added to the LCS.

10.2.2.3 Matrix Spikes (MS/MSD) – Add 0.5-0.6g of the soil sample selected for the batch matrix spike to a 125mL glass bottle. Add 0.1mL of the 500ug/L Hg Intermediate Standard to the sample. Prepare in accordance with Section 10.1.2.

10.3 Analysis

10.3.1 Instrument Start-up and Operating Conditions

The instrument conditions listed in this SOP are provided for guidance purposes. The actual conditions used by the laboratory may be slightly different from those listed here and must be documented in the instrument maintenance log, data system, and/or run log.

Instrument maintenance must be performed in accordance with Attachment 4 of this SOP.

Before analysis begins, inspect the system (pump tubes, mixing coil, gas/liquid separator) to see if any parts need to be cleaned or replaced.

Inspect the drying tube. Clean or replace as needed with a pre-made drying tube from Leeman Labs that has been inspected for discoloration. Caution should be used if moisture is visible in the tubing that follows the drying tube.

Fill the rinse tank with rinse water.

If the lamp is not already on and warmed up, turn on the lamp. The lamp must warm up for a minimum of 2 hours.

If the lamp is already on and warmed up, make sure the platens have the appropriate tension and turn on the pump. Allow a minimum of 20 minutes of pump time for the pump tubes to break in each day.

Rinse and fill the stannous chloride reagent bottle with stannous chloride solution. Switch the reagent line from the rinse bottle to the stannous chloride reagent bottle. Allow the reagent to reach the sample stream before starting an autosampler run.

Autosampler setup
Fill the standard tubes with the appropriate standards for the protocol being followed. (Refer to Section 10.3.4 for more information on method-specific analytical sequence and standards required.)

Fill the labeled sample test tubes with the samples and calibration verification standards in the proper order.

The method blank will be analyzed first. The LCS will follow immediately after the method blank. The samples, matrix spikes, and duplicates will then follow with a maximum of 10 analyses between CCVs/CCBs.

Enter the sample/QC IDs into the autosampler table giving each rack a unique name.

Load the rack(s) onto the autosampler.

10.3.2 Initial and Continuing Calibration

Calibrate the instrument using the standards and criteria described given in Section 9.2.1. Once the calibration has been established and verified with an ICV in accordance with Section 9.2.2, sample analysis may proceed.

Verify the calibration curve with a continuing calibration verification using the standards and criteria described given in Section 9.2.4.

Calibration of the Mercury Analyzer
Call up the required protocol. Open a new data folder.

Go to CALIBRATION, RESET, and reset the calibration for a new calibration.

Go to CALIBRATION, STANDARDS, and ensure that calibration standards are entered at the proper concentrations.

Analyze the standards, beginning with standard 1 (Blank), proceeding from lowest to highest concentration.

When all calibration standards have been analyzed, go to CALIBRATION, LINE CALIBRATION. If calibration is within acceptable limits, accept the linear calibration and print the calibration curve.

10.3.3 Sample Analysis

The digestate must be analyzed using the same volume as that used for the calibration standards. Samples known to be relatively clean should be analyzed first. Samples suspected of containing high concentrations should be analyzed last. Instrument blanks may be analyzed after suspected high concentration samples to allow the detector response to stabilize.

The default procedure is to include QC items (method blank, LCS, MS/MSD, and SD) in determining the maximum number of samples between CCVs/CCBs.

Sample Analysis
Go to AUTOSAMPLER, SETUP. Enter the Rack IDs and the cup numbers to be analyzed.

Carryover from high concentration samples usually affects only the next one to two samples in the sequence. The two samples following an off-scale sample that is greater than 10ug/L must be reanalyzed to verify the presence or absence of mercury and the

quantitation of mercury. It is the responsibility of the analyst to clearly demonstrate that all mercury results are accurate and free from carry-over contamination.

10.3.4 Example Analytical Sequence

An example analytical sequence is listed below.

Analytical Sequence for samples immediately following an initial calibration:

Description	Comments
Blank	
Initial Calibration	
ICV	Second Source
ICB	
RL Standard	Required for EPA 245.1 (Not a requirement for EPA 7470A, EPA 7471A, and EPA 7471B if calibrated to RL)
Samples & Batch QC Items	Up to 9 analyses, including QC.
CCV	Level 3.0ug/L
CCB	
Samples & Batch QC Items	Up to 10 analyses, including QC.
CCV	Level 3.0ug/L
CCB	

Analytical Sequence for samples not immediately following an initial calibration:

Description	Comments
CCV	Level 3.0ug/L
CCB	
Samples & Batch QC Items	Up to 10 analyses, including QC.
CCV	Level 3.0ug/L
CCB	
Samples & Batch QC Items	Up to 10 analyses, including QC.
CCV	Level 3.0ug/L
CCB	

11.0 Calculations / Data Reduction

11.1 Data Reduction

Data must be evaluated in accordance with SOP SA-QA-02: *Data Generation and Review.*

11.1.1 Dilutions

If the concentration of a sample is above the calibration range of the Hg analyzer, the sample digestate must be diluted and reanalyzed. The amount of digestate needed to prepare the desired dilution is determined from the following equation:

$$V_{digest} = \frac{V_{fv}}{DF}$$

Where:

V_{digest} = volume of sample digestate used to make the dilution
V_{fv} = final volume of diluted sample
DF = dilution factor

Note: Samples should be diluted with digested blank solution.

Note: This calculation assumes all applicable unit correction factors are applied.

The dilution factor is calculated as follows:

$$DF = \frac{V_{fv}}{V_{digest}}$$

Where:

V_{digest} = volume of sample digestate used to make the dilution
V_{fv} = final volume of diluted sample
DF = dilution factor

Note: This calculation assumes all applicable unit correction factors are applied.

If a sample exceeds the calibration range of the instrument by more than a factor of 10 (i.e., if the final, calculated result is greater than 50ug/L Hg at the instrument) the samples should be re-digested and reanalyzed with a smaller amount. This is a good check for possible positive bias of the sample by incomplete digestion of organic compounds. Initial weights or volumes of <0.2g or <1.0mL should be avoided, if possible, so that a representative sample can be achieved. If, due to the level of mercury in the samples, greater dilutions are required, consult with the Department Manager for further instructions.

11.1.2 Historical Data

Many of the laboratory's clients submit samples for repeat monitoring purposes. Prior to analysis, verify the TALS Worksheet Notes and/or use the TALS Historical Data Tracker feature to determine if historical data is available for review.

11.1.3 Chemical Relationships

When available, the following chemical relationships must be evaluated for each sample. If these relationships are not met, the Department Manager must be contacted immediately.

- Total Results are ≥ Dissolved results (e.g. metals)

11.1.4 Drinking Water Compliance Evaluation

Public water suppliers (PWS) are governed by EPA-specified Maximum Contaminant Levels (MCL) above which indicates noncompliance. The MCL associated with this procedure is 0.002mg/L.

11.2 Calculations

11.2.1 The calculations associated with batch QC determinations are given in SOP SA-QA-17. Applicable calculations include accuracy (% recovery) and precision (%RPD).

11.2.2 The calculations associated with initial and continuing calibrations and are given in SOP SA-QA-16. Applicable calculations include determination for: calibration factor, standard deviation, relative standard deviation, relative response factor, and relative standard deviation.

11.2.3 The calculation to determine final concentration is given as follows:

Regression Curve:

$$FinalConcentration = CONC_{Sample} \otimes \frac{F}{I \times dw} \otimes D$$

Where:

$CONC_{Sample}$= Concentration of the sample
F = Final volume/weight
I = Initial volume/weight
dw = % Solids decimal equivalent
D = Dilution factor

Note: All dry weight corrections are performed automatically in LIMS.

Note: This calculation assumes all applicable unit correction factors are applied.

12.0 Method Performance

12.1 Reporting Limit Verification (RLV)

At a minimum, RLVs must be performed initially upon method set-up in accordance with SOP SA-QA-07: *Determination and Verification of Detection and Reporting Limits.*

For analytes and methods certified by DOD ELAP, RLVs must also be performed quarterly thereafter. For all other analytes and methods, RLVs must also be performed annually thereafter. Exceptions may be made for project-specific non-routine analytes.

12.2 Method Detection Limit (MDL) Study

The MDL is the lowest concentration that can be detected for a given analytical method and sample matrix with 99% confidence that the analyte is present. MDLs reflect a calculated (statistical) value determined under ideal laboratory conditions in a clean matrix and may not be achievable in all environmental matrices. The current MDLs associated with this procedure are given in the Method Limit Group (MLG) in TALS.

At a minimum, MDL Studies must be performed initially upon method set-up in accordance with SOP SA-QA-07: *Determination and Verification of Detection and Reporting Limits.*

Note: MDL Studies are not required for non-routine analytes provided results are not reported below the RL (i.e., MDL equals RL in TALS).

12.3 Method Detection Limit Verification (MDLV)

At a minimum, MDLVs must be performed initially upon method set-up in accordance with SOP SA-QA-07: *Determination and Verification of Detection and Reporting Limits.*

For analytes and methods certified by DOD ELAP, MDLVs must also be performed quarterly thereafter. For all other analytes and methods, MDLVs must also be performed annually thereafter.

Note: MDLVs are not required for non-routine analytes provided results are not reported below the RL (i.e., MDL equals RL in TALS).

12.4 Determination of the Instrument Detection Limit (IDL)

The instrument detection limit (IDL) is the concentration of analyte that can be statistically distinguished from the background noise of the instrument. The IDL limit must be determined annually, at a minimum, for each analyte in accordance with SOP SA-QA-07: *Determination and Verification of Detection and Reporting Limits (RLs, MDLs, and IDLs).*

The IDL is defined as three times the average of the standard deviation of seven replicate analyses of the IDL solution performed over three non-consecutive days. The IDL may be elevated above the background noise (blank levels). The current IDL associated with this procedure is given in the Equipment Limit Group (ELG) in LIMS.

12.5 QC Limit Generation, Control Charting, and Trend Analysis

The control limits for the batch QC items (LCS, MS/MSD, Analytical Spike) for this procedure are specified in the reference method and cannot be broadened; therefore, the laboratory defaults to the method-defined limits and does not utilize in-house or laboratory-derived limits for the evaluation of batch QC items.

Although the laboratory must default to the method-defined QC limits, control charting is a useful tool and is performed to assess analyte recoveries over time to evaluate trends. Control charting must be performed periodically (at a minimum annually) in accordance with SOP SA-QA-17: *Evaluation of Batch QC Data.*

12.6 Demonstrations of Capability

Initial and continuing demonstration of capability must be performed in accordance with SOP SA-QA-06: *Training Procedures.*

Prior to performing this procedure unsupervised, each new analyst who performs this analysis must demonstrate proficiency per method/analyte combination by successful completion of an initial demonstration of capability. The IDOC is performed by the

analysis of 4 consecutive LCSs that meet the method criteria for accuracy and precision. The LCSs must be from a second source than that used to prepare the calibration standards. The IDOC must be documented on the IDOC Form shown in SOP SA-QA-06 with documentation routed to the QA Department for filing.

Annual continuing demonstrations of capability (CDOCs) are also required per analyst per method/analyte combination. The CDOC requirement may be met by the consecutive analysis of four LCS all in the same batch, by the analysis of four LCS analyzed in four consecutive batches (in different batches on different days), via acceptable results on a PT study, or analysis of client samples with statistically indistinguishable results when compared to another certified analyst. The CDOC must be documented and routed to the QA Department for filing.

12.7 Training Requirements

All training must be performed and documented in accordance with SOP SA-QA-06: *Training Procedures*.

Note: The SOPs listed in the Reference/Cross-Reference Section are applicable to this procedure. All employees performing this procedure must also be trained on these SOPs.

13.0 Pollution Control

It is TestAmerica's policy to evaluate each method and look for opportunities to minimize waste generated (e.g., examining recycling options, ordering chemicals based on quantity needed, preparing reagents based on anticipated usage and reagent stability, etc.). Employees must abide by the policies in Section 13 of the Environmental Health and Safety Manual and the Savannah Addendum to the EHSM.

This procedure has been evaluated for opportunities to minimize the waste generated. Where reasonably feasible, pollution control procedures have been incorporated.

14.0 Waste Management

Waste management practices must be conducted consistent with all applicable federal, state, and local rules and regulations. All waste (i.e., excess reagents, samples, and method process wastes) must be disposed of in accordance with Section 9 of the TestAmerica Savannah Addendum to the EHSM. Waste description rules and land disposal restrictions must be followed.

14.1 Waste Streams Produced by the Method

The following waste streams are produced when this method is carried out:

- Excess aqueous samples – Dispose according to characterization on the sample disposal sheets. Neutralize non-hazardous samples before disposal into drain/sewer. Transfer hazardous samples (identified on disposal sheets) to the waste department for disposal.

- Excess soil and solid samples – Dispose according to characterization on sample disposal sheets. Transfer non-hazardous samples to TCLP container for characterization in hazardous waste department. Transfer hazardous samples (identified on disposal sheets) to waste department for disposal.

- Acidic sample digestions – Neutralize before disposal into drain/sewer system.

- Excess oil samples – Transfer to waste department for storage/disposal.

15.0 References / Cross-References

- SOP SA-AN-100: *Laboratory Support Equipment (Verification and Use)*
- SOP SA-AN-041: *Reagent and Standard Materials Procedures*
- SOP SA-QA-02: *Data Generation and Review*
- SOP SA-QA-05: *Preventive and Corrective Action Procedures*
- SOP SA-QA-06: *Training Procedures*
- SOP SA-QA-07: *Determination and Verification of Detection and Reporting Limits (RLs, MDLs, and IDLs)*
- SOP SA-QA-15: *Homogenization, Compositing, and Segregation of Samples*
- SOP SA-QA-16: *Evaluation of Calibration Curves*
- SOP SA-QA-17: *Evaluation of Batch QC Data*
- TestAmerica Savannah Quality Assurance Manual
- TestAmerica Environmental Health and Safety Manual
- TestAmerica Savannah Addendum to the Environmental Health and Safety Manual
- Method OB 10/90: Extraction and Analysis of Organics in Biological Tissue; U.S Environmental Protection Agency Environmental Services Division, Region IV Analytical Support Branch Athens, GA
- *Test Methods for Evaluating Solid Waste, Third Edition*; U.S. EPA Office of Solid Waste and Emergency Response: Washington, D.C., November 1986 (SW-846 Update III).
  - Method 7000A, Revision 1: Atomic Absorption Methods; July 1992.
  - Method 7470A, Revision 1: Mercury in Liquid Waste (Manual Cold-Vapor Technique); September 1994.
  - Method 7471A, Revision 1: Mercury in Solid or Semisolid Waste (Manual Cold-Vapor Technique); September 1994.
- *Test Methods for Evaluating Solid Waste, Third Edition*; U.S. EPA Office of Solid Waste and Emergency Response: Washington, D.C., February 2007 (SW-846 Update IV).
  - Method 7000B, Revision 2: Flame Atomic Absorption Spectrophotometry; February 2007.
  - Method 7471B, Revision 2: Mercury in Solid or Semisolid Waste (Manual Cold-Vapor Technique); February 2007.
- *Methods for Analysis of Water and Waste*; U.S. EPA Office of Research and Development: Cincinnati, OH, March 1983.
  - Method 245.1, Revision 3.0, EMMC Version: Determination of Mercury in Water by Cold Vapor Atomic Adsorption Spectrometry; 1994.
- *Methods for the Determination of Metals in Environmental Samples*; US EPA Office of Research and Development. Washington, DC.
  - Method 245.6, Revision 2.3, Determination of Mercury in Tissues by Cold Vapor Atomic Absorption Spectrometry, 1991

- *Standard Methods for the Examination of Water and Wastewater, Online Edition;* American Public Health Association: Washington, DC.
    - SM3020: Quality Assurance/Quality Control
    - SM3112B: *Metals by Cold vapor Atomic Absorption Spectrometry*; 1999

16.0 Method Modifications

16.1 Incorporation of Non-Routine Matrices

This procedure may be modified to analyze other matrices (e.g., waste (oil), wipe, tissue, and TCLP/SPLP leachate samples) upon client request. This will need to be arranged by the Project Manager at the initiation of the project.

Waste (oil), wipe, and tissue matrices are non-routine, and the laboratory is not currently NELAC certified for these matrices. The laboratory uses its routine soil RLs (converted for initial and final volumes, etc.) and soil QC limits to evaluate wipe, waste, and tissue samples. Soil DOCs can be used to satisfy analyst demonstrations of capability for these types of non-routine matrices. Teflon chips or blank sand are used as the blank matrix for tissues unless a "true" tissue matrix is required by the project. The laboratory uses its routine soil RLs (converted for initial and final volumes, etc.) and soil QC limits to evaluate TCLP/SPLP leachate samples. Water DOCs can be used to satisfy analyst demonstrations of capability for TCLP/SPLP matrices.

16.1.1 Collection and Handling Procedures for Non-Routine Matrices

Waste (oil) samples are collected in 8oz plastic soil containers. Waste (oil) samples must be iced at the time of collection and maintained at 4°C (less than 6°C but not frozen) until the time of digestion. Waste (oil) samples must be digested and analyzed within 28 days of collection. Waste (oil) digestates are stored at room temperature until the time of analysis.

Wipe samples are routinely collected in 40mL VOA vials containing acetic acid in water, pH 4.93 +/- 0.05. Wipe samples must be iced at the time of collection and maintained at 4°C (less than 6°C but not frozen) until the time of digestion. Wipe samples must be digested and analyzed within 28 days of collection. Wipe digestates are stored at room temperature until the time of analysis. Refer to the Work Instruction on *Wipe Tests: Sampling and Analysis* for additional information on wipe procedures.

Tissue samples are routinely collected in plastic containers with the size dependent upon the type of tissue being collected. Plastic jars or plastic baggies can be used. Upon receipt, tissue samples must be placed in the freezer at -10° to -20°C if extraction/digestion cannot be completed that day. Per the EPA Region 4 guidance document used for tissue analyses, tissue samples can be stored frozen for up to 6 months, and must be digested and analyzed within 28 days of thawing.

For TCLP and SPLP samples, once the TCLP/SPLP extraction procedure has been performed, the leachate is transferred to a plastic container and refrigerated at 4°C (less than 6°C with no frozen samples). TCLP/SPLP leachates must be stored at 4°C (less than 6°C with no frozen samples) until the time of preparation and/or analysis. The leachate

sample must be digested and analyzed within 28 days of completion of the TCLP/SPLP extraction.

16.1.2 Preparation and Analytical Procedures for Non-Routine Matrices

16.1.2.1 Waste (oil) samples are prepared in the same manner as routine soil samples, as outlined in Section 10.1 of this SOP. Waste (oil) QC samples are prepared in the same manner as routine soil samples, as outlined in Section 10.2 of this SOP.

16.1.2.2 Tissue samples are calculated on an "as is" basis and are prepared as outlined below. Tissue QC samples are prepared in the same manner as routine soil QC as outlined in Section 10.2 of this SOP.

Weigh between 1.0g and 1.2g of the sample and place into a 125-mL glass bottle. Add 2mL H_2SO_4 and 0.5mL HNO_3 to each sample and digest in the waterbath or heating block for at least 30 minutes at 80°C +/- 3°C or until the tissue is completely dissolved.

After samples are cooled, add 7.5mL of $KMnO_4$ (more $KMnO_4$ may be added if required), 4mL potassium persulfate solution, 25mL DI water and put samples back into water bath for an additional at least 90 minutes at 30°C +/- 3°C. Be sure the purple color of $KMnO_4$ persists for at least 15 minutes prior to placing samples in the water bath or block digestion apparatus. If not, add 7.5mL of $KMnO_4$ solution up to three additional times.

Remove the samples and allow them to cool. Add 3mL of sodium chloride-hydroxylamine sulfate solution to each bottle to neutralize excess $KMnO_4$. Add 26mL DI water and shake well. This should give a final volume of 68mL.

Note: If additional volume(s) of $KMnO_4$ were added, compensate for the addition(s) by adding less DI water so that the final volume will remain constant.

16.1.2.3 Wipe samples are prepared as outlined in the Work Instruction *Wipe Tests: Sampling and Analysis.*

16.1.2.4 Waste (oil), tissue, and wipe samples are analyzed in the same manner as routine matrices as outlined in Section 10.3.

16.2 Other Considerations

16.2.1 The EPA Manual for the Certification of Laboratories Analyzing Drinking Water requires a LFB at the MRL to be performed each day. The laboratory meets this requirement by preparing an LCS at the RL in each EPA 245.1 batch of drinking water samples. The EPA DW Manual does not specify criteria for the low-level LCS (LLCS). The laboratory requires detection of this LLCS to be acceptable.

16.2.2 The reference methods state that the standards are to be made up daily and require the entire standard to be analyzed for the calibration; therefore, the standard had to be re-prepared for the next calibration. The newer technologies used by the laboratory require only a small amount of standard to be used (<10mL). Additionally, comparison studies have been performed, and the digested standards have been found to be stable for at

least 28 days. As such, a 28-day expiration date is used by the laboratory for these standards.

16.2.3 The referenced liquid preparation methods call for an initial volume of 100mL of sample. The reference methods utilize BOD bottles that required 100mL of sample to reach the required detection limit. The newer instrumentation utilized by the laboratory requires less than 10mL of the final digestion for analysis. Therefore, this SOP utilizes a 50mL initial volume and the reagents added for digestion are lowered proportionately.

16.2.4 EPA 245.1 specifies a 100mL initial volume but allows for reduced volumes as long as the reagent ratios and quality control are met. The laboratory uses 50mL as its default initial volume, and reagent ratios have been adjusted accordingly. All method detection limits, demonstrations of capability, and PTs have been performed in this same manner.

16.2.5 EPA 245.1 specifies the use of stannous chloride/sulfuric acid suspension used to reduce mercury to elemental mercury. EPA 7470A, EPA 7471A, and EPA 7471B specify stannous sulfate to be used to reduce elemental mercury to mercury; however, these methods also state stannous chloride dissolved in hydrochloric acid can be used as an option. In accordance with the instrument manufacturer's recommendations, the laboratory uses stannous chloride dissolved in hydrochloric acid as the stannous chloride/sulfuric acid suspension tend to clog the instrument's lines. All method detection limits, demonstrations of capability, and PTs have been performed in this same manner.

16.2.6 EPA 245.1 and SM3112B specify a Method Detection Limit (MDL) study to be performed annually and when a new analyst begins. The laboratory performs an MDL study initially, with MDL Verifications performed quarterly, and when a significant change is made to the equipment. The laboratory does not use analyst-specific MDLs; therefore, new analysts are required only to perform an initial demonstration of capability (IDOC) as described in Section 12.4.

16.2.7 EPA 245.1 specifies control criteria for the method blank as >10% the analyte concentration in the sample or 2.2 times the MDL, whichever is greater. The laboratory requires the method blank to be <1/2RL. The RL for this procedure is routinely within a factor of within ~3-5x the MDL; therefore, the 1/2RL criteria used for the method blank satisfies the method requirement.

16.2.8 EPA 245.1 and SM3112B specify a Linear Dynamic Range (LDR) to be performed initially and then annually thereafter, and these methods allow for samples to be reported without dilution provided they are no more than 90% greater than the LDR. The laboratory defines the LDR as the high point of the calibration curve and dilutes all samples with concentrations above the LDR such that the final concentration of the sample is within the LDR. As such, formal annual LDR studies are not performed. Re-evaluation of the calibration curve as samples is performed.

16.2.9 EPA 7470A states non-aqueous samples must be analyzed as soon as possible. EPA 7471B states non-aqueous samples must be analyzed as soon as possible but should be held no longer than 28 days. Therefore, the laboratory defaults to a 28-day holding time for these methods.

16.2.10 EPA 7471A states the waterbath temperature should be 90-95°C. EPA 7471B states the waterbath temperature should be 95 +/- 3°C. The laboratory has defaulted to the criteria listed in EPA 7471B.

16.2.11 EPA 7471A states to weigh triplicate portions of sample to obtain a final weight of 0.6g. EPA 7471B states to weigh an aliquot of sample equal to 0.5-0.6g. The laboratory weighs out 0.5-0.6 gram of wet sample. All PE studies, MDLs, and analyst demonstrations of capability are performed in this same manner.

16.2.12 EPA 245.1 and SM3112B do not contain a method-defined batch precision requirement. The laboratory's default QC items incorporate an MSD to satisfy the Clean Water Act requirements and those clients who batch require precision to be reported. Additionally, if insufficient sample volume is provided to perform the MS/MSD, the LCS is routinely prepared in duplicate (i.e., LCS/LCSD).

17.0 Attachments

The following Tables, Diagrams, and/or Validation Data are included as Attachments:

Attachment 1: SOP Summary
Attachment 2: Sample Collection, Preservation, and Holding Time Table
Attachment 3: QC Summary
Attachment 4: Instrument Maintenance and Troubleshooting
Attachment 5: Standard and Spike Solution Posting
Attachment 6: Glassware Cleaning Posting

Attachment 1:
SOP Summary

Sample Preparation and Analysis Summary

This procedure is based on the absorption of characteristic radiation at 253.7nm by mercury vapor. After digestion, to convert all forms of mercury to the same oxidation state, the mercury ions are reduced to mercury by the addition of stannous chloride and aerated from solution after passing through a mixing coil. The mixture passes through a gas/liquid separator and through a drying tube. The vapor is passed through a flow cell positioned in the light path of an atomic absorption spectrophotometer. Mercury concentration is measured as a function of absorbance.

Analytical Sequence

Analytical Sequence for samples immediately following an initial calibration:

Description	Comments
Blank	
Initial Calibration	
ICV	Second Source
ICB	
RL Standard	Required for EPA 245.1 and SM4110B (Not a requirement for EPA 7470A, EPA 7471A, and 7471B if calibrated to RL)
Samples & Batch QC Items	Up to 9 analyses, including QC.
CCV	Level 3.0ug/L
CCB	
Samples & Batch QC Items	Up to 10 analyses, including QC.
CCV	Level 3.0ug/L
CCB	

Analytical Sequence for samples not immediately following an initial calibration:

Description	Comments
CCV	Level 3.0ug/L
CCB	
Samples & Batch QC Items	Up to 10 analyses, including QC.
CCV	Level 3.0ug/L (same as the 3.0ug/L calibration standard)
CCB	
Samples & Batch QC Items	Up to 10 analyses, including QC.
CCV	Level 3.0ug/L (same as the 3.0ug/L calibration standard)
CCB	

Attachment 2:
Sample Collection, Preservation, and Holding Time Table

Matrix	Routine Sample Container	Routine Sample Size	Minimum Sample Size	Dechlorination Agent	Chemical Preservation	Thermal Preservation	Holding Time[1]
Water	250mL plastic	50mL	10mL	Not Applicable	Nitric Acid pH<2	None[2]	28 days from collection
Soil	8oz plastic soil jar	10g	0.2g	Not Applicable	None	None[2]	28 days from collection

[1] Inclusive of digestion and analysis.
[2] Thermal preservation is not required; however, samples are routinely maintained at less than 6°C with no frozen samples.

Attachment 3:
QC Summary

QC Item	Frequency	Criteria	Corrective Action
Initial Calibration	Daily	1 blank and 5 standards Correlation coefficient ≥ 0.995	Recalibrate
Initial Calibration Verification Standard (ICV)	At the beginning of the analysis	SW846 = within ± 10% 245.1 = within ± 5%	Recalibrate
Instrument Performance Check (IPC) (Note: ICV and CCV is used to satisfy IPC.)	EPA 245.1 only: After each ICAL and every 10 samples	Initial IPC = within 5% Subsequent IPC = within 10%	Recalibrate
2nd Source Quality Control (QCS) (Note: ICV is used to satisfy QCS.)	EPA 245.1 only: Quarterly	within 10%	Recalibrate
Continuing Calibration Verification (CCV)	At the beginning and end of the analysis and every 10 samples.	SW846 = within ± 20% 245.1 = within ±10%	Terminate the analysis. Correct the problem and reanalyze all samples since the last compliant CCV.
Calibration Blank (ICB/CCB)	After ICV and every CCV	Absolute value of the calibration blank must be < ½ RL	Terminate the analysis. Correct the problem and reanalyze all samples since the last compliant CCB.
RL Standard	After every calibration but not before the ICV. This standard is not a requirement of SW846, if a multi-point calibration encompassing the RL level is used.	50-150% of true value	Recalibrate
Method Blank (MB)	One per batch of twenty or fewer samples	Result < ½ RL	Refer to SOP SA-QA-17
Low-Level Laboratory Control Sample	EPA 245.1 Drinking Water Only:	Qualitatively identified	If the "regular" LCS meets criteria,

QC Item	Frequency	Criteria	Corrective Action
(LLCS)	One per batch of twenty or fewer samples		initiate NCM and report data If the "regular" LCS does not meet criteria, redigest and reanalyze batch
Laboratory Control Sample (LCS)	One per batch of twenty or fewer samples	MLG Limits	Refer to SOP SA-QA-17
Matrix Spike (MS)	EPA 245.1: One MS per 10% of samples (i.e., 2 MS per batch of 20 samples) Other Methods: One MS per 5% of samples (i.e., 1 MS per batch of 20 samples)	MLG Limits	Refer to SOP SA-QA-17
Matrix Spike Duplicate (MSD)	1 per batch	MLG Limits	Refer to SOP SA-QA-17
Post Digestion Spikes (PDS)	When MS/MSD is unacceptable	Refer to Section 9.2.9 for guidance	Refer to Section 9.2.9 for guidance
Initial Demonstration of Capability (IDOC)	Initially, per analyst, per analyte/method/matrix combination	Refer to SOP SA-QA-06	Refer to SOP SA-QA-06 Note: Unsupervised work must not begin until acceptable IDOC is obtained.
Continuing Demonstration of Capability (CDOC)	Annually, per analyst, per analyte/method combination	Refer to SOP SA-QA-06	Refer to SOP SA-QA-06
Reporting Limit Verification (RLV)	Upon method/instrument set-up, per analyte/method/matrix	Refer to SOP SA-QA-07	Refer to SOP SA-QA-07

QC Item	Frequency	Criteria	Corrective Action
	combination. Then quarterly thereafter (for DOD ELAP) or annually thereafter (for non-DOD ELAP)		
Method Detection Limit Study (MDL)	Upon method/instrument set-up, per analyte/method/matrix combination	Refer to SOP SA-QA-07	Refer to SOP SA-QA-07
MDL Verification (MDLV)	Upon method/instrument set-up, per analyte/method/matrix combination. Then quarterly thereafter (for DOD ELAP) or annually thereafter (for non-DOD ELAP)	Refer to SOP SA-QA-07	Refer to SOP SA-QA-07
Instrument Detection Limit (IDL)	Upon method/instrument set-up, and then quarterly thereafter	Refer to SOP SA-QA-07	Refer to SOP SA-QA-07

Attachment 4:
Instrument Maintenance and Troubleshooting

Instrument Labeling
Each instrument must be labeled with its name or ID (e.g., MSA, ICP-D, etc.). Additionally, non-operational instruments must be isolated from service or marked as being out of service. Each piece of equipment has an "Operational / Not Operational" sticker that is used for this purpose.

Maintenance Log
A maintenance log must be established for each piece of equipment used in the laboratory.

All maintenance that is performed on the instrument must be recorded in the log including:
- analyst or technician performing the maintenance
- date the maintenance was performed
- detailed explanation of the reason for the maintenance
- resolution of the problem and return to control
- all service calls from instrument representatives

Preventive Maintenance
Refer to the instrument manufacturer's guides for trouble-shooting items.

LABORATORY EQUIPMENT PREVENTIVE MAINTENANCE SCHEDULE								
EQUIPMENT ITEM	Service Interval							SERVICE LEVEL
	D	W	M	Q	SA	A	AN	
Pump Tubing	X							Inspect daily, replace as needed
Standard Cups	X							Inspect daily, replace as needed
Drying Tube	X							Inspect daily, dry drying tube and all connection tubes or replace as needed
Mixing Coil		X						Inspect weekly, clean or replace as needed
Sample Probe			X					Inspect monthly, clean or replace as needed
Mercury Lamp							X	Clean or replace as needed

D = daily; W = Weekly; M = monthly; Q = Quarterly; SA = semi-annually; A = annually; AN = as needed

Troubleshooting
Troubleshooting should be documented as outlined above. If possible, troubleshooting is best performed in a step-wise manner to systematically isolate instrument components. Refer to the instrument manufacturer's guides for specific information and strategies. Enlist assistance from technical and/or department management as needed.

Contingency Plan
Maintenance contracts are carried for most instrumentation and close contact is maintained with service personnel to ensure optimal instrument functioning. An extensive spare parts inventory is maintained for routine repairs, consisting of Hg lamps, drying tubes, flow cells, tubing, and other common instrumentation components. Since instrumentation is

standardized throughout the laboratory network, spare parts and components can be readily exchanged among the network.

In general, the laboratory has at least one backup unit for each critical unit. In the event of instrument failure, portions of the sample load may be diverted to duplicate instrumentation, the analytical technique switched to an alternate approved technique (such as manual colorimetric determination as opposed to automated colorimetric determination), or samples shipped to another properly certified or approved TestAmerica location.

Attachment 5:
Standard and Spike Solution Posting

MERCURY STANDARDS AND SPIKE SOLUTIONS
PREPARATION INSTRUCTIONS / RECIPE

Standard	ICV standard, 2nd source	Calibration standards	CCV solution	LCS	MS/MSD	Analytical (post-digestion) spike
Source	Baker	SPEX	SPEX	SPEX	SPEX	SPEX

NOTES:
The purchased Baker stock (1000mg/L) will be used to create the 2nd Source (ICV) Intermediate standard (1.0 mg/L), which will then be used to create the ICV standard (3.0µg/L).

The purchased SPEX stock (1000mg/L) will be used to create the Hg intermediate standard (0.50mg/L), which will then be used to directly create each of the calibration standards (including the CCV standard, 3.0µg/L), the LCS, and the MS/MSD.

The Hg Intermediate standard (0.50mg/L) will also be used to make the analytical spike standard (73.26µg/L), which will then be used to create the analytical spike (1.0µg/L).

Standard Name	Source 1	Volume	Source 2	Volume	Final Volume*	Comments	Final Concentration
		mL		mL	mL		
2nd Source (ICV) Intermediate	Baker Stock (1000mg/L)	0.10	HNO3	2.5	100		1.0 mg/L
ICV solution	2nd Source (ICV) Intermediate	0.15			50	Digest	3.0µg/L
Hg Intermediate	SPEX Stock (1000mg/L)	0.050mL	HNO3	2.5	100		0.50mg/L
Calibration Standards	Hg Intermediate	0.0, 0.02, 0.04, 0.10, 0.30, and 0.50			50	Digest	0.0, 0.2, 0.4, 1.0, 3.0 and 5.0µg/L
CCV solution	Hg Intermediate	0.30			50	Digest	3.0µg/L
LCS	Hg Intermediate	0.25			50	Digest	2.5µg/L
MS/MSD	Hg Intermediate	0.10			50	Digest	1.0µg/L
Analytical Spiking standard	Hg Intermediate	20	HNO3	2.5	136.5	Use a graduated cylinder	73.26µg/L
Analytical (Post-digestion) spike	Analytical Spiking standard	0.10				Add to 10mL of digested sample	1.0µg/L

*DI water is used to dilute standards to final volume

*****Note. This is a convenient reference for the basic instructions for the preparation of typical Hg standards and spike solutions, and should only be used in combination with a thorough understanding of Section 8 of SOP ME28.*

FME160:10.17.07:0

TestAmerica

Attachment 6:
Glassware Cleaning Posting

GLASSWARE CLEANING PROCEDURES
METALS DEPARTMENT

Graduated Cylinders

1. Scrub with hot, soapy H_2O and brush.
2. Rinse thoroughly with tap H2O.
3. Rinse with 10% HNO_3
4. Rinse thoroughly with DI H_2O.

Volumetric Flasks

1. Empty contents of flask
2. Squirt a small amount of cleaning detergent directly into volumetric flask
3. Fill flask 1/3 full with **HOT** H_2O
4. Replace top and shake flask.
5. Empty flask and rinse with **HOT** H_2O until no soap remains in flask.
6. Add approximately 10mL concentrated HNO_3 to 50mL, 100mL, and 250mL flasks ---- replace top and shake well.

For 500mL or 1000mL flasks use 25mL and for 10mL flasks use 2 - 5mL of concentrated HNO_3.

7. Rinse 3 times with DI H_2O, filling flask 1/3 full and replacing top. Store until needed.

*** NEVER PLACE VOLUMETRIC FLASKS OR TOPS IN SINK OR DISHPAN WITH OTHER DIRTY DISHES.**

***Dispose of all acid waste in accordance with the TestAmerica Savannah Addendum to the Corporate Environmental Health and Safety Manual.**

FME023:12.29.10:4

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18.0 Revision History

Summary of Changes from Previous Revision:

- Minor editorial, grammatical, and formatting changes made. Boilerplate text added. Updated referenced SOP titles and document control numbers to reflect current versions.
- Added section to describe analytical data system, software, and hardware. Section 6.2
- Added note that if an LCS and LCSD are performed, both QC items must be evaluated and reported. Acceptable recoveries (as well as %RPD) for both LCS and LCSD are required. Section 9.1
- Clarified requirements and frequency for RLVs, MDL Studies, and MDLVs to be consistent with SOP SA-QA-07 and to include the quarterly frequency as defined by DOD. Section 12.1 - 12.3 and Attachment 3
- Added note that unsupervised work must not begin until acceptable IDOC is obtained. Attachment 3
- Added section on troubleshooting. Attachment 4
- Revised batch QC frequency (i.e., default batch QC items). Section 9.1, Section 16, and Attachment 3
- Removed requirement to notify PM immediately via NCM for sample detections above the MCL. This notification is automatically generated via the Action Limit feature in TALS.
- Removed requirement to verify pH paper upon receipt.
- Incorporated method requirements from SM3112B.

ELEMENTS BY ICP-MS

(Methods: EPA 200.8, EPA 6020, and EPA 6020A)

Approvals (Signature/Date):

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1.0 Scope and Application

This SOP gives the procedures for the determination of various metals by inductively coupled plasma mass spectrometry (ICP-MS).

Note: The routine matrices for this procedure are waters and soils; however, this procedure may be adapted to accommodate other matrices as outlined in Section 16.1.

A complete target analyte list, the reporting limits (RL), the method detection limits (MDL), and the accuracy and precision criteria associated with this procedure are provided in the LIMS Method Limit Groups (MLGs).

This SOP was written by and for TestAmerica's Savannah laboratory.

2.0 Summary of Method

Prior to analysis by ICP-MS, the sample must be solubilized or digested using the sample preparation method appropriate to the matrix. Sample digestates are aspirated and nebulized into a spray chamber. A stream of argon gas carries the sample aerosol through the innermost of three concentric tubes and injects it into the middle of the donut-shaped plasma. The sample elements are dissociated, atomized, and excited to a higher energy level. The ions that are produced are entrained in the plasma gas and introduced, by means of an interface, into a mass spectrometer. The ions are sorted according to their mass to charge ratios and quantified with a channel mass spectrometer.

This SOP is based on the following methods: EPA Method 200.8, SW-846 Method 6020, and SW-846 Method 6020A.

3.0 Definitions

Refer to the Glossary Section of the *Quality Assurance Manual* (QAM) for a complete listing of applicable definitions and acronyms.

4.0 Interferences

4.1 Procedural Interferences

4.1.1 Interferences may be caused by contaminants in solvents, reagents, glassware, and other sample processing apparatus and can make identification and/or quantification of the target analytes difficult.

4.1.2 All sample collection containers are single-use disposable containers which limits the potential for contamination. All non-disposable labware must be scrupulously cleaned in accordance with the posted Labware Cleaning Instructions to ensure it is free from contaminants and does not contribute artifacts.

4.1.3 High purity reagents and solvents are used to help minimize interference problems. Hydrochloric acid and nitric acid must be verified prior to use in accordance with the TestAmerica Solvent Lot Testing Program.

4.1.4 Instrument and/or method blanks are routinely used to demonstrate all reagents and apparatus are free from interferences under the conditions of the analysis.

4.2 Matrix Interferences

4.2.1 Matrix interferences may be caused by contaminants that are co-extracted from the sample matrix. The sample may require cleanup such as filtration or dilution prior to analysis to reduce or eliminate the interferences.

4.2.2 Interfering contamination may occur when a sample containing low concentrations of analytes is analyzed immediately following a sample containing relatively high concentrations of analytes. As such, samples known to be clean should be analyzed first. To prevent carryover into subsequent samples, analysis of reagent blanks may be needed after the analysis of a sample containing high concentrations of analytes.

4.2.3 Isobaric elemental interferences in the ICP-MS are caused by isotopes of different elements forming atomic ions with the same nominal mass-to-charge ratio (m/z) as the target analyte. These can be managed by the selection of an alternate isotope or by the use of elemental interference equations. Most isobaric interferences that could affect the ICP-MS analysis for elements in this SOP have been identified. The basic elemental interference equations are based on natural isotopic abundances. The most precise coefficients for an instrument must be determined from the ratio of the net isotope signals that are observed for a known standard solution at a concentration sufficient to produce suitable counting statistics.

4.2.4 Physical interferences are effects associated with the sample nebulization and transport processes as well as ion-transmission efficiencies. Changes in viscosity can cause significant inaccuracies, especially in samples containing high concentrations of dissolved solids or high acid concentrations. These changes in matrix can cause significant signal suppression or enhancement. Dissolved solids can deposit on nebulizer tips and interface cones (reducing the orifice size and the instrument's performance). Internal standards can be used to correct for physical interferences if they are carefully matched to the analyte so that both elements react similarly to the matrix changes.

4.2.5 Memory interferences can occur when analytes from a previous sample contribute to signals measured from subsequent samples. The memory effects can result from analyte deposition of sample on the sample tubing, joints, nebulizer, spray chamber, torch, and/or interface cones. Routine maintenance on the sample introduction system is necessary in order to minimize the memory interferences. The memory effects must be taken into account when setting up a suitable rinse times. The evaluation of a minimum of three replicate integrations will help to determine memory problems.

5.0 Safety

Employees must abide by the policies and procedures in the TestAmerica Environmental Health and Safety Manual (EHSM), the TestAmerica Savannah Addendum to the EHSM, and this document.

This procedure may involve hazardous materials, operations, and equipment. This SOP does not purport to address all of the safety problems associated with its use. It is the responsibility of the user to follow appropriate safety, waste disposal, and health practices under the assumption that all samples and reagents are potentially hazardous.

The analyst must protect himself/herself from exposure to the sample matrix. Many of the samples that are tested may contain hazardous chemical compounds or biological organisms. The analyst must, at a minimum, wear protective clothing (lab coat), eye protection (safety glasses or face shield), disposable gloves, and closed-toe, nonabsorbent shoes when handling samples.

5.1 Specific Safety Concerns or Requirements

Nitric and hydrochloric acids are extremely hazardous as oxidizers, corrosives, poisons, and are reactive. Inhalation of the vapors can cause coughing, choking, irritation of the nose, throat, and respiratory tract, breathing difficulties, and lead to pneumonia and pulmonary edema. Contact with the skin can cause severe burns, redness, and pain. Nitric acid can cause deep ulcers, and staining of the skin to a yellow or yellow-brown color. These acid vapors are irritating and can cause damage to the eyes. Contact with the eyes can cause permanent damage.

Samples that contain high concentrations of carbonates or organic matter, or samples that are at elevated pH can react violently when acids are added. Acids must be added to samples under a hood to avoid splash/splatter hazards and/or possibly toxic vapors that will be given off when the samples are acidified.

5.2 Primary Materials Used

The following is a list of the materials used in this procedure, which have a serious or significant hazard rating, and a summary of the primary hazards listed in their MSDS.

NOTE: This list does not include all materials used in the procedure. A complete list of materials used in this procedure can be found in the Reagents and Standards Section and the Equipment and Supplies Section of this SOP

Employees must review the information in the MSDS for each material before using it for the first time or when there are major changes to the MSDS. Electronic copies of MSDS can be found using the "MSDS Online" button on the Oasis homepage, on the EH&S webpage on Oasis, and on the QA Navigator.

Material	Hazards	Exposure Limit[1]	Signs and Symptoms of Exposure
Hydrochloric Acid[2]	Corrosive Poison	5ppm Ceiling	Inhalation of vapors can cause coughing, choking, inflammation of the nose, throat, and upper respiratory tract, and in severe cases, pulmonary edema, circulatory failure, and death. Can cause redness, pain, and severe skin burns. Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
Hydrofluoric Acid	Corrosive Poison	3ppm TWA	Extremely hazardous liquid and vapor. Can cause severe burns which may not be immediately painful or visible. Ingestion or inhalation can cause severe damage or death. Can cause burns to the skin, eyes, and respiratory tract. Can cause bone damage.
Nitric Acid[2]	Corrosive Oxidizer Poison	2ppm TWA 4ppm STEL	Nitric acid is extremely hazardous; it is corrosive, reactive, an oxidizer, and a poison. Inhalation of vapors can cause breathing difficulties and lead to pneumonia and pulmonary edema, which may be fatal. Other symptoms may include coughing, choking, and irritation of the nose, throat, and respiratory tract. Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and stain skin a yellow or yellow-brown color. Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
[1]Exposure limit refers to the OSHA regulatory exposure limit.			
[2]Always add acid to water to prevent violent reactions.			

6.0 Equipment and Supplies

6.1 Equipment and Instrumentation

Agilent 7500CE equipped with an Octopole Reaction System (ORS). The ORS is a small enclosed chamber that can be pressurized with a collision/reaction gas and mounted on-axis to the quadrapole for high ion transmission. The reaction gases used are:

Helium (UHP grade) - reduces both matrix based interferences, such as chlorides, and simple plasma based interferences, such as argon oxide or the doubly charged argon argon+, attributed from the argon plasma.

Hydrogen (UHP grade) - reduces the intense plasma-based interferences which the helium mode may not be efficient enough to correct for, such as argon hydride, argon gas, or argon oxide.

The ORS corrects for most of the interferences associated with a non-collision cell ICP-MS, but there are a few analytes that are evaluated in a "no gas" or normal mode that still require an interference equation. They are typically:

Cd 111: (1 * 111) - (0.00124 * 95)
Sn 115: (1 * 115) - (118 * 0.016)
Pb 208: (1 * 206) + (1 * 207) + (1 * 208)

If analyzing drinking water samples in "normal" mode only (no collision or reaction gas), then the following interference equations are recommended by the EPA. These equations are guidelines and can differ from instrument to instrument.

As 75: (1 * 75) - [(3.127 * 77) - (0.815 * 82)]
Cd 111: (1 * 111) - [(1.073 * 108) - (0.712 * 106)]
Pb 208: (1 * 206) + (1 * 207) + (1 * 208)
Mo 98: (1 * 98) - (0.146 * 99)
V 51: (1 * 51) - [(3.127 * 53) - (0.113 * 52)]
In 115: (1 * 115) - (0.016 * 118)

Data System: Chemstation and MARRS software are used to acquire, store, reduce, and output ICP mass spectral data. This software has the capability of processing stored ICPMS data. The software allows for the calculation of concentrations of analytes using the calibration curve.

6.2 Lab Supplies

Volumetric Containers – various sizes; Class A, where applicable. Verify in accordance with SOP SA-AN-100: *Laboratory Support Equipment (Verification and Use)*

Mechanical Pipettes – various sizes. Verify in accordance with SOP SA-AN-100: *Laboratory Support Equipment (Verification and Use)*

Argon gas supply and appropriate fittings

Cooling water supply

Hydrogen gas (UHP)

Helium gas (UHP)

Detergent – Citranox or comparable cleaner, used for washing non-disposable labware.

Filters – 0.45um syringe filters, used to filter samples for dissolved metals in the lab. Also used to remove particulates from sample digestions.

Syringes – 10mL luer lock syringes, used to filter samples

6.3 Sample Collection Containers

All sample collection containers are single-use disposable containers which limits the potential for contamination.

The routine sample collection containers supplied by the laboratory are:

Waters:
Total Metals:

250mL plastic with nitric acid – purchased with Certificate of Analysis attesting to purity.
Dissolved Metals:
250mL plastic – purchased with Certificate of Analysis attesting to purity.

Soils:
8oz plastic soil jar – purchased with Certificate of Analysis attesting to purity.

7.0 Reagents and Standards

7.1 Expiration Dates

Expiration dates (time from initial use or receipt to final use) for standard and reagent materials must be set according to the guidance in this SOP. Note: These are maximum expiration dates and are not to be considered an absolute guarantee of standard or reagent quality. Sound judgment must be used when deciding whether to use a standard or reagent. If there is doubt about the quality of a standard or reagent material, a new material must be obtained or the standard or reagent material verified. Data quality must not be compromised to extend a standard's life – i.e., when in doubt, throw it out.

The expiration date of any standard or reagent must not exceed the expiration date of the standard or reagent that was used to prepare it; that is, the "children may not outlive the parents".

7.2 Reagents

Reagents must be prepared and documented in accordance with SOP SA-AN-41: *Reagent and Standard Materials Procedures.*

Hydrochloric acid and nitric acid must be verified prior to use in accordance with the TestAmerica Solvent Lot Testing Program.

Laboratory Reagent Water – ASTM Type II or better; water from the Modulab filtration system (i.e., ASTM Type I) should be used as the default.

Nitric acid (HNO_3) - trace metal grade.
Storage: Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Store away from sunlight, heat, water, and incompatible materials. Stable under ordinary conditions of use and storage.
Expiration: Manufacturer's expiration date

Hydrochloric acid (HCl) - trace metal grade.
Storage: Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Store away from sunlight, heat, water, and incompatible materials. Stable under ordinary conditions of use and storage.
Expiration: Manufacturer's expiration date

Hydrofluoric acid (HF) – reagent grade
Storage: Store in a cool, dry, well ventilated area in a polyethylene container. Keep separated from other reagents.

7.3 Standards

Standards must be prepared and documented in accordance with SOP SA-AN-41: *Reagent and Standard Materials Procedures.* Certificates of analysis or purity must be received with all purchased standards, and scanned and filed in the Data Archival Folder on the G-drive.

7.3.1 Calibration Stock Standards

The following individual analytes are purchased at the concentrations listed:
Aluminum – 10000mg/L
Antimony – 1000mg/L
Arsenic – 1000mg/L
Barium – 1000mg/L
Beryllium – 1000mg/L
Boron – 1000mg/L
Cadmium – 1000mg/L
Calcium – 10000mg/L
Chromium – 1000mg/L
Cobalt – 1000mg/L
Copper – 1000mg/L
Iron – 10000mg/L
Lead – 1000mg/L
Magnesium – 10000mg/L
Manganese – 1000mg/L
Mercury – 1000mg/L
Molybdenum – 1000mg/L
Nickel – 1000mg/L
Potassium – 10000mg/L
Selenium – 1000mg/L
Silver – 1000mg/L
Sodium – 10000mg/L
Strontium – 1000mg/L
Thallium – 1000mg/L
Tin – 1000mg/L
Titanium – 1000mg/L
Vanadium – 1000mg/L
Zinc – 1000mg/L

Storage: room temperature
Expiration: opened and unopened containers are given the manufacturer's expiration date

7.3.2 Initial Calibration Verification Stock Standards

The following individual analytes are routinely purchased from Absolute standards (this standard must be purchased from a vendor different than the vendor of the calibration standards) at the concentrations listed:
Aluminum – 10000mg/L
Antimony – 1000mg/L
Arsenic – 1000mg/L
Barium – 1000mg/L
Beryllium – 1000mg/L

Boron – 1000mg/L
Cadmium – 1000mg/L
Calcium – 10000mg/L
Chromium – 1000mg/L
Cobalt – 1000mg/L
Copper – 1000mg/L
Iron – 10000mg/L
Lead – 1000mg/L
Magnesium – 10000mg/L
Manganese – 1000mg/L
Mercury – 100mg/L
Molybdenum – 1000mg/L
Nickel – 1000mg/L
Potassium – 10000mg/L
Selenium – 1000mg/L
Silver – 1000mg/L
Sodium – 10000mg/L
Strontium – 1000mg/L
Thallium – 1000mg/L
Tin – 1000mg/L
Titanium – 1000mg/L
Vanadium – 1000mg/L
Zinc – 1000mg/L

Storage: room temperature
Expiration: opened and unopened containers are given the manufacturer's expiration date

7.3.3 Interference Check Standard

A/B Stock Standards:

Solution Component	Concentration Solution A (mg/L)	Concentration Solution B (mg/L)
Aluminum (Al)	1000	
Calcium (Ca)	1000	
Iron (Fe)	1000	
Magnesium (Mg)	1000	
Sodium (Na)	1000	
Phosphorus (P)	1000	
Potassium (K)	1000	
Sulfur (S)	1000	
Carbon (C)	2000	
Chloride (Cl)	10000	
Molybdenum (Mo)	20	
Titanium (Ti)	20	
Arsenic (As)		10
Cadmium (Cd)		10
Chromium (Cr)		10
Cobalt (Co)		10
Copper (Cu)		10
Manganese (Mn)		10
Nickel (Ni)		10
Silver (Ag)		10
Zinc (Zn)		10

Storage: room temperature
Expiration: opened and unopened containers are given the manufacturer's expiration date

7.3.3 Internal Standard Stock Standard
The following elements are used as the internal standards: Bi, In, Li6, Sc, Tb, Y and Ge. A mixed standard containing all elements is purchased from a vendor at a concentration of 10mg/L.

Storage: room temperature
Expiration: opened and unopened containers are given the manufacturer's expiration date

7.3.4 Prepared Standards
Refer to Attachment 7 for information on prepared standards.

8.0 Sample Collection, Preservation, Shipment, and Storage

8.1 Water Samples

8.1.1 Total Metals

Water samples are routinely collected in 250mL plastic containers containing 3mL of a 1:3

nitric acid preservative. The preservative should be sufficient to achieve a sample pH of less than 2.

Although no temperature preservation is required, samples are routinely iced at the time of collection at 4°C (less than 6°C but not frozen). Samples are stored at room temperature until the time of digestion. Samples must be digested and analyzed within 6 months of collection, unless mercury is requested. Samples for mercury analysis must be digested and analyzed within 28 days of sample collection. Digestates are stored at room temperature until the time of analysis.

NCMs must be initiated for samples collected in improper containers and containing improper or insufficient preservatives.

8.1.2 Dissolved Metals

Water samples for dissolved metals are routinely filtered at the time of sampling and collected in 250mL plastic containers containing 3mL of a 1:3 nitric acid preservative. The preservative should be sufficient to achieve a sample pH of less than 2.

Note: If the sample is to be filtered in the laboratory, the sample must be collected in 250mL plastic container with no preservatives. Once filtered, the laboratory will add nitric acid to obtain a pH of less than 2. Unpreserved water samples that are to be filtered in the laboratory must be iced at the time of collection at 4°C (less than 6°C but not frozen). The samples must be kept refrigerated until the time of filtration and preservation.

Although no temperature preservation is required when the samples are preserved with nitric acid, samples are routinely iced at the time of collection at 4°C (less than 6°C but not frozen). Samples are stored at room temperature until the time of digestion. Samples must be digested and analyzed within 6 months of collection, unless mercury is requested. Samples for mercury analysis must be digested and analyzed within 28 days of sample collection. Digestates are stored at room temperature until the time of analysis.

NCMs must be initiated for samples collected in improper containers and containing improper or insufficient preservatives.

8.2 Soil Samples

Soil samples are routinely collected in 8oz plastic soil containers.

Samples must be iced at the time of collection and maintained at 4°C (less than 6°C but not frozen) until the time of digestion and analysis. Samples must be digested and analyzed within 6 months of collection, unless mercury is requested. Samples for mercury analysis must be digested and analyzed within 28 days of sample collection. Digestates are stored at room temperature until the time of analysis.

9.0 Quality Control

SOP SA-QA-17: *Evaluation of Batch QC Data* and the SOP Summary in Attachment 3 provide requirements for evaluating QC data.

9.1 Batch QC

9.1.1 EPA 200.8 – Drinking Water

A digestion batch consists of up to 20 environmental samples and the associated QC items digested together within a 24 hour period.

The minimum QC items required for each digestion batch are: a method blank, a laboratory control sample (LCS), a low-level LCS (LLCS), a matrix spike (MS) to be performed on a minimum of 10% of samples or one per batch – whichever is greater, and a matrix spike duplicate (MSD).

This frequency equates to the following:

- For a batch of 10 or fewer samples, the minimum QC items are a method blank, an LCS, an LLCS, 1 matrix spike, and 1 matrix spike duplicate.
- For a batch of 11-20 samples, the minimum QC items are a method blank, an LCS, an LLCS, 1 matrix spike (from sample 1-10), another matrix spike (from sample 11-20), and a matrix spike duplicate.

The routine container supplied for this method is a 250mL container. 50mL is required for digestion. Reduced sample initial volumes may be necessary to achieve the required batch matrix spike frequency; however, the minimum digestion volume to be used for the matrix spike samples is 25mL. Note: Final volumes and spike amounts must be adjusted to compensate for these reduced initial volumes.

If there is insufficient sample volume to perform the required matrix spike(s), the LCS must be prepared in duplicate (i.e., LCSD). An NCM must be initiated on all affected samples to denote this situation. Insufficient sample volume is defined as receiving less than a total of 100mL.

Note: If an LCS and LCSD are performed, both QC items must be evaluated and reported. Acceptable recoveries (as well as %RPD) for both LCS and LCSD are required.

The sample preparation and digestion procedures are listed in the following SOPs:

Matrix	SOP
Aqueous samples	SA-ME-050

Batch QC must meet the criteria given in Attachment 3 of this SOP.

9.1.2 EPA 200.8 – Clean Water Act

An extraction batch consists of up to 20 environmental samples and the associated QC items extracted together within a 24 hour period.

The minimum QC items required for each extraction batch are: a method blank, a laboratory control sample (LCS), a matrix spike (MS) to be performed on a minimum of 10% of samples or one per batch – whichever is greater, and a matrix spike duplicate (MSD).

This frequency equates to the following:

- For a batch of 10 or fewer samples, the minimum QC items are a method blank, an LCS, 1 matrix spike, and 1 matrix spike duplicate.
- For a batch of 11-20 samples, the minimum QC items are a method blank, an LCS, 1 matrix spike (from sample 1-10), another matrix spike (from sample 11-20), and a matrix spike duplicate.

The routine container supplied for this method is a 250mL container. 50mL is required for extraction. Reduced sample initial volumes may be necessary to achieve the required batch matrix spike frequency; however, the minimum extraction volume to be used for the matrix spike samples is 25mL. Note: Final volumes and spike amounts must be adjusted to compensate for these reduced initial volumes.

If there is insufficient sample volume to perform the required matrix spike(s), the LCS must be prepared in duplicate (i.e., LCSD). An NCM must be initiated on all affected samples to denote this situation. Insufficient sample volume is defined as receiving less than a total of 100mL.

Note: If an LCS and LCSD are performed, both QC items must be evaluated and reported. Acceptable recoveries (as well as %RPD) for both LCS and LCSD are required.

The sample preparation and digestion procedures are listed in the following SOPs:

Matrix	SOP
Aqueous samples	SA-ME-050

Batch QC must meet the criteria given in Attachment 3 of the associated analytical SOP.

9.1.3 EPA 6020 and EPA 6020A

A digestion batch consists of up to 20 environmental samples and the associated QC items. The minimum QC items required for each digestion batch are: a method blank, a laboratory control sample (LCS), a matrix spike (MS), and a matrix spike duplicate (MSD) or a sample duplicate.

If there is insufficient sample to perform the MS/MSD or sample duplicate, an NCM must be initiated on all affected samples to denote this situation.

The routine container supplied for this method is a 250mL container. 50mL is required for digestion. Reduced sample initial volumes may be necessary to achieve the required batch matrix spike frequency; however, the minimum digestion volume to be used for the matrix spike samples is 25mL. Note: Final volumes and spike amounts must be adjusted to compensate for these reduced initial volumes.

If there is insufficient sample volume to perform the required matrix spike(s), the LCS must be prepared in duplicate (i.e., LCSD). An NCM must be initiated on all affected samples to denote this situation. Insufficient sample volume is defined as receiving less than a total of 100mL.

Note: If an LCS and LCSD are performed, both QC items must be evaluated and reported. Acceptable recoveries (as well as %RPD) for both LCS and LCSD are required.

The sample preparation and digestion procedures are listed in the following SOPs:

Matrix	SOP
Water samples	SA-ME-050
Soil samples	SA-ME-051

Batch QC must meet the criteria given in Attachment 3 of this SOP.

9.2 Instrument QC

9.2.1 Initial Calibration (ICAL)

The instrument must be calibrated in accordance with SOP SA-QA-16: *Evaluation of Calibration Curves*. This SOP provides requirements for establishing the calibration curve and gives the applicable formulas.

Instrument calibration is performed by analyzing a series of known standards. The calibration curve must consist of a minimum of a single standard and a blank; however a multi-point calibration is used for most analytes.

Note: During method development for the EPA 200.8 drinking water procedure (which does not permit use of the collision cell technology), it was determined that a single point calibration (i.e., a blank and a high standard) was more accurate at low concentrations for the majority of the elements. Therefore, the laboratory's default procedure for drinking water samples is to quantitate results using a single point calibration for the majority of the elements and a multi-point calibration curve for copper and magnesium only. A multi-point calibration curve is analyzed for all the elements due to the fact that the standards mixes include every element; however, the software is directed to evaluate only the blank and a high standard for those elements utilizing a single point calibration (i.e., all elements except copper and magnesium). This evaluation is built into the software set-up and is not being made at the time of calibration using analyst discretion.

Refer to Attachment 7 for the standard preparation instructions. Other standard concentrations may be used provided they support the reporting limit and are fully documented in accordance with SOP SA-AN-41.

Tabulate the concentrations and corresponding responses for each analyte. Establish a calibration curve by plotting the concentration along the x-axis and the corresponding response along the y-axis.

The regression coefficient (r^2) of the regression curve must be greater than 0.998 for the initial calibration curve to be acceptable.

9.2.2 Second Source Initial Calibration Verification (ICV)

The calibration curve must be verified initially – prior to any sample analyses – in accordance with SOP SA-QA-16 with a standard obtained from a second source.

The ICV must be within +/-10% to be acceptable.

Refer to Attachment 7 for the standard preparation instructions. Another standard concentration may be used provided it is mid-level and fully documented in accordance with SOP SA-AN-41.

9.2.3 Initial Calibration Blank (ICB) / Continuing Calibration Blank (CCB)

The instrument must be shown to be free from contamination by the analysis of calibration blanks. Initial calibration blanks are analyzed at the beginning of each analytical run immediately following the ICV. Continuing calibration blanks are analyzed every 10 analyses immediately following each CCV.

Initial and continuing calibration blanks must be <1/2RL to be acceptable.

9.2.4 Continuing Calibration Verification

The initial calibration curve must be verified every 10 analyses with a mid-level standard.

The CCV must be within +/-10% to be acceptable.

Refer to Attachment 7 for the standard preparation instructions. Another standard concentration may be used provided it is mid-level and fully documented in accordance with SOP SA-AN-41.

9.2.5 Internal Standard (ISTD)

This procedure utilizes internals standards. See Attachment 7 for the concentrations and masses of the internal standard elements.

The internal standard solution is added to all standards, samples, and QC items by way of a peristaltic pump, a "T" connector, and a mixing coil at the instrument. The solution used is 1mg/L for each of the internal standard elements. Other concentrations may be used provided it is mid-level and fully documented in accordance with SOP SA-AN-41.

9.2.5.1 EPA 200.8

The response of the internal standard in all samples and QC items must be within 60-125% of the response of the internal standard in the calibration blank. If the response is outside this range, flush the instrument with rinse blank and re-analyze the calibration blank. If the responses are within limits, re-analyze the samples at a dilution of 2.

9.2.5.2 EPA 6020

The response of the internal standard for CCV and CCB must be within 80-120% of the response of the internal standard in the original calibration solution. If the response is outside this range, terminate the analysis, correct the problem, and re-calibrate.

The response of the internal standard for samples and batch QC must be within 30-120% of the response of the internal standard in the initial calibration standard. If the response is outside this range, re-analyze the sample at a dilution of 5.

9.2.5.3 EPA 6020A

The response of the internal standard in all samples and QC items must not fall below 70% of the response of the internal standard in the initial calibration standard. If the response is outside this range for instrument QC, terminate the analysis, correct the problem, and re-calibrate. If the response is outside this range for samples, re-analyze the sample at a dilution of 5.

9.2.6 Post Digestion Spike

A post-digestion spike is performed on one sample per analytical batch to determine if matrix interferences are present. This post-digestion spike is evaluated if the serial dilution fails or if the analyte concentration is not at least 50 times the instrument detection limit. This should be the same sample selected for the serial dilution in Section 10.4, above.

9.2.6.1 Transfer 10mL of a digestate to a suitable vial.

9.2.6.2 Spike the sample with appropriate volumes of the ICP-MS LCS/Matrix Spike Solution. The theoretical concentration of the post digestion spike is the same as the LCS or MS if the volume of spiking solution is discounted.

9.2.6.3 Analyze the spiked aliquot and an un-spiked aliquot (the un-spiked may have been analyzed previously and does not need to be reanalyzed).

9.2.6.4 Calculate the percent recovery of the post digestion spike as follows:

$$\%REC = \frac{C_{ps} - C_s}{C_2} \times 100$$

Where: C_{ps} = concentration of post digestion spike (ug/L)
C_s = concentration of un-spiked sample (ug/L)
C_2 = theoretical concentration of spike (ug/L)
(Refer to Section 10.2.5.2)

9.2.6.5 Evaluate the recovery using the following decision matrix. Limits for post digestion spikes are 80-120%.

Result of Post Digestion Spikes	Action
Within 80-120% limits	None
>120% recovery	Repeat analysis. Remake spiking solutions, re-spike, and reanalyze. Reanalyze un-spiked sample.
<80% recovery but >50%	1) Dilute and re-spike. Elevate RL accordingly (for

recovery	all associated samples). 2) Spike and evaluate all associated samples. 3) Spike and evaluate all associated samples by single point MSA. 4) Qualify all associated samples.
<50% recovery	Dilute digestate and repeat spike. ***Treat all samples associated with spike in the same manner as the spiked sample (i.e., spike or dilute samples).*** If recoveries are not 80-120%, analyze all associated samples by single point MSA. Note – high level of target analytes may inhibit spike recovery. Consult the supervisor in events where high levels of targets appear to be interfering.

Note: The >50% recovery of the post digestion spike is a benchmark below which samples may be biased high if corrected for spike recovery.

9.2.6.6 The post digestion spike and the method of standard additions must not be applied to samples analyzed at a dilution that produces a significant negative response. The analyst must use good judgment when evaluating data where the sample response is negative. Where a significant negative response is present, the digestate should be diluted and reanalyzed to determine the extent of the matrix interferences. If necessary, adjust the interference corrections and reanalyze the samples.

9.2.6.7 Single Point Method of Standard Additions

Two identical aliquots of the sample digest, V_x, are taken. One aliquot is spiked with a solution of known concentration, C_s. The second aliquot is analyzed un-spiked (the small volume of standard added to the spiked sample should be disregarded). The concentration of both aliquots is measured and the sample concentration, C_x, is calculated as follows:

$$C_x = \frac{S_2 V_s C_s}{(S_1 - S_2) V_x}$$

Where: S_1 = absorbance or concentration of the spiked aliquot
S_2 = absorbance or concentration of the un-spiked aliquot
Vs = volume of spike solution

Example:	Sample concentration (S_2):	523ug/L.
	Spike solution concentration (C_s):	50,000ug/L
	Volume of spike solution (V_s):	0.10mL
	Volume of sample aliquots (V_x):	10mL
	Spiked sample concentration (S_1):	95ug/L

C_x = [(523)*(0.10)*(50,000)] / [(951-523)*10)] = [2,615,000]/[4280] = 611 ug/L

9.2.7 Dilution Test (Serial Dilution)

A 1/5 dilution is prepared and analyzed on one sample per batch (one for every ten samples for EPA 200.8, or whichever is greater) to determine if matrix interferences are present.

9.2.7.1 Select a sample digestate that contains one or more target analytes at concentrations greater than 50 times the method detection limit.

9.2.7.2 Dilute the digestate by a factor of 5, and analyze the dilution using the same procedures used for the un-diluted aliquot.

9.2.7.3 Compare the results of the diluted and un-diluted aliquots of sample digestate.

9.2.7.4 If the results of the dilution are within +/-10% of the results of the undiluted sample, no matrix interference is present. If the results differ by greater than +/-10%, matrix interference should be suspected and the sample digestate should be subjected to a post-digestion spike (refer to Section 10.5).

If the concentration of the analyte in the sample is not at least 50 times the instrument detection limit, evaluate the post-digestion spike.

9.2.8 Determination of Linear Range of the ICP-MS

If the instrument is not calibrated over its entire linear range for a particular element, a linear range standard must be analyzed daily to validate the linear range.

9.2.8.1 The ICSA solution is utilized as a linear range standard for those elements included in the solution. For elements not contained in the ICSA solution, a linear range standard must be prepared and analyzed.

9.2.8.2 Prepare the standard at concentrations that are expected to define the linear range of the instrument. The calibration standards and the linear range standards must be matrix matched; that is, they have the same percentage of hydrochloric and nitric acids.

9.2.8.3 Analyze the standard(s) after the initial calibration is validated.

9.2.8.4 Compare the concentration of the linear range standard with its true concentration using the following equation:

$$PercentDifference = \left| \frac{Ccal - Ctrue}{Ctrue} \right| \otimes 100$$

Where:
C_{cal} = concentration determined from analysis
C_{true} = true concentration of the standard

If the percent difference is less than or equal to 10%, the linear range is confirmed at that concentration. If the percent difference is greater than 10%, repeat the analysis with a lower concentration. For elements validated in this manner, data may be reported up to 90% of that linear range before a dilution is required.

9.3 <u>Corrective Action for Out-of-Control Data</u>

When the quality control parameters do not meet the criteria set forth in this SOP, corrective action must be taken in accordance with SOP SA-QA-05: *Preventive and Corrective Action Procedures* the QC Summary Table in Attachment 3. SOP SA-QA-05 provides contingencies for out-of-control data and gives guidance for exceptionally permitting departures from approved policies and procedures. Nonconformance Memos must be initiated to document all instances where QC criteria are not met and all departures from approved policies and procedures.

10.0 Procedure

10.1 Sample Preparation

The sample preparation procedures are given in the following SOPs:

Matrix	SOP #
Aqueous Samples	SA-ME-050
Soil Samples	SA-ME-051

10.2 QC Sample Preparation

The QC sample preparation procedures are given in the following SOPs:

Matrix	SOP #
Aqueous Samples	SA-ME-050
Soil Samples	SA-ME-051

10.3 Analysis

10.3.1 Instrument Operating Conditions

The instrument conditions listed in this SOP are provided for guidance purposes. The actual conditions used by the laboratory may be slightly different from those listed here and must be documented in the instrument maintenance log, data system, and/or run log.

Instrument maintenance must be performed in accordance with Attachment 4 of this SOP. Turn the ICP-MS on and initiate the tune screen. Start the tune screen to allow the instrument to become thermally stable before analyzing the calibration standards. While the instrument is warming up, if the sample and skimmer cones are new or have been cleaned, aspirate the interference check solution (or similar solution) for about 15 minutes to pre-condition the cones.

10.3.1.1 Aspirate a 1ppb solution containing Lithium 7, Cesium, Yttrium, and Thallium and check the tune parameters for the following conditions:

Sensitivity: should yield counts greater than 1500 for Li7 and 2500 for Y and Tl
Precision: should be less than 10% RSD of 200 replicates
Oxides: must be less than 3% as CeO
Doubly charged ions: must be less than 10%

After the instrument is tuned to the above specifications then a P/A (pulse to analog) factor must be established for the dual-mode detector. Aspirate a 100ppb solution containing the analytes used in the calibration and the internal standards used for the method. Under the "tune" pull-down menu select P/A factor, and the software will calculate a factor used when the detector switches from analog to pulse due to high concentration.

Note: If an analyte does not have a factor and the concentration in the sample causes the detector to switch to pulse, the software will use the closest factor available in the calculation.

10.3.1.2 Analyze the calibration standards and calibrate the ICP-MS in accordance with SOP SA-QA-16: *Evaluation of Calibration Curves.*

Note: During method development for the EPA 200.8 drinking water procedure (which does not permit use of the collision cell technology), it was determined that a single point calibration (i.e., a blank and a high standard) was more accurate at low concentrations for the majority of the elements. Therefore, the laboratory's default procedure for drinking water samples is to quantitate results using a single point calibration for the majority of the elements and a multi-point calibration curve for copper and magnesium only. A multi-point calibration curve is analyzed for all the elements due to the fact that the standards mixes include every element; however, the software is directed to evaluate only the blank and a high standard for those elements utilizing a single point calibration (i.e., all elements except copper and magnesium). This evaluation is built into the software set-up and is not being made at the time of calibration using analyst discretion.

10.3.2 Internal Standard (ISTD)

Prior to analysis, internal standards must be added to all standards, samples, and QC items. The concentration of the internal standard must be the same in all calibration samples, field samples, and QC samples. The internal standard solution is added at the time of analysis by using a peristaltic pump, a "T" connection, and a mixing coil that is inserted in the sample uptake line before the instrument's nebulizer. The concentration of the internal standard solution is listed in Attachment 7 of this document.

10.3.3 Initial and Continuing Calibration Verifications

Calibrate the instrument using the standards and criteria described given in Section 9.2. Once the calibration has been established and verified with an ICV in accordance with Section 9.2, sample analysis may proceed.

Verify the calibration curve with a continuing calibration verification using the standards and criteria described given in Section 9.2.

10.3.4 Sample Analysis

The samples/digestates must be analyzed using the same procedures as those used for the calibration standards.

Note: It is the laboratory's default procedure to analyze soil samples at a dilution factor of 10 and non-drinking water samples at a dilution factor of 5. The dilution is prepared immediately preceding analysis by diluting 1mL of digestate to a 10mL final volume of rinse water (for soil samples) or diluting 2mL of digestate to a 10mL final volume (for non-drinking water samples). These dilution factors are captured by adjusting the default final volume in the Method Limit Groups. Reporting limits and MDLs have been elevated accordingly.

The default procedure is to include QC items (method blank, LCS, MS/MSD, and SD) in determining the maximum number of samples in the clock.

10.3.5 Example Analytical Sequence

An example analytical sequence is listed below.

Analytical Sequence for samples immediately following an initial calibration:

Description	Comments
Blank	
Initial Calibration	
ICV	Second Source
ICB	
Samples & Batch QC Items	RL check standard, ICSA, ICSAB, up to 7 additional analyses.
CCV	
CCB	
Samples & Batch QC Items	Up to 10 analyses, including QC.
CCV	
CCB	

Analytical Sequence for samples not immediately following an initial calibration:

Description	Comments
CCV	
CCB	
Samples & Batch QC Items	ICSA, ICSAB (minimum of every 12 hours) Up to 8 additional analyses.
CCV	
CCB	
Samples & Batch QC Items	Up to 10 analyses, including QC.
CCV	
CCB	

Note: If the analysis run proceeds for more than 12 hours after the ICV, the analyst must repeat the analysis of the ICSA and ICSAB solutions.

The "up to 10 analyses" includes analysis of all analytical and batch QC items with the exception of the CCV and CCB analyses.

11.0 Calculations / Data Reduction

11.1 Data Reduction

Data must be evaluated in accordance with SOP SA-QA-02: *Data Generation and Review.*

11.1.1 Dilutions

If the concentration of a sample is above the calibration range (or linear range for single point curves) of the instrument the sample digestate must be diluted and reanalyzed.

11.1.2 Historical Data

Many of the laboratory's clients submit samples for repeat monitoring purposes. Prior to analysis, verify LIMS Worksheet Notes to determine if historical data is available for review.

11.1.3 Chemical Relationships

When available, the following chemical relationships must be evaluated for each sample. If these relationships are not met the Department Manager must be contacted immediately.

- Total Results are $\geq$ Dissolved results (e.g. metals)

11.1.4 Drinking Water Compliance Evaluation

Public water suppliers (PWS) are governed by EPA-specified Maximum Contaminant Levels (MCL) above which indicates noncompliance. Many analytes also have a Maximum Contaminant Level Goal (MCLG), which is often lower than the MCL. The MCLs and MCLGs associated with this procedure are given in Attachment 8. Notify the PM immediately via a Nonconformance Memo if any sample contains a detection above these levels.

11.2 Calculations

11.2.1 The calculations associated with batch QC determinations are given in SOP SA-QA-17. Applicable calculations include accuracy (% recovery) and precision (%RPD).

11.2.2 The calculations associated with initial and continuing calibrations and are given in SOP SA-QA-16. Applicable calculations include determination for: calibration factor, standard deviation, relative standard deviation, relative response factor, and relative standard deviation.

11.2.3 The calculation to determine final concentration is given as follows:

Regression Curve:

$$FinalConcentration = CONC_{Sample} \otimes \frac{F}{I \times dw} \otimes D$$

Where:

$CONC_{Sample}$ = Concentration of the sample
F = Final volume/weight
I = Initial volume/weight
D = Dilution factor
dw = % Solids decimal equivalent

Note: All dry weight corrections are performed automatically in LIMS.

Note: This calculation assumes all applicable unit correction factors are applied.

12.0 Method Performance

12.1 Reporting Limit Verification (RLV)

At a minimum, RLVs must be performed initially upon method set-up in accordance with SOP SA-QA-07: *Determination and Verification of Detection and Reporting Limits.*

For analytes and methods certified by DOD ELAP, RLVs must also be performed quarterly thereafter. For analytes and methods certified by NELAC, RLVs must also be performed annually thereafter. Exceptions may be made for project-specific non-routine analytes.

12.1.1 Lower Limit of Quantitation Check (QCS)

EPA 6020A requires a Lower Limit of Quantitation Check (LLQC) to be performed after establishing the reporting limit and on an as needed basis to demonstrate sensitivity. As such, the laboratory requires a Low-Level LCS (spiked at the reporting limit) to be performed annually, at a minimum. The recovery of the LLCS must be within 70-130% of the true value, or the reporting limit must be re-evaluated and elevated accordingly.

12.2 Method Detection Limit (MDL) Study

The MDL is the lowest concentration that can be detected for a given analytical method and sample matrix with 99% confidence that the analyte is present. MDLs reflect a calculated (statistical) value determined under ideal laboratory conditions in a clean matrix and may not be achievable in all environmental matrices. The current MDLs associated with this procedure are given in the Method Limit Group (MLG) in TALS.

At a minimum, MDL Studies must be performed initially upon method set-up in accordance with SOP SA-QA-07: *Determination and Verification of Detection and Reporting Limits.*

Note: MDL Studies are not required for non-routine analytes provided results are not reported below the RL (i.e., MDL equals RL in TALS).

12.3 Method Detection Limit Verification (MDLV)

At a minimum, MDLVs must be performed initially upon method set-up in accordance with SOP SA-QA-07: *Determination and Verification of Detection and Reporting Limits.*

For analytes and methods certified by DOD ELAP, MDLVs must also be performed quarterly thereafter. For analytes and methods certified by NELAC, MDLVs must also be performed annually thereafter.

Note: MDLVs are not required for non-routine analytes provided results are not reported below the RL (i.e., MDL equals RL in TALS).

12.4 Determination of the Instrument Detection Limit (IDL)

The instrument detection limit (IDL) is the concentration of analyte that can be statistically distinguished from the background noise of the instrument. The IDL limit must be determined annually, at a minimum, for each analyte in accordance with SOP SA-QA-07: *Determination and Verification of Detection and Reporting Limits.*

The IDL for EPA 6020 and EPA 6020A is defined as three times the standard deviation of

seven replicate analyses of a blank solution analyzed over three non-consecutive days. The IDL for EPA 200.8 is defined as the concentration equivalent to the analyte signal which is equal to three times the standard deviation of a series of ten replicate measurements of the calibration blank signal at the selected mass(es). The IDL may be elevated above the background noise (blank levels). The current IDL associated with this procedure is given in the Equipment Limit Group (ELG) in LIMS.

12.5 QC Limit Generation, Control Charting, and Trend Analysis

The control limits for the batch QC items (LCS and MS/MSD) for this procedure are specified in the reference method and cannot be broadened; therefore, the laboratory defaults to the method-defined limits and does not utilize in-house or laboratory-derived limits for the evaluation of batch QC items.

Although the laboratory must default to the method-defined QC limits, control charting is a useful tool and is performed to assess analyte recoveries over time to evaluate trends. Control charting must be performed periodically (at a minimum annually) in accordance with SOP SA-QA-17: *Evaluation of Batch QC Data.*

12.6 Demonstrations of Capability

Initial and continuing demonstration of capability must be performed in accordance with SOP SA-QA-06: *Training Procedures.*

Prior to performing this procedure unsupervised, each new analyst who performs this analysis must demonstrate proficiency per method/analyte combination by successful completion of an initial demonstration of capability. The IDOC is performed by the analysis of 4 consecutive LCSs that meet the method criteria for accuracy and precision. The LCSs must be from a second source than that used to prepare the calibration standards. The IDOC must be documented on the IDOC Form shown in SOP SA-QA-06 with documentation routed to the QA Department for filing.

Annual continuing demonstrations of capability (CDOCs) are also required per analyst per method/analyte combination. The CDOC requirement may be met by the consecutive analysis of four LCS all in the same batch, by the analysis of four LCS analyzed in four consecutive batches (in different batches on different days), via acceptable results on a PT study, or analysis of client samples with statistically indistinguishable results when compared to another certified analyst. The CDOC must be documented and routed to the QA Department for filing.

12.7 Training Requirements

All training must be performed and documented in accordance with SOP SA-QA-06: *Training Procedures.*

Note: The SOPs listed in the Reference/Cross-Reference Section are applicable to this procedure. All employees performing this procedure must also be trained on these SOPs, and/or have a general understanding of these procedures, as applicable.

13.0 Pollution Control

It is TestAmerica's policy to evaluate each method and look for opportunities to minimize waste generated (e.g., examining recycling options, ordering chemicals based on quantity needed, preparing reagents based on anticipated usage and reagent stability, etc.). Employees must abide by the policies in Section 13 of the Environmental Health and Safety Manual (EHSM) and the Savannah Addendum to the EHSM.

This procedure has been evaluated for opportunities to minimize the waste generated. Where reasonably feasible, pollution control procedures have been incorporated.

14.0 Waste Management

Waste management practices must be conducted consistent with all applicable federal, state, and local rules and regulations. All waste (i.e., excess reagents, samples, and method process wastes) must be disposed of in accordance with Section 9 of the TestAmerica Savannah Addendum to the EHSM. Waste description rules and land disposal restrictions must be followed.

14.1 Waste Streams Produced by the Method

The following waste streams are produced when this method is carried out:

- Excess aqueous samples – Dispose according to characterization on the sample disposal sheets. Neutralize non-hazardous samples before disposal into drain/sewer. Transfer hazardous samples (identified on disposal sheets) to the waste department for disposal.

- Excess soil and solid samples – Dispose according to characterization on sample disposal sheets. Transfer non-hazardous samples to TCLP container for characterization in hazardous waste department. Transfer hazardous samples (identified on disposal sheets) to waste department for disposal.

- Acidic sample digestions – Neutralize before disposal into drain/sewer system.

15.0 References / Cross-References

- SOP SA-AN-100: *Laboratory Support Equipment (Verification and Use)*
- SOP SA-AN-41: *Reagent and Standard Materials Procedures*
- SOP SA-QA-02: *Data Generation and Review*
- SOP SA-QA-05: *Preventive and Corrective Action Procedures*
- SOP SA-QA-06: *Training Procedures*
- SOP SA-QA-07: *Determination and Verification of Detection and Reporting Limits*
- SOP SA-QA-15: *Homogenization, Compositing, and Segregation of Samples*
- SOP SA-QA-16: *Evaluation of Calibration Curves*
- SOP SA-QA-17: *Evaluation of Batch QC Data*
- TestAmerica Savannah Quality Assurance Manual
- TestAmerica Environmental Health and Safety Manual
- TestAmerica Savannah Addendum to the Environmental Health and Safety Manual

- *Methods for Chemical Analysis of Water and Waste*; U.S EPA Office of Research and Development: Cincinnati, OHIO, March 1983.
- *Test Methods for Evaluating Solid Waste, Third Edition*; U.S. EPA Office of Solid Waste and Emergency Response: Washington, D.C., November 1986 (Revision III and IV).
  - SW-846 Method 6020, Revision 0: Inductively Coupled Plasma – Mass Spectrometry, September 1994
  - SW-846 Chapter 3, Revision 3: Inorganic Analytes, December 1996
  - SW-846 Method 6020A, Revision 1: Inductively Coupled Plasma – Mass Spectrometry, February 2007
  - SW-846 Chapter 3, Revision 4: Inorganic Analytes, February 2007
- *Methods for the Determination of Metals in Environmental Samples*; US EPA Office of Research and Development. Washington, DC, May 1994.
- EPA Method 200.8, Revision 5.4: Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma – Mass Spectrometry, 1994

16.0 Method Modifications

16.1 Incorporation of Other Matrices

This procedure may be modified to analyze other matrices (e.g., wipe, waste, tissue, filter, and TCLP/SPLP leachate samples) based on the needs of the client. This will need to be arranged by the Project Manager at the initiation of the project.

Wipe, waste, filter, and tissue matrices are non-routine, and the laboratory is not currently NELAC certified for these matrices. The laboratory uses its routine soil RLs (converted for initial and final volumes, etc.) and soil QC limits to evaluate wipe, waste, filter, and tissue samples. Soil DOCs can be used to satisfy analyst demonstrations of capability for these types of non-routine matrices. The laboratory uses its routine soil RLs (converted for initial and final volumes, etc.) and soil QC limits to evaluate TCLP/SPLP leachate samples. Water DOCs can be used to satisfy analyst demonstrations of capability for TCLP/SPLP matrices. Teflon chips, Ottawa sand, or equivalent is used as the blank matrix for wipes, wastes, filters, and tissues unless specifically requested otherwise by the project.

16.1.1 Collection and Handling Procedures for Non-Routine Matrices

Waste samples may be collected in 8oz plastic soil jars; however, it should be noted that an alternate container may be required as some organic wastes (oils) may not be conducive to plastic. Tissue samples may be collected in 8oz plastic soil jars. Wipes and filters may be collected in a variety of different containers.

Wipe, waste, and filter samples must be iced at the time of collection and maintained at 4°C (less than 6°C but not frozen) until the time of digestion/leaching. Samples for mercury must be digested/leached and analyzed within 28 days of collection. All other samples must be digested and analyzed within 6 months of collection. Digestates may be stored at room temperature until the time of analysis.

Tissue samples must be iced at the time of collection and maintained at -10°C to -20°C for up to 6 months. Samples for mercury must be digested/leached and analyzed within 28

days of thawing. All other samples must be digested and analyzed within 6 months of thawing. Digestates may be stored at room temperature until the time of analysis.

Wipe, waste, filter, and tissue matrices are prepared in the same manner as soil samples with the following exceptions:

- The initial amount for wipe or filter samples is 1 wipe or 1 filter.
- The initial amount for tissue and waste samples is 1.0-1.2g.

Once the TCLP/SPLP extraction procedure has been performed, the TCLP/SPLP leachate must be transferred to a 500mL plastic container and preserved with 1.0mL nitric acid to a pH <2. Preserved TCLP/SPLP leachates are stored at room temperature until the time of digestion. The leachate sample must be digested within 6 months of completion of the TCLP/SPLP extraction. Digestates are stored at room temperature until the time of analysis and must be analyzed within 6 months of completion of the TCLP/SPLP extraction.

16.1.2 Preparation and Analytical Procedures for Non-Routine Matrices

Wipe, waste, filter, and tissue samples are prepared in the same manner as routine soil samples as outlined in SOP SA-ME-051. TCLP/SPLP matrices are prepared in the same manner as routine water samples as outlined in SOP SA-ME-050. Refer to the applicable preparation SOPs for more information.

Wipe, waste, filter, tissue, and TCLP/SPLP matrices are analyzed in the same manner as routine samples as outlined in this SOP.

16.2 Other Considerations

16.2.1 EPA 6020A notes to use gold as a preservative for mercury; however, the laboratory has not implemented this preservative. The instrument manufacturer's recommendations do not include this reagent if HCl is used in standards and samples. Additionally, initial method validation did not indicate this preservative was necessary to prevent carryover as intended by the method.

16.2.3 EPA 6020 and EPA 200.8 require the regression coefficient (r^2) of the regression curve to be greater than 0.995 for the initial calibration curve to be acceptable. EPA 6020A requires the r^2 of the regression curve to be greater than 0.998 for the initial calibration curve to be acceptable. The laboratory has adopted the 0.998 criteria for all three methods.

16.2.4 The EPA Manual for the Certification of Laboratories Analyzing Drinking Water requires a LFB at the MRL to be performed each day. The laboratory meets this requirement by preparing an LCS at the RL in each EPA 200.8 batch of drinking water samples. The EPA DW Manual does not specify criteria for the low-level LCS; therefore, the laboratory defaults to qualitative identification.

16.12 There is no method-defined batch precision requirement for EPA 200.8. The EPA does require precision for all samples analyzed under the Clean Water Act, and the laboratory routinely performs an MSD to support clients who require precision to be reported. If insufficient sample volume is provided to perform the MS/MSD, the laboratory performs the LCS in duplicate (i.e., LCS/LCSD).

16.13 It is the laboratory's default procedure to analyze soil samples at a dilution factor of 10 and non-drinking water samples at a dilution factor of 5. The dilution is prepared immediately preceding analysis by diluting 1mL of digestate to a 10mL final volume of rinse water (for soil samples) or diluting 2mL of digestate to a 10mL final volume (for non-drinking water samples). These dilution factors are captured by adjusting the default final volume in the Method Limit Groups. Reporting limits and MDLs have been elevated accordingly.

17.0 Attachments

The following Tables, Diagrams, and/or Validation Data are included as Attachments:

Attachment 1: SOP Summary
Attachment 2: Sample Collection, Preservation, and Holding Time Table
Attachment 3: QC Summary
Attachment 4: Instrument Maintenance and Troubleshooting
Attachment 5: Analysis Masses, Internal Standards, and Tune Steps
Attachment 6: Element-specific Masses and Concentrations
Attachment 7: Standard Preparation
Attachment 8: Drinking Water MCLGs and MCLs
Attachment 9: Hardness Calculation Work Instruction

Attachment 1:
SOP Summary

Sample Preparation Summary

Prior to analysis by ICP-MS, the sample must be solubilized or digested using the sample preparation method appropriate to the matrix.

Samples should be prepared according to the appropriate matrix-specific SOP.

Matrix	SOP
Aqueous Samples	SA-ME-050
Soil Samples	SA-ME-051

Sample Analysis Summary

Sample digestates are aspirated and nebulized into a spray chamber. A stream of argon gas carries the sample aerosol through the innermost of three concentric tubes and injects it into the middle of the donut-shaped plasma. The sample elements are dissociated, atomized, and excited to a higher energy level. The ions that are produced are entrained in the plasma gas and introduced, by means of an interface, into a mass spectrometer. The ions are sorted according to their mass to charge ratios and quantified with a channel mass spectrometer.

Analytical Sequence

Analytical Sequence for samples immediately following an initial calibration:

Description	Comments
Blank	
Initial Calibration	
ICV	Second Source
ICB	
Samples & Batch QC Items	RL check standard, ICSA, ICSAB, up to 7 additional analyses.
CCV	
CCB	
Samples & Batch QC Items	Up to 10 analyses, including QC.
CCV	
CCB	

Analytical Sequence for samples not immediately following an initial calibration:

Description	Comments
CCV	
CCB	
Samples & Batch QC Items	ICSA, ICSAB Up to 8 additional analyses.
CCV	
CCB	
Samples & Batch QC Items	Up to 10 analyses, including QC.
CCV	
CCB	

Note: If the analysis run proceeds for more than 12 hours after the ICV, the analyst must repeat the analysis of the ICSA and ICSAB solutions.

The "up to 10 analyses" includes analysis of all analytical and batch QC items with the exception of the CCV and CCB analyses.

Attachment 2:
Sample Collection, Preservation, and Holding Time Table

Matrix	Routine Sample Container	Routine Sample Size	Minimum Sample Size	Dechlorination Agent	Chemical Preservation	Thermal Preservation	Holding Time[2]
Water	250mL plastic	50mL	25mL	Not Applicable	3mL 1:3 HNO_3, to pH<2	Not Applicable	Mercury: 28 days Other Metals: 6 months
Soil	8oz plastic soil jar	10g	5g	Not Applicable	Not Applicable	4°C[1]	Mercury: 28 days Other Metals: 6 months

[1] Samples are collected on ice and maintained at <6°C with no frozen samples.
[2] Inclusive of digestion and analysis.

Note: If dissolved metals are requested, the sample must be filtered prior to the acid being added to the sample.

Attachment 3:
QC Summary

QC Item	Frequency	Criteria	Corrective Action
Initial Calibration: minimum 1 standard and 1 blank	Daily	Correlation ≥0.998 (for multipoint curves)	Recalibrate
Initial Calibration Verification Standard (ICV)	At the beginning of the analysis	Within ±10%	Recalibrate
Continuing Calibration Verification Standard (CCV)	At the beginning and end of the analysis, and every 10 samples	Within ±10% of the true value	Terminate the analysis, fix the problem and reanalyze the previous 10 samples.
Calibration Blank (ICB/CCB)	After ICV and every CCV	<½ RL	Terminate the analysis, correct problem and reanalyze the previous 10 samples
Internal Standard	All samples and QC items	Refer to Section 9.2.5	Refer to Section 9.2.5
Batch Definition	Digested together w/in 24-hr timeframe; not to exceed 20 field samples	Not Applicable	Not Applicable
Method Blank	One per batch	|result| <½ RL	Redigest and reanalyze batch
Laboratory Control Sample (LCS)	One per batch	LIMS MLG	Redigest and reanalyze batch
Laboratory Control Sample Duplicate (LCSD)	One per batch, if insufficient sample provided for MS/MSD	LIMS MLG	Redigest and reanalyze batch
Low-Level Laboratory Control Sample (LLCS) – spiked at the RL	EPA 200.8 DW: One per batch of 20 samples or less	Qualitatively identified	If the "regular" LCS meets criteria, initiate NCM and report data If the "regular" LCS does not meet criteria, redigest and reanalyze batch

QC Item	Frequency	Criteria	Corrective Action
Lower Limit of Quantitation Check (LLQC) – spiked at the RL	EPA 6020A: Annually, at a minimum, and as needed thereafter	70-130%	Re-evaluate RL and elevate accordingly
Matrix Spike (MS)	EPA 200.8: 10% of samples prepared; i.e., 2 separate matrix spikes per batch of twenty samples EPA 6020 & EPA 6020A: 5% of samples prepared; i.e., 1 matrix spike per batch of twenty samples	LIMS MLG	Flag and report data
Matrix Spike Duplicate (MSD) or Sample Duplicate (SD)	EPA 200.8 (Clean Water Act), EPA 6020 & EPA 6020A: One MSD or sample duplicate per batch of twenty samples or less	LIMS MLG	Flag and report data
Serial Dilution (1/5 Dilution)	One per batch of twenty samples or less	Refer to Section 9.2.7	Refer to Section 9.2.7
Post Digestion Spike (PDS)	One per batch of twenty samples or less	Refer to Section 9.2.6	Refer to Section 9.2.6
Reporting Limit Check Solution	At the beginning of analysis run	Recovery +/-50% of the true concentration (if the instrument is not calibrated at or below the RL).	Stop the analysis, fix the problem and reanalyze the affected samples.
Initial Demonstration of Capability (IDOC)	Initially, per analyst, per analyte/method/matrix combination	Refer to SOP SA-QA-06	Refer to SOP SA-QA-06 Note: Unsupervised work must not begin until acceptable IDOC is obtained.

QC Item	Frequency	Criteria	Corrective Action
Continuing Demonstration of Capability (CDOC)	Annually, per analyst, per analyte/method combination	Refer to SOP SA-QA-06	Refer to SOP SA-QA-06
Reporting Limit Verification (RLV)	Upon method/instrument set-up, per analyte/method/matrix combination. Then quarterly thereafter (for DOD ELAP) or annually thereafter (for NELAC)	Refer to SOP SA-QA-07	Refer to SOP SA-QA-07
Method Detection Limit Study (MDL Study)	Upon method/instrument set-up, per analyte/method/matrix combination	Refer to SOP SA-QA-07	Refer to SOP SA-QA-07
MDL Verification (MDLV)	Upon method/instrument set-up, per analyte/method/matrix combination. Then quarterly thereafter (for DOD ELAP) or annually thereafter (for NELAC)	Refer to SOP SA-QA-07	Refer to SOP SA-QA-07

Attachment 4:
Instrument Maintenance and Troubleshooting

Instrument Labeling

Each instrument must be labeled with its name or ID (e.g., MSA, ICP-D, etc.). Additionally, non-operational instruments must be isolated from service or marked as being out of service. Each piece of equipment has an "Operational / Not Operational" sticker that is used for this purpose.

Maintenance Log

A maintenance log must be established for each piece of equipment used in the laboratory.

All maintenance that is performed on the instrument must be recorded in the log including:

- analyst or technician performing the maintenance
- date the maintenance was performed
- detailed explanation of the reason for the maintenance
- resolution of the problem and return to control
- all service calls from instrument representatives

Preventive Maintenance

Refer to the instrument manufacturer's guides for trouble-shooting items.

LABORATORY EQUIPMENT PREVENTIVE MAINTENANCE SCHEDULE								
EQUIPMENT ITEM	Service Interval							SERVICE LEVEL
	D	W	M	Q	SA	A	AN	
Cones							X	Clean, as needed.
Intake							X	Wipe down as needed.
Lenses							X	Clean or replace as needed.
Nebulizer							X	Clean, as needed.
Pump oil							X	Replace as needed.
Pump Tubing							X	Change as needed

D = daily; W = Weekly; M = monthly; Q = Quarterly; SA = semi-annually; A = annually; AN = as needed

Troubleshooting

Troubleshooting should be documented as outlined above. If possible, troubleshooting is best performed in a step-wise manner to systematically isolate instrument components. Refer to the instrument manufacturer's guides for specific information and strategies. Enlist assistance from technical and/or department management as needed.

Contingency Plan

Maintenance contracts are carried for most instrumentation and close contact is maintained with service personnel to ensure optimal instrument functioning. An extensive spare parts inventory is maintained for routine repairs, consisting of detectors, pump tubing, cones, lenses, torches, and other common instrumentation components. Since instrumentation is standardized throughout the laboratory network, spare parts and components can be readily exchanged among the network.

In general, the laboratory has at least one backup unit for each critical unit. In the event of instrument failure, portions of the sample load may be diverted to duplicate instrumentation, the analytical technique switched to an alternate approved technique (such as manual colorimetric determination as opposed to automated colorimetric determination), or samples shipped to another properly certified or approved TestAmerica location.

Attachment 5:
Recommended Analysis Masses, Internal Standards, and Tune Steps

The following are the recommended analysis masses, internal standards, and tune steps:

Element	IS	Tune Step	Element	IS	Tune Step
Be 9	Li 6	3	Cu 63	Ge 74	2
B 11	Li 6	3	Zn 66	Ge 74	3
Na 23	Sc 45	1	As 75	Ge 74	2
Mg 24	Sc 45	1	Se 78	Ge 74	1
Al 27	Sc 45	1	Sr 88	Y 89	3
K 39	Ge 74	2	Mo 95	In 115	3
Ca 40	Sc 45	1	Ag 107	In 115	3
Ti 47	Sc 45	3	Cd 111	In 115	3
V 51	Ge 74	2	Sn 118	In 115	3
Cr 52	Ge 74	2	Sb 121	In 115	3
Mn 55	Ge 74	3	Ba 137	In 115	3
Fe 56	Sc 45	1	Hg 202	Bi 209	3
Co 59	Ge 74	3	Tl 205	Tb 159	3
Ni 60	Ge 74	2	Pb 208*	Tb 159	3

* Pb 208 = Pb 208 + Pb 207 + Pb 206

Note: Different masses and internal standards may be utilized, as matrix issues deem necessary.

Tune Steps:

1. H_2 reaction mode, typical flows of 3.8 to 5.8 mL/min of Hydrogen gas
2. He collision mode, typical flows of 3.8 to 5.8 mL/min of Helium gas
3. Normal mode

Tune Check Criteria:

Instrument tunes must be performed before each calibration. A solution at ~1ppb of Be, Mg, Co, In, and Pb is analyzed, and the precision, mass calibration, and resolution are checked.

The following limits are used to evaluate the tune:

Mass calibration:	+/- 0.1amu
Resolution check:	<0.9amu at 10% peak height (baseline resolution)
Stability (5 reps):	<5%

Attachment 6:
Recommended Element-specific Masses and Concentrations

Element	Mass/ Mode #	Calibration Conc. (ug/L)	ICV/CCV Conc. (ug/L)	RL Std. Conc. (ug/L)	Linear Range Std. Conc. (ug/L)*	Matrix Spike / Post Spike Conc.	
						Water (ug/L)	Soil (mg/kg)
Aluminum (Al)	27 / #1	1000,500,10, 5	400/500	10	100000	5000	500
Antimony (Sb)	121 / #3	100,50,1,0.5	40/50	0.50	Not Applicable Use Cal Range	50	5
Arsenic (As)	75 / #2	100,50,1,0.5	40/50	0.50	2000	100	10
Barium (Ba)	137 / #3	100,50,1,0.5	40/50	1.0	2000	100	10
Beryllium (Be)	9 / #3	100,50,1,0.5	40/50	0.10	Not Applicable Use Cal Range	50	5.0
Boron (B)	11 / #3	200,100,2,1	80/100	20	2000	200	20
Cadmium (Cd)	111 / #3	100,50,1,0.5	40/50	0.50	Not Applicable Use Cal Range	50	5.0
Calcium (Ca)	40 / #1	10000,5000, 100,50	4000/5000	50	100000	5000	500
Chromium (Cr)	52 / #2	100,50,1,0.5	40/50	1.0	2000	100	10
Cobalt (Co)	59 / #3	100,50,1,0.5	40/50	0.10	2000	50	5
Copper (Cu)	65 / #2	100,50,1,0.5	40/50	0.50	Not Applicable Use Cal Range	100	10
Iron (Fe)	56 / #1	10000,5000, 100,50	4000/5000	20	100000	5000	500
Lead (Pb)	208 / #3	100,50,1,0.5	40/50	0.30	2000	50	5.0
Magnesium (Mg)	24 / #1	10000,5000, 100,50	4000/5000	50	100000	5000	500
Manganese (Mn)	55 / #3	1000,500,10, 5	400/500	1.0	2000	500	50
Mercury (Hg)	202 / #3	5,2.5,0.05,0. 025	2.0/2.5	0.10	Not Applicable Use Cal Range	5.0	0.50
Molybdenum (Mo)	95 / #3	100,50,1,0.5	40/50	1.0	2000	100	10
Nickel (Ni)	60 / #2	100,50,1,0.5	40/50	0.20	2000	100	10
Potassium (K)	39 / #2	10000,5000, 100,50	4000/5000	50	100000	5000	500
Selenium (Se)	78 / #1	100,50,1,0.5	40/50	0.50	Not Applicable Use Cal Range	100	10
Silver (Ag)	107 / #3	100,50,1,0.5	40/50	0.20	Not Applicable Use Cal Range	50	5.0
Sodium (Na)	23 / #1	10000,5000, 100,50	4000/5000	50	100000	5000	500
Strontium (Sr)	88 / #3	100,50,1,0.5	40/50	0.20	2000	100	10
Thallium (Tl)	205 / #3	20,10,0.2,0.1	8/10	0.20	Not Applicable Use Cal Range	40	4.0

Element	Mass/ Mode #	Calibration Conc. (ug/L)	ICV/CCV Conc. (ug/L)	RL Std. Conc. (ug/L)	Linear Range Std. Conc. (ug/L)*	Matrix Spike / Post Spike Conc.	
						Water (ug/L)	Soil (mg/kg)
Tin (Sn)	118 / #3	100,50,1,0.5	40/50	1.0	2000	100	10
Titanium (Ti)	47 / #3	100,50,1,0.5	40/50	1.0	2000	100	10
Vanadium (V)	51 / #2	100,50,1,0.5	40/50	1.0	2000	100	10
Zinc (Zn)	66 / #3	100,50,1,0.5	40/50	4.0	2000	100	10

*For guidance only - instrument sensitivity will vary.

Attachment 7:
Standard Preparation

Note: All standards must be stored at room temperature and have an expiration date of 6 months from date prepared.

All calibration standards should contain 0.5% hydrochloric acid and 2% nitric acid by volume. The following table lists the volume of each acid needed to prepare the desired final volume of standard.

Standard Final Volume (mL)	Hydrochloric acid (mL)	Nitric Acid (mL)
100	0.5	2.0
200	1.0	4.0
500	2.5	10
1000	5.0	20

For example, to prepare 500mL of a standard:

- Add 100mL to 200mL of reagent water to a clean 500mL volumetric flask.
- Add 10mL of concentrated nitric acid (HNO_3) and 2.5mL of hydrochloric acid (HCl) to the volumetric flask.
- Add the volumes of the stock standards given in the table to the volumetric flask:
- Dilute to a final volume of 500mL with reagent water. Store the standard at room temperature.

CALIBRATION STANDARDS

Calibration Standard Stock Solution

Element	Parent Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Volume (mg/L)
Aluminum (Al)	10000	1.0	100	100
Antimony (Sb)	1000	1.0		10
Arsenic (As)	1000	1.0		10
Barium (Ba)	1000	1.0		10
Beryllium (Be)	1000	1.0		10
Boron (B)	1000	2.0		20
Cadmium (Cd)	1000	1.0		10
Calcium (Ca)	10000	10		1000
Chromium (Cr)	1000	1.0		10
Cobalt (Co)	1000	1.0		10
Copper (Cu)	1000	1.0		10
Iron (Fe)	10000	10		1000
Lead (Pb)	1000	1.0		10
Magnesium (Mg)	10000	10		1000
Manganese (Mn)	1000	10		100
Mercury (Hg)	1000	0.050		0.50
Molybdenum (Mo)	1000	1.0		10
Nickel (Ni)	1000	1.0		10
Potassium (K)	10000	10		1000
Selenium (Se)	1000	1.0		10
Silver (Ag)	1000	1.0		10
Sodium (Na)	10000	10		1000
Strontium (Sr)	1000	1.0		10
Thallium (Tl)	1000	0.2		2.0
Tin (Sn)	1000	1.0		10
Titanium (Ti)	1000	1.0		10
Vanadium (V)	1000	1.0		10
Zinc (Zn)	1000	1.0		10

The above standards may be grouped together into more than one stock standard to maximize the stability of the standards. For example, silver may need to be kept as a separate stock due to the stability of the silver in solution.

WORKING CALIBRATION STANDARDS

Calibration Blank (ICB, CCB) – All standards are made up to the same acid concentrations as the calibration blank

Add 500mL to 600mL of reagent water to a clean 1-L volumetric flask. Add 20mL of concentrated nitric acid (HNO_3) and 5.0mL of hydrochloric acid (HCl) to the volumetric flask. Dilute to a final volume of 1000mL with reagent water. Store the standard at room temperature. Other volumes may be prepared at the discretion of the lab. The nitric acid concentration must be 2% by volume and the hydrochloric acid concentration must be 0.5% by volume. Hydrofluoric acid may be added to the rinse blank at a rate of 3-4 drops/250mL of calibration blank. This will aid in the rinsing of certain metals and can help stabilize the baseline. **USE CAUTION!**

Calibration Standards concentration (ug/L) – example for a final volume of 1000mL

Element	Standard 4 – 10mL of stock	Standard 3 – 5.0mL of stock	Standard 2 – 0.10mL of stock	Standard 1 – 0.050mL of stock
Aluminum (Al)	1000	500	10	5.0
Antimony (Sb)	100	50	1.0	0.50
Arsenic (As)	100	50	1.0	0.50
Boron (B)	200	100	2.0	1.0
Barium (Ba)	100	50	1.0	0.50
Beryllium (Be)	100	50	1.0	0.50
Cadmium (Cd)	100	50	1.0	0.50
Calcium (Ca)	10000	5000	100	50
Cobalt (Co)	100	50	1.0	0.50
Chromium (Cr)	100	50	1.0	0.50
Copper (Cu)	100	50	1.0	0.50
Iron (Fe)	10000	5000	100	50
Lead (Pb)	100	50	1.0	0.50
Magnesium (Mg)	10000	5000	100	50
Manganese (Mn)	1000	500	10	5.0
Mercury (Hg)	5.0	2.5	0.050	0.025
Molybdenum (Mo)	100	50	1.0	0.50
Nickel (Ni)	100	50	1.0	0.50
Potassium (K)	10000	5000	100	50
Selenium (Se)	100	50	1.0	0.50
Silver (Ag)	100	50	1.0	0.50
Sodium (Na)	10000	5000	100	50
Strontium (Sr)	100	50	1.0	0.50
Thallium (Tl)	20	10	0.20	0.10
Tin (Sn)	100	50	1.0	0.50
Titanium (Ti)	100	50	1.0	0.50
Vanadium (V)	100	50	1.0	0.50
Zinc (Zn)	100	50	1.0	0.50

Note: The Standard 4 listed above is utilized when calibrating with a single standard and a blank.

CONTINUING CALIBRATION VERIFICATION (CCV) STANDARD

The calibration standard 3 is used as the continuing calibration verification standard.

INITIAL CALIBRATION VERIFICATION (ICV) SOLUTION

All standards must be from a different source than those used for the calibration standards.

Preparation of the ICP-MS initial calibration verification solution

Element	Parent Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (mg/L)
Aluminum (Al)	10000	0.40	100	40
Antimony (Sb)	1000	0.40		4.0
Arsenic (As)	1000	0.40		4.0
Boron (B)	1000	0.80		8.0
Barium (Ba)	1000	0.40		4.0
Beryllium (Be)	1000	0.40		4.0
Cadmium (Cd)	1000	0.40		4.0
Calcium (Ca)	10000	4.0		400.0
Cobalt (Co)	1000	0.40		4.0
Chromium (Cr)	1000	0.40		4.0
Copper (Cu)	1000	0.40		4.0
Iron (Fe)	10000	4.0		400.0
Lead (Pb)	1000	0.40		4.0
Magnesium (Mg)	10000	4.0		400.0
Manganese (Mn)	1000	1.0		40.0
Mercury (Hg)	100	0. 40		4.0
Molybdenum Mo)	1000	0.40		4.0
Nickel (Ni)	1000	0.40		4.0
Potassium (K)	10000	4.0		400.0
Selenium (Se)	1000	0.40		4.0
Silver (Ag)	1000	0.40		4.0
Sodium (Na)	10000	4.0		400.0
Strontium (Sr)	1000	0.40		4.0
Thallium (Tl)	1000	0.20		0.8
Tin (Sn)	1000	0.40		4.0
Titanium (Ti)	1000	0.40		4.0
Vanadium (V)	1000	0.40		4.0
Zinc (Zn)	1000	0.40		4.0

Preparation of Initial Calibration Verification Working Standard

Dilute 1.0mL of the ICP-MS initial calibration verification solution to a final volume of 100mL using the same matrix solution as the calibration blank.

The final concentrations of the various elements are the same as listed in Table 1.

REPORTING LIMIT (RL) CHECK STANDARD

RL/PQL Stock A

Element	Parent Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (mg/L)
Aluminum (Al)	10000	1.0	100	100
Antimony (Sb)	1000	0.50		5.0
Arsenic (As)	1000	1.0		10
Boron (B)	1000	5.0		50
Barium (Ba)	1000	1.0		10
Beryllium (Be)	1000	0.10		1.0
Cadmium (Cd)	1000	0.50		5.0
Calcium (Ca)	10000	5.0		500
Cobalt (Co)	1000	1.0		10
Chromium (Cr)	1000	1.0		10
Copper (Cu)	1000	1.0		10
Iron (Fe)	10000	0.50		50
Lead (Pb)	1000	0.30		3.0
Magnesium (Mg)	10000	5.0		500
Manganese (Mn)	1000	1.0		10
Molybdenum Mo)	1000	1.0		10
Nickel (Ni)	1000	1.0		10
Potassium (K)	10000	5.0		500
Selenium (Se)	1000	0.50		5.0
Silver (Ag)	1000	1.0		10
Sodium (Na)	10000	5.0		500
Strontium (Sr)	1000	1.0		10
Thallium (Tl)	1000	0.20		2.0
Tin (Sn)	1000	1.0		10
Titanium (Ti)	1000	1.0		10
Vanadium (V)	1000	1.0		10
Zinc (Zn)	1000	1.0		10

* Other standard concentrations may be used to verify higher or lower reporting limits.

RL/PQL Stock B

Element	Parent Standard (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (mg/L)
Mercury (Hg)	1000	0.10	100	1.0

Preparation of RL/PQL Working Standard

Dilute 10uL of the RL/PQL stock solutions A and B to a final volume of 100mL using the same matrix solution as the calibration blank.

ICP INTERFERENCE CHECK SOLUTIONS (for SW846 6020/6020A)

Preparation of ICP Interference Check Solution A

Element	Parent Standard (mg/L)	Volume Stock A (mL)	Final Volume (mL)	Final Concentration (mg/L)
Aluminum (Al)	1000	50	500	100
Calcium (Ca)	1000			100
Iron (Fe)	1000			100
Magnesium (Mg)	1000			100
Sodium (Na)	1000			100
Phosphorus (P)	1000			100
Potassium (K)	1000			100
Sulfur (S)	1000			100
Carbon (C)	2000			200
Chloride (Cl)	10000			1000
Molybdenum (Mo)	20			2.0
Titanium (Ti)	20			2.0

Preparation of ICP Interference Check Solution AB

Element	Parent Concentration (mg/L)	Volume Stock A (mL)	Volume Stock B (mL)	Final Volume (mL)	Final Concentration (mg/L)
Aluminum (Al)	1000	50	1.0	500	100
Calcium (Ca)	1000				100
Iron (Fe)	1000				100
Magnesium (Mg)	1000				100
Sodium (Na)	1000				100
Phosphorus (P)	1000				100
Potassium (K)	1000				100
Sulfur (S)	1000				100
Carbon (C)	2000				200
Chloride (Cl)	10000				1000
Molybdenum (Mo)	20				2.0
Titanium (Ti)	20				2.0
Arsenic (As)	10				0.020
Cadmium (Cd)	10				0.020
Chromium (Cr)	10				0.020
Cobalt (Co)	10				0.020
Copper (Cu)	10				0.020
Manganese (Mn)	10				0.020
Nickel (Ni)	10				0.020
Silver (Ag)	10				0.020
Zinc (Zn)	10				0.020

ICP-MS LCS/MATRIX SPIKE SOLUTION

Preparation of the ICP-MS Matrix Spiking / Post Digestion Spiking Solution

Element	Parent Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (mg/L)
Aluminum (Al)	10000	5.0	100	500
Antimony (Sb)	1000	0.5		5
Arsenic (As)	1000	1.0		10
Boron (B)	1000	2.0		20
Barium (Ba)	1000	1.0		10
Beryllium (Be)	1000	0.5		5.0
Cadmium (Cd)	1000	0.5		5.0
Calcium (Ca)	10000	5.0		500
Cobalt (Co)	1000	1.0		5.0
Chromium (Cr)	1000	1.0		10
Copper (Cu)	1000	1.0		10
Iron (Fe)	10000	5.0		500
Lead (Pb)	1000	0.50		5.0
Magnesium (Mg)	10000	5.0		500
Manganese (Mn)	1000	5.0		50
Mercury (Hg)	1000	0.050		0.50
Molybdenum Mo)	1000	1.0		10
Nickel (Ni)	1000	1.0		10
Potassium (K)	10000	5.0		500
Selenium (Se)	1000	1.0		10
Silver (Ag)	1000	0.50		5.0
Sodium (Na)	10000	5.0		500
Strontium (Sr)	1000	1.0		10
Thallium (Tl)	1000	0.4		4.0
Tin (Sn)	1000	1.0		10
Titanium (Ti)	1000	1.0		10
Vanadium (V)	1000	1.0		10
Zinc (Zn)	1000	1.0		10

Separate mixtures can be utilized for stability considerations.

MDL SOLUTION

The MDL solution is used to determine the Method Detection Limit (MDL) of each target analyte (SOP SA-QA-07).

Preparation of Recommended MDL Intermediate Stock Solution

Element	Parent Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (mg/L)
Antimony (Sb)	1000	2.0	100	20
Arsenic (As)	1000	5.0		50
Barium (Ba)	1000	5.0		50
Beryllium (Be)	1000	0.50		5.0
Cadmium (Cd)	1000	1.0		10
Cobalt (Co)	1000	0.30		3.0
Chromium (Cr)	1000	5.0		50
Copper (Cu)	1000	5.0		50
Lead (Pb)	1000	1.0		10
Magnesium (Mg)	10000	3.0		300
Manganese (Mn)	1000	2.0		20
Mercury (Hg)	1000	0.40		4.0
Molybdenum Mo)	1000	1.5		15
Nickel (Ni)	1000	1.0		10
Selenium (Se)	1000	1.0		10
Silver (Ag)	1000	0.50		5.0
Strontium (Sr)	1000	1.0		10
Thallium (Tl)	1000	0.5		5.0
Tin (Sn)	1000	2.0		20
Titanium (Ti)	1000	4.0		40
Vanadium (V)	1000	2.0		20

Preparation of MDL Working Stock Solution

Element	Parent Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (mg/L)
Intermediate Stock Solution	See above	1.0	100	Varied
Aluminum (Al)	10000	0.10		10
Boron (B)	1000	0.20		2.0
Calcium	10000	0.10		10
Iron (Fe)	10000	0.10		10
Potassium (K)	10000	0.30		30
Sodium (Na)	10000	0.15		15
Zinc	1000	0.30		3.0

Preparation of MDL Solutions:

For MDL solutions to be prepared for aqueous digestions (3005A, 3010A), dilute the MDL working stock solution by a factor of 1/200.

For MDL solutions to be prepared for 200.8 drinking water digestions (3005A, 3010A), dilute the MDL working stock solution by a factor of 1/1000.

For MDL solutions to be prepared for solid digestions, dilute the MDL working stock solution by a factor of 1/100. For solid digestions to be diluted to a final volume of 100mL, spike the digestions with 1mL of the MDL working stock solution.

Linearity Check Solutions:
The linearity check solutions are prepared individually according to the following equation:

$$Vs = \frac{Vlc \otimes Clc}{Cs}$$

Where: Vs = volume of stock standard (mL)
Cs = concentration of stock standard (mg/L)
Vlc = volume of linearity check standard to prepare (mL)
Clc = concentration of linearity check standard to prepare (mg/L)

The linearity check solutions are prepared at the concentrations specified in Attachment 6. Prepare sufficient volume to perform the linearity check, maintaining the hydrochloric acid concentration at 0.5% by volume and the nitric acid concentration at 1% by volume.

Internal Standards:
A solution at 1mg/L is prepared for all elements. That solution is added in-stream by the use of a T-fitting. The sample is pumped into the T-fitting with a white/white peristaltic pump tube and the internal standard is pumped in using a blue/orange pump tube.

Attachment 8:
Drinking Water MCLGs and MCLs

Element	Regulation	MCLG (mg/L)	MCL (mg/L)	Secondary Standard (mg/L)
Antimony	National Primary Drinking Water Regulations	0.006	0.0060	
Arsenic		0	0.010	
Barium		2.0	2.0	
Beryllium		0.0040	0.0040	
Cadmium		0.0050	0.0050	
Chromium		0.10	0.10	
Copper [1]		1.3	Action Level = 1.3	
Lead [1]		0	Action Level = 0.015	
Mercury		0.0020	0.0020	
Selenium		0.050	0.050	
Thallium		0.00050	0.0020	
Aluminum	National Secondary Drinking Water Regulations			0.05 – 0.2
Copper				1.0
Iron				0.30
Manganese				0.050
Silver				0.10
Zinc				5.0

[1] Lead and copper are regulated by a Treatment Technique that requires systems to control the corrosiveness of their water. If more than 10% of tap water samples exceed the action level, water systems must take additional steps. For copper, the action level is 1.3 mg/L, and for lead is 0.015 mg/L.

Attachment 9:
Hardness Calculation Work Instruction

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Work Instruction
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CALCULATION OF HARDNESS

(as Calcium Carbonate)

Method: SM2340B

Summary of Procedure:

An aqueous sample is analyzed for calcium and magnesium using ICP by methods EPA 200.7 or 6010B (SOP ME70: *Elements by ICP*), or using ICP/MS by methods EPA 200.8 or 6020 (SOP ME74: *Elements by ICP/MS*). The concentrations of these elements are converted to equivalents of calcium carbonate using the equation below and added together to give the final result.

Calculation:

Determine the concentration of calcium and magnesium as described in SOP ME70 or ME74.

Calculate the hardness as calcium carbonate using the following equation:

Hardness (as mg/L calcium carbonate) = (4.118 X [Mg]) + (2.497 X [Ca])

where:
[Mg] = Concentration of magnesium (mg/L)
[Ca] = Concentration of calcium (mg/L)

Quality Control:

Report the method blank as the default QC unless otherwise requested.

Formal detection limit studies, as described in 40CFR Part 136B and SOP QA07: *Determination of Detection Limits*, are not required for SM2340B.

This procedure is a calculation based on another analytical procedure; therefore, demonstration of capability (DOC) is accomplished by successful completion of analytical DOCs. (i.e. If the analyst has a successful DOC on file for Ca and Mg by EPA 200.7/6010B or EPA 200.8/6020, proficiency has been shown for SM2340B by default.)

18.0 Revision History

Summary of Changes from Previous Revision:

- Minor editorial, grammatical, and formatting changes made. Boilerplate text added.
- Updated references to reflect current SOPs.
- Added hydrofluoric acid to the rinse blank and safety sections of the SOP.
- Revised batch QC frequency and default batch QC items. LCSD is performed if insufficient sample is provided for MS/MSD/SD. Section 9.1 and Attachment 3
- Added note that if an LCS and LCSD are performed, both QC items must be evaluated and reported. Acceptable recoveries (as well as %RPD) for both LCS and LCSD are required. Section 9.1.1
- Clarified requirements and frequency for RLVs, MDL Studies, and MDLVs to be consistent with SOP SA-QA-07 and to include the frequency as defined by DOD and NELAC. Section 12.1 - 12.3 and Attachment 3
- Added note that unsupervised work must not begin until acceptable IDOC is obtained. Attachment 3
- Added section on troubleshooting. Attachment 4
- Removed references to an IDL solution. IDLs are determined by the analysis of a blank solution.
- Included Hardness by Calculation Work Instruction, Attachment 9.
- Revised criteria for serial dilution to select sample with concentration greater than 50X MDL. Section 9.2.7.1.
- Expanded holding time and preservation table in Attachment 2.
- Added information on default dilution factors for non-drinking water samples and soil samples (DF5 and DF10). Section 10.3.4 and 16.13

SEMI-VOLATILE COMPOUNDS BY GC/MS

(Methods: EPA 625, EPA 8270C, EPA 8270C_LL, EPA 8270C_LL_PAH, EPA 8270D, EPA 8270D_LL, EPA 8270D_LL_PAH, and SM6410B)

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1.0 Scope and Application

This SOP contains the procedures for the determination of extractable semi-volatile organic compounds (SVOC) by gas chromatography/mass spectrometry (GC/MS).

The routine matrices performed by this procedure are waters and soils. Other matrices which may be performed include wipes, leachates, tissues, and wastes.

A complete target analyte list, the reporting limits (RL), the method detection limits (MDL), and the accuracy and precision criteria associated with this procedure are provided in the LIMS Method Limit Groups (MLGs).

2.0 Summary of Method

A measured volume or weight of sample is extracted using continuous liquid-liquid or sonication extraction procedures. The extract is then analyzed by GC/MS. Qualitative identification of the target compounds in the extract is based on the retention time and the relative abundance of the characteristic masses determined from standards analyzed on the same GC/MS under the same conditions. Quantitative analysis is performed using the internal standard technique with a single characteristic ion.

This SOP is based on the following methods: EPA 625, EPA 8270C, EPA 8270D, and SM6410B.

Note: This SOP contains the procedures for several variations of the SW-846 methods. These variations include:

- EPA 8270C and EPA 8270D (i.e., routine 8270)
- EPA 8270C_LL and EPA 8270D_LL (i.e., low-level 8270)
- EPA 8270C_LL_PAH and EPA 8270D_LL_PAH (i.e., low-level 8270 for polynuclear aromatics hydrocarbons only)

These three sets of procedures incorporate slightly different standard concentrations, surrogate compounds, instrument configuration, and QC evaluation criteria, which are outlined separately in the applicable sections of this SOP.

This SOP also gives the procedures for analyzing and reporting samples using the MS in Selective Ion Monitoring (SIM) mode.

3.0 Definitions

Refer to the Glossary Section of the *Quality Assurance Manual* (QAM) for a complete listing of applicable definitions and acronyms.

4.0 Interferences

4.1 Procedural Interferences

4.1.1 Interferences may be caused by contaminants in solvents, reagents, glassware, and other sample processing apparatus and can make identification and/or quantification of the target analytes difficult.

4.1.2 All sample collection containers are single-use disposable containers which limits the potential for contamination. All non-disposable labware must be scrupulously cleaned in accordance with the posted Labware Cleaning Instructions to ensure it is free from contaminants and does not contribute artifacts.

4.1.3 High purity reagents and solvents are used to help minimize interference problems. Acetone and methylene chloride must be verified prior to use in accordance with the TestAmerica Solvent Lot Testing Program.

4.1.4 Instrument and/or method blanks are routinely used to demonstrate all reagents and apparatus are free from interferences under the conditions of the analysis.

4.2 Matrix Interferences

4.2.1 Matrix interferences may be caused by contaminants that are co-extracted from the sample matrix. The sample may require cleanup or dilution prior to analysis to reduce or eliminate the interferences. Sample extracts that contain high concentrations of non-volatile material such as lipids and high molecular weight resins and polymers may require the optional gel permeation chromatography (GPC) cleanup prior to analysis. The GPC cleanup is generally not effective in removing non-target material that is associated with common petroleum products like diesel. Refer to extraction SOPs for further information on the GPC procedure.

4.2.2 Interfering contamination may occur when a sample containing low concentrations of analytes is analyzed immediately following a sample containing relatively high concentrations of analytes. As such, samples known to be clean should be analyzed first. To prevent carryover into subsequent samples, analysis of reagent blanks may be needed after the analysis of a sample containing high concentrations of analytes.

4.2.3 If there is interference with the primary ion, then secondary ions may be used for quantification. If a secondary ion is used for quantification, the linearity of the secondary ion must be established by meeting the criteria in Section 11.

4.2.3 The basic conditions of the initial extraction may cause hydrolysis and degradation of some target compounds. The degradation may be pronounced in phthalate esters.

4.2.4 Refer to Section 11.1.5 for more information on the chemical relationships of these compounds.

5.0 Safety

Employees must abide by the policies and procedures in the TestAmerica Environmental Health and Safety Manual (EHSM), the TestAmerica Savannah Addendum to the EHSM, and this document.

This procedure may involve hazardous materials, operations, and equipment. This SOP does not purport to address all of the safety problems associated with its use. It is the responsibility of the user to follow appropriate safety, waste disposal, and health practices under the assumption that all samples and reagents are potentially hazardous.

The analyst must protect himself/herself from exposure to the sample matrix. Many of the samples that are tested may contain hazardous chemical compounds or biological organisms. The analyst must, at a minimum, wear protective clothing (lab coat), eye protection (safety glasses or face shield), disposable gloves, and closed-toe, nonabsorbent shoes when handling samples.

5.1 Specific Safety Concerns or Requirements

The toxicity or carcinogenicity of chemicals used in this method has not been precisely defined; therefore, each chemical should be treated as a potential health hazard, and exposure to these chemicals should be minimized.

Methylene chloride is a carcinogen and an irritant. It causes irritation to the respiratory tract and has a strong narcotic effect with symptoms of mental confusion, light-headedness, fatigue, nausea, vomiting, and headache. May be absorbed through the skin and can cause irritation and pain to the skin and eyes.

The gas chromatograph and mass spectrometer contain zones that have elevated temperatures. The analyst needs to be aware of the locations of those zones, and must cool them to room temperature prior to working on them.

The mass spectrometer is under deep vacuum. The mass spectrometer must be brought to atmospheric pressure prior to working on the source.

There are areas of high voltage in both the gas chromatograph and the mass spectrometer. Depending on the type of work involved, either turn the power to the instrument off, or disconnect it from its source of power.

5.2 Primary Materials Used

The following is a list of the materials used in this procedure, which have a serious or significant hazard rating, and a summary of the primary hazards listed in their MSDS.

NOTE: This list does not include all materials used in the procedure. A complete list of materials used in this procedure can be found in the Reagents and Standards Section and the Equipment and Supplies Section of this SOP

Employees must review the information in the MSDS for each material before using it for the first time or when there are major changes to the MSDS. Electronic copies of MSDS

can be found using the "MSDS" link on the Oasis homepage, on the EH&S webpage on Oasis, and on the QA Navigator.

Material	Hazards	Exposure Limit [1]	Signs and Symptoms of Exposure
Acetone	Flammable	1000ppm TWA	Inhalation of vapors irritates the respiratory tract. May cause coughing, dizziness, dullness, and headache.
Methylene Chloride	Carcinogen Irritant	25ppm TWA 125ppm STEL	Causes irritation to respiratory tract. Has a strong narcotic effect with symptoms of mental confusion, light-headedness, fatigue, nausea, vomiting and headache. Causes irritation, redness and pain to the skin and eyes. Prolonged contact can cause burns. Liquid degreases the skin. May be absorbed through skin.
[1]Exposure limit refers to the OSHA regulatory exposure limit.			

6.0 Equipment and Supplies

6.1 Equipment and Instrumentation

Gas chromatograph - Agilent 5890, 6890, 7890, or equivalent with compatible autosampler, split/splitless injector, and direct capillary interface.

Mass spectrometer- Agilent 5973, 5975, or equivalent

Top-loading Balance – Verify in accordance with SOP SA-AN-10: *Balance Calibration and Use*

6.2 Analytical Data System / Software / Hardware

Chemstation software is used on a Windows-based PC to schedule and acquire data. Target (UNIX and/or Windows) software is used on a Windows-based PC to store, reduce/evaluate, and output the data to the laboratory's LIMS system (i.e., TALS). Target software has the capability of processing stored GC/MS data by recognizing a GC peak within any given retention time window, comparing the mass spectrum from the GC peak with spectral data in a user-created data base, and generating a list of tentatively identified compounds with their retention times and scan numbers. The software also allows integration of the ion abundance of any specific ion between specified time or scan number limits, calculation of response factors as or construction of a linear regression calibration curve, calculation of response factor statistics (mean and standard deviation), and calculation of concentrations of analytes using either the calibration curve or the response factors.

6.3 Lab Supplies

Volumetric Containers – various sizes; Class A, where applicable. Verify in accordance with SOP SA-AN-30: *Pipette and Volumetric Container Calibration Verification*

Disposable Transfer Pipettes and Bulbs – various sizes

Gas-Tight Syringes – various sizes. Verify in accordance with SOP SA-AN-30: *Pipette and Volumetric Container Calibration Verification*

Column – Supelco SLB5-MS, 30m x 0.25mm ID, 0.25um film thickness or equivalent

Injector Liner – 4mm ID quartz or 4mm glass, deactivated

Autosampler Vials and Caps – various sizes

7.0 Reagents and Standards

7.1 Expiration Dates

Expiration dates (time from initial use or receipt to final use) for standard and reagent materials must be set according to the guidance in this SOP. Note: These are maximum expiration dates and are not to be considered an absolute guarantee of standard or reagent quality. Sound judgment must be used when deciding whether to use a standard or reagent. If there is doubt about the quality of a standard or reagent material, a new material must be obtained or the standard or reagent material verified. Data quality must not be compromised to extend a standard's life – i.e., when in doubt, throw it out.

The expiration date of any standard must not exceed the expiration date of the standard that was used to prepare it; that is, the "children may not outlive the parents".

7.2 Reagents

Reagents must be prepared and documented in accordance with SOP SA-AN-41: *Reagent and Standard Materials Traceability.*

Acetone and methylene chloride must be verified prior to use in accordance with the TestAmerica Solvent Lot Testing Program.

7.2.1 Methylene chloride: pesticide grade, for preparation of analytical standards
Storage: Room temperature
Expiration: Unopened and Opened - Manufacturer's expiration date

7.2.2 Acetone: pesticide residue grade, for cleaning glassware.
Storage: Room temperature
Expiration: Unopened and Opened - Manufacturer's expiration date

7.3 Standards

Standards must be prepared and documented in accordance with SOP SA-AN-41: *Reagent and Standard Materials Traceability.* Certificates of analysis or purity must be received with all purchased standards, and scanned and filed in the Data Archival Folder on the G-drive.

Refer to Attachment 9 for the laboratory's current standards and recipes.

8.0 Sample Collection, Preservation, Shipment, and Storage

8.1 Aqueous Samples

Aqueous samples are routinely collected in 1L amber glass containers with PTFE-lined lids.

Samples must be iced at the time of collection and maintained at 4°C (less than 6°C but not frozen) until the time of preparation. Samples must be prepared within 7 days of collection. Extracts must be stored at 4°C (less than 6°C but not frozen) until the time of analysis and analyzed within 40 days of extraction.

Note: In the presence of samples containing residual chlorine, phenol-d_6 has been known to react to form chlorinated phenolic compounds that are not detected as the original spiked surrogate. Therefore, aqueous samples must be evaluated for the presence of residual chlorine prior to extraction.

8.2 Soil Samples

Soil samples are routinely collected in 16oz soil containers with PTFE-lined lids.

Samples must be iced at the time of collection and maintained at 4°C (less than 6°C but not frozen) until the time of preparation. Samples must be prepared within 14 days of collection. Extracts must be stored at 4°C (less than 6°C but not frozen) until the time of analysis and analyzed within 40 days of extraction.

9.0 Quality Control

SOP SA-QA-17: *Evaluation of Batch QC Data* and the SOP Summary in Attachment 3 provide requirements for evaluating QC data.

9.1 Batch QC

An extraction batch consists of up to 20 environmental samples and the associated QC items.

For EPA 625, the minimum QC items required for each extraction batch are: a method blank, a laboratory control sample (LCS), and a matrix spike (MS) per 10% of samples extracted.

For EPA 8270C, EPA 8270D, EPA 8270C_LL, EPA 8270D_LL, EPA 8270C_LL_PAH, EPA 8270D_LL_PAH, and SM6410B the laboratory's default QC items performed for each extraction batch are: a method blank, a laboratory control sample (LCS), a matrix spike (MS), and a matrix spike duplicate (MSD).

Note: LCS and LCSD are performed if insufficient sample is provided for MS/MSD. If an LCS and LCSD are performed, both QC items must be evaluated and reported. Acceptable recoveries (as well as %RPD) for both LCS and LCSD are required.

Refer to applicable preparation SOP listed in Section 10.1 for further information on batch QC.

Batch QC must meet the criteria given in Attachment 3 of this SOP.

9.1.1 Poor Performers

As indicated in SW-846 and/or via assessment of laboratory control sample (LCS) recoveries and control charts, the compounds listed in Attachment 11 are poor performers and/or behave erratically. These compounds will not be included in the LCS/LCSD/MS/MSD marginal exceedance count, as outlined in SOP SA-QA-17: *Evaluation of Batch QC Data,* provided they are qualitatively detected.

Note: An NCM must be initiated to denote this situation.

9.2 Instrument QC

9.2.1 DFTPP

A solution containing DFTPP (difluorotriphenyl phosphate) must be analyzed at the beginning of each analytical clock. The analytical clock begins with the injection of the DFTPP standard and is defined as 12 hours for EPA 8270C, EPA 8270C_LL, EPA 8270C_LL_PAH, EPA 8270D, EPA 8270D_LL, EPA 8270D_LL_PAH, and SM6410B and is defined as 24 hours for EPA 625.

Meeting the DFTPP tuning criteria demonstrates that the instrument is measuring the proper masses in the proper ratios. The DFTPP analysis takes place under the same instrument conditions as the calibration standards and samples except that a different temperature program can be used to allow for the timely elution of DFTPP. All other instrument conditions including the mass range, scan rate, and multiplier voltage must be identical.

A 1uL aliquot of the 50ng/uL DFTPP/Column Evaluation solution is utilized for EPA 625, EPA 8270C, EPA 8270D, and SM6410B. A 1uL aliquot of the 5ng/uL DFTPP/Column Evaluation solution is utilized for EPA 8270C_LL, EPA 8270D_LL, EPA 8270C_LL_PAH, and EPA 8270D_LL_PAH.

The DFTPP solution must also contain benzidine, pentachlorophenol, and p,p'-DDT at the following concentrations:

EPA 625, EPA 8270C, EPA 8270D, and SM6410B – 50ug/mL
EPA 8270C_LL and EPA 8270D_LL – 5ug/mL
EPA 8270C_LL_PAH and 8270D_LL_PAH – 5ug/mL

9.2.1.1 DFTPP Spectrum Criteria

The spectrum of the DFTPP must meet the criteria for each method listed in Attachment 6. Background subtraction must be straightforward, that is, no scan within the elution window of DFTPP may be subtracted from another scan within the elution window, and designed only to eliminate column bleed or instrumental background. Scans ± 2 scans from the apex can be evaluated for the DFTPP criteria. Consecutive scans within this range may be averaged to meet the criteria.

Note: The DFTPP analysis should be evaluated as to the relative size of the DFTPP peak under the m/z 198 profile. A benchmark area window should be established for each instrument and data system. Area outside of this window suggests instrumental problems such as a bad injection, clogged autosampler syringe, leaking injector, reduced or elevated detector sensitivity, improper electron multiplier voltage selection, wrong tune method or tune file selected for this analysis, PFTBA valve left open, etc.

If the DFTPP fails to meet the criteria, the instrument may require tuning (manually or automatically with PFTBA). Depending on the nature of the results from the DFTPP analysis, other corrective measures may include remaking the DFTPP standard, cleaning the mass spectrometer source, etc.

9.2.1.2 DFTPP Tailing Factor Criteria

The analysis of benzidine and pentachlorophenol serves as a check on the system performance. The tailing factor for pentachlorophenol and benzidine is calculated as outlined in Attachment 7 and must meet the following criteria:

EPA 625, EPA 8270C, EPA 8270C_LL, and SM6410B:
pentachlorophenol <5
benzidine <3

EPA 8270D and EPA 8270D_LL:
pentachlorophenol <2
benzidine <2

EPA 8270_LL_PAH and 8270D_LL_PAH:
There are no tailing factor criteria for these methods.

If the criteria above are not met, perform injector port and column maintenance and reanalyze the DFTPP standard.

9.2.1.3 DFTPP Percent Breakdown Criteria

DFTPP percent breakdown must be evaluated for EPA 8270C, EPA 8270C_LL, EPA 8270D, and EPA 8270D_LL.

Percent breakdown is calculated using the areas from the total ion chromatogram using following equation:

$$\%Breakdown = \frac{(areaDDE + areaDDD)}{(areaDDT + areaDDE + areaDDD)} x\,100$$

The percent breakdown of p,p'-DDT must not exceed 20% for the methods cited above.

There is no percent breakdown requirement for EPA 625, EPA 8270C_LL_PAH, EPA 8270D_LL_PAH, and SM6410B.

9.2.2 Initial Calibration (ICAL)

The instrument must be calibrated in accordance with SOP SA-QA-16: *Evaluation of Calibration Curves.* This SOP provides requirements for establishing the calibration curve and gives the applicable formulas.

Instrument calibration is performed by analyzing a series of known standards. The calibration curve must consist of a minimum of 3 standards for EPA 625 and SM6410B and a minimum of 5 standards for EPA 8270C, EPA 8270D, EPA 8270C_LL, EPA 8270D_LL, EPA 8270C_LL_PAH, and EPA 8270D_LL_PAH. The lowest level calibration standard must be at or below the reporting limit, and the remaining standards will define the working range of the analytical system.

Note: A minimum of 6 points is required for a quadratic curve. Higher order curves are not permitted. Some programs and agencies (e.g., SC DHEC) do not allow the use of quadratic curves. Refer to the Project Requirement Summary and/or Project Plan to determine if this curve type is prohibited.

The initial calibration standard concentrations currently in use in the laboratory are as follows:

EPA 8270C / EPA 8270D / EPA 625 / SM6410B

Standard Level	Concentration (ug/mL)
1	10
2	20
3	50
4	80
5	100
6	200

EPA 8270C_LL / EPA 8270D_LL

Standard Level	Concentration (ug/mL)
1	0.20
2	0.50
3	1.0
4	2.0
5	5.0
6	10
7	20
8	50

EPA 8270C_LL_PAH / EPA 8270D_LL_PAH

Standard Level	Concentration (ug/mL)
1	0.20

2	0.50
3	1.0
4	2.0
5	5.0
6	10
7	20

Refer to Attachment 9 for the standard preparation instructions. Other standard concentrations may be used provided they support the reporting limit and are fully documented in accordance with SOP SA-AN-41.

ICAL evaluation steps and acceptance criteria vary between the methods. Refer to Attachment 1 for a summary of the method-specific requirements.

9.2.3 Instrument Blanks

The instrument must be shown to be free from contamination by the analysis of instrument blanks or method blanks. Instrument blanks are analyzed at the beginning of each clock before analysis of any samples. The instrument blanks should be analyzed following the ICV or CCV.

Instrument blanks or method blank must be <1/2RL to be acceptable

9.2.4 Second Source Initial Calibration Verification (ICV)

The calibration curve must be verified initially – prior to any sample analyses – in accordance with SOP SA-QA-16 with a standard obtained from a second source.

The initial calibration verification standard concentration currently in use in the laboratory is equivalent to Level 4 of the ICAL for EPA 625, EPA 8270C, EPA 8270C_LL_PAH, EPA 8270D, EPA 8270D_LL_PAH, and SM6410B and equivalent to Level 6 for EPA 8270C_LL and EPA 8270D_LL. Refer to Section 7.3.2.5 for the standard preparation instructions. Another standard concentration may be used provided it is mid-level and fully documented in accordance with SOP SA-AN-41.

ICV evaluation steps and acceptance criteria vary between the methods. Refer to Attachment 1 for a summary of the method-specific requirements.

9.2.5 Continuing Calibration Verification (CCV)

The initial calibration curve must be verified at the beginning of each clock with a mid-level standard. The analytical clock is defined as 12 hours for EPA Method 8270C, EPA 8270C_LL, EPA 8270C_LL_PAH, EPA 8270D, EPA 8270D_LL, EPA 8270D_LL_PAH, and SM6410B and is defined as 24 hours for EPA Method 625. The initiation of the clock begins with the injection of the DFTPP.

The continuing calibration verification standard concentration currently in use in the laboratory is equivalent to Level 4 of the ICAL for EPA 8270C, EPA 8270C_LL_PAH, EPA 8270D, EPA 8270D_LL_PAH, EPA 625, and SM6410B and is equivalent to Level 6 of the ICAL EPA 8270C_LL and EPA 8270D_LL. Refer to Section 7.3.2.2 for the standard

preparation instructions. Another standard concentration may be used provided it is mid-level and fully documented in accordance with SOP SA-AN-41.

Note: An additional, low-level (RL) CCV is incorporated into the procedure for EPA 8270D, EPA 8270D_LL, and EPA 8270D_LL_PAH. This low-level CCV is used to demonstrate sensitivity at the RL can be obtained. Refer to the applicable CCV section for more information on how this CCV is utilized.

Note: CCV evaluation steps and acceptance criteria vary between the methods. Refer to Attachment 1 for a summary of the method-specific requirements.

9.2.6 Isomer Resolution Criteria

Monitor GC resolution of structural isomers in the ICAL and CCV. In the ICAL use the calibration level that will be utilized as the CCV.

Structural isomers that produce very similar mass spectra should be identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved if the height of the valley between two isomer peaks is less than 50% of the average of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs. This criteria is important for the identification of benzo(b)fluoranthene and benzo(k)fluoranthene.

Note: The resolution should be monitored utilizing the signal resolution of the extracted ion profiles for the quantitation ion for each analyte. Sufficient GC resolution is needed to identify the individual isomeric peaks by retention time. If target software is able to integrate and define separate peaks for the isomeric pairs, then sufficient resolution has been achieved. If there is sufficient evidence to support the identification of the individual component, then the component is identified, quantified, and reported.

9.2.7 Internal Standard (ISTD)

This procedure is an internal standard (ISTD) procedure. The internal standards used are 1,4-dichlorobenzene-d_4, naphthalene-d_8, acenaphthene-d_{10}, phenanthrene-d_{10}, chrysene-d_{12}, and perylene-d_{12}.

Prior to analysis, this internal standard must be added to all standards, samples, and QC items. The concentration of the internal standard must be the same in all calibration samples, field samples, and QC samples. A concentration of 40ug/mL is used for EPA 8270C, EPA 8270D, EPA 625, and SM6410B. A concentration of 2.0ug/mL is used for EPA 8270C_LL, EPA 8270C_LL_PAH, EPA 8270D_LL, and EPA 8270D_LL_PAH.

9.2.7.1 ISTD Criteria

9.2.7.1.1 ICV/CCV ISTD Criteria - EPA 8270C, EPA 8270C_LL, EPA 8270C_LL_PAH, EPA 8270D, EPA 8270D_LL, and EPA 8270D_LL_PAH

The response of the ISTD in the ICV/CCVIS must be within a factor of 2 of the response of the ISTD in the CCV-level standard in the initial calibration sequence. Due to the number of analytes reported in this method, multiple CCVs can be analyzed. The primary CCV is defined as the CCVIS and used to monitor ISTD response in samples. If the

response is outside of this range, the analysis of the CCVIS must be repeated and any samples associated with the CCVIS must also be re-analyzed. Repeated failure of the ISTD response may require instrument maintenance, re-preparation of standards, and/or re-calibration.

9.2.7.1.2 ICV/CCV ISTD Criteria - EPA 625 and SM6410B

There are no ICV or CCV ISTD criteria for EPA 625 or SM6410B.

9.2.7.1.3 Sample and Batch QC ISTD Criteria - EPA 8270C, EPA 8270C_LL, EPA 8270C_LL_PAH, EPA 8270D, EPA 8270D_LL, and EPA 8270D_LL_PAH

The response of the ISTD in samples and batch QC items must be within a factor of 2 of the response of the previous CCVIS. If the response is outside of this range, corrective action must be taken. Corrective actions include re-analysis (for field samples) and/or re-extraction (if batch QC item).

9.2.7.1.4 Sample and Batch QC ISTD Criteria - EPA 625 and SM6410B

There are no specific ISTD criteria in EPA 625 and SM6410B. The laboratory has adopted the criteria outlined in EPA 8270C and EPA 8270D.

9.2.8 Surrogates

This procedure uses surrogates to evaluate the extraction process.

The surrogates currently used by the laboratory for EPA 625, EPA 8270C, EPA 8270C_LL, EPA 8270D, EPA 8270D_LL, and SM6410B are phenol-d6 (acid), 2-fluorophenol (acid), 2,4,6-tribromophenol (acid), nitrobenzene-d5(base), 2-fluorobiphenyl (base), and p-terphenyl-d14 (base).

The surrogate currently used by the laboratory for EPA 8270C_LL_PAH and EPA 8270D_LL_PAH is ortho-terphenyl (OTP).

Prior to preparation, the surrogate analytes are added to all samples and QC items. The concentration of the surrogate is the same in all field samples and QC samples. A concentration of 100ug/mL is used for EPA 625, EPA 8270C, EPA 8270C_LL, EPA 8270D, EPA 8270D_LL, and SM6410B. A concentration of 2.0ug/mL is used for EPA 8270C_LL_PAH and EPA 8270D_LL_PAH.

The percent recovery of the surrogate in all field samples and QC samples must be within the limits listed in the Method Limit Groups (MLGs) in LIMS.

9.2.8.1 Surrogate Dilution Factor Threshold

Due to the level of dilution required for samples, surrogates may be diluted out. As such, recoveries will be reported as "0D" in dilutions at 1:10 or greater. Control limits will not apply to samples analyzed at dilutions of 1:10 or greater.

An NCM must be initiated to denote this situation.

9.2.8.2 One Acid / One Base Surrogate Exception

The laboratory allows one acid and one base surrogate compound to be outside acceptance limits, in field samples and MS/MSD, provided their recovery is greater than 10%. All surrogate compounds must pass in method blanks and LCS/LCSD.

An NCM must be initiated to denote this situation.

9.3 Corrective Action for Out-of-Control Data

When the quality control parameters do not meet the criteria set forth in this SOP, corrective action must be taken in accordance with SOP SA-QA-05: *Preventive and Corrective Action Procedures* and the QC Summary Table in Attachment 3. SOP SA-QA-05 provides contingencies for out-of-control data and gives guidance for exceptionally permitting departures from approved policies and procedures. Nonconformance Memos must be initiated to document all instances where QC criteria are not met and all departures from approved policies and procedures.

10.0 Procedure

10.1 Preparation

10.1.1 Aqueous Sample Preparation

For continuous liquid-liquid extraction, the sample is adjusted to a specific pH, as required by the analyte list, transferred to a continuous liquid-liquid extractor, and extracted using methylene chloride. The extract is concentrated to a 1mL final volume using the Zymark nitrogen blow-down concentrator procedure.

For separatory funnel extraction, the sample is placed into a separatory funnel, adjusted to a specific pH, as required by the analyte list, and extracted using methylene chloride. The extract is concentrated to a 1mL final volume using the Zymark nitrogen blow-down concentrator procedure.

The preferred method for preparing aqueous samples is the continuous liquid-liquid extraction procedure. When required by a client QAPP, the laboratory may prepare aqueous samples using the separatory funnel extraction procedure.

Refer to SOP SA-EX-030: *Liquid Extraction Procedures: Continuous Liquid-Liquid and Separatory Funnel* for specifics on the aqueous and leachate sample preparation process.

10.1.2 Soil Sample Preparation

For ultrasonic extraction, the sample is combined with anhydrous, purified sodium sulfate to form a free flowing, sandy mixture. A 1:1 acetone/methylene chloride mixture is added to the dried sample, and the sample is extracted using an ultrasonic disrupter for three minutes. The solvent is decanted, and the extraction is repeated two more times. The extract is filtered and concentrated to a 1mL final volume in methylene chloride using the Zymark nitrogen blow-down concentrator procedure.

Refer to SOP SA-EX-040: *Sonication Procedures* for specifics on the soil sample preparation process.

10.2 Analysis

10.2.1 Instrument Operating Conditions

The instrument conditions listed in this SOP are provided for guidance purposes. The actual conditions used by the laboratory may be slightly different from those listed here and must be documented in the instrument maintenance log, data system, and/or run log.

Instrument maintenance must be performed in accordance with Attachment 4 of this SOP.

The goal is to have maximum separation between the target compounds in the shortest run time while maintaining sufficient sensitivity to detect the target compounds at the reporting limit and MDL (if required).

Example GC Parameters
Injector: 250-280°C
Injector Mode:
- Split – EPA 8270C, EPA 8270D, EPA 625
- Splitless – EPA 8270C_LL, EPA 8270D_LL
- Pulsed Spitless (20psi at injection for 0.30 minutes) – EPA 8270C_LL_PAH, EPA 8270D_LL_PAH

Column – HP5 MS 30m x 0.25mm ID, 0.25um film thickness; or equivalent

Carrier Gas Flow: Helium at 0.5-1.0mL/min (column)
Mass spectrometer interface: 280-300°C
Mass spectrometer source temperature: 230°C
Mass spectrometer quad temp: 150C
Mass range: 35-500amu, with a minimum scan time of 1.0 scan per second

Temperature Program: EPA 8270C, EPA 8270D, EPA 625

Initial Temp:	55°C
Initial Hold:	1.5 min
Program Rate:	30°C/min to 190°C, 32°C/min to 320°C
Final Temp:	320°C (hold until elution time of Benzo(ghi)perylene or last eluting analyte)
Injected Volume:	1-2uL per column
Inlet Purge Time:	0.8 minutes

Temperature Program: EPA 8270C_LL, EPA 8270D_LL

Initial Temp:	55°C
Initial Hold:	1.5 min
Program Rate:	30°C/min to 190°C, 32°C/min to 320°C
Final Temp:	320°C (hold until elution time of Benzo(ghi)perylene or last eluting analyte)
Injected Volume:	1-2uL per column
Inlet Purge Time:	0.8 minutes

Temperature Program: EPA 8270C_LL_PAH, EPA 8270D_LL_PAH

Initial Temp:	60°C
Initial Hold:	1.0min
Program Rate:	25°C/min to 130°C, hold 0 minutes 16°C/min to 240°C, hold 0 minutes 2°C/min to 310°C, hold 4 minutes
Final Temp:	310°C
Injected Volume:	1uL
Inlet Purge Time:	0.8 minutes

The injection volume must be the same for all standards and sample extracts.

10.2.2 Internal Standard (ISTD)

Prior to analysis, a volume of internal standard must be added to all standards, samples, and QC items that provides a concentration of 40ug/mL for EPA 8270C, EPA 8270D, EPA 625, and SM6410B or 2.0ug/mL for EPA 8270_LL, EPA 8270D_LL, EPA 8270C_LL_PAH, and EPA 8270D_LL_PAH.

The concentration of the internal standard must be the same in all calibration samples, field samples, and QC samples.

A volume of 20uL of the ISTD spiking mix is used for EPA 8270C, EPA 8270D, EPA 625, and SM6410B for a final concentration of 40ug/mL.

A volume of 10uL of the ISTD spiking mix is used for EPA 8270C_LL, EPA 8270D_LL, EPA 8270C_LL_PAH, and EPA 8270D_LL_PAH for a final concentration of 2ug/mL.

10.2.3 DFTPP Evaluation

The DFTPP standard must be analyzed at the beginning of each clock. The analytical clock is defined as 12 hours for EPA 8270C, EPA 8270C_LL, EPA 8270C_LL_PAH, EPA 8270D, EPA 8270D_LL, EPA 8270D_LL_PAH, and SM6410B and is defined as 24 hours for EPA 625. The initiation of the clock begins with the injection of the DFTPP.

Evaluate the DFTPP in accordance with Section 9.2.1.

10.2.4 Initial and Continuing Calibration

Calibrate the instrument using the standards and criteria described given in Section 9.2.2. Once the calibration has been established and verified with an ICV in accordance with Section 9.2.3, sample analysis may proceed.

Verify the calibration curve with a continuing calibration verification using the standards and criteria described given in Section 9.2.4.

10.2.5 Sample Analysis

Remove the extracts from the refrigerator and allow them to come to room temperature.

The sample extract must be injected using the same injection volume used for the calibration standards. Samples that are known to be relatively clean should be analyzed first. Samples suspected of containing high concentrations should be analyzed last. Instrument blanks may be analyzed after suspected high concentration samples to allow the detector response to stabilize.

The term "clock time" defines the continuing calibration frequency. The clock time starts at the injection of the DFTPP, followed by CCV. The analysis of samples and batch QC items may continue until the clock time expires. A new DFTPP and CCV (i.e., a new clock) is required to proceed with the analysis of more samples and/or batch QC items. The clock times are defined as outlined below:

- 12-hour clock for EPA 8270C, EPA 8270C_LL, EPA 8270C_LL_PAH, EPA 8270D, EPA 8270D_LL, EPA 8270D_LL_PAH, and SM6410B
- 24-hour clock for EPA 625

10.2.6 Example Analytical Sequence

Description	Comments
DFTPP	Clock time begins.
Initial Calibration	
ICV	
Instrument Blank	
Samples & Batch QC Items	EPA 625: Clock time ends at 24 hours from DFTPP EPA 8270C, EPA 8270C_LL, EPA 8270C_LL_PAH, EPA 8270D, EPA 8270D_LL, EPA 8270D_LL_PAH, and SM6410B: Clock time ends at 12 hours from DFTPP
DFTPP	Clock time begins.
CCV	
RL CCV	EPA 8270D, EPA 8270D_LL, and EPA 8270D_LL_PAH only
Instrument Blank	
Samples & Batch QC Items	EPA 625: Clock time ends at 24 hours from DFTPP EPA 8270C, EPA 8270C_LL, EPA 8270C_LL_PAH, EPA 8270D, EPA 8270D_LL, EPA 8270D_LL_PAH, and SM6410B: Clock time ends at 12 hours from DFTPP

11.0 Calculations / Data Reduction

11.1 Data Reduction

Data evaluation must be performed in accordance with SA-QA-08: *Evaluation of Chromatographic Data.* This SOP includes specific information regarding the evaluation of chromatographic data, including the requirements for performing manual integrations and the evaluation of retention times.

Data review and reporting must be performed in accordance with SA-QA-02: *Data Generation and Review.*

11.1.1 Target Analyte Identification

A target compound is identified by the visual comparison of the sample mass spectrum with the mass spectrum of the target compound from the daily calibration standard or a reference spectrum of the target compound stored in a library generated on the same instrument or a standard spectral library such as the NIST/NBS.

The following criteria must be met in order to positively identify a compound:

1) Elution of the sample component within +/-0.06 RRT (relative retention time) units of the daily standard containing that compound. RRT is calculated as follows:

$$RRT = \frac{\textit{retention time of the target compound}}{\textit{retention time of the associated internal standard}}$$

2) Correspondence of the target compound spectrum and the standard component mass spectrum

   All ions present in the standard component mass spectrum at a relative intensity greater than 10% (most abundant ion = 100%) should be present in the sample component mass spectrum. Other ions may be present in the sample component. Coelution of a non-target compound with a target compound will make the identification of the target compound more difficult. Ions due to the non-target compound should be subtracted from the sample component spectrum as part of the background to account for the discrepancy between the sample spectrum and the standard spectrum.

   The relative intensities of the ions present in the sample component spectrum should agree within ±30% of the relative intensities of the ions in the standard reference spectrum. For example, an ion with an abundance of 50% in the reference spectrum should have a corresponding abundance between 20% and 80% in the sample component spectrum.

3) The intensities of the characteristic ions of a compound must maximize in the same scan or within one scan of each other. Selection of a peak by a data system target compound search routine where the search is based on the presence of a target chromatographic peak containing ions specific for the target compound at a compound-specific retention time will be accepted as meeting this criterion.

4) Q Test – The ratios of Quant to Qual ions are updated with the analysis of the CCV. The ratio of the quant to qual ions in samples should be within +/- 20% of the ratio in the CCV.

5) Structural isomers that produce very similar mass spectra should be identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved if the height of the valley between two isomer peaks is less than 50% of the average of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs.

   If the above criteria are not met, the analyst should seek help from a senior analyst or supervisor. If there is sufficient evidence to support the identification of the component, then the component is identified, quantified, and reported. If there is not sufficient evidence to support identification of the component, then an NCM must be generated to note that the isomers should be identified as the isomeric pair.

6) Ions present in the sample spectrum, but not in the reference spectrum, should be reviewed for possible subtraction from the sample spectrum because of over-lapping or co-eluting peaks.

Ions present in the reference spectrum, but not in the sample spectrum, should be reviewed for possible subtraction from the sample spectrum because of coeluting peaks.

11.1.2 Evaluation of Tentatively Identified Compounds (TICs)

For samples containing components not associated with the calibration standards, a library search on a reference library, such as the NIST/NBS, may be conducted in order to identify the non-target compounds. Only after visual comparison between the sample spectra and the library-generated reference spectra will the mass spectral analyst assign tentative identification. Note: TICs can not be provided from a SIM analysis.

Refer to Attachment 13 for the laboratory's TIC procedures.

11.1.3 Dilutions

Unless otherwise specified by the Worksheet Note, results from a single analysis are reported as long as the largest target analyte (when multiple analytes are present) is in the upper half if the calibration range. When reporting results from dilutions, appropriate data flags must be used or qualification in a case narrative provided to the client.

For clients who require we provide lower detection limits, a general guide would be to report the dilution detailed above and one additional run at a dilution factor 1/10 of the dilution with the highest target in the upper half of the calibration curve. For example, if samples analyzed at a 1/50 dilution resulted in a target in the upper half of the calibration curve, the sample would be analyzed at a dilution factor of 1/5 to provide lower reporting limits.

Note: If samples are analyzed at a dilution factor of 1:10 or greater, report the surrogate result as 0%D, to denote a dilution above the Dilution Threshold. Control limits will not apply to samples analyzed at dilutions of 1:10 or greater.

Dilute samples according to the following table:

Dilution Factor	Extract Aliquot (uL)	ISTD Aliquot (uL)	Final Volume* (mL)
2	500	5	1.0
5	200	8	1.0
10	100	9	1.0
20	50	9.5	1.0
50	20	10	1.0
100	10	10	1.0

*Final solvent = methylene chloride

11.1.4 Historical Data

Many of the laboratory's clients submit samples for repeat monitoring purposes. Prior to analysis, verify TALS Worksheet Notes and/or use the TALS Historical Data Tracker feature to determine if historical data is available for review.

11.1.5 Chemical Relationships

The analyst must be aware of the following chemical relationships:

- Several analytes reported as "total" are summed from the individual components. For example, Aramite, Diallate, and Total Cresols are summed as follows:

  Aramite = aramite peak 1 + aramite peak 2
  Diallate = diallate peak 1 + diallate peak 2
  Total cresols = m/p-cresols + o-cresol

  Note that o-cresol and m/p-cresol are also reported as individual analytes. Aramite and diallate are always reported as the sum of the component peaks.

- Chromatographically unresolved isomers are reported together since isomers cannot be resolved by differences in mass. For example, m-cresol and o-cresol are reported as cresols.

  It is important that closely eluting isomers be resolved chromatographically so that the analyte can be properly identified. The most critical separation is benzo(b)fluoranthene and benzo(k)fluoranthene.

- Acid/Base Compounds

  Basic Compounds: In aqueous samples, several target compounds are soluble in methylene chloride only at basic pH (>12). These compounds form methylene chloride insoluble salts at acidic pH and remain in the aqueous phase. When the pH is adjusted to basic, the ionic compound reverts to its original form and can be extracted out of aqueous solution. Examples of these compounds include pyridine (TCLP, AP9), benzidine (625PP), and a,a-dimethylphenethylamine (AP9). If acid-only extraction is performed, basic compounds will not be extracted and detected.

  Neutral Compounds: In aqueous samples, neutral compounds can extract into methylene chloride at either acidic pH (<2) or at basic pH (>12). That is, these compounds do not convert to salts or ionic forms at either acidic pH. If the acid pH is performed first, the compounds partition into the methylene chloride and would be detected in the acid fraction; if the basic pH extraction is performed first, these compounds partition into the methylene chloride and would be detected in the base fraction. Exceptions include the phthalate esters (e.g., dimethyl phthalate, diethyl phthalate) and other esters which may be irreversibly converted (hydrolyzed) to salts if subjected to the basic pH extraction first.

  Acid Compounds: In aqueous samples, the acidic compounds can be extracted into methylene chloride at acid pH (pH<2). The acidic compounds are the phenols and benzoic acid. At basic pH, the phenols forms water soluble salts which are not soluble in methylene chloride. When the pH is adjusted to <2 the salt is converted back to the phenol or acid form. Some phenols (2,4-dimethyl phenol and the cresols) do not completely ionize at basic pH and may be present in both the acid and base fractions of a dual pH extraction.

- Single pH (<2) Extractions

  Single pH extractions are performed at pH<2 and include the compounds that are soluble in methylene chloride at acidic pH. The primary application of the single pH extraction is for the routine target compound list (TCL), which includes most of the target compounds that are monitored for and are detected in field samples. The advantages of the single pH extraction are a shorter extraction time and efficient extraction of all phenolic compounds and compounds subject to hydrolysis under basic pH conditions. The drawback is that basic compounds are not extracted under single pH conditions.

- Dual pH Extractions

  Dual pH extractions may be performed with the basic pH extraction first followed by the acidic pH or the acidic pH extraction may be performed first followed by the basic pH extraction. The table below summarizes some of the positive and negative aspects of dual pH extractions.

Extraction	Pros	Cons
Acidic pH first followed by basic pH Examples: TCLP, Appendix IX	No hydrolysis of phthalate esters	Acid and base/neutral surrogates are both extracted into solvent at acidic pH. There is no surrogate to determine whether the sample pH was adjusted to basic pH, to determine the extraction efficiency of the basic pH extraction
Basic pH first followed by acidic pH Example: EPA 625 PP	Acid compounds (phenols) and base/neutral compounds can be separated into two extracts. The partitioning of the target analytes into separate extracts can sometimes help to minimize the effect of the sample matrix on the target compounds.	Some compounds may be partitioned into both the acid and base/neutral extracts. Examples include 2,4-dimethylphenol and the cresol compounds.
		Phthalate esters are converted (hydrolyzed) to salts under basic conditions which causes irreversible loss of the compounds. Dimethyl phthalate and diethyl phthalate are the most effected compounds.
		Some phenolic compounds may have reduced recoveries

- Compounds with similar structures and properties are often found together in a sample or in the samples from the same project or site. That is, when one of that type of compound is detected, the analyst should be looking for other compounds of that type. For example, when one PAH compound (e.g., naphthalene, phenanthrene, benzo(a)pyrene, etc.) is detected, the analyst should expect other PAH compounds to be present. When chlorinated benzenes (e.g., 1,2-DCB, 1,3-DCB, 1,4-DCB,are present, the analyst should be aware that other chlorinated benzenes may be present. When pentachlorophenol is detected, the analyst should also look for tetrachlorophenols and trichlorophenols.

11.1.6 Confirmation of GC Analyses

If required, GC/MS can be used to confirm some GC-only analytes. Based on the response of the standard, concentrate the SVOC GC extract to an appropriate final volume.

Note for SVOC: The pesticide extracts cannot be used to confirm the presence of herbicides since the extract has not been properly prepared.

- Add an appropriate volume of internal standard to the extract or sample to give the same concentration as in the calibration standard. Analyze the extract under the same conditions as the standard.

- Compare the retention time of the sample to the retention time of the standard.

If a peak is detected at the retention time of the target compound containing the selected masses in the same ratio as the standard, the peak is confirmed as the target compound and the concentration is calculated. The relative intensities of the ions in the sample should agree within ±20% of the intensities of the ions in the standard.

If a peak is not present at the appropriate retention time or if the ratios of the ions are not the same as the standard, the analyte is not confirmed.

11.2 Calculations

11.2.1 The calculations associated with batch QC determinations are given in SOP SA-QA-17. Applicable calculations include accuracy (% recovery) and precision (%RPD).

11.2.2 The calculations associated with initial and continuing calibrations and are given in SOP SA-QA-16. Applicable calculations include determination for: calibration factor, standard deviation, relative standard deviation, relative response factor, and relative standard deviation.

11.2.3 The calculation to determine final concentration is given as follows:

$$FinalConcentration = CONC_{Sample} \otimes \frac{F}{I \times dw} \otimes D$$

Where:

$CONC_{Sample}$ = Concentration of the sample
F = Final volume/weight
I = Initial volume/weight
D = Dilution factor
dw = % Solids decimal equivalent

Note: All dry weight corrections are performed automatically in LIMS.

Note: This calculation assumes all applicable unit correction factors are applied.

12.0 Method Performance

12.1 Reporting Limit Verification (RLV)

At a minimum, RLVs must be performed initially upon method set-up in accordance with SOP SA-QA-07: *Determination and Verification of Detection and Reporting Limits.*

For analytes and methods certified by DOD ELAP, RLVs must also be performed quarterly thereafter. For all other analytes and methods, RLVs must also be performed annually thereafter. Exceptions may be made for project-specific non-routine analytes.

12.2 Method Detection Limit (MDL) Study

The MDL is the lowest concentration that can be detected for a given analytical method and sample matrix with 99% confidence that the analyte is present. MDLs reflect a calculated (statistical) value determined under ideal laboratory conditions in a clean matrix and may not be achievable in all environmental matrices. The current MDLs associated with this procedure are given in the Method Limit Group (MLG) in TALS.

At a minimum, MDL Studies must be performed initially upon method set-up in accordance with SOP SA-QA-07: *Determination and Verification of Detection and Reporting Limits.*

Note: MDL Studies are not required for non-routine analytes provided results are not reported below the RL (i.e., MDL equals RL in TALS).

12.3 Method Detection Limit Verification (MDLV)

At a minimum, MDLVs must be performed initially upon method set-up in accordance with SOP SA-QA-07: *Determination and Verification of Detection and Reporting Limits.*

For analytes and methods certified by DOD ELAP, MDLVs must also be performed quarterly thereafter. For all other analytes and methods, MDLVs must also be performed annually thereafter.

Note: MDLVs are not required for non-routine analytes provided results are not reported below the RL (i.e., MDL equals RL in TALS).

12.4 QC Limit Generation, Control Charting, and Trend Analysis

12.4.1 EPA 625

The control limits for the batch QC items (LCS, MS/MSD, SD) for this procedure are specified in the reference method and cannot be broadened; therefore, the laboratory defaults to the method-defined limits and does not utilize in-house or laboratory-derived limits for the evaluation of batch QC items.

Although the laboratory must default to the method-defined QC limits, control charting is a useful tool and is performed to assess analyte recoveries over time to evaluate trends. Control charting must be performed periodically (at a minimum annually) in accordance with SOP SA-QA-17: *Evaluation of Batch QC Data.*

12.4.2 EPA 8270C and EPA 8270D

The control limits for the batch QC items (LCS, MS/MSD, SD) for this procedure are not specified by the reference method; therefore, the laboratory defaults to in-house and/or laboratory-derived limits for the evaluation of batch QC items.

Control charting is a useful tool and is performed to assess analyte recoveries over time to evaluate trends. Control charting must be performed periodically (at a minimum annually) in accordance with SOP SA-QA-17: *Evaluation of Batch QC Data.*

12.5 Demonstrations of Capability

Initial and continuing demonstration of capability must be performed in accordance with SOP SA-QA-06: *Training Procedures.*

Prior to performing this procedure unsupervised, each new analyst who performs this analysis must demonstrate proficiency per method/analyte combination by successful completion of an initial demonstration of capability. The IDOC is performed by the analysis of 4 consecutive LCSs that meet the SOP criteria for accuracy and precision. The LCSs must be from a second source than that used to prepare the calibration standards. The IDOC must be documented on the IDOC Form shown in SOP SA-QA-06 with documentation routed to the QA Department for filing.

Annual continuing demonstrations of capability (CDOCs) are also required per analyst per method/analyte combination. The CDOC requirement may be met by the consecutive analysis of four LCS all in the same batch, by the analysis of four LCS analyzed in four consecutive batches (in different batches on different days), via acceptable results on a PT study, or analysis of client samples with statistically indistinguishable results when compared to another certified analyst. The CDOC must be documented and routed to the QA Department for filing.

12.6 Training Requirements

All training must be performed and documented in accordance with SOP SA-QA-06: *Training Procedures.*

Note: The SOPs listed in the Reference/Cross-Reference Section are applicable to this procedure. All employees performing this procedure must also be trained on these SOPs, and/or have a general understanding of these procedures, as applicable.

13.0 Pollution Control

It is TestAmerica's policy to evaluate each method and look for opportunities to minimize waste generated (e.g., examining recycling options, ordering chemicals based on quantity needed, preparing reagents based on anticipated usage and reagent stability, etc.). Employees must abide by the policies in Section 13 of the Environmental Health and Safety Manual and the Savannah Addendum to the EHSM.

This procedure has been evaluated for opportunities to minimize the waste generated. Where reasonably feasible, pollution control procedures have been incorporated.

14.0 Waste Management

Waste management practices must be conducted consistent with all applicable federal, state, and local rules and regulations. All waste (i.e., excess reagents, samples, and method process wastes) must be disposed of in accordance with Section 9 of the TestAmerica Savannah Addendum to the EHSM. Waste description rules and land disposal restrictions must be followed.

14.1 Waste Streams Produced by the Method

The following waste streams are produced when this method is carried out:

- Excess samples, reagents, and standards must be disposed in accordance with the TestAmerica Savannah Addendum to the EHSM.
- Flammable waste (acetone from extracts, rinsings, and standards) – Transfer to a satellite container designated for flammable waste and transfer to waste disposal department when the container is full.
- Methylene chloride extracts – Dispose according to characterization on sample disposal sheets. If non-hazardous, transfer extract to chlorinated waste container. If hazardous, transfer to hazardous waste department for storage.
- Methylene chloride used to rinse glassware, etc. – Transfer to chlorinated waste container.
- Excess aqueous samples – Dispose according to characterization on sample disposal sheets. If non-hazardous, dispose down drain/sewer. If hazardous, transfer to hazardous waste department for storage.
- Excess soil and solid samples – Dispose according to characterization on sample disposal sheets. Transfer non-hazardous samples to TCLP container for characterization in hazardous waste department. Transfer hazardous samples (identified on disposal sheets) to waste department for disposal.
- Excess oil samples – Transfer to waste department for storage/disposal

15.0 References / Cross-References

- SOP SA-AN-10: *Balance Calibration and Use*
- SOP SA-AN-30: *Pipette and Volumetric Container Calibration Verification*
- SOP SA-AN-41: *Reagent and Standard Materials Traceability*
- SOP SA-EX-015: *Toxicity Characteristic Leaching Procedure (TCLP) and Synthetic Precipitation Leaching Procedure (SPLP)*
- SOP SA-EX-030: *Liquid Extraction Procedures: Continuous Liquid-Liquid and Separatory Funnel*
- SOP SA-EX-040: *Sonication Procedures*
- SOP SA-EX-042: *Waste Dilution Extraction*
- SOP SA-PS-025: *Wipe Tests: Sampling and Analysis*
- SOP SA-QA-02: *Data Generation and Review*
- SOP SA-QA-05: *Preventive and Corrective Action Procedures*
- SOP SA-QA-06: *Training Procedures*
- SOP SA-QA-07: *Determination and Verification of Detection and Reporting Limits*
- SOP SA-QA-08: *Evaluation of Chromatographic Data*
- SOP SA-QA-15: *Homogenization, Compositing, and Segregation of Samples*
- SOP SA-QA-16: *Evaluation of Calibration Curves*

- SOP SA-QA-17: *Evaluation of Batch QC Data*
- TestAmerica Savannah Quality Assurance Manual
- TestAmerica Environmental Health and Safety Manual
- TestAmerica Savannah Addendum to the Environmental Health and Safety Manual
- Method 8000C: *Test Methods for Evaluating Solid Wastes, Third Edition, SW-846;* U.S. EPA Office of Solid Waste and Emergency Response: Washington, DC.
- Method 8270C: *Test Methods for Evaluating Solid Wastes, Third Edition, SW-846;* U.S. EPA Office of Solid Waste and Emergency Response: Washington, DC.
- Method 8270D: *Test Methods for Evaluating Solid Wastes, Third Edition, SW-846;* U.S. EPA Office of Solid Waste and Emergency Response: Washington, DC.
- EPA Method 625*: Base/Neutrals and Acids.* 40 CFR Part 136, Appendix A, July 1, 1995.
- *Standard Methods for the Examination of Water and Wastewater, Online Edition;* American Public Health Association: Washington, DC.
  - SM6020: Quality Assurance/Quality Control
  - SM6410B: *Extractable Base/Neutrals and Acids; Liquid-Liquid Extraction and Gas Chromatographic/Mass Spectrometric Method; 2000*

16.0 Method Modifications

16.1 Incorporation of Other Matrices

This procedure may be modified to analyze other matrices (e.g., wipe, waste, tissue, and TCLP/SPLP leachate samples) based on the needs of the client. This will need to be arranged by the Project Manager at the initiation of the project.

Wipe, waste, and tissue matrices are non-routine, and the laboratory is not currently NELAC certified for these matrices. The laboratory uses its routine soil RLs (converted for initial and final volumes, etc.) and default QC limits to evaluate wipe, waste, filter, and tissue samples. Soil DOCs can be used to satisfy analyst demonstrations of capability for these types of non-routine matrices. The laboratory uses its routine aqueous RLs (converted for initial and final volumes, etc.) and default QC limits to evaluate TCLP/SPLP leachate samples. Water DOCs can be used to satisfy analyst demonstrations of capability for TCLP/SPLP matrices. Teflon chips, Ottawa sand, or equivalent is used as the blank matrix for wipes, wastes, and tissues unless specifically requested otherwise by the project.

16.1.1 Collection and Handling Procedures

Waste (Oil) Samples:
Waste (oil) samples are collected in 8-oz soil containers with PTFE-lined lids. Waste (oil) samples must be iced at the time of collection and maintained at 4°C (less than 6°C but not frozen) until the time of preparation. Samples must be prepared within 14 days of collection. Extracts must be stored at 4°C (less than 6°C but not frozen) until the time of analysis and analyzed within 40 days of extraction.

Wipe Samples:
Wipe samples are routinely collected in 40-mL VOA vials. Wipe samples must be iced at the time of collection and maintained at 4°C (less than 6°C but not frozen) until time of preparation. Samples must be prepared within 14 days of collection. Extracts must be

stored at 4°C (less than 6°C but not frozen) until the time of analysis and analyzed within 40 days of extraction. Refer to SOP SA-PS-25: *Wipe Tests: Sampling and Analysis* for additional information on wipe procedures.

Tissue Samples:
Tissue samples are routinely collected in plastic containers with the size dependent upon the type of tissue being collected. Plastic jars or plastic baggies can be used. Upon receipt, samples must be placed in the freezer at -10° to -20°C if extraction/digestion cannot be completed that day. Samples must be prepared within 14 days of defrosting. Extracts must be stored at 4°C (less than 6°C but not frozen) until the time of analysis and analyzed within 40 days of extraction.

TCLP/SPLP Leachate Samples
Once the TCLP/SPLP extraction procedure has been performed, the leachate is transferred to a 1L glass container. TCLP/SPLP leachates must be stored at 4°C (less than 6°C with no frozen samples) until the time of preparation. The leachate sample must be prepared within 7 days of completion of the TCLP/SPLP extraction. Extracts must be stored at 4°C (less than 6°C but not frozen) until the time of analysis and analyzed within 40 days of extraction.

16.1.2 Preparation and Analytical Procedures

Wipe, waste, and tissue samples are prepared in the same manner as routine soil samples as outlined in SOP SA-EX-040. TCLP/SPLP matrices are prepared in the same manner as routine water samples as outlined in SOP SA-EX-030. Refer to the applicable preparation SOPs for more information.

Wipe, waste, filter, tissue, and TCLP/SPLP matrices are analyzed in the same manner as routine samples as outlined in this SOP.

16.2 Other Considerations

16.2.1 SW-846 allows alternate criteria to be used for DFTPP evaluation. As such the laboratory has incorporated criteria from the following methods:

- EPA 8270C, EPA 8270C_LL, EPA 8270D, and EPA 8270D_LL tune criteria is taken from CLP OLM04.0 (January 1998)
- EPA 8270C and EPA 8270C_LL tailing factor criteria is taken from EPA 625
- EPA 8270C_LL_PAH and EPA 8270D_LL_PAH tune criteria is taken from EPA 525.2

16.2.2 The laboratory allows one acid and one base surrogate compound to be outside acceptance limits, in field samples and MS/MSD, provided their recovery is greater than 10%. All surrogate compounds must pass in method blanks and LCS/LCSD.

16.2.3 EPA Method 625 and EPA Method 8270C do not require the analysis of an ICV. NELAC requires an ICV; however, it does not list specific criteria. The laboratory has adopted the default criteria listed in Section 9.2.3 for ICVs for these methods.

Additionally, EPA Method 8270D lists recommended criteria of 30%D for the ICV and acknowledges that alternative acceptance limits may be appropriate based on project-specific data quality objectives. The laboratory defaults to the criteria outlined in this SOP; however, more stringent, project-specific requirements can be accommodated upon client request.

16.2.4 The laboratory has defined the analytes listed in Attachment 11 as poor or erratic performers and allows for exceptions to the ICV, CCV, LCS, MS/MSD, and Sporadic Marginal Exceedance criteria for these analytes as outlined in this SOP.

16.2.5 EPA Method 8270C does not place a cap on an individual analyte's %D or %RSD when evaluating the grand mean exception. The laboratory has adopted more stringent in-house requirements as outlined in this SOP.

16.2.6 The reference methods do not require the analysis of an instrument blank; however, the laboratory routinely analyzes instrument blanks items and has adopted in-house criteria as outlined in this SOP.

16.2.7 EPA Method 8270C does not contain calibration verification criteria for non-CCC analytes nor does it require non-CCC analytes to be evaluated for response; however, the laboratory has adopted in-house criteria for non-CCC analytes as outlined in this SOP.

16.2.8 EPA Method 8270D does not place a cap on an individual analyte's %D or %RSD when evaluating the CCV. The laboratory has adopted more stringent in-house requirements as outlined in this SOP.

16.2.9 Due to maintenance procedures, the laboratory allows internal standard retention times in continuing calibration checks (CCVs) for EPA 8270C, EPA 8270C_LL, EPA 8270C_LL_PAH, EPA 8270D, EPA 8270D_LL, and EPA 8270D_LL_PAH to vary by more than 30 seconds when compared to the retention time of the internal standards in the most recent initial calibration. A component of column maintenance is to remove a portion of the front of the column to eliminate reactive spots caused by injection of field samples. As the column is shortened, the retention times of the internal standards are also shortened. As long as peak resolution and sensitivity are maintained by meeting the CCV criteria, calibration of the analytical system is not required.

Note: This modification is used for CCVs only. The laboratory has made no similar modification to sample ISTD evaluation.

16.2.10 EPA Method 8270D indicates indeno(1,2,3)pyrene and di-n-octylphthalate will be quantitated using ISTD Perylene-12. EPA 8270C indicates Chrysene-d12 will be utilized. The laboratory uses Chrysene-d12 for both methods as this compound is more stable.

16.2.11 EPA Method 8270D states the method blank must be less than the MDL, 5% of the regulatory limit, or 5% of the sample result, whichever is greater. The laboratory's criteria for the method blank is <1/2RL. More stringent, project-specific requirements can be accommodated upon client request.

16.2.12 Laboratory-specific RRF criteria have been defined as outlined in Attachment 12 and differ slightly from the method recommended criteria as indicated by the footnoted analytes.

16.2.13 EPA Method 8270D specifies a reporting limit standard quantitation criteria of 30% when utilizing a linear fit for the ICAL. With Technical Management approval, the laboratory allows analysis to proceed for analytes with recovery outside 30% of the expected value, provided reasonable sensitivity is achieved.

16.2.14 EPA Method 8270D states that structural isomer resolution should be verified in the initial calibration and continuing calibration verification. These criteria have been added to the EPA 8270C analysis since the same ICALs and CCVs may be used for both methods.

17.0 Attachments

The following Tables, Diagrams, and/or Validation Data are included as Attachments:

Attachment 1: SOP Summary
Attachment 2: Sample Collection, Preservation, and Holding Time Table
Attachment 3: QC Summary
Attachment 4: Preventative Maintenance and Troubleshooting
Attachment 5: EPA 8270C Calibration Criteria: SPCCs and CCCs
Attachment 6: DFTPP Criteria
Attachment 7: Example Tailing Factor Calculation
Attachment 8: Target Compound Information: Quant ions and ISTDs
Attachment 9: Standard Preparation Postings
Attachment 10: Procedures for SIM Analyses
Attachment 11: Poor Responder Information
Attachment 12: EPA 8270D Minimum RRF Table
Attachment 13: Procedures for Evaluation of Tentatively Identified Compounds (TICs)

Attachment 1:
SOP Summary

Sample Preparation Summary
Samples should be prepared according to the appropriate matrix-specific SOP.

Matrix	SOP
Aqueous samples	SA-EX-030
Soil samples	SA-EX-040

Aqueous Sample Preparation:
For continuous liquid-liquid extraction, the sample is adjusted to a specific pH, as required by the analyte list, transferred to a continuous liquid-liquid extractor, and extracted using methylene chloride. The extract is concentrated to a 1mL final volume using the Zymark nitrogen blow-down concentrator procedure.

For separatory funnel extraction, the sample is placed into a separatory funnel, adjusted to a specific pH, as required by the analyte list, and extracted using methylene chloride. The extract is concentrated to a 1mL final volume using the Zymark nitrogen blow-down concentrator procedure.

Soil Sample Preparation:
For ultrasonic extraction, the sample is combined with anhydrous, purified sodium sulfate to form a free flowing, sandy mixture. A 1:1 acetone/methylene chloride mixture is added to the dried sample, and the sample is extracted using an ultrasonic disrupter for three minutes. The solvent is decanted, and the extraction is repeated two more times. The extract is filtered and concentrated to a 1mL final volume in methylene chloride using the Zymark nitrogen blow-down concentrator procedure.

Sample Analysis Summary
The extract is analyzed by GC/MS. Qualitative identification of the target compounds in the extract is based on the retention time and the relative abundance of the characteristic masses determined from standards analyzed on the same GC/MS under the same conditions. Quantitative analysis is performed using the internal standard technique with a single characteristic ion.

Example Analytical Sequence

Description	Comments
DFTPP	Clock time begins.
Initial Calibration	
ICV	
Instrument Blank	
Samples & Batch QC Items	EPA 625: Clock time ends at 24 hours from DFTPP EPA 8270C, EPA 8270C_LL, EPA 8270C_LL_PAH, EPA 8270D, EPA 8270D_LL, and EPA 8270D_LL_PAH: Clock time ends at 12 hours from DFTPP for
DFTPP	Clock time begins.
CCV	
RL CCV	EPA 8270D, EPA 8270D_LL, and EPA 8270D_LL_PAH only
Instrument Blank	
Samples & Batch QC Items	EPA 625: Clock time ends at 24 hours from DFTPP EPA 8270C, EPA 8270C_LL, EPA 8270C_LL_PAH, EPA 8270D, EPA 8270D_LL, and EPA 8270D_LL_PAH: Clock time ends at 12 hours from DFTPP for

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Initial and Continuing Calibration Requirements Summary

1.0 EPA 8270C and EPA 8270C_LL

1.1 Initial Calibration (ICAL)

1.1.1 CCC and SPCC Criteria

The initial calibration must be evaluated specifically for the calibration check compounds (CCC) and the system performance check compounds (SPCC). The CCC and SPCC analytes are identified in Attachment 5.

The following steps outline the evaluation of the CCCs and SPCCs:

1. The %RSD for each CCC analyte must be <30%. This CCC %RSD criteria must be met before the analysis of sample extracts can begin. If the CCC %RSD criteria are not met, re-calibration is required.

2. The minimum average RRF for each SPCC analyte must be ≥0.050. This minimum average RRF for SPCC must be met before the analysis of sample extracts can begin. If the SPCC minimum RRF criteria are not met, re-calibration is required.

   After the CCC and SPCC evaluation items listed in #1 and #2, above, have been met, the following steps are taken:

3. If any CCC has %RSD >15% (i.e., between 15% and 30% RSD), a regression curve must be applied to that compound, in accordance with SOP SA-QA-16. The criteria for the regression coefficient is r^2>0.990. If the r^2 criteria are not met, the only remaining option is to utilize the grand mean exception, as outlined in Section 1.1.3, below.

4. If the grand mean exception is not acceptable, then recalibration is required.

1.1.2 Non-CCC Linearity Criteria

After the CCC and SPCC initial calibration criteria have been met, all other compounds must be evaluated for linearity. The following steps outline evaluation of the non-CCC compounds:

1. Determine the %RSD for each compound. The %RSD of each compound must be <15% for the average RF to be used for quantitation of samples. If the %RSD criteria are not met, the next option is to utilize a regression curve for that compound, in accordance with SOP SA-QA-16. If the %RSD is less than 15%, a regression curve may still be used if it provides a better calibration model over the calibration range than the average RF.

2. If the %RSD criteria are not met, the next option is to utilize a regression curve for that compound, in accordance with SOP SA-QA-16.

3. For a regression curve to be used, the regression coefficient (r^2) must be greater than 0.990. If the r^2 criteria are not met, the only remaining option is to utilize the grand mean exception, as outlined in Section 1.1.3, below.

4. If the grand mean exception is not acceptable, then recalibration is required.

1.1.3 Grand Mean Exception

EPA 8000B allows the use of the "grand mean exception" as described below. This exception should only be applied to initial calibration curves in extraordinary circumstances because of the difficulty of maintaining and providing documentation on an on-going basis.

Grand Mean Exception (GME): If one or more analytes exceed the %RSD criteria, the calibration curve is acceptable if the average of the %RSDs for all of the analytes in the ICAL (i.e., the grand mean) is less than or equal to the ICAL %RSD criteria.

SW-846 does not place a cap on an individual analyte's %RSD as long as the average is within criteria; however, the laboratory has adopted the requirement that no individual analyte can exceed 60% RSD. Therefore, the calibration curve is acceptable if the average of the %RSDs is less than or equal 15% with no individual analyte exceeding 60%.

Note: Some programs and agencies do not allow the use of the grand mean exception. Refer to the Project Requirement Summary and/or Project Plan to determine if GME is not allowed.

1.2 Second Source Initial Calibration Verification (ICV)

The initial calibration verification (ICV) is acceptable if the average %D of all the analytes in the ICV is less than or equal 20% with no individual analyte exceeding 60%.

If the %D criteria are not met, re-calibration is required.

1.2.1 ICV Poor Performers

Refer to Attachment 11 for the identification of poor and/or erratic performing analytes. These analytes may have a %D >60% if the average %D of all the analytes in the ICV is 20%.

1.3 Continuing Calibration (CCV)

1.3.1 CCC & SPCC Criteria

The CCC and SPCC criteria listed in Attachment 5 must be met for the CCV to be acceptable. If these criteria are not met, re-analysis is required.

Note: The SPCC criteria must be met even if the regression curve option is used for quantitation.

1.3.2 %D Criteria

The reference method requires only the CCC analytes to be evaluated for response; however, the laboratory has adopted stricter criteria. Therefore, in addition to the CCC and SPCC criteria listed in Attachment 5, the average %D of all analytes must be <20% with no single analyte's %D >60% for the CCV to be acceptable.

Refer to Attachment 11 for information on Poor Performers.

2.0 EPA 8270C_LL_PAH

2.1 Initial Calibration (ICAL)

2.1.1 Linearity Criteria

The %RSD for each analyte must be <30% for the average RF to be used for quantitation of samples. This %RSD criteria must be met before the analysis of sample extracts can begin. If the %RSD criteria are not met, re-calibration is required for the affected analytes.

Once all analytes have been evaluated against the 30% RSD criteria, the following additional step must be performed. If any analyte has %RSD >15% (i.e., between 15% and 30% RSD), a regression curve is applied to that compound, in accordance with SOP SA-QA-16. The criteria for the regression coefficient is r^2 >0.990. If the r^2 criteria are not met, re-calibration is required for the affected analytes.

If the %RSD is less than 15%, a regression curve may still be used if it provides a better calibration model over the calibration range than the average RF.

2.2 Second Source Initial Calibration Verification (ICV)

The initial calibration verification (ICV) is acceptable if the average %D of all the analytes in the ICV is less than or equal 20% with no individual analyte exceeding 60%.

If the %D criteria are not met, re-calibration is required.

2.3 Continuing Calibration Verification (CCV)

2.3.1 %D Criteria

All analytes in the CCV must be within 20% of the true value to be acceptable.

3.0 EPA 625

3.1 Initial Calibration (ICAL)

3.1.1 Linearity Criteria

All compounds must be evaluated for linearity. The following steps outline the evaluation:

1. The relative standard deviation (%RSD) of the calibration standards must be <35% for the initial calibration curve to be acceptable.

2. A minimum of 3 points is required. The lowest calibration point must at or lower than the reporting limit (RL).

3.2 Second Source Initial Calibration Verification (ICV)

3.2.1 ICV Criteria

The initial calibration verification (ICV) is acceptable if the average %D of all the analytes in the ICV is less than or equal 20% with no individual analyte exceeding 60%.

If the %D criteria are not met, re-calibration is required.

3.2.2 ICV Poor Performers

Refer to Attachment 11 for the identification of poor and/or erratic performing analytes. These analytes may have a %D >60% if the average %D of all the analytes in the ICV is 20%.

3.3 Continuing Calibration

3.1 %D Criteria

All analytes in the CCV must be within 20% of the true value to be acceptable.

4.0 EPA 8270D, EPA 8270D_LL, and EPA 8270D_LL_PAH

4.1 Initial Calibration (ICAL)

4.1.1 Minimum Relative Response Factor (RRF) Criteria

The minimum RRF criteria and control analytes are listed in Attachment 12. If the minimum RRF criteria for each compound in each level of the ICAL are not met, analysis of an RLCCV is required in each clock. An NCM is required to denote this situation.

4.1.2 Linearity Criteria

All compounds must be evaluated for linearity. The following steps outline the evaluation:

1. Determine the %RSD for each compound. The %RSD of each compound must be <20% to be acceptable.

2. If the %RSD criteria are not met, the next option is to utilize a linear regression curve for that compound, in accordance with SOP SA-QA-16. For a linear regression curve to be acceptable, the regression coefficient (r^2) must be greater than 0.990.

   Note: When a linear regression curve is used, the reporting limit standard must be re-quantitated as a sample and recover within 30% of the expected value. If these criteria are not met, the initial calibration curve may be evaluated utilizing a quadratic curve or the compound may be quantitated using the average response factor as outlined in Item #3, below.

For a quadratic curve to be acceptable, the regression coefficient (r^2) must be greater than 0.990.

3. If the r^2 criteria are not met, the only remaining option is to utilize the average response factor (i.e., %RSD) and report that compound as estimated. In this situation, an NCM must be initiated to describe the issue.

   Note: SW-846 does not put a cap on an individual analyte's %RSD; however, the laboratory has adopted the requirement that no individual analyte can exceed 60% RSD. Therefore, if any analyte's %RSD is >60%, then re-calibration is required.

4. If more than 10% of the analytes do not meet both the %RSD criteria <u>and</u> don't meet the r^2 criteria, then recalibration is required.

   Note: Several standard mixes are utilized to perform an initial calibration for the full list of target analytes (e.g., TCL, Appendix IX, etc). Each of these mixes constitutes its own initial calibration. Therefore, when evaluating the numbers of acceptable analytes, each mix will be evaluated separately. Re-calibration need only involve the affected mixes.

5. For any analyte associated with a calibration that does not meet 20% or 0.990 or minimum response factor, an RLCCV must be analyzed with each subsequent clock. An NCM must be initiated to denote this situation. Any positive results should be noted as estimated.

4.2 Second Source Initial Calibration Verification (CV)

The initial calibration verification (ICV) is acceptable if the %D of each analytes in the ICV is less than or equal 30%.

4.2.1 ICV Poor Performers

Refer to Attachment 11 for the identification of poor and/or erratic performing analytes. These analytes are allowed a %D >30% but must be <50%D to be acceptable. If there are poor performers that exceed 50%D, the data may be reported provided results are noted as estimated. An NCM must be initiated to denote this situation.

4.3 Continuing Calibration Verification (CCV)

4.3.1 Minimum RRF Criteria

The recommended minimum RRF for each compound is listed in Attachment 12.

If the minimum RRF criteria are not met, take corrective action to correct the problem. Possible problems can include standard mixture degradation, injection port inlet contamination, contamination at the front end of the analytical column, and active sites in the column or chromatographic system.

Note: The RRF criteria for certain analytes have been modified for the EPA 8270D_LL method.

4.3.2 %D Criteria

The CCV %D criteria is <20%.

The reference method makes the exception, however, such that due to the large numbers of analytes in each CCV, some analytes may not meet these criteria.

- If more than 20% of the analytes in a CCV exceed the %D criteria, the CCV is unacceptable, and re-analysis is required.

- If less than 20% of the analytes in a CCV exceed the %D criteria, run an RLCCV (i.e., a CCV at the reporting limit). Analytes that do not meet CCV %D criteria may be reported if the affected analytes are qualitatively identified in the RL CCV.
  - If the affected analyte is not detected in the associated client sample, the result is reported without qualification.
  - If the affected analyte is detected in the associated client sample, the result must be reported as estimated.
  - Note: An NCM must be initiated to denote this situation.

Note: SW-846 does not put a cap on an individual analyte's %D; however, the laboratory has the requirement that no individual analyte can exceed 60%D. Therefore, if any analyte's %D is >60%, then corrective action is required. Corrective actions include instrument maintenance, re-injection, and/or re-calibration.

5.0 SM6410B

5.1 Initial Calibration (ICAL)

5.1.1 Linearity Criteria

All compounds must be evaluated for linearity. The following steps outline the evaluation:

1. The relative standard deviation (%RSD) of the calibration standards must be <35% for the initial calibration curve to be acceptable.
2. Alternatively, a regression curve may be performed. The criteria for the regression coefficient is r^2 >0.990. If a regression curve is performed, each level of the ICAL must be re-quantitated as a sample and fall within 20% of its true value to be acceptable.
3. A minimum of 3 points is required. The lowest calibration point must at or lower than the reporting limit (RL).

5.2 Second Source Initial Calibration Verification (ICV)

5.2.1 ICV Criteria

The initial calibration verification (ICV) is acceptable if the average %D of all the analytes in the ICV is less than or equal 20% with no individual analyte exceeding 60%.

If the %D criteria are not met, re-calibration is required.

5.2.2 ICV Poor Performers

Refer to Attachment 11 for the identification of poor and/or erratic performing analytes. These analytes may have a %D >60% if the average %D of all the analytes in the ICV is 20%.

5.3 Continuing Calibration

5.1 %D Criteria

All analytes in the CCV must be within 20% of the true value to be acceptable.

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Attachment 2:
Sample Collection, Preservation, and Holding Time Table

Matrix	Routine Sample Container	Routine Sample Size	Minimum Sample Size	Chemical Preservation	Thermal Preservation	Dechlorination Agent	Holding Time
Water	1L amber glass	1L	500mL	None	4°C[1]	None	7 days to extract 40 days to analyze
Soil	16oz glass soil jar	30g	15g	None	4°C[1]	None	14 days to extract 40 days to analyze

[1]Samples must be maintained at 0-6°C, with no frozen samples.

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Attachment 3:
QC Summary

QC Item	Method	Frequency	Criteria	Corrective Action
Clock Time	EPA 625	24 hours	Clock time starts with the injection of the DFTPP. Analysis of samples and QC items must conclude within expiration of clock time. Subsequent analysis requires new DFTPP.	Not applicable
	All Other Methods	12 Hours		
Tune/Column Evaluation Standard (DFTPP) - Spectrum Criteria	All Methods	At beginning of each clock	Spectrum Criteria: Refer to Attachment 6.	- Perform instrument maintenance - Re-tune.
Tune/Column Evaluation Standard (DFTPP) - Tailing Factor Criteria	EPA 625 EPA 8270C EPA 8270C_LL SM6410B	At beginning of each clock	Pentachlorophenol <5 Benzidine <3	- Perform instrument maintenance - Re-tune.
	EPA 8270D EPA 8270D_LL		Pentachlorophenol <2 Benzidine <2	
	EPA 8270C_LL_PAH EPA 8270D_LL_PAH		None	
Tune/Column Evaluation Standard (DFTPP) - Breakdown Criteria	EPA 8270C EPA 8270C_LL EPA 8270D EPA 8270D_LL	At beginning of each clock	<20%	- Perform instrument maintenance - Re-tune.
	EPA 625 EPA 8270_LL_PAH EPA 8270D_LL_PAH SM6410B		None	

QC Item	Method	Frequency	Criteria	Corrective Action
Initial Calibration (ICAL)	EPA 625 SM6410B	Upon instrument set-up, and after unsuccessful CCV	3-point Minimum %RSD < 35%	-Re-analyze standard(s) -Prepare new standard(s) and reanalyze -Perform injector port maintenance and reanalyze standards -Replace column and/or clean source, and reanalyze standards
	EPA 8270C EPA 8270C_LL		5-point Minimum CCC: %RSD < 30% SPCC: RRF_{avg} > 0.050 If %RSD >15%, use curve fit with r^2 > 0.990. GME: Avg %RSD <15%; No single analyte %RSD > 60%.	
	EPA 8270C_LL_PAH		5-point Minimum %RSD < 30% If %RSD >15%, use curve fit with r^2 > 0.990.	
	EPA 8270D EPA 8270D_LL EPA 8270D_LL_PAH		5-point Minimum RRF per Attachment 11. %RSD < 20%. If %RSD > 20%, use curve fit w/ r^2 > 0.990; If linear fit, RL Level: 30% of true; If r^2 < 0.990, use %RSD (allowed for <10% of total # analytes; no analyte >60% RSD).	
	SIM		3-point Minimum r^2 > 0.990	

QC Item	Method	Frequency	Criteria	Corrective Action
Initial Calibration Verification (ICV) - Second Source	EPA 625 EPA 8270C EPA 8270C_LL EPA 8270C_LL_PAH SM6410B	After each ICAL	Average %D < 20%. No analyte %D > 60%. Poor performers per Attachment 11.	-Reanalyze standard -Prepare new standard and reanalyze -Recalibrate
	EPA 8270D EPA 8270D_LL EPA 8270D_LL_PAH		%D < 30%. Poor performers %D <50% as per Attachment 11.	
Continuing Calibration Verification (CCV)	EPA 625 EPA 8270C_LL_PAH SM6410B	Per clock (Analyze after DFTPP)	%D < 20%	-Reanalyze standard -Prepare new standard and reanalyze -Recalibrate Note 1: If <20% total # analytes >20%D, evaluate RL CCV. RL CCV must be qualitatively identified. - If client sample is ND for affected analyte, report unqualified result. - If client sample has detection for affected analyte, report result as estimated.
	EPA 8270C EPA 8270C_LL		CCC: %D < 20%. SPCC: RRF > 0.050. Average %D < 20%. No analyte %D > 60%. Poor performers per Attachment 11.	
	EPA 8270D EPA 8270D_LL EPA 8270D_LL_PAH		RRF per Attachment 11. %D < 20%. Poor performers per Attachment 11. See Note 1.	
	All Methods		Spectrum Criteria: Refer to Attachment 6.	

QC Item	Method	Frequency	Criteria	Corrective Action
Reporting Limit Continuing Calibration Verification (RL CCV)	EPA 8270D EPA 8270D_LL EPA 8270D_LL_PAH	Per clock, if needed. (Analyze after CCV) When RRF criteria is not met in ICAL, or CCV criteria not met.	Affected analytes must be qualitatively identified.	- Perform instrument maintenance - Reanalyze affected samples. - Recalibrate
Internal Standards (ISTD)	All Methods	Spiked in all CCVIS, samples, and batch QC items	CCVIS: Area within 50% to +200% of corresponding level in the ICAL. Samples & batch QC items: - Area within 50% to +200% of CCVIS. - RT within +/-30 seconds from previous CCVIS.	Evaluate chromatogram, spectra, and integrations -Reanalyze extract -Perform instrument maintenance and reanalyze extract -Re-extract and reanalyze if sufficient sample available
Surrogate Compounds	All Methods	Spiked (during extraction procedure) in all samples and batch QC items.	Within MLG limits 1 Acid / 1 Base Allowance: samples and MS/MSD, only, with %R >10% Surrogate Threshold Dilution Factor = 10	-Evaluate chromatogram, spectra, and integrations -Reanalyze extract(s) -Re-extract and reanalyze if sufficient sample available
Extraction Batch Definition	All Methods	Extracted together w/in 24-hr timeframe; not to exceed 20 field samples	Not Applicable	Not Applicable
Method Blank (MB)	All Methods	One per extraction batch	<1/2RL	Refer to SOP SA-QA-17

QC Item	Method	Frequency	Criteria	Corrective Action
Laboratory Control Sample (LCS)	All Methods	One per extraction batch	Within TALS MLG Limits	Refer to SOP SA-QA-17
Laboratory Control Sample Duplicate (LCSD)	All Methods	One per extraction batch, when insufficient sample is provided for MS/MSD/SD	Within TALS MLG Limits	Refer to SOP SA-QA-17
Matrix Spike (MS)	All Methods	One per extraction batch	Within TALS MLG Limits	Refer to SOP SA-QA-17
Matrix Spike Duplicate (MSD)	All Methods	One per extraction batch	Within TALS MLG Limits	Refer to SOP SA-QA-17
Initial Demonstration of Capability (IDOC)	All Methods	Initially, per analyst, per analyte/method/matrix combination	Refer to SOP SA-QA-06	Refer to SOP SA-QA-06 Note: Unsupervised work must not begin until acceptable IDOC is obtained.

QC Item	Method	Frequency	Criteria	Corrective Action
Continuing Demonstration of Capability (CDOC)	All Methods	Annually, per analyst, per analyte/method/matrix combination	Refer to SOP SA-QA-06	Refer to SOP SA-QA-06
Reporting Limit Verification (RLV)	All Methods	Upon method/instrument set-up, per analyte/method/matrix combination. Then quarterly thereafter (for DOD ELAP) or annually thereafter (for non-DOD ELAP)	Refer to SOP SA-QA-07	Refer to SOP SA-QA-07
Method Detection Limit Study (MDL)	All Methods	Upon method/instrument set-up, per analyte/method/matrix combination	Refer to SOP SA-QA-07	Refer to SOP SA-QA-07

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QC Item	Method	Frequency	Criteria	Corrective Action
MDL Verification (MDLV)	All Methods	Upon method/instrument set-up, per analyte/method/matrix combination. Then quarterly thereafter (for DOD ELAP) or annually thereafter (for non-DOD ELAP)	Refer to SOP SA-QA-07	Refer to SOP SA-QA-07

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Attachment 4:
Preventative Maintenance and Troubleshooting

LABORATORY EQUIPMENT PREVENTIVE MAINTENANCE SCHEDULE								
EQUIPMENT ITEM	Service Interval							SERVICE LEVEL
	D	W	M	Q	SA	A	AN	
Septum							X	Replace, recommended daily
Splitless Disc							X	Replace, recommended daily
Column/Injector							X	Change sleeve and cut front of column, recommended daily
Autosampler							X	Clean syringe as needed; replace syringe as needed
Injector Port							X	Replace injector port as needed
Lines							X	Flush lines as needed; replace lines as needed
Column							X	Change column as needed
Mass Spectrometer							X	Clean as needed
Rough Pump							X	Change oil as needed

D = daily; W = Weekly; M = monthly; Q = Quarterly; SA = semi-annually; A = annually; AN = as needed

Troubleshooting

Troubleshooting should be documented as outlined above. If possible, troubleshooting is best performed in a step-wise manner to systematically isolate instrument components. Refer to the instrument manufacturer's guides for specific information and strategies. Enlist assistance from technical and/or department management as needed.

Contingency Plan

Maintenance contracts are carried for most instrumentation and close contact is maintained with service personnel to ensure optimal instrument functioning. An extensive spare parts inventory is maintained for routine repairs. Since instrumentation is standardized throughout the laboratory network, spare parts and components can be readily exchanged among the network.

In general, the laboratory has at least one backup unit for each critical unit. In the event of instrument failure, portions of the sample load may be diverted to duplicate instrumentation, the analytical technique switched to an alternate approved technique (such as manual colorimetric determination as opposed to automated colorimetric determination), or samples shipped to another properly certified or approved TestAmerica location.

Maintenance Log

A maintenance log must be established for each piece of equipment used in the laboratory. All maintenance that is performed on the instrument must be recorded in the log including:

- analyst or technician performing the maintenance
- date the maintenance was performed
- detailed explanation of the reason for the maintenance
- resolution of the problem and return to control
- all service calls from instrument representatives

Instrument Labeling

Each instrument must be labeled with its name or ID (e.g., MSA, ICP-D, etc.). Additionally, non-operational instruments must be isolated from service or marked as being out of service. Each piece of equipment has an "Operational / Not Operational" sticker that is used for this purpose.

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Attachment 5:
EPA 8270C Calibration Criteria: SPCCs and CCCs

Initial Calibration	Continuing Calibration*
CCC: <= 30% RSD SPCC: RRFavg >= 0.050	CCC: <= 20% difference from initial calibration SPCC: RRF>= 0.050

*If CCC and/or SPCC do not meet the stated criteria, all targets that are reported must meet the CCC criteria.

Calibration Check Compounds (CCC):
Phenol, 1,4-Dichlorobenzene, 2-Nitrophenol, 2,4-Dichlorophenol, Hexachlorobutadiene, 4-Chloro-3-methylphenol, 2,4,6-Trichlorophenol, Acenapthene, N-Nitrosodiphenylamine, Pentachlorophenol, Fluoranthene, Di-n-octylphthalate, Benzo(a) pyrene

System Performance Check Compounds (SPCC)
N-Nitrosodi-n-propylamine, Hexachlorocyclopentadiene, 2,4-Dinitrophenol, 4-Nitrophenol

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Attachment 6:
DFTPP Criteria

EPA 625 and SM6410B

m/z	Ion Abundance Criteria
51	30-60% of mass 198
68	<2% of mass 69
70	<2% of mass 69
127	40-60% of mass 198
197	<1.0% of mass 198
198	Base peak, 100% relative abundance
199	5-9% of mass 198
275	10-30% of mass 198
365	>1% of mass 198
441	Present but less than mass 443
442	>40% of mass 198
443	17-23% of mass 442

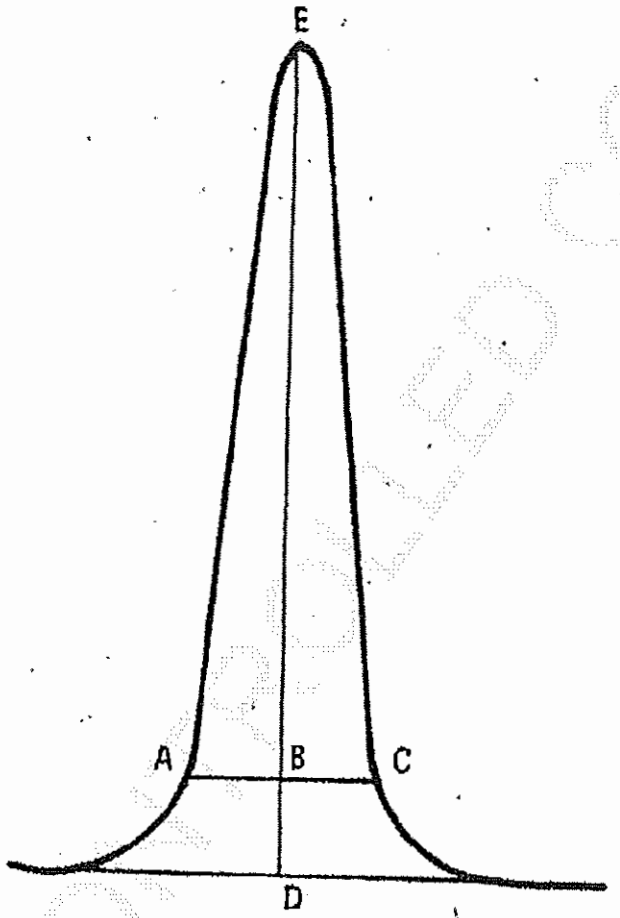
EPA 8270C, EPA 8270C_LL, EPA 8270D, and EPA 8270D_LL

m/z	Ion Abundance Criteria
51	30.0-80.0% of 198
68	Less than 2.0% of mass 69
69	Present
70	Less than 2.0% of mass 69
127	25.0-75.0% of 198
197	Less than 1% of mass 198
198	Base peak, 100% relative abundance
199	5.0-9.0% of mass 198
275	10.0-30.0% of 198
365	Greater than 0.75% of mass 198
441	Present but less than mass 443
442	40.0-110.0% of mass 198
443	15.0-24.0% of mass 442

EPA 8270C_LL_PAH and EPA 8270D_LL_PAH

m/z	Ion Abundance Criteria
51	10-80% of 442
68	Less than 2.0% of mass 69
69	Present
70	Less than 2.0% of mass 69
127	10-80% of 198
197	Less than 2% of mass 198
198	>50% mass 442
199	5.0-9.0% of mass 198
275	10-60% of 442
365	Greater than1% of mass 442
441	0-100% of mass 443
442	Base peak, 100% relative abundance
443	15-24% of mass 442

Attachment 7:
Example Tailing Factor Calculation



TAILING FACTOR= $\frac{BC}{AB}$

Example calculation: Peak Height = DE = 100 mm
10% Peak Height = BD = 10 mm
Peak Width at 10% Peak Height = AC = 23 mm
AB = 11 mm
BC = 12 mm

Therefore: Tailing Factor = $\frac{12}{11}$ = 1.1

Attachment 8:
Target Compound Information: Quant Ions and ISTDs*

PARAMETER	Quant Ion	Secondary Ions			ISTD	pH 2 (Only)	pH2 or pH11
1,1'-Biphenyl	154	76		3	3	X	
1,2,3-Trichlorobenzene	216	214		1	1		X
1,2,4,5-Tetrachlorobenzene	216	214	179	3	3		X
1,2,4-Trichlorobenzene	180	182	145	2	2	X	
1,2-Dichlorobenzene	146	148		1	1	X	
1,2-Diphenylhydrazine	77	105	182	4	4	X	
1,3,5-Trichlorobenzene	180	145		1	1		X
1,3,5-Trinitrobenzene	213	74	120	4	4		X
1,3-Dichlorobenzene	146	148	111	1	1	X	
1,3-Dinitrobenzene	168	76	50	3	3		X
1,4-Dichlorobenzene	146	148	111	1	1	X	
1,4-Dioxane	88	58	45	1	1	X	
1,4-Naphthoquinone	158	104	76	3	3		X
1-Diallate	86	43	234	4	4		X
1-Methylnaphthalene	142	141		2	2	X	
1-Naphthylamine	143	115	116	3	3		X
2,2'-oxybis[1-chloropropane]	45	121		1	1	X	
2,3,4,5-Tetrachlorophenol	232	230	131	3	3		
2,3,4,6-Tetrachlorophenol	232	230	131	3	3	X	
2,3,5,6-Tetrachlorophenol	232	96	131	3	3	X	
2,3,6-Trichlorophenol	196	198		2	2	X	
2,3-Dimethylphenol	107	122	121	1	1	X	
2,4 & 2,5-Dimethylphenol	107	122	121	1	1	X	
2,4,5-Trichlorophenol	196	198	200	3	3	X	
2,4,6-Trichlorophenol	196	198	200	3	3	X	
2,4-Dinitrochlorobenzene	202	110	75	2	2		X
2,4-Dichlorophenol	162	164	98	2	2	X	
2,4-Dimethylphenol	122	107	121	2	2	X	
2,4-Dinitrophenol	184	63	154	3	3	X	
2,4-Dinitrotoluene	165	89	63	3	3	X	
2,5-Dimethylphenol	107	122	121	1	1	X	
2,5-Dinitrophenol	184	63		1	1	X	
2,6-Dichlorophenol	162	164	98	2	2	X	
2,6-Dimethylphenol	107	122	121	1	1	X	
2,6-Dinitrotoluene	165	89	63	3	3	X	
2-Acetylaminofluorene	181	180	223	5	5		X
2-Chloronaphthalene	162	164	127	3	3	X	
2-chloronitrobenzene/4-chloronitrobenzene	157	111	75	2	2		X
2-Chlorophenol	128	130	64	1	1	X	
2-Diallate	86	43	234	4	4		X
2-Mercaptobenzothiazole	167	108		5	5		X
2-Methylnaphthalene	142	141		2	2	X	
2-Methylphenol	107	108	77	1	1	X	
2-Naphthylamine	143	115	116	3	3		X

PARAMETER	Quant Ion	Secondary Ions			ISTD	pH 2 (Only)	pH2 or pH11
2-Nitroaniline	65	92	138	3	3	X	
2-Nitrobiphenyl	152	115		3	3		X
2-Nitrophenol	139	109	65	2	2	X	
2-Picoline	93	66		1	1		X
2-Toluidine	106	107	79	2	2		X
3 & 4 Methylphenol	107	108		1	1	X	
3,3'-Dichlorobenzidine	252	254	126	5	5	X	
3,3'-Dimethylbenzidine	212	196	106	5	5		X
3,4-Dichloronitrobenzene	109	133	191	2	2		X
3,4-Dimethylphenol	107	122	121	1	1	X	
3-Methylcholanthrene	268	252	253	6	6		X
3-Nitroaniline	138	108	92	3	3	X	
3-Nitrobiphenyl	152	199		4	4		X
3-Nitrochlorobenzene	157	111	75	2	2		X
3-Nitrophenol	139	65		1	1	X	
4,6-Dinitro-2-methylphenol	198	105	121	4	4	X	
4-Aminobiphenyl	169	168	170	4	4		X
4-Bromophenyl phenyl ether	248	250	141	4	4	X	
4-Chloro-3-methylphenol	107	144	142	2	2	X	
4-Chloroaniline	127	129	65	2	2	X	
4-Chloronitrobenzene	157	111	75	2	2		X
4-Chlorophenol	65	128		2	2	X	
4-Chlorophenyl phenyl ether	204	141	206	3	3	X	
4-Nitroaniline	138	108	92	3	3	X	
4-Nitrobiphenyl	152	199		4	4		X
4-Nitrophenol	65	109	139	3	3	X	
4-Nitroquinoline-1-oxide	174	101	128	4	4		X
5-Nitro-o-toluidine	152	77	106	3	3		
7,12-Dimethylbenz(a)anthracene	256	239	241	6	6		X
Acenaphthene	154	153	152	3	3	X	
Acenaphthylene	152	151	153	3	3	X	
Acetophenone	105	77	51	2	2	X	
alpha,alpha-Dimethyl phenethylamine	58	91	42	2	2		X
alpha-Pinene	93	121		1	1		X
Aniline	93	66		1	1		X
Anthracene	178	176	179	4	4	X	
Aramite, Total	185	191	319	5	5		X
Aramite-1	185	191	319	5	5		X
Aramite-2	185	191	319	5	5		X
Atrazine	200	173	215	4	4	X	
Benzaldehyde	77	105		1	1	X	
Benzidine	184	92	185	4	4		X
Benzo[a]anthracene	22	229	226	5	5	X	
Benzo[a]pyrene	252	125	253	6	6	X	
Benzo[b]fluoranthene	252	253	125	6	6	X	
Benzo[g,h,i]perylene	276	277	138	6	6	X	
Benzo[k]fluoranthene	252	253	125	6	6	X	

PARAMETER	Quant Ion	Secondary Ions			ISTD	pH 2 (Only)	pH2 or pH11
Benzoic acid	105	122		2	2	X	
Benzyl alcohol	108	79	77	1	1	X	
Bis(2-chloroethoxy)methane	93	123	95	2	2	X	
Bis(2-chloroethyl)ether	63	93	95	1	1	X	
Bis(2-ethylhexyl) phthalate	149	167	279	5	5	X	
Butyl benzyl phthalate	149	91	206	5	5	X	
Caprolactam	113	55		2	2	X	
Carbazole	167			4	4	X	
Catechol	110	64		1	1		X
Chrysene	228	226	229	5	5	X	
Di(2-ethylhexyl)adipate	129	57		3	3	X	
Diallate	86	43		4	4		X
Dibenz(a,h)anthracene	287	139	279	6	6	X	
Dibenzofuran	168	139		3	3	X	
Diethyl phthalate	149	177	150	3	3	X	
Dimethoate	87	93	125	4	4		X
Dimethyl phthalate	163	194	164	3	3	X	
Dimethyl terephthalate	194	135		2	2		X
Di-n-butyl phthalate	149	150	104	4	4	X	
Di-n-octyl phthalate	149	43		6	6	X	
Dinoseb	211	163	147	4	4	X	
Disulfoton	88	60		4	4		X
Ethyl methanesulfonate	79	109	97	1	1		X
Ethyl Parathion	109	97		4	4		X
Famphur	218	93	125	4	4		X
Fluoranthene	202	203	101	4	4	X	
Fluorene	166	165	167	3	3	X	
Hexachlorobenzene	284	142	249	4	4	X	
Hexachlorobutadiene	225	223	227	2	2	X	
Hexachlorocyclopentadiene	237	235	272	3	3	X	
Hexachloroethane	117	201	199	1	1	X	
Hexachlorophene	196	198		6	6		X
Hexachloropropene	213	211	215	2	2		X
Indeno[1,2,3-cd]pyrene	276	138		6	6	X	
Isophorone	82	95	138	2	2	X	
Isosafrole	162	104	131	2	2		X
Methapyrilene	97	58	191	4	4		X
Methyl Benzoate	105	77	51	1	1		X
Methyl methanesulfonate	80	79	65	1	1		X
Methyl parathion	109	125		4	4		X
Methyl Phenols, Total	107	108		1	1	X	
Monomethyl Terephthalate	149	121		3	3		X
Naphthalene	128	129		2	2	X	
Nitrobenzene	77	123	65	2	2	X	
N-Nitro-o-toluidine	152	77	106	3	3		X
N-Nitrosodiethylamine	102	42	44	1	1	X	

PARAMETER	Quant Ion	Secondary Ions			ISTD	pH 2 (Only)	pH2 or pH11
N-Nitrosodimethylamine	42	74		1	1		X
N-Nitrosodi-n-butylamine	84	57	41	2	2		X
N-Nitrosodi-n-propylamine	70	42		1	1	X	
N-Nitrosodiphenylamine	169	168	167	4	4	X	
N-Nitrosomethylethylamine	88	42	43	1	1		X
N-Nitrosomorpholine	56	86		1	1		X
N-Nitrosopiperidine	114	42	55	2	2		X
N-Nitrosopyrrolidine	100	41	42	2	2		X
o,o',o"-Triethylphosphorothioate	65	97	93	2	2		X
p-Dimethylamino azobenzene	120	225	77	5	5		X
Pentachlorobenzene	250	248	252	3	3		X
Pentachloronitrobenzene	237	295	142	4	4		X
Pentachlorophenol	266	264	268	4	4	X	
Phenacetin	108	109	179	3	3		X
Phenanthrene	178	176	179	4	4	X	
Phenol	94	66	65	1	1	X	
Phenyl ether	170	141		3	3		X
Phorate	75	121		4	4		X
p-Phenylene diamine	108	80	107	2	2		X
Pronamide	173	175	145	4	4		X
Pyrene	202	200	203	5	5	X	
Pyridine	79	52	51	1	1		X
Quinoline	129	102		1	1		X
Safrole, Total	162	104	135	2	2		X
Sulfotepp	97	65		4	4		X
Thionazin	107	96	97	4	4		X
Toluic acid	91	119	136	2	2		X

SURROGATES

Nitrobenzene-d5[1]	82	128	54	2	2
2-Fluorobiphenyl[1]	172	171		3	3
Phenol-d5 [2]	99	71		1	1
2-Fluorophenol [2]	112	64		1	1
2,4,6-Tribromophenol [2]	330	332	144	3	3
Terphenyl-d14[1]	244	122	212	5	5

[1]Base Surrogate
[2]Acid Surrogate

INTERNAL STANDARDS

1,4-Dichlorobenzene-d4	152	150	115	1	1
Naphthalene-d8	136	68		2	2
Acenaphthene-d10	164	162	160	3	3
Phenanthrene-d10	188	94	80	4	4
Chrysene-d12	240	236	120	5	5
Perylene-d12	264	265	260	6	6

For a complete list of target analytes for each method refer to the LIMS Method Limit Groups (MLGs).

Attachment 9:
Standard Preparation Information

SOURCE MIXES			
Vendor Name	Standard Description	Part number	Concentration (ug/mL)
Supelco	8270 Tuning Mix	47548-U	1000
Supelco	Internal Standard	5M07296	2000
Supelco	N-Nitrosodiphenylamine	46702-U	5000
Supelco	BNA CAL 1	506508	1000
Supelco	Cal Mix 5	8M61215	2000
Supelco	8270 Benzidines	48467	2000
Supelco	OLM 4.2	47514-U	2000
Supelco	Custom- CHT	CUSTOM	2000
Supelco	a'a-Dimethylphenethylamine	47448-U	2000
Supelco	Organophos	507202	2000
Supelco	Hexachlorophene	40323	5000
Supelco	Custom- Kingsford List	CUSTOM	2000
Supelco	Ap9 Mega Custom	CUSTOM	1000
Supelco	AP9 Short Custom	CUSTOM	2000
Supelco	Methylmethanesulfonate	21022012	2000
Supelco	8270 Surrogates	861155	4000
Supelco	1,4-Phenylenediamine	48298	2000
Supelco	PAH Mix 2	47543-U	2000
Restek	8270 Mega Mix	31850	1000
Restek	AP9 Mix 2	31806	1000
Restek	Benzoic Acid	31415	1000
Restek	Benzidines	31688	2000
Restek	Dinoseb	32251	1000
Restek	Organophos	32419	2000
Restek	Custom Phenols	562381	2000
Restek	O-Terphenyl	31066	2000
Restek	1,3-Dinitrobenzene	31662	1000
Restek	AP9 Mix 1	31625	2000
Restek	Custom Ap9	562586	2000
Restek	2,3,4,6-Tetrachlorophenol	31402	1000
Restek	Base Surrogates	31024	1000
Restek	Acid Surrogates	31025	2000
Restek	Hexachlorophene	31811	2000

Storage: 0°C to 6°C

Expiration:
Un-opened: Manufacturer's expiration date
Opened: 6 months from date opened or manufacturer's expiration date, whichever is sooner

8270/625 Standards

8270/625 DFTPP @ 50ug/mL

Mix	Concentration (ug/mL)	Aliquot (uL)	Final Volume (mL)
8270 Tuning Solution	1000	500	10

Solvent: Methylene Chloride

Storage: 0°C to 6°C

Expiration: 3 months from date prepared or parent's expiration date, whichever is sooner

Primary BNA Mix @ 500ug/mL

Mixes	Concentration (ug/mL)	Aliquot (uL)	Final Volume (mL)
BNA CAL 1	1000	5000	10
N-nitrosodiphenylamine	5000	1000	
Cal Mix 5	2000	2500	
8270 Surrogates	4000	1250	

Solvent: Methylene Chloride

Storage: 0°C to 6°C

Expiration: 3 months from date prepared or parent's expiration date, whichever is sooner

8270/625 BNA Working Standards, Final Volume = 2mL

Standards	BNA500 (uL) (500ug/mL)	Benzidines (uL) (2000 ug/mL)	OLM4.2 (uL) (2000ug/mL)	Internal Standard (uL)
BNA010	40	10	10	40
BNA020	80	20	20	40
BNA050	200	50	50	40
BNA080	320	80	80	40
BNA100	400	100	100	40
BNA200	800	200	200	40

Solvent: Methylene Chloride

Storage: 0°C to 6°C

Expiration: 3 months from date prepared or parent's expiration date, whichever is sooner

8270/625 AP-9 Mix @ 500ug/mL, Final Volume = 5mL

Mix	Aliquot Volume (uL)
AP9-Mega Custom (1000mg/mL)	2500
AP9 Short Custom (2000mg/mL)	1250
KING (Kingsford) (2000mg/mL)	1250

Solvent: Methylene Chloride

Storage: 0°C to 6°C

Expiration: 3 months from date prepared or parent's expiration date, whichever is sooner

8270/625 AP-9 Working Standards, Final Volume = 2mL

Standards	AP-9 500 (uL) (500ug/mL)	Organophos Mix 2 (uL) (2000ug/mL)	Hexaclorophene (uL) (5000ug/mL)	a'a-Dimethylphenethylamine (uL) (2000ug/mL)	Methyl Methanesulfonate (uL)	Internal Standard (uL)
AP9-010	40	10	50	10	20	40
AP9-020	80	20	100	20	40	40
AP9-050	200	50	200	50	100	40
AP9-080	320	80	300	80	160	40
AP9-100	400	100	400	100	200	40
AP9-200	800	200	500	200	0	40

Solvent: Methylene Chloride

Storage: 0°C to 6°C

Expiration: 3 months from date prepared or parent's expiration date, whichever is sooner

RESTEK BNA ICV RECIPE

8270/625 BNAICV @ 80ug/mL, Final Volume = 1mL

Parent Standard	Restek Part Number	Aliquot Volume (uL)
8270 Mega Mix (1000ug/mL)	31850	80
AP9 Mix 2 (1000 ug/mL)	31806	80
Benzoic Acid (1000 ug/mL)	31415	80
Benzidines (2000 ug/mL)	31688	40
Dinoseb (1000 ug/mL)	32251	80
Base Surrogates (1000ug/mL)	31024	80
Acid Surrogates (2000 ug/mL)	31025	40
8270 ISTD		20

Solvent: Methylene Chloride

Storage: 0°C to 6°C

Expiration: 3 months from date prepared or parent's expiration date, whichever is sooner

RESTEK AP-9 ICV

8270/AP-9 ICV @ 80ug/mL, Final Volume= 1mL

Parent Standard	Restek Part Number	Aliquot Volume (uL)
AP9 Mix 1 (2000ug/mL)	31625	40
AP9 Mix 2 (1000ug/mL)	31806	80
Hexachlorophene (2000ug/mL)	31811	400
Custom Phenols	562381	40
Custom Ap9	562586	40
8270 ISTD		20

Solvent: Methylene Chloride

Storage: 0°C to 6°C

Expiration: 3 months from date prepared or parent's expiration date, whichever is sooner

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8270LL Full Standards

Primary BNA Mix @ 50ug/mL

Mixes	Concentration (ug/mL)	Aliquot (uL)	Final Volume (mL)
BNA CAL 1	1000	500	10
N-nitrosodiphenylamine	5000	100	
Cal Mix 5	2000	250	
8270 Surrogates	4000	125	
OLM4.2	2000	250	
Benzidines	2000	250	

Solvent: Methylene Chloride

Storage: 0°C to 6°C

Expiration: 3 months from date prepared or parent's expiration date, whichever is sooner

8270 BNA Working Standards, Final Volume = 2mL

Level	BNA50 (uL)	Internal Standard (uL)
LLBNA0.20	8	20ul
LLBNA0.50	20	20ul
LLBNA1.0	40	20ul
LLBNA2.0	80	20ul
LLBNA5.0	200	20ul
LLBNA10.0	400	20ul
LLBNA20.0	800	20ul
LLBNA50.0	2000	20ul

Solvent: Methylene Chloride

Storage: 0°C to 6°C

Expiration: 3 months from date prepared or parent's expiration date, whichever is sooner

8270LL AP-9 Intermediate Mix @ 50ug/mL

Mixes	Concentration (ug/mL)	Aliquot (uL)	Final Volume (mL)
a'a-Dimethylphenethylamine	2000	125	5
Kingsford Custom	2000	125	
AP9 Mega Custom	1000	250	
AP9 Short Custom	2000	125	
Methyl Methanesulfonate	1000	250	
CHT Custom	2000	125	
Hexachlorophene	5000	500	

Solvent: Methylene Chloride

Storage: 0°C to 6°C

Expiration: 3 months from date prepared or parent's expiration date, whichever is sooner

8270LL AP-9 Calibration @ 50ug/mL

Level	LLAP9 Intermediate (uL)	Internal Standard (uL)
LLAP91.0	40	20
LLAP92.0	80	20
LLAP95.0	200	20
LLAP910.0	400	20
LLAP920.0	800	20
LLAP950.0	2000	20

Solvent: Methylene Chloride

Storage: 0°C to 6°C

Expiration: 3 months from date prepared or parent's expiration date, whichever is sooner

RESTEK LLBNA ICV RECIPE

LLBNAICV @ 10ug/mL, Final Volume = 2mL

Parent Standard	Restek Part Number	Aliquot Volume (uL)
8270 Mega Mix (1000ug/mL)	31850	20
AP9 Mix 2 (1000 ug/mL)	31806	20
Benzoic Acid (1000 ug/mL)	31415	20
Benzidines (2000 ug/mL)	31688	10
Dinoseb (1000 ug/mL)	32251	20
Base Surrogates (1000ug/mL)	31024	20
Acid Surrogates (2000 ug/mL)	31025	10
ISTD Solution		20

Solvent: Methylene Chloride

Storage: 0°C to 6°C

Expiration: 3 months from date prepared or parent's expiration date, whichever is sooner

RESTEK AP-9 ICV

LLAP-9 ICV @ 10ug/mL, Final Volume= 1mL

Parent Standard	Restek Part Number	Aliquot Volume (uL)
AP9 Mix 1 (2000ug/mL)	31625	5
AP9 Mix 2 (1000ug/mL)	31806	10
Hexachlorophene (2000ug/mL)	31811	50
Custom Phenols	562381	5
Custom Ap9	562586	5
ISTD Solution		10

Solvent: Methylene Chloride

Storage: 0°C to 6°C

Expiration: 3 months from date prepared or parent's expiration date, whichever is sooner

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8270 LL_PAH Standards

Internal Standard Solution @ 200ug/ml

Mix	Concentration (ug/mL)	Aliquot	Final Volume (mL)
8270 Internal Standard Mix	2000 ug/ml	1000 uL	10

Solvent: Methylene Chloride

Storage: 0°C to 6°C

Expiration: 3 months from date prepared or parent's expiration date, whichever is sooner

LLTuning Solution @ 5.0ug/ml

Mix	Concentration (ug/mL)	Aliquot	Final Volume (mL)
8270 Tuning Solution	1000	50	10

Solvent: Methylene Chloride

Storage: 0°C to 6°C

Expiration: 3 months from date prepared or parent's expiration date, whichever is sooner

LLPAH Intermediate @ 20ug/ml

Mix	Concentration (ug/mL)	Aliquot	Final Volume (mL)
Supelco PAH Mix 2	2000	50	5
Supelco O-terphenyl	2000	50	

Solvent: Methylene Chloride

Storage: 0°C to 6°C

Expiration: 3 months from date prepared or parent's expiration date, whichever is sooner

LLPAH Calibration

Level	Intermediate (uL)	Internal Standard (uL)	Final Volume (mL)
LLPAH0.2	20	20	2
LLPAH0.5	50	20	
LLPAH1.0	100	20	
LLPAH2.0	200	20	
LLPAH5.0	500	20	
LLPAH10.0	1000	20	
LLPAH20.0	2000	20	

Solvent: Methylene Chloride

Storage: 0°C to 6°C

Expiration: 3 months from date prepared or parent's expiration date, whichever is sooner

LLPAH ICV

MIX	Concentration (ug/mL)	Aliquot	Final Volume (mL)
Restek 8270Mega	1000	4	2
Restek O-terphenyl	2000	2	
ISTD Solution	200	20	

Solvent: Methylene Chloride

Storage: 0°C to 6°C

Expiration: 3 months from date prepared or parent's expiration date, whichever is sooner

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Attachment 10:
Procedures for SIM Analyses

Analytical Procedures for SIM Analysis

The mass spectrometer (MS) may be used in the selected ion monitoring mode to increase the sensitivity of the GC/MS analysis. In SIM mode, the MS is set to monitor for only a few selected ions; therefore, more ions of the selected mass(es) can be filtered and counted, resulting in an increase of sensitivity of 10 to 100 fold over scan monitoring, depending on the compound. SIM GC/MS analysis sacrifices selectivity for sensitivity since only a few characteristic ions are monitored. A spectral match cannot be made against a reference library and tentatively identified compounds (TICs) cannot be determined from a SIM run. In general, the SIM analysis should be used only when a few compounds are required to be monitored. SIM can also be used to confirm the presence of a target compound determined by GC when the routine GC/MS scan analysis cannot provide confirmation.

The following procedures are based on the guidance in SW-846 Method 8270D. The analytical sequence is the same as is given in the associated analytical SOPs, with mass tune criteria and calibration verification every 12 or 24 hours.

- Analyze the 50 ug/mL DFTPP in the scan mode. Evaluate the DFTPP against the acceptance criteria given in previous sections in the SOP.

- Determine the approximate retention time of the target by analyzing the target analyte(s) by GC/MS scan.

- Set the MS to monitor for the characteristic ions (minimum of two ions) for the target analyte(s) and internal standard(s). The ion dwell time should be set to give at least six integrations across the peak. A dwell time of 50-100ms is common.

- Prepare and analyze a minimum of three calibration standards for the target compounds. The lowest standard should be at the required quantitation limit and the other two standards should define the working range of the GC/MS. The internal standard(s) should be at a concentration of approximately 4ug/mL for SVOC.

- Evaluate the resulting calibration curve according to the initial calibration procedures given in SOP SA-QA-16. If r^2 is >0.990, the calibration curve is acceptable.

If the initial calibration criteria are not met, action must be taken to bring the analytical system into compliance with the criteria. This action may include injection port maintenance, source cleaning, changing the column, or replacement of injection port lines and assembly. In any case, if the criteria are not met, the initial calibration must be repeated. The analyst must be aware of the 24-hour clock for the DFTPP analysis in 625 SIM and the 12-hour clock for the DFTPP analysis in 8270 SIM.

SIM Analysis of Target Compounds

- Add an appropriate volume of internal standard to the extract or sample to give the same concentration as in the calibration standards. Analyze the extract or sample under the same conditions as the standard.

Note: It is advised that the extract be split before addition of ISTD solution. One split can be utilized for scan analysis and second split reserved for SIM analysis.

- Compare the retention time of the sample to the retention time of the standard.

  If a peak is detected at the retention time of the target compound containing the selected masses in the same ratio as the standard, the peak is confirmed as the target compound and the concentration is calculated. The relative intensities of the ions in the sample should agree within ±20% of the intensities of the ions in the standard.

  If a peak is not present at the appropriate retention time or if the ratios of the ions are not the same as the standard, the analyte is not confirmed

- If the concentration of the target compound exceeds the highest calibration standard, analyze a more dilute aliquot of the sample or extract, maintaining the internal standard concentration at the same level as the calibration standards.

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Attachment 11:
Poor Responder Information

The following analytes have been identified, in the reference method and/or via historical data, to be poor and/or erratic performers:

1-naphthylamine
1,4-Napthaquinone
2-naphthylamine
2-picoline (2-methylpyridine)
3,3'-dichlorobenzidine
3,3'-dimethylbenzidine
a,a-dimethylphenethylamine
Atrazine
Benzaldehyde
Benzidine
Benzoic acid
Dinoseb
Famphur
Hexachlorocyclopentadiene*
Hexachlorophene
Methyl Methanesulfonate
Methapyriline
o,o',o''-triethylphosphoro-thioate
p-Dimethylamino azobenzene
p-phenylenediamine

These analytes are exempt from the LCS, MS, MSD, Sporadic Marginal Exceedance, ICV, and CCV criteria as listed in this SOP.

*Exception applied to LCS, MS, MSD Only

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Attachment 12:
EPA 8270D Minimum RRF Criteria

Analyte	Minimum RRF Criteria
1,2,4,5-Tetrachlorobenzene	0.010
1,1'-Biphenyl	0.010
2,3,4,6-Tetrachlorophenol	0.010
2,2'-Oxibis(1-chloroporopane)	0.010
2-Chloronaphthalene	0.800
2-Chlorophenol	0.800
2-Methylphenol	0.600[1]
2-Methylnaphthalene	0.400
2-Nitroaniline	0.010
2-Nitrophenol	0.100
2,4-Dichlorophenol	0.200
2,4-Dimethylphenol	0.200
2,4-Dintirophenol	0.010
2,4-Dinitrotoluene	0.200
2,4-Dinitrotoluene (Low-Level)[3]	0.100
2,4,5-Trichlorophenol	0.200
2,4,6-Trichlorophenol	0.200
2,6-Dinitrotoluene	0.200
2,6-Dinitrotoluene (Low-Level)[3]	0.100
3-Nitroaniline	0.010
3,3'-Dichlorobenzidine	0.010
4-Bromophenyl phenyl ether	0.100
4-Chloro-3-methylphenol	0.200
4-Chloroaniline	0.010
4-Chlorophenyl phenyl ether	0.400
4-Methylphenol	0.600
4-Nitroaniline	0.010
4-Nitrophenol	0.010
4,6-Dinitro-2-methylphenol	0.010
Acenaphthene	0.900
Acenaphthylene	0.900
Acetophenone	0.010
Atrazine	0.010
Anthracene	0.700
Benzaldehyde	0.010
Benzo(a)anthracene	0.700[2]
Benzo(a)pyrene	0.700
Benzo(a)pyrene (Low-Level)[3]	0.400
Benzo(b)fluoranthene	0.700
Benzo(b)fluoranthene (Low-Level)[3]	0.400
Benzo(g,h,i)perylene	0.500
Benzo(g,h,i)perylene (Low-Level)[3]	0.200
Benzo(k)fluoranthene	0.700
Benzo(k)fluoranthene (Low-Level)[3]	0.400

Analyte	Minimum RRF Criteria
Bis(2-choroethyl)ether	0.700
Bis (2-chloroethoxy)methane	0.300
Bis (2-ethylhexyl)phthalate	0.010
Butyl benzyl phthalate	0.010
Caprolactam	0.010
Carbazole	0.010
Chrysene	0.700
Dibenz(a,h)anthracene	0.400
Dibenz(a,h)anthracene (Low-Level)[3]	0.200
Dibenzofuran	0.800
Diethyl phthalate	0.010
Dimethyl phthalate	0.010
Di-n-butyl phthalate	0.010
Di-n-octyl phthalate	0.010
Fluoranthene	0.600
Fluorene	0.900
Hexachlorobenzene	0.100
Hexachlorobutadiene	0.010
Hexachlorocyclopentadiene	0.050
Hexachloroethane	0.300
Indeno(1,2,3-cd)pyrene	0.500
Indeno(1,2,3-cd)pyrene (Low-Level)[3]	0.200
Isophorone	0.400
Naphthalene	0.700
Nitrobenzene	0.200
N-Nitroso-di-n-propylamine	0.500
N-Nitroso-di-phenylamine	0.010
Pentachlorophenol	0.050
Pentachlorophenol (Low-Level)[3]	0.050
Phenanthrene	0.700
Phenol	0.800
Pyrene	0.600

[1]Minimum RF has been revised to be equivalent to 4-methylphenol.
[2]Minimum RF has been revised to be equivalent to chrysene.
[3]Minimum RF has been revised, as listed, for EPA 8270D_LL and EPA 8270D_LL_PAH methods.

Attachment 13
Procedures for Evaluation of Tentatively Identified Compounds (TICs)

Tentatively identified peaks (TICs) are defined by TestAmerica Savannah as:
1) a calibrated analyte that is not part of the list of analytes requested by the client; or
2) a non-calibrated analyte with a response of 10% or greater than the closest internal standard (ISTD).

The laboratory's default procedure is to report the top 20 TICs with the highest concentration.

Note: Internal standards or surrogates added to the sample, whether they are included in the ICAL or not, must not be identified as TICs. For example, the surrogate o-Terphenyl is added to the low-level 8270 surrogate spiking mix but is used as a surrogate only for LL PAH. This compound would be excluded as a TIC. Also, for semi-volatile analyses, routine target volatile analytes included on the EPA CLP OLM04.2 list (e.g., xylenes) are not included as TICs.

Data Evaluation Steps:
Identification of TICs is made by comparison of the mass spectrum to the reference spectrum (peaks with calibration) or by comparison of the mass spectrum to a reference library such as NIST (peaks without a calibration). Only after visual comparison between the sample spectra and the library-generated reference spectra will the mass spectral analyst assign tentative identification.

The unknown compounds are tentatively identified using a search of the reference library. If the library search produces a match at or above 85%, report that compound. If the library search produces more than one compound at or above 85%, report the first compound (the highest match quality). If the library search produces no matches at or above 85%, report the compound as unknown. If possible, provide a general classification of the unknown – for example, unknown aromatic, unknown hydrocarbon, etc.

TICs should be evaluated within the retention time range from the first eluting target or surrogate (whichever is first in the target list) to the elution of the last target compound.

Relative intensities of the major ions (masses) in the reference spectra (ions >10% of the most abundant ion) should be present in the sample spectrum. The relative intensities of the major ions should agree within approximately ±20%.

Molecular ions present in the reference spectrum should be present in the sample spectrum. Note, however, that differences in the spectra may be attributed to over-lapping or co-eluting peaks. If, in the opinion of the analyst, there is enough evidence to support the tentative identification of a compound even though the above criteria are not met exactly, the peak may be considered tentatively identified. The analyst should consult the Department Manager if there are any questions concerning interpretation of spectra.

The estimated concentration of the tentatively identified compound (TIC) is calculated using the total ion area of the tentatively identified peak and total ion area of the nearest internal standard that has no interferences. The concentration of TICs with a calibration is the concentration from the calibration curve at the dilution that the target list is reported, even if

the concentration is above the calibration range (an "E" value). The concentration of the non-calibrated TIC is as directed in the SOP and as calculated in the Target data system.

Data Processing Steps:

- Evaluate the peaks in the total ion chromatogram for:
  - correct integration
  - peaks that may not have been integrated, paying particular attention to large or odd-shaped peaks.
  - closely eluting peaks
- Manually integrate any peaks that were not detected by the data system and re-process the unknowns.
- Evaluate TICs in Target, as outlined above.
- Merge to TALS.
- Under the TIC tab, reject all "TGT" and "TIC" analytes.
- Right-click and select "Auto-Set TICs Primary". This should set the number of TICs and TGTs requested with the highest concentration to a "Primary" status.
- Highlight all TGT compounds (still under the TIC tab) and right-click.
- Choose "Result Conditions".
- Right-click and choose "Show Assigned Conditions".
- Uncheck all assigned conditions.
- Right-click and choose "Show Flag Suite Conditions".
- Select J, N, and T. Be sure to choose the J-flag defined as "Estimated Result TIC – Manual Flag".

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18.0 Revision History

Summary of Changes:

- Minor editorial, grammatical, and formatting changes made. Boilerplate text added.
- Added section to describe analytical data system, software, and hardware. Section 6.2
- Added note that if an LCS and LCSD are performed, both QC items must be evaluated and reported. Acceptable recoveries for both LCS and LCSD are required. Section 9.1
- Added note that some programs and agencies do not allow the use of quadratic curves and to refer to the Project Requirement Summary and/or Project Plan to determine if this curve type is prohibited. Section 9.2.2
- Added reference to TALS Historical Data Tracker feature. Section 11.1.4
- Clarified requirements and frequency for RLVs, MDL Studies, and MDLVs to be consistent with SOP SA-QA-07 and to include the quarterly frequency as defined by DOD. Section 12.1 - 12.3 and Attachment 3
- Added note that unsupervised work must not begin until acceptable IDOC is obtained. Attachment 3
- Added section on troubleshooting. Attachment 4
- Updated TIC procedure for consistency with SOP SA-QA-08. Attachment 11
- Revised tuning criteria for EPA 8270C, EPA 8270C_LL, EPA 8270D, and EPA 8270D_LL. Attachment 6
- Updated column ID used in analysis from SLB5 MS to HP5 MS.
- Added information on instrument blanks to prescribe frequency. Section 9.2.4
- Added information on ICAL and CCV resolution criteria. Section 9.2.5.1 Added note that NCM must be initiated if resolution is not achieved for structural isomers and isomers must be reported as an isomeric pair. Section 11.1.1 Expanded Modifications section to note that isomeric resolution criteria have been adopted for EPA 8270C. Section 16.2.14 (2010 Corporate Internal Audit Finding.)
- Removed regression curve option for EPA 625. Attachment 1 and Attachment 3
- Updated Poor Performer list. Attachment 11
- Expanded Attachment 2 to match SOP template.
- Added note to Modifications Section that RRF criteria for certain analytes have been modified for the EPA 8270D_LL_PAH method.
- Added dilution factor table. Section 11.1.3
- Corrected typo in Attachment 3. Revised ISTD criteria for CCV listed in Attachment 3 to match that listed SOP text and actual laboratory practice.
- Revised EPA 8270D ICAL, ICV, and CCV criteria to be consistent with 05/17/10 Corporate Memo from Richard Burrows. Added requirement to perform RLCCV when RRF, ICAL, or CCV criteria are not met. Removed option to evaluate average RRF in ICAL as opposed to RRF for each compound in each level. Replaced 60% cap on poor performers with 50% cap. Attachment 1 and Attachment 3
- Removed reference to sample duplicate. Not typically performed. MSD is routinely performed in lieu of sample duplicate as allowed by the reference method.
- Incorporated procedures and criteria for method SM6410B.

VOLATILE COMPOUNDS BY GC/MS

(Methods: EPA 8260B, EPA 624, and SM6200B)

Approvals (Signature/Date):

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1.0 Scope and Application

This SOP contains the procedures for the determination of volatile organic compounds (VOC) by purge and trap gas chromatography/mass spectrometry (GC/MS). This procedure is applicable to a wide variety of low molecular weight compounds that have low aqueous solubility and boiling points less than 200°C.

The routine matrices for this procedure are waters and soils (for EPA 8260B) and waters (for EPA 624 and SM6200B); however, this procedure may be adapted to accommodate other matrices as outlined in Section 16.1. This procedure may also be used to perform Custer Rule analyses for chloroform only (via a modified EPA 624 analysis).

A complete target analyte list, the reporting limits (RL), the method detection limits (MDL), and the accuracy and precision criteria associated with this procedure are provided in the LIMS Method Limit Groups (MLGs).

2.0 Summary of Method

Volatile organic compounds (VOCs) are purged from the sample matrix with helium. The VOCs are transferred from the sample matrix to the vapor phase. The vapor is swept through a sorbent tube where the VOCs are trapped. After the purging is completed, the trap is heated and backflushed with helium to desorb the VOCs onto a GC column. The GC is temperature-programmed to separate the VOCs, which are then detected by a mass spectrometer. Qualitative identification of the target compounds in the sample is based on the relative retention time and the mass spectra of the characteristic masses (ions) determined from standards analyzed on the same GC/MS under the same conditions. Quantitative analysis is performed using the internal standard technique with a single characteristic ion.

Water samples are routinely purged at ambient conditions; however, a heated purge may be used if required by the project. A 5mL purge volume is used as the default. The calibration standards and the associated QC must be analyzed under the same conditions and volume. This sample introduction procedure is based on EPA 5030B, EPA 624, and SM6200B.

Low-level (nominally<1mg/kg) soil samples are purged at 40°C in a purge and trap instrument designed to add water and internal standards to the vial containing the sample without breaking the seal. The sample is stirred during purging to thoroughly mix the soil and water. The calibration standards and associated QC are purged under the same conditions. This sample introduction procedure is based on EPA 5030A (for soil samples collected in bulk) and EPA 5035A (for soil samples collected via Encore/Terracore devices).

High level soils (nominally>1mg/kg) and waste samples are extracted with methanol (1mL of methanol per gram of sample). An aliquot of the methanol extract is injected into reagent water. The methanol extract/reagent water is purged at ambient temperature using the same instrument conditions and calibration used for aqueous samples.

This SOP is based on EPA 8260B, EPA 624, and SM6200B.

3.0 Definitions

Refer to the Glossary Section of the *Quality Assurance Manual* (QAM) for a complete listing of applicable definitions and acronyms.

4.0 Interferences

4.1 Procedural Interferences

4.1.1 Interferences may be caused by contaminants in solvents, reagents, glassware, and other sample processing apparatus and can make identification and/or quantification of the target analytes difficult.

4.1.2 All sample collection containers are single-use disposable containers which limits the potential for contamination. All non-disposable labware must be scrupulously cleaned in accordance with the posted Labware Cleaning Instructions to ensure it is free from contaminants and does not contribute artifacts.

4.1.3 High purity reagents and solvents are used to help minimize interference problems. Methanol and Hydrochloric Acid must be verified prior to use in accordance with the TestAmerica Solvent Lot Testing Program.

4.1.4 Instrument and/or method blanks are routinely used to demonstrate all reagents and apparatus are free from interferences under the conditions of the analysis.

4.1.5 VOCs commonly used in the laboratory are potential sources of contamination. Methylene chloride, acetone, Freon-113, MEK, hexane, toluene, and isopropanol are used in the laboratory and tend to present the most problems.

4.1.5 The Teflon seals of the purge and trap device can absorb and outgas many of the compounds that are included in this method. These Teflon fittings should be periodically checked for integrity. If the contamination is suspected, the fittings may be heated at 105°C for one hour or replaced.

4.1.6 The addition of acid to the sample during collection will cause the degradation of several target compounds. Acrolein and acrylonitrile recovery may be reduced and 2-chloro-ethyl vinyl ether will be completely degraded. The recovery of 2-chloroethyl vinyl ether will also be reduced as the purge and trap lines become acidic. For this reason, unpreserved vials must be utilized if these analytes are requested.

4.2 Matrix Interferences

4.2.1 Matrix interferences may be caused by contaminants that are purged from the sample matrix.

Contamination by carryover can occur whenever high concentration samples and low concentration samples are analyzed sequentially. As such, samples known to be clean should be analyzed first. Where practical, high concentration samples should be followed by a blank to check for cross-contamination. If the targets found in the highly

concentrated sample are found in subsequent samples, the analyst must verify that the port and P/T system are not contributing contamination to the subsequent samples. If the target compound(s) are not present in subsequent samples, the analysis of a blank is not required but may be a prudent preventative measure. Frequent trap bakeout and purging of the entire purging system may be necessary when carry-over is suspected. Reagent blanks must be analyzed when contamination is suspected to ensure that the system is free from contamination.

A common type of contamination is from samples containing high concentrations of hydrocarbons such as gasoline or mineral spirits. At high concentrations, these compounds may cause elevated baselines that can obscure the mass ion signals of target compounds with masses similar to the hydrocarbons. For example, a common mass in hydrocarbons is mass 43, which is also present in many ketones. Mineral spirits at high concentrations can be very problematic as it contains hydrocarbons beyond C12, which can linger in the purge and trap unit and carryover for quite a few samples. High concentrations of hydrocarbons can also degrade the trap much more quickly than would be expected.

4.2.3 The volatiles laboratory must be kept as free from contamination as possible. Highly contaminated samples must be segregated from routine samples. Contact with sections of the laboratory where solvents are used should be minimized. Refrigerator and freezer blanks must be prepared, stored, and analyzed to evaluate the sample storage areas for possible contamination. Guidance is provided in SOP SA-QA-15: *Homogenization, Compositing, and Segregation of Samples.*

4.2.4 Matrix interferences may be overcome by the use of the secondary ions for quantitation. An example of this is the use of mass 82 for quantitation with chlorobenzene-d5 internal standard when a potential co-eluter, 1,1,1,2-tetrachloroethane, is a target compound. One of the mass fragments of 1,1,1,2-tetrachloroethane is mass 117, which is the recommended quantitation ion for chlorobenzene-d5. The use of the secondary ions should be used for quantitation in such cases when the laboratory can clearly demonstrate matrix problems. Mass 58 is recommended for quantitation of acetone due to the elution of a hydrocarbon at the same retention time.

5.0 Safety

Employees must abide by the policies and procedures in the TestAmerica Environmental Health and Safety Manual (EHSM), the TestAmerica Savannah Addendum to the EHSM, and this document.

This procedure may involve hazardous materials, operations, and equipment. This SOP does not purport to address all of the safety problems associated with its use. It is the responsibility of the user to follow appropriate safety, waste disposal, and health practices under the assumption that all samples and reagents are potentially hazardous.

The analyst must protect himself/herself from exposure to the sample matrix. Many of the samples that are tested may contain hazardous chemical compounds or biological organisms. The analyst must, at a minimum, wear protective clothing (lab coat), eye protection (safety glasses or face shield), disposable gloves, and closed-toe,

nonabsorbent shoes when handling samples. Note: Cut-resistant gloves should be worn, or other hand protection material used, when opening and closing VOA vials.

5.1 Specific Safety Concerns or Requirements

The gas chromatograph and mass spectrometer contain zones that have elevated temperatures. The analyst must be aware of the locations of those zones, and must cool them to room temperature prior to working on them.

The mass spectrometer is under deep vacuum. The mass spectrometer must be brought to atmospheric pressure prior to working on the source.

There are areas of high voltage in both the gas chromatograph and the mass spectrometer. Depending on the type of work involved, either turn the power to the instrument off, or disconnect it from its source of power.

The exit vent of the split injector must have a carbon trap in-line to collect the volatile compounds that are vented during the injection of the sample. The traps should be changed a minimum of every three months and must be disposed of in accordance with Section 9 of the TestAmerica Savannah Addendum to the EHSM.

Methanol is a flammable solvent. It can cause irritation to the respiratory tract. Overexposure can cause fatigue, confusion, headache, dizziness, and drowsiness.

5.2 Primary Materials Used

The following is a list of the materials used in this procedure, which have a serious or significant hazard rating, and a summary of the primary hazards listed in their MSDS.

Note: This list does not include all materials used in the procedure. A complete list of materials used in this procedure can be found in the Reagents and Standards Section and the Equipment and Supplies Section of this SOP

Employees must review the information in the MSDS for each material before using it for the first time or when there are major changes to the MSDS. Electronic copies of MSDS can be found using the "MSDS" link on the Oasis homepage, on the EH&S webpage on Oasis, and on the QA Navigator.

Material	Hazards	Exposure Limit[1]	Signs and Symptoms of Exposure
Methanol	Flammable Poison Irritant	200ppm TWA	A slight irritant to the mucous membranes. Toxic effects exerted upon nervous system, particularly the optic nerve. Symptoms of overexposure may include headache, drowsiness and dizziness. Methyl alcohol is a defatting agent and may cause skin to become dry and cracked. Skin absorption can occur; symptoms may parallel inhalation exposure. Irritant to the eyes.
Hydrochloric Acid[2]	Corrosive Poison	5ppm Ceiling	Inhalation of vapors can cause coughing, choking, inflammation of the nose, throat, and upper respiratory tract, and in severe cases, pulmonary edema, circulatory failure, and death. Can cause redness, pain, and severe skin burns. Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
[1]Exposure limit refers to the OSHA regulatory exposure limit.			
[2]Always add acid to water to prevent violent reactions.			

6.0 Equipment and Supplies

6.1 Equipment and Instrumentation

A list of the instruments, with their basic configuration, is provided in Attachment 8. These instruments were in use at the time of SOP revision. Other instruments and configurations may be used provided they are fully documented and validated in accordance with laboratory procedures.

Top-loading Balance – Verify in accordance with SOP SA-AN-100: *Laboratory Support Equipment (Verification and Use)*

6.2 Analytical Data System / Software / Hardware

Chemstation software is used on a Windows-based PC to schedule and acquire data. Target (UNIX and/or Windows) software is used on a Windows-based PC to store, reduce/evaluate, and output the data to the laboratory's LIMS system (i.e., TALS). Target software has the capability of processing stored GC/MS data by recognizing a GC peak within any given retention time window, comparing the mass spectrum from the GC peak with spectral data in a user-created data base, and generating a list of tentatively identified compounds with their retention times and scan numbers. The software also allows integration of the ion abundance of any specific ion between specified time or scan number limits, calculation of response factors as or construction of a linear regression

calibration curve, calculation of response factor statistics (mean and standard deviation), and calculation of concentrations of analytes using either the calibration curve or the response factors.

6.3 Lab Supplies

Supelco Vocarb 3000 trap or equivalent – Other traps may be used as long as the target compounds can be detected at the required quantitation limit.

Recommended Column: J&W DB-624: 20m x 0.18mm ID, 1.8um film

Volumetric Containers – various sizes; Class A, where applicable. Verify in accordance with SOP SA-AN-100: *Laboratory Support Equipment (Verification and Use)*

Pump-style Pipettes – various sizes. Verify in accordance with SOP SA-AN-100: *Laboratory Support Equipment (Verification and Use)*

Gas-Tight Syringes – various sizes. Verify in accordance with SOP SA-AN-100: *Laboratory Support Equipment (Verification and Use)*

6.4 Sample Collection Containers

All sample collection containers are single-use disposable containers which limits the potential for contamination. Containers are received from vendors with a statement that the containers are suitable for the intended use and have been tested and certified to be free of contamination.

Refer to SOP SA-VM-021: *Preparation, Screening, and Storage of Volatiles Samples* for the containers routinely used to collect field samples.

7.0 Reagents and Standards

7.1 Expiration Dates

Expiration dates (time from initial use or receipt to final use) for standard and reagent materials must be set according to the guidance in this SOP. Note: These are maximum expiration dates and are not to be considered an absolute guarantee of standard or reagent quality. Sound judgment must be used when deciding whether to use a standard or reagent. If there is doubt about the quality of a standard or reagent material, a new material must be obtained or the standard or reagent material verified. Data quality must not be compromised to extend a standard's life – i.e., when in doubt, throw it out.

The expiration date of any standard must not exceed the expiration date of the standard that was used to prepare it; that is, the "children may not outlive the parents".

7.2 Reagents

Reagents must be prepared and documented in accordance with SOP SA-AN-41: *Reagent and Standard Materials Traceability.*

Methanol and Hydrochloric Acid must be verified prior to use in accordance with the TestAmerica Solvent Lot Testing Program.

7.2.1 Reagent water – ASTM Type II; lab generated water

7.2.2 Blank sand – Accusands Industrial Quartz (50lb); used as blank matrix for soil samples; Purify by heating at 160°C for four hours or longer in a shallow tray.

7.2.3 Methanol – for purge and trap analysis; J.T. Baker 9077-02 (1L)

7.3 Standards

Standards must be prepared and documented in accordance with SOP SA-AN-41: *Reagent and Standard Materials Traceability*. Certificates of analysis or purity must be received with all purchased standards, and scanned and filed in the Data Archival Folder on the G-drive.

The recipes for the preparation of standards are provided in Attachment 9. The recipes contain the stock standards, preparation steps, storage, and expiration dates for the routine target compounds.

8.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

Refer to Attachment 3 for a summary of the routine containers, holding times, preservation requirements, etc.

Refer to SOP SA-VM-021: *Preparation, Screening, and Storage of Volatiles Samples* for information on the preservation and dechlorination checks required for these methods.

Samples must be iced or refrigerated (at <6°C, with no frozen samples) from the time of collection until analysis.

9.0 Quality Control

SOP SA-QA-17: *Evaluation of Batch QC Data* and the QC Summary in Attachment 3 provide requirements for evaluating QC data.

9.1 Batch QC

All batch QC must meet the criteria given in Attachment 3 of this SOP.

9.1.1 Soil Samples

A batch consists of up to 20 environmental samples and the associated QC items. The laboratory defaults to the following as the minimum QC items required for each batch: a method blank, a laboratory control sample (LCS), a matrix spike (MS), and a matrix spike duplicate (MSD).

If there is insufficient sample to perform the MS/MSD, the LCS must be prepared in duplicate (i.e., LCS/LCSD). An NCM must be initiated on all affected samples to denote this situation. Insufficient sample is defined as receiving less than 30g for bulk samples or less than 4 Encores/Terracores.

Note: If an LCS and LCSD are performed, both QC items must be evaluated and reported. Acceptable recoveries (as well as %RPD) for both LCS and LCSD are required.

9.1.2 Aqueous Samples

A batch consists of up to 20 environmental samples and the associated QC items. The laboratory defaults to the following as the minimum QC items required for each batch:

EPA 8260B and SM6200B:
method blank, a laboratory control sample (LCS), a matrix spike (MS), and a matrix spike duplicate (MSD).

EPA 624:
method blank, a laboratory control sample (LCS), a matrix spike (MS) performed per 10% of samples analyzed, and a matrix spike duplicate (MSD). This equates to 1 MS and 1MSD for a batch of 10 or less samples or equates to 1 MS (from sample 1-10), 1 MS (from sample 11-20), and 1 MSD for a batch of 11-20 samples.

If there is insufficient sample to perform the required MS and/or MSD, the LCS must be prepared in duplicate (i.e., LCS/LCSD). An NCM must be initiated on all affected samples to denote this situation. Insufficient sample is defined as receiving less than less than 4 vials.

Note: If an LCS and LCSD are performed, both QC items must be evaluated and reported. Acceptable recoveries (as well as %RPD) for both LCS and LCSD are required.

9.1.3 Poor Performers / Erratic Compounds

As indicated in EPA 8260B and/or via assessment of laboratory control sample recoveries and control charts, the compounds listed in Attachment 10 are Poor Performers and/or behave erratically. These compounds will not be included in the LCS/LCSD/MS/MSD marginal exceedance count, provided their %R is >10%.

Note: An NCM must be initiated to denote this situation.

9.2 Instrument QC

The term "clock time" or "analytical clock" refers to the amount of time that can pass before additional instrument QC items must be performed. The analytical clock begins with the injection of the BFB, and all subsequent injections must be completed before the clock time expires - at which point new instrument QC is performed and a new clock is initiated.

The clock times are defined as follows:

- EPA 8260B and SM6200B= 12 hours
- EPA 624 = 24 hours
- EPA 624 Cluster Rule (chloroform only) = 8 hours

Note: Due to instrument configurations employing dual concentrators, most of the laboratory instruments can analyze more than 20 injections within the designated clock times. An analytical batch is still defined as 20 field samples; therefore, if more than 20 field samples are analyzed within a clock, additional batch QC is required (i.e., another method blank, LCS, and LCSD or MS/MSD must be performed).

9.2.1 BFB Tune Check

9.2.1.1 Fifty nanograms of 4-BFB must be analyzed at the beginning of each clock as a check on the "tune" of the mass spectrometer. Meeting the tuning criteria ensures that the instrument is measuring the proper masses in the proper ratios. The 4-BFB analysis takes place under the same instrument conditions as the calibration standards and samples except that a different temperature program can be used to allow for the timely elution of 4-BFB. All other instrument conditions must be identical - the mass range, scan rate, and multiplier voltage.

If the instrument is configured for direct injection, 50ng of 4-BFB may be injected directly on to the column. If the purge and trap is used to analyze the 4-BFB, the purge and trap conditions must be the same as for the calibration standards and samples.

9.2.1.2 Evaluation of the 4-BFB peak

9.2.1.2.1 The chromatogram must exhibit acceptable baseline behavior and the 4-BFB peak must be symmetrical (i.e., Gaussian). A spectrum of the baseline that shows high abundances of mass 40 (Argon) and mass 44 (carbon dioxide) may indicate a leak or contaminated carrier gas.

9.2.1.2.2 The spectrum of the 4-BFB must meet the criteria listed in Attachment 6. Background subtraction must be straightforward and designed only to eliminate column bleed or instrumental background. Scans ±1 scan from the apex can be evaluated for the 4-BFB criteria. Consecutive scans within this range can be averaged to meet the criteria.

9.2.1.2.3 The 4-BFB analysis should be evaluated as to the relative size of the 4-BFB peak under the m/z 95 profile. A benchmark area window should be established for each instrument. Response outside of this window suggests instrumental problems such as a poor purge, clogged jet separator, leak in the Tekmar purging device, reduced or elevated detector sensitivity, improper electron multiplier voltage selection, wrong tune method or tune file selected for this analysis, PFTBA valve left open, or other anomalies.

9.2.1.2.4 If the 4-BFB fails to meet the acceptance criteria, the instrument may require tuning (manually or automatically with PFTBA). Depending on the nature of the results from the 4-BFB analysis, other corrective measures may include remaking the 4-BFB standard and/or cleaning the mass spectrometer source.

9.2.2 Trap Check Standard

The trap check standard is used to evaluate the condition of the trap by monitoring the formation of chloromethane and bromomethane. Chloromethane and bromomethane may be formed on a degraded trap by thermal decomposition of halogenated compounds.

9.2.2.1 Prepare the trap check standard by injecting 2uL of a 50ug/mL bromoform standard into 5mL of reagent water. Other sample volumes may be used but the sample must transfer 100ng of bromoform to the column. Add the internal standards and surrogates. Analyze the sample using the same analytical system conditions used for samples and standards.

9.2.2.2 Evaluate the chromatogram for the presence of chloromethane and bromomethane. Compare the response to the 1.0ug/L standard. The response must be less than or equal to one half of the response of the 1.0ug/L standard, and the trap check standard must quantify less than 0.5ug/L when compared to the initial calibration curve.

Note: Ensure sure that the spectra match the reference spectra and that the most abundant ions are present for both compounds - chloromethane (m/z 50, 52) and bromomethane (94, 96).

9.2.2.3 If the trap check standard does not meet the acceptance criteria, the trap must be replaced, conditioned, and the system re-calibrated prior to the analysis of samples.

9.2.3 Initial Calibration (ICAL)

The instrument must be calibrated in accordance with SOP SA-QA-16: *Evaluation of Calibration Curves*. This SOP provides requirements for establishing the calibration curve and gives the applicable formulas.

Instrument calibration is performed by analyzing a series of known standards. The calibration curve must consist of a minimum of 5 standards. The lowest level calibration standard must be at or below the reporting limit, and the remaining standards will define the working range of the analytical system.

The initial calibration standard concentrations currently in use in the laboratory are as follows:

EPA 8260B and SM6200B:

Standard Level	Concentration (ng)	Final Concentration – Waters (ug/L)	Final Concentration – Soils (ug/kg)
1	5	1.0	
2	25	5.0	5.0
3	50	10	10
4	100	20	20*
5	250	50*	50
6	500	100	100
7	1000	200	200

*CCV Level

EPA 624:

Standard Level	Concentration (ng)	Final Concentration – Waters (ug/L)
1	5	1.0
2	25	5.0
3	50	10
4	100	20*
5	500	100
6	1000	200

*CCV Level

Refer to Attachment 9 for the standard preparation instructions. Other standard concentrations may be used provided they support the reporting limit and are fully documented in accordance with SOP SA-AN-41.

9.2.3.2 ICAL Criteria

9.2.3.2.1 EPA 8260B

The initial calibration is evaluated specifically for the calibration check compounds (CCC) and the system performance check compounds (SPCC). The CCC and SPCC criteria are given in Attachment 5 of this SOP. The %RSD criteria for CCC and minimum RRF for SPCC must be met before the analysis of samples can begin.

After the CCC and SPCC initial calibration criteria have been met, each target must be evaluated for linearity. The relative standard deviation of the calibration standards must be <15% for the initial calibration curve to be acceptable.

If one or more compounds do not meet the %RSD criterion, the next option is to evaluate a regression curve. The regression coefficient (r^2) of the regression curve must be greater than 0.990 for the initial calibration curve to be acceptable.

Note: A minimum of 6 points is required for a quadratic curve. Higher order curves are not permitted. Some programs and agencies (e.g., SC DHEC) do not allow the use of quadratic curves. Refer to the Project Requirement Summary and/or Project Plan to determine if this curve type is prohibited.

SW-846 allows the use of the "grand mean exception" as described below. This exception should only be applied to initial calibration curves in extraordinary circumstances due to the difficulty of maintaining and providing documentation on an on-going basis.

Grand Mean Exception (GME): If one or more analytes exceed the %RSD criteria, the calibration curve is acceptable if the average of the %RSDs for <u>all</u> of the analytes in the ICAL (i.e., the Grand Mean) is less than or equal to the ICAL %RSD criteria.

SW-846 does not place a cap on an individual analyte's %RSD as long as the average is within criteria; however, the laboratory has adopted the requirement that no individual analyte can exceed 3X the ICAL criteria. Therefore, the calibration curve is acceptable if the average of the %RSDs is less than or equal 15% with no individual analyte exceeding 45%.

Note: Some programs and agencies do not allow the use of the Grand Mean Exception. Refer to the Project Requirement Summary and/or Project Plan to determine if GME is not allowed.

9.2.3.2.2 EPA 624

The relative standard deviation of the calibration standards must be <35% for the initial calibration curve to be acceptable. If one or more compounds do not meet the %RSD criterion of <35%, the next option is to evaluate a regression curve. The regression coefficient (r^2) of the regression curve must be greater than 0.990 for the initial calibration curve to be acceptable.

9.2.3.2.3 SM6200B

The relative standard deviation of the calibration standards must be <20% for the initial calibration curve to be acceptable. If one or more compounds do not meet the %RSD criterion, the next option is to evaluate a regression curve. The regression coefficient (r^2) of the regression curve must be greater than 0.994 for the initial calibration curve to be acceptable.

Note: If a regression curve is used, all standards must be re-quantitated as samples. The concentration determined must be within +/-20% of the expected concentration to be acceptable.

9.2.4 Second Source Initial Calibration Verification (ICV)

The calibration curve must be verified initially – prior to any sample analyses – in accordance with SOP SA-QA-16 with a standard obtained from a second source.

The initial calibration verification standard concentration currently in use in the laboratory is equivalent to the CCV concentration. Refer to Attachment 9 for the standard preparation instructions. Another standard concentration may be used provided it is mid-level and fully documented in accordance with SOP SA-AN-41.

9.2.4.1 EPA 8260B ICV Criteria

The initial calibration verification (ICV) is acceptable if the average %D of all the analytes in the ICV is less than or equal 20% with no individual analyte exceeding 60%.

The analytes listed in Attachment 10 behave erratically and/or are poor performers; therefore, these analytes may exceed the ICV %D criteria such that their %D may be >60% if the average %D of all the analytes in the ICV is <20%. An NCM must be initiated to denote this situation.

9.2.4.2 EPA 624 ICV Criteria

The initial calibration verification (ICV) is acceptable if each analyte meets the criteria outlined in Attachment 12.

9.2.4.3 SM6200B ICV Criteria

The initial calibration verification (ICV) is acceptable if the average %D of all the analytes in the ICV is less than or equal 20% with no individual analyte exceeding 60%.

The analytes listed in Attachment 10 behave erratically and/or are poor performers; therefore, these analytes may exceed the ICV %D criteria such that their %D may be >60% if the average %D of all the analytes in the ICV is <20%. An NCM must be initiated to denote this situation.

9.2.5 Continuing Calibration Verification (CCV)

The initial calibration curve must be verified at the beginning of each clock with a mid-level standard.

For SM6200B, the CCV concentration should be varied throughout the range of the calibration curve and must also be performed at the end of the clock (i.e., capping CCV is required).

The continuing calibration verification standard concentration currently in use in the laboratory is specified in Section 9.2.3. Refer to Attachment 9 for the standard preparation instructions. Another standard concentration may be used provided it is mid-level and fully documented in accordance with SOP SA-AN-41.

9.2.5.1 EPA 8260B CCV Criteria

For EPA 8260B, the CCC and SPCC criteria (Attachment 5) must be met for the CCV to be acceptable.

Note: EPA 8260B requires only the CCC analytes to be evaluated for response; however, the laboratory has adopted stricter criteria. Therefore, in addition to the CCC and SPCC criteria listed in Attachment 5, the average %D of all non-CCC and non-SPCC analytes must be <20% with no single analyte's %D >60% for the CCV to be acceptable.

Note: The SPCC criteria must be met even if the regression curve option is used for quantitation.

In addition to the response criteria given in this section, the CCV must be evaluated for internal standard response. The extracted ion current profile (EICP) area for each of the internal standards in the CCV must be within -50% to +100% from the last initial calibration sequence to be acceptable. If these criteria are not met, the analytical system must be inspected for problems and corrective action instituted.

The analytes listed in Attachment 10 behave erratically and/or are poor performers; therefore, these analytes may exceed the CCV %D criteria such that their %D may be >60% if the average %D of all the analytes in the ICV is <20%. An NCM must be initiated to denote this situation.

9.2.5.2 EPA 624 CCV Criteria

For EPA Method 624, all target analytes must meet the criteria outlined in Attachment 12 to be acceptable.

9.2.5.3 SM6200B CCV Criteria

For SM6200B, all gas compounds must be within 60-140%D and all other compounds must be within 70-130% to be acceptable.

9.2.6 Internal Standard (ISTD)

This procedure is an internal standard (ISTD) procedure. 1,2-dichloroethane-d4, 1,4-difluorobenzene, and chlorobenzene-d5 are the internal standards.

Prior to analysis, the internal standards must be added to all standards, samples, and QC items. The concentration of the internal standards must be the same in all calibration samples, field samples, and QC samples. A concentration of 50ug/L is used for each of the ISTD analytes.

EPA 8260B and EPA 624:
The response of the ISTD in the ICV/CCV must be within -50% to +100% of the response of the ISTD in the CCV-level standard in the initial calibration sequence. If the response is outside of this range, the analysis of the CCV must be repeated and any samples associated with the CCV must also be re-analyzed. Repeated failure of the ISTD response will require re-calibration.

The response of the ISTD in the samples and batch QC items must be within -50% to +100% of the response of the previous CCV. If the response is outside of this range, corrective action must be taken.

SM6200B:
The response of the ISTD in the ICV/CCV must be within +/-30% of the response of the ISTD in the CCV-level standard in the initial calibration sequence. If the response is outside of this range, the analysis of the CCV must be repeated and any samples associated with the CCV must also be re-analyzed. Repeated failure of the ISTD response will require re-calibration.

The response of the ISTD in the samples and batch QC items must be within +/-30% of the response of the previous CCV. If the response is outside of this range, corrective action must be taken.

9.2.7 Surrogates

This procedure uses surrogates to evaluate the analytical process. Dibromofluoromethane, toluene-d8, and p-BFB are the surrogates.

Prior to preparation, these surrogates must be added to all samples and QC items. The concentration of the surrogates must be the same in all field samples and QC samples. A concentration of 50ug/L is used for each of the surrogate analytes.

The percent recovery of the surrogate in all field samples and QC samples must be within the limits listed in the Method Limit Groups (MLGs) in LIMS. If the percent recovery is outside of this range, the analysis of the sample must be repeated. Repeated failure of the surrogate percent recovery may indicate re-extraction is necessary.

9.3 Corrective Action for Out-of-Control Data

When the quality control parameters do not meet the criteria set forth in this SOP, corrective action must be taken in accordance with SOP SA-QA-05: *Preventive and Corrective Action Procedures* the QC Summary Table in Attachment 4. SOP SA-QA-05 provides contingencies for out-of-control data and gives guidance for exceptionally permitting departures from approved policies and procedures. Nonconformance Memos must be initiated to document all instances where QC criteria are not met and all departures from approved policies and procedures.

10.0 Procedure

10.1 Preparation

10.1.1 Aqueous Sample Preparation

Remove the samples from the refrigerator and allow them to come to room temperature.

Using a 50uL syringe, add 43uL of the ISSU to the sample, injecting the solution through the vial septum. Invert the vial several times to mix. Transfer to the instrument.

10.1.2 Aqueous QC Preparation

The method blank and LCS are prepared in reagent water using a 50mL volumetric flask.

- For the method blank, add 50uL ISSU to 50mL reagent water. Pour into a VOA vial and place on the instrument.
- For the LCS, add 50uL ISTD, 50uL Mega Mix, and 150uL MeOH to 50mL reagent water. Pour into a VOA vial and place on the instrument.
- For the MS/MSD, add 43uL ISTD, 43uL Mega Mix, and 129uL MeOH into each sample vial selected for the MS and MSD. Place on the instrument.

10.1.3 Soil Sample Preparation

Refer to SOP SA-VM-021: *Preparation, Screening, and Storage of Volatiles Samples* for the soil specific sample preparation procedures. This information is summarized below.

Three Terracore/Encore devices and one bulk container are routinely received for each soil sample. Two of the Terracores/Encores are prepared for low level analysis and one is extracted in methanol for medium-level analysis to be used if the low-level samples exceed the calibration range. The bulk container is used for determining the type of preservation for the low-level samples and for screening.

At the time of analysis, the following steps are taken:

For low-level samples, 5mL reagent water and 5uL ISSU are added directly to the samples vial. The sample is then ready for analysis.

For medium-level samples, a dilution is prepared and analyzed. The default dilution is a DF40 (i.e., using 125uL of sample). 5uL VOA Surrogate Mix is added directly to the sample vial (if 5mL of MeOH were used) or 10uL VOA Surrogate Mix is added (if 10mL of MeOH were used). A aliquot of the sample is removed (to prepare the necessary dilution) and added to 10mL reagent water in VOA vial. 5uL ISTD is added. The sample is then ready for analysis.

10.1.4 Soil QC Preparation

For low-level samples, the method blank and LCS are prepared using blank sand directly in a VOA vial.

- For the method blank, add 5g sand, a stir bar, 10mL reagent water, and 5uL ISSU.
- For the LCS, add 5g sand, a stir bar, 10mL reagent water, 5uL ISTD, 5uL Mega Mix, and 15uL methanol.
- For the MS/MSD, add 5mL water, 5uL ISTD, 5uL Mega Mix, and 15uL methanol directly to the selected sample.

For medium-level samples, the method blank and LCS are prepared using Ottawa sand directly in a VOA vial.

- For the method blank, add 5g blank sand, 10uL methanol, and 10uL VOA Surrogate Mix. Remove a 125uL aliquot and add to 10mL reagent water spiked with 5uL ISTD.
- For the LCS, add 5g blank sand, 5uL methanol, 62.5uL Mega Mix, and 10uL VOA Surrogate Mix. Remove a 125uL aliquot and add to 10mL reagent water spiked with 5uL ISTD.
- For the MS/MSD, add 5g blank sand, 5uL methanol, 62.5uL Mega Mix, and 10uL VOA Surrogate Mix to the sample containers selected for the MS/MSD. Remove a 125uL aliquot and add to 10mL reagent water spiked with 5uL ISTD.

10.2 Analysis

10.2.1 Instrument Operating Conditions

The instrument conditions listed in this SOP are provided for guidance purposes. The purge time must be 11 minutes. All other parameters are optimized by the lab for the target compounds and documented in the maintenance log. Therefore, the actual conditions used by the laboratory may be slightly different from those listed here and must be documented in the instrument maintenance log, data system, and/or run log.

Instrument maintenance must be performed in accordance with Attachment 4 of this SOP.

The goal is to have maximum separation between the target compounds in the shortest run time while maintaining sufficient sensitivity to detect the target compounds at the reporting limit and MDL (if required).

GC Parameters
Column: 20m x 0.18mm ID x 1.0um

Column: Flow: 0.5-1.0mL/min
Injector: Split/Splitless operated in the split mode with 1mm ID quartz insert
Split ratio (desorb to column flow): 40:1 or 80:1

MS Parameters
Mass spectrometer interface: 240°C (direct column interface)
Mass spectrometer source temperature: 250°C
Mass scan range: 35-300amu, with a minimum scan cycle of 1 scan per second
Injector: 100°C

Temperature Program:
Initial Temperature: 50°C
Program Rate: 18°C/minute
Final Temperature: 200°C

Example Purge and Trap Conditions
The purge and trap conditions listed in this section are for guidance. The lab must document the actual conditions used. The purge time must be 11 minutes. Other parameters may be varied to optimize the detection of the target compounds.

VOCARB 3000 trap
Purge Time: 11 minutes
Purge temperature: aqueous-ambient; soils-heated 40°C
Desorb time: 0.50 minutes
Desorb temperature: 250°C
Bake time: 8 minutes at 260°C
Purge flow: Approximately 30-40mL/minute
Valve temperature: 150°C
Transfer line: 150°C

The purge flow must be balanced for adequate sensitivity of the target compounds. If the purge flow is too high, the response of the gases will be low and not reproducible. The SPCC criteria for chloromethane may not be achieved if the purge flow is too high. If the purge flow is too low, the response of the more water-soluble targets - ketones, ethers, bromoform - may be low and the reporting limit may not be achieved on a routine basis.

10.2.2 Internal Standard (ISTD)

Prior to analysis, internal standard must be added to all standards, samples, and QC items. The concentration of the internal standard must be the same in all calibration samples, field samples, and QC samples. Instructions for the addition of the internal standard spiking mix is given in the previous sections.

10.2.3 BFB Tune Check

A BFB tune check must be analyzed at the beginning of each clock as a check on the "tune" of the mass spectrometer. This check must meet the criteria described given in Section 9.2.1.

If the instrument is configured for direct injection, inject 2uL of the 25ng/uL solution into the GC and analyze the 4-BFB using the instrument conditions listed in Section 10.1. A solvent delay should be set to allow the methanol to pass through the mass spectrometer while the MS is "off".

If the purge and trap is used to introduce the 4-BFB into the MS, add 1uL of the 50ng/uL solution to 5.0mL of reagent water. Transfer the 5.0mL to the purge and trap device and purge the sample using the same conditions used for sample analysis.

10.2.4 Trap Check Standard

The trap check standard is used to evaluate the condition of the trap by monitoring the formation of chloromethane and bromomethane. Chloromethane and bromomethane may be formed on a degraded trap by thermal decomposition of halogenated compounds. This check must meet the criteria described given in Section 9.2.2.

10.2.5 Initial and Continuing Calibration

Calibrate the instrument using the standards and criteria described given in Section 9.2.3. Once the calibration has been established and verified with an ICV in accordance with Section 9.2.4, sample analysis may proceed.

Verify the calibration curve with a continuing calibration verification using the standards and criteria described given in Section 9.2.6.

10.2.6 Sample Analysis

The sample/extract must be injected using the same injection volume used for the calibration standards. The samples can only be analyzed after the tune, the trap check, the calibration (initial or continuing), and the method blank and LCS criteria have been met. Samples that are known to be relatively clean should be analyzed first. Samples suspected of containing high concentrations should be analyzed last. Instrument blanks may be analyzed after suspected high concentration samples to allow the detector response to stabilize.

10.2.7 Example Analytical Sequence

A typical example analytical sequence is listed below.

Description	Comments
Blank	
BFB	Clock time begins with injection of the BFB
Initial Calibration	
ICV	Second Source
BFB	Clock time begins with injection of the BFB
CCV	
LCS	
LCSD	If insufficient sample provided for MS/MSD
Trap Check	
MB	
Samples & Batch	

QC Items	
BFB	Clock time begins with injection of the BFB
CCV	
LCS	
LCSD	If insufficient sample provided for MS/MSD
Trap Check	
MB	
Samples & Batch QC Items	
CCV	Capping CCV required only for SM6200B

11.0 Calculations / Data Reduction

11.1 Data Reduction

Data evaluation must be performed in accordance with SA-QA-08: *Evaluation of Chromatographic Data.* This SOP includes specific information regarding the evaluation of chromatographic data, including the requirements for performing manual integrations and the evaluation of retention times.

Data review and reporting must be performed in accordance with SA-QA-02: *Data Generation and Review.*

11.1.1 Target Analyte Identification

A target compound is identified by the visual comparison of the sample mass spectrum with the mass spectrum of the target compound from a reference spectrum of the target compound stored in a library generated on the same instrument or a standard spectral library such as the NIST/NBS.

11.1.1.1 Two criteria must be met in order to identify a target compound:

- Elution of the sample component within ±0.06 Relative Retention Time (RRT) units of the daily standard containing that compound. The RRT is calculated as follows:

$$RRT = \frac{\textit{retention time of the target compound}}{\textit{retention time of the associated internal standard}}$$

- Correspondence of the target compound spectrum and the standard component mass spectrum

11.1.1.2 All ions present in the standard component mass spectrum at a relative intensity greater than 10% (most abundant ion = 100%) should be present in the sample component mass spectrum. Other ions may be present in the sample component. Coelution of a non-target compound with a target compound will make the identification of the target compound more difficult. The ions due to the non-target compound should be subtracted from the sample component spectrum as part of the background to account for the discrepancy between the sample spectrum and the standard spectrum.

11.1.1.3 The relative intensities of the ions present in the sample component spectrum should agree within ± 30% of the relative intensities of the ions in the standard reference spectrum. For example, an ion with an abundance of 50% in the reference spectrum should have a corresponding abundance between 20% and 80% in the sample component spectrum.

11.1.1.4 If the above criteria are not met exactly, the analyst should seek help from a senior analyst or the Department Manager. If there is sufficient evidence to support the identification of the component, then the component is identified, quantified, and reported.

1.1.2 Dilutions

Unless otherwise specified by a client QAPP, results from a single analysis are reported as long as the largest target analyte (when multiple analytes are present) is in the upper half if the calibration range. When reporting results from dilutions, appropriate data flags must be used or qualification in a case narrative provided to the client.

For clients who require we provide lower detection limits, a general guide would be to report the dilution detailed above and one additional run at a dilution factor 1/10 of the dilution with the highest target in the upper half of the calibration curve. For example, if samples analyzed at a 1/50 dilution resulted in a target in the upper half of the calibration curve, the sample would be analyzed at a dilution factor of 1/5 to provide lower reporting limits.

11.1.3 Historical Data

Many of the laboratory's clients submit samples for repeat monitoring purposes. Prior to analysis, verify TALS Worksheet Notes or use the TALS Historical Data Tracker feature to determine if historical data is available for review.

11.1.4 Chemical Relationships

Benzene, toluene, ethylbenzene, and the xylenes are generally present together in samples and indicate the presence of gasoline

m/p-Xylenes are generally higher than o-xylene

Hydrocarbons present is samples containing gasoline generally contain mass 43 and may co-elute with target analytes with mass 43 as the quant or confirmation ion or may skew the spectrum of a compound with mass 43 as part of the spectrum.

Cis-isomers are generally more prevalent than the trans- isomers

Pay particular attention to the retention time of isomer because the only way to positively identify them is by retention time. The isomers are:

1,1-dichloroethane and 1,2-dichloroethane
1,1-dichloroethene, cis-1,2-dichloroethene, and trans-1,2-dichloroethene
1,1,1-trichloroethane and 1,1,2-trichloroethane
ethyl benzene, m/p-ylene, and o-xylene
1,3-dichlorobenzene, 1,4-dichlorobenzene, and 1,2-dichlorobenzene

1,1-dichloropropene, cis-1,2-dichloropropene, and trans-1,2-dichloropropene
2-chlorotoluene and 4-chlorotoluene
1,2,3-trichlorobenzene and 1,2,4-trichlorobenzene
1.3.5-trimethylbenzene and 1,2,4-trimethylbenzene
4-methyl-2-pentanone (MIBK) and 2-hexanone
n-butylbenzene, sec-butylbenzene, tert-butylbenzene, and isopropylbenzene

Higher chlorinated alkanes and alkenes may have lower chlorinated alkanes or alkenes present due to degradation. The following table lists some common chlorinated compounds and their degradation products. Look for the degradation product(s) when the concentration of the compound in the left column is present at high concentrations.

Analyte	Degration Product
1,1,2,2-tetrachloroethane	trichloroethene (TCE) cis-1,2-dichloroethene (c-1,2-DCE) trans-1,2-dichloroethene (t-1,2-DCE) vinyl chloride 1,1,2-trichloroethane (1,1,2-TCA) 1,2-dichloroethane (1,2-DCA) Chloroethane
1,1,2-trichloroethane (1,1,2-TCA)	1,2-dichloroethane (1,2-DCA) Chloroethane
1,1,1-trichloroethane (1,1,1-TCA)	1,1-dichloroethene (1,1-DCE) 1,1-dichloroethane (1,1-DCA) Chloroethane
Carbon tetrachloride	Chloroform Methylene chloride Chloromethane
Tetrachloroethene (PCE) (PCE = perchloroethylene which is a common name for tetrachloroethene)	trichloroethene (TCE) cis-1,2-dichloroethene (c-1,2-DCE) trans-1,2-dichloroethene (t-1,2-DCE) Chloroethene
1,2,4-trichlorobenzene	1,4-dichlorobenzene (1,4-DCB) 1,2-dichlorobenzene (1,2-DCB) Chlorobenzene

11.2 Calculations

11.2.1 The calculations associated with batch QC determinations are given in SOP SA-QA-17. Applicable calculations include accuracy (% recovery) and precision (%RPD).

11.2.2 The calculations associated with initial and continuing calibrations and are given in SOP SA-QA-16. Applicable calculations include determination for: calibration factor, standard deviation, relative standard deviation, relative response factor, and relative standard deviation.

11.2.3 The calculation to determine final concentration is given as follows:

$$FinalConcentration = CONC_{Sample} \otimes \frac{F}{I \times dw} \otimes D$$

Where:

$CONC_{Sample}$= Concentration of the sample extract (at the instrument)
F = Final volume of the extract
I = Initial volume/weight
dw = % Solids decimal equivalent
D = Dilution factor

Note: All dry weight corrections are performed automatically in TALS.

Note: This formula assumes all unit conversion factors are applied.

12.0 Method Performance

12.1 Reporting Limit Verification (RLV)

At a minimum, RLVs must be performed initially upon method set-up in accordance with SOP SA-QA-07: *Determination and Verification of Detection and Reporting Limits.*

For analytes and methods certified by DOD ELAP, RLVs must also be performed quarterly thereafter. For all other analytes and methods, RLVs must also be performed annually thereafter. Exceptions may be made for project-specific non-routine analytes.

12.2 Method Detection Limit (MDL) Study

The MDL is the lowest concentration that can be detected for a given analytical method and sample matrix with 99% confidence that the analyte is present. MDLs reflect a calculated (statistical) value determined under ideal laboratory conditions in a clean matrix and may not be achievable in all environmental matrices. The current MDLs associated with this procedure are given in the Method Limit Group (MLG) in TALS.

At a minimum, MDL Studies must be performed initially upon method set-up in accordance with SOP SA-QA-07: *Determination and Verification of Detection and Reporting Limits.*

Note: MDL Studies are not required for non-routine analytes provided results are not reported below the RL (i.e., MDL equals RL in TALS).

Note: For SM6200B, MDL Studies should be performed over 3-5 days.

12.3 Method Detection Limit Verification (MDLV)

At a minimum, MDLVs must be performed initially upon method set-up in accordance with SOP SA-QA-07: *Determination and Verification of Detection and Reporting Limits.*

For analytes and methods certified by DOD ELAP, MDLVs must also be performed quarterly thereafter. For all other analytes and methods, MDLVs must also be performed annually thereafter.

Note: MDLVs are not required for non-routine analytes provided results are not reported below the RL (i.e., MDL equals RL in TALS).

12.4 QC Limit Generation, Control Charting, and Trend Analysis

12.4.1 EPA 624 and SM6200B

The control limits for the batch QC items (LCS/LCSD and MS/MSD) for this procedure are specified in the reference method and cannot be broadened; therefore, the laboratory defaults to the method-defined limits and does not utilize in-house or laboratory-derived limits for the evaluation of batch QC items.

Although the laboratory must default to the method-defined QC limits, control charting is a useful tool and is performed to assess analyte recoveries over time to evaluate trends. Control charting must be performed periodically (at a minimum annually) in accordance with SOP SA-QA-17: *Evaluation of Batch QC Data.*

12.4.2 EPA 8260B

The control limits for the batch QC items (LCS/LCSD and MS/MSD) for this procedure are not specified by the reference method; therefore, the laboratory defaults to in-house and/or laboratory-derived limits for the evaluation of batch QC items.

Control charting is a useful tool and is performed to assess analyte recoveries over time to evaluate trends. Control charting must be performed periodically (at a minimum annually) in accordance with SOP SA-QA-17: *Evaluation of Batch QC Data.*

12.5 Demonstrations of Capability

Initial and continuing demonstration of capability must be performed in accordance with SOP SA-QA-06: *Training Procedures.*

Prior to performing this procedure unsupervised, each new analyst who performs this analysis must demonstrate proficiency per method/analyte combination by successful completion of an initial demonstration of capability (IDOC). The IDOC is performed by the analysis of 4 consecutive LCSs that meet the method criteria for accuracy and precision. The LCSs must be from a second source than that used to prepare the calibration standards. The IDOC must be documented on the IDOC Form shown in SOP SA-QA-06 with documentation routed to the QA Department for filing.

Note: SM6200B requires IDOCs to be within 80-120% for the average recovery and <20%RSD.

Annual continuing demonstrations of capability (CDOCs) are also required per analyst per method/analyte combination. The CDOC requirement may be met by the consecutive analysis of four LCS all in the same batch, by the analysis of four LCS analyzed in four consecutive batches (in different batches on different days), via acceptable results on a PT study, or by the analysis of client samples with statistically indistinguishable results when compared to another certified analyst. The CDOC must be documented and routed to the QA Department for filing.

12.6 Training Requirements

All training must be performed and documented in accordance with SOP SA-QA-06: *Training Procedures.*

Note: The SOPs listed in the Reference/Cross-Reference Section are applicable to this procedure. All employees performing this procedure must also be trained on these SOPs, and/or have a general understanding of these procedures, as applicable.

13.0 Pollution Control

It is TestAmerica's policy to evaluate each method and look for opportunities to minimize waste generated (e.g., examining recycling options, ordering chemicals based on quantity needed, preparing reagents based on anticipated usage and reagent stability, etc.). Employees must abide by the policies in Section 13 of the Environmental Health and Safety Manual.

This procedure has been evaluated for opportunities to minimize the waste generated. Where reasonably feasible, pollution control procedures have been incorporated.

14.0 Waste Management

Waste management practices must be conducted consistent with all applicable federal, state, and local rules and regulations. All waste (i.e., excess reagents, samples, and method process wastes) must be disposed of in accordance with Section 9 of the TestAmerica Savannah Addendum to the EHSM. Waste description rules and land disposal restrictions must be followed.

14.1 Waste Streams Produced by the Method

The following waste streams are produced when this method is carried out:

- Excess samples, reagents, and standards must be disposed in accordance with the TestAmerica Savannah Addendum to the EHSM.
- Methanolic waste from rinsings and standards – Transfer to satellite container for methanolic (flammable) waste. Transfer to hazardous waste section when satellite container is full.
- Excess aqueous samples – Dispose according to characterization on the sample disposal sheets. Neutralize non-hazardous samples before disposal into drain/sewer. Transfer hazardous samples (identified on disposal sheets) to the waste department for disposal.
- Excess soil and solid samples – Dispose according to characterization on sample disposal sheets. Transfer non-hazardous samples to TCLP container for characterization in hazardous waste department. Transfer hazardous samples (identified on disposal sheets) to waste department for disposal.

15.0 References / Cross-References

- SOP SA-AN-41: *Reagent and Standard Materials Traceability*
- SOP SA-AN-100: *Laboratory Support Equipment (Verification and Use)*
- SOP SA-QA-02: *Data Generation and Review*
- SOP SA-QA-05: *Preventive and Corrective Action Procedures*
- SOP SA-QA-06: *Training Procedures*
- SOP SA-QA-07: *Determination and Verification of Detection and Reporting Limits*
- SOP SA-QA-08: *Evaluation of Chromatographic Data*
- SOP SA-QA-15: *Homogenization, Compositing, and Segregation of Samples*
- SOP SA-QA-16: *Evaluation of Calibration Curves*
- SOP SA-QA-17: *Evaluation of Batch QC Data*
- SOP SA-VM-021: *Preparation, Screening, and Storage of Volatiles Samples*
- TestAmerica Savannah Quality Assurance Manual
- TestAmerica Environmental Health and Safety Manual
- TestAmerica Savannah Addendum to the Environmental Health and Safety Manual
- Method 8000C: *Test Methods for Evaluating Solid Wastes, Third Edition, SW-846;* U.S. EPA Office of Solid Waste and Emergency Response: Washington, DC.
- Method 8260B: *Test Methods for Evaluating Solid Wastes, Third Edition, SW-846;* U.S. EPA Office of Solid Waste and Emergency Response: Washington, DC.
- EPA Method 624: *Purgeables.* 40 CFR Part 136, Appendix A, July 1, 1995.
- *Standard Methods for the Examination of Water and Wastewater, Online Edition;* American Public Health Association: Washington, DC.
  - SM6020: Quality Assurance/Quality Control
  - SM6200B: *Volatile Organic Compounds; Purge and Trap Capillary-Column Gas Chromatographic/ Mass Spectrometric Method;* 1997

16.0 Method Modifications and Clarifications

16.1 Incorporation of Other Matrices

This procedure may be modified to analyze other matrices (e.g., wipe, waste, and TCLP/SPLP leachate samples) based on the needs of the client. This will need to be arranged by the Project Manager at the initiation of the project.

Wipe and waste matrices are non-routine, and the laboratory is not currently NELAC certified for these matrices. The laboratory uses its routine soil RLs (converted for initial and final volumes, etc.) and default QC limits to evaluate waste samples and its routine water RLs (converted for initial and final volumes, etc.) and default QC limits to evaluate wipe samples. Soil and/or water DOCs can be used to satisfy analyst demonstrations of capability for these types of non-routine matrices, as applicable. The laboratory uses its routine aqueous RLs (converted for initial and final volumes, etc.) and default QC limits to evaluate TCLP/SPLP leachate samples. Water DOCs can be used to satisfy analyst demonstrations of capability for TCLP/SPLP matrices. Ottawa sand is used as the blank matrix for wipes and wastes unless specifically requested otherwise by the project.

16.1.1 Collection and Handling Procedures

Waste (oil) samples are routinely collected in 40mL VOA vials. Waste (oil) samples must be iced at the time of collection and maintained at 4°C (less than 6°C but not frozen) until

time of preparation. Samples must be analyzed within 14 days of collection.

Wipe samples are routinely collected in 40mL VOA vials. Wipe samples must be iced at the time of collection and maintained at 4°C (less than 6°C but not frozen) until time of preparation. Samples must be analyzed within 14 days of collection.

Once the TCLP/SPLP extraction procedure has been performed, the leachate is transferred to a Tedlar bag. TCLP/SPLP leachates must be stored at 4°C (less than 6°C with no frozen samples) until the time of preparation. The leachate sample must be analyzed within 14 days of completion of the TCLP/SPLP extraction.

16.1.2 Preparation and Analytical Procedures

Wipe samples are analyzed in the same fashion as water samples. Refer to Work Instruction FQA088: *Wipe Tests: Sampling and Analysis* for additional information on wipe procedures.

Waste samples are prepared and analyzed in the same fashion as medium-level soil samples. Note: Waste samples often require large dilutions.

TCLP/SPLP matrices are prepared and analyzed in the same manner as routine water samples; however, a default dilution factor of 20 is used.

16.2 Other Considerations

16.2.1 EPA Method 8260B does not contain calibration verification criteria for non-CCC analytes nor does it require non-CCC analytes to be evaluated for response; however, the laboratory has adopted in-house criteria for non-CCC analytes as outlined in this SOP.

16.2.2 EPA Method 8260B does not require the analysis of an ICV. NELAC requires an ICV; however, it does not list specific criteria. The laboratory has adopted in-house criteria for ICVs for EPA 8260B as outlined in this SOP. The SM6200B reference method requires an externally-prepared QCS to be performed quarterly. The laboratory satisfies this requirement via the ICV performed with each ICAL.

16.2.3 EPA Method 8260B allows alternate criteria to be used for the BFB evaluation. As such the laboratory has incorporated criteria the CLP OLMO4.0 (January 1998) method.

16.2.4 The laboratory has defined the analytes listed in Attachment 10 as poor or erratic performers and allows for exceptions to the ICV, CCV, LCS/LCSD, MS/MSD, and Sporadic Marginal Exceedance criteria for these analytes as outlined in this SOP.

16.2.5 EPA Method 8260B does not place a cap on an individual analyte's %D or %RSD when evaluating the Grand Mean Exception. The laboratory has adopted more stringent in-house requirements as outlined in this SOP.

16.2.6 It has been determined that increased methanol concentrations can suppress the response of the gas compounds, leading to erratic recovery and reduced linearity. As such, the laboratory normalizes the volume of methanol in all standards and QC items to minimize this effect. By introducing a constant volume of methanol to initial calibration

standards, CCV/ICV, LCS, and MS/MSD, better sensitivity and recovery of these analytes is achieved.

16.2.7 The 7-day holding time for samples with pH>2 is listed in EPA 624 and is not included in the SW-846 methods. The laboratory has adopted this as internal guidance for EPA Method 8260B as is common industry practice and will make every effort to analyze samples with pH>2 within 7 days.

16.2.8 Historical standard practice for most laboratories was to combine all analytes into one analysis using a single acid preserved container. This practice is still acceptable in those cases where the compounds of interest are not adversely affected by the addition of the hydrochloric acid (HCl) preservative; however, EPA 624 and EPA 8260B both list special preservation requirements for acrolein, acrylonitrile, and 2-chloroethylvinyl ether (2-CEVE). Although these analytes are rarely found in the environment, preservation at pH<2 (as achieved using HCl preservative) breaks down these analytes and may result in a significantly low bias and/or non-detect value.

The reference methods suggest to preserve these analytes to a pH between 4-5. Achieving this narrow pH range is problematic; therefore, the only other alternative is to use an unpreserved container for these analytes. As such, if acrolein, acrylonitrile, and/or 2-CEVE are on the requested target analyte list, the laboratory now defaults to using an unpreserved container. The other target analytes reported for these methods are not adversely affected by using an unpreserved container provided they are analyzed within the shorter, method-prescribed holding times (HT) defined for unpreserved samples. Specific information on VOA holding times, preservation requirements, and analyte-specific requirements is given in Attachment 2.

16.2.9 The 40mL VOA vials used by the laboratory have been demonstrated to actually contain approximately 43mL. As such, standard spiking amounts have been adjusted accordingly to accommodate for this volume (e.g., spiking 43uL instead of 40uL).

16.2.10 The laboratory has incorporated the batch QC items as outlined in Section 9.1. Some additional QC items are performed which differ from those specified in the reference methods (e.g., LCSD or MSD) to satisfy common state regulatory requirements and/or client requests for precision data and/or to facilitate scheduling and data evaluation. The method-specified batch QC items are as follows:

EPA 8260B:
Method blank, LCS, MS, and sample duplicate or MSD

EPA 624
Method blank, LCS, MS per 10% of samples analyzed
SM6200B:
Method blank, LCS, MS, and MSD

16.2.11 EPA Method 624 specifies a required concentration range criteria for the evaluation of QC items (i.e., the Q-Table). The laboratory has converted these values into percent recovery limits to be used to assess CCV, ICV, LCS/LCSD, and MS/MSD.

16.2.12 The EPA 8260B reference method specifies a 1-week expiration date for the gas standards. The laboratory prepares a 25mL volume of MegaMix standard and splits it

into five 5mL Mini-nert vials. Each vial is assigned a 1-week expiration date from the date that vial is opened, not to exceed 14 days from the preparation date of the 25mL volume. Note: This expiration date is a maximum. Shorter expiration dates may be used based on evidence of gas compound volatility as evaluated via CCVs.

16.2.13 The EPA 8260B reference method recommends 4 surrogates to be used but allows for other surrogates. Due to improved instrument conditions and shorter run times, the laboratory has incorporated the 3 surrogates specified in EPA Method 624.

16.2.14 Due to client requests, the analyte list utilized by the laboratory may be different than those listed in the reference methods.

16.2.15 The SM6200B reference method states that the MDL should be determined annually but does not specify the procedure to be used. The laboratory performs MDL Studies initially, in accordance with 40CFR Part 136B, and re-establishes the MDL annually or quarterly (as dictated by agency-specific requirements) via an MDLV study.

16.2.16 The SM6200B reference method states that the Method Quantitation Limit (MQL) must be 4 times the MDL. The laboratory typically defines the MQL (i.e., the RL) based on the low-point of the calibration curve as opposed to a factor of the MDL.

16.2.17 The SM6200B reference method states that internal standard areas must be within 30% of the ICAL mean. Due to a software limitation, the laboratory evaluates each CCV against the midpoint of the ICAL and all field samples and QC items to their associated CCV. This is consistent with the requirements outlined in SW846 Update IV.

17.0 Attachments

The following Tables, Diagrams, and/or Validation Data are included as Attachments:

Attachment 1: SOP Summary
Attachment 2: Sample Collection, Preservation, and Holding Time Table
Attachment 3: QC Summary
Attachment 4: Preventative Maintenance and Troubleshooting
Attachment 5: EPA 8260B Calibration Criteria: SPCCs and CCCs
Attachment 6: BFB Tune Criteria
Attachment 7: Target Compound Information: Ions and ISTDs
Attachment 8: Instrument Configurations
Attachment 9: Standard Information and Recipes
Attachment 10: Poor Performers
Attachment 11: Evaluation of TICs
Attachment 12: EPA 624 CCV & ICV Criteria (Q-Table)

Attachment 1:
SOP Summary

Sample Preparation Summary

Aqueous samples are routinely purged at ambient conditions; however, a heated purge may be used if required by the project. A 5mL purge volume is used as the default. The calibration standards and the associated QC must be analyzed under the same conditions and volume.

Low-level soil samples are purged at 40°C in a purge and trap instrument designed to add water and internal standards to the vial containing the sample without breaking the seal. The sample is stirred during purging to thoroughly mix the soil and water. The calibration standards and associated QC are purged under the same conditions.

High level soils and waste samples are extracted with methanol (1mL of methanol per gram of sample). An aliquot of the methanol extract is injected into reagent water. The methanol extract/reagent water is purged at ambient temperature using the same instrument conditions and calibration used for aqueous samples.

Sample Analysis Summary

VOCs are purged from the sample matrix with helium. The VOCs are transferred from the sample matrix to the vapor phase. The vapor is swept through a sorbent tube where the VOCs are trapped. After the purging is completed, the trap is heated and backflushed with helium to desorb the VOCs onto a GC column. The GC is temperature-programmed to separate the VOCs, which are then detected by a mass spectrometer. Qualitative identification of the target compounds in the sample is based on the relative retention time and the mass spectra of the characteristic masses (ions) determined from standards analyzed on the same GC/MS under the same conditions. Quantitative analysis is performed using the internal standard technique with a single characteristic ion.

Description	Comments
Blank	
BFB	Clock time begins with injection of the BFB
Initial Calibration	
ICV	Second Source
BFB	Clock time begins with injection of the BFB
CCV	
LCS	
LCSD	If insufficient sample is provided for MS/MSD
Trap Check	
MB	
Samples & Batch QC Items	
BFB	Clock time begins with injection of the BFB
CCV	
LCS	
LCSD	If insufficient sample is provided for MS/MSD
Trap Check	
MB	
Samples & Batch QC Items	
CCV	Capping CCV required for SM6200B only

Attachment 2:
Sample Collection, Preservation, and Holding Time Table

Aqueous samples are routinely collected in 40mL VOA vials. The table below outlines the laboratory's default procedures for aqueous samples:

Method	Acrolein, Acrylonitrile, or 2-CEVE Requested?	Chemical Preservation	Thermal Preservation	Holding Time
EPA 8260B	Yes	None	<6°C	7 days
EPA 8260B	No	HCl (pH<2)	<6°C	14 days
EPA 624	Yes	None	<6°C	3 days*
EPA 624	No	HCl (pH<2)	<6°C	14 days
SM6200B	Yes	None	<6°C	7 days
SM6200B	No	HCl (pH<2)	<6°C	14 days

*Note: 3-day HT is specific to acrolein. If acrolein is not requested, 7 days is used for the remaining target compounds.

The table below outlines the laboratory's procedures for soil samples:

Sample Container	Chemical Preservation	Thermal Preservation	Holding Time
Terracore Kit: 5g Terracore sampler, 2 x pre-weighed 40-mL VOA w/ H2O, pre-weighed 40-mL VOA w/ MeOH, 2oz. bulk jar	H_2O & MeOH	<-10°C	48 hours to freeze, 14 days to analyze
Encore Kit: 3 x 5g Encore samplers, 4oz. bulk jar	$NaHSO_4$, H_2O, or MeOH (added in lab)	<6°C	48 hours to preserve, 14 days to analyze
Encore Kit: 3 x 5g Encore samplers, 2 x pre-weighed 40-mL VOA w/ NaHSO4, pre-weighed 40-mL VOA w/ MeOH, 4oz. bulk jar	$NaHSO_4$ or MeOH	<6°C	48 hours to preserve, 14 days to analyze

Attachment 3:
QC Summary

QC Item	Frequency	Criteria	Corrective Action
Clock Time	EPA 8260B: 12 hours EPA 624: 24 hours EPA 624 Cluster Rule (Chloroform Only): 8 hours SM6200B: 12 hours or 20 samples, whichever occurs first	Clock time starts with the injection of the BFB. Analysis of samples and QC items must conclude within expiration of clock time. Subsequent analysis requires new BFB.	Not applicable
Tune Standard (BFB)	At beginning of each clock	Refer to Attachment 6.	- Perform instrument maintenance - Re-tune.
Trap Check Standard	At beginning of each clock	<0.5ug/L (Chloromethane & bromomethane)	- Perform instrument maintenance. - Change trap. - Recalibrate

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QC Item	Frequency	Criteria	Corrective Action
Initial Calibration (ICAL) - Minimum of 3 points for EPA 624. - Minimum of 5 points for EPA 8260B and SM6200B.	Upon instrument set-up, and after unsuccessful CCV	EPA 624: %RSD < 35% If %RSD > 35%, use curve fit w/ r^2>0.990. EPA 8260B: - CCC: %RSD < 30% - SPCC: RRF_{avg} > Attachment 5 - If %RSD >15%, use curve fit with r^2 > 0.990. - GME: Avg %RSD <15%; No single analyte %RSD > 45%. SM6200B: %RSD < 20% If %RSD > 20%, use curve fit w/ r^2>0.994. Requant all levels, w/ 20%D.	-Reanalyze standard(s) -Prepare new standard(s) and reanalyze -Perform injector port maintenance and reanalyze standards -Retune and reanalyze standards -Replace column and reanalyze standards -Clean source and reanalyze standards
Initial Calibration Verification (ICV) - Second Source	After each ICAL	EPA 624: Attachment 12 EPA 8260B and SM6200B: Avg %RSD <20%; No single analyte %RSD > 60%.	-Reanalyze standard -Prepare new standard and reanalyze -Recalibrate

QC Item	Frequency	Criteria	Corrective Action
Continuing Calibration Verification (CCV)	EPA 8260B and EPA 624: After BFB SM6200B: After BFB and at end of each clock	EPA 624: Attachment 12 EPA 8260B: - CCC: %D < 20% - SPCC: RRF > Attachment 5 - Non-CCC and non-SPCC: Avg %D <20%; No single analyte %D >60% SM6200B: %D < 20%	-Reanalyze standard -Prepare new standard and reanalyze -Recalibrate
Internal Standards (ISTD)	Spiked in all CCVIS, samples, and batch QC items	EPA 8260B & EPA 624: CCVIS: - Area -50% to +100% CCV in ICAL. - RT +/-30 seconds from ICAL. Samples & batch QC items: - Area within -50% to +100% of previous CCVIS. SM6200B: CCVIS: - Area +/-30% CCV in ICAL. Samples & batch QC items: - Area within +/-30% of previous CCVIS.	-Evaluate chromatogram, spectra, and integrations -Reanalyze extract -Perform instrument maintenance and reanalyze extract -Re-extract and reanalyze if sufficient sample available
Surrogate Compounds	Spiked in all samples and batch QC items.	Within MLG limits	-Evaluate chromatogram, spectra, and integrations -Reanalyze sample, if sufficient sample available

QC Item	Frequency	Criteria	Corrective Action
Analytical Batch Definition	Analyzed together w/in 24-hr timeframe; not to exceed 20 field samples	Not Applicable	Not Applicable
Method Blank (MB)	One per batch	<1/2RL	Refer to SOP SA-QA-17
Laboratory Control Sample (LCS)	One per batch	Within TALS MLG Limits	Refer to SOP SA-QA-17
Laboratory Control Sample Duplicate (LCSD)	One per batch, when insufficient sample is provided for MS/MSD	Within TALS MLG Limits	Refer to SOP SA-QA-17
Matrix Spike (MS)	EPA 8260B and SM6200B: One per batch EPA 624: 1 per 10% of samples	Within TALS MLG Limits	Refer to SOP SA-QA-17
Matrix Spike Duplicate (MSD)	One per batch	Within TALS MLG Limits	Refer to SOP SA-QA-17
Initial Demonstration of Capability (IDOC)	Initially, per analyst, per analyte/method/matrix combination	Refer to SOP SA-QA-06	Refer to SOP SA-QA-06 Note: Unsupervised work must not begin until acceptable IDOC is obtained.
Continuing Demonstration of Capability (CDOC)	Annually, per analyst, per analyte/method/matrix combination	Refer to SOP SA-QA-06	Refer to SOP SA-QA-06

QC Item	Frequency	Criteria	Corrective Action
Reporting Limit Verification (RLV)	Upon method/instrument set-up, per analyte/method/matrix combination. Then quarterly thereafter (for DOD ELAP) or annually thereafter (for non-DOD ELAP)	Refer to SOP SA-QA-07	Refer to SOP SA-QA-07
Method Detection Limit Study (MDL)	Upon method/instrument set-up, per analyte/method/matrix combination	Refer to SOP SA-QA-07	Refer to SOP SA-QA-07
MDL Verification (MDLV)	Upon method/instrument set-up, per analyte/method/matrix combination. Then quarterly thereafter (for DOD ELAP) or annually thereafter (for non-DOD ELAP)	Refer to SOP SA-QA-07	Refer to SOP SA-QA-07

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Attachment 4:
Preventative Maintenance and Troubleshooting

Instrument Labeling
Each instrument must be labeled with its name or ID (e.g., MSA, ICP-D, etc.). Additionally, non-operational instruments must be isolated from service or marked as being out of service. Each piece of equipment has an "Operational / Not Operational" sticker that is used for this purpose.

Maintenance Log
A maintenance log must be established for each piece of equipment used in the laboratory.

All maintenance that is performed on the instrument must be recorded in the log including:
- analyst or technician performing the maintenance
- date the maintenance was performed
- detailed explanation of the reason for the maintenance
- resolution of the problem and return to control
- all service calls from instrument representatives

Preventive Maintenance

LABORATORY EQUIPMENT PREVENTIVE MAINTENANCE SCHEDULE								
	Service Interval							
EQUIPMENT ITEM	D	W	M	Q	SA	A	AN	SERVICE LEVEL
Injector Port							X	Replace septum, sleeve, inlet seal, and washer (Recommend every 2 weeks)
Sparge Tubes							X	Clean (Recommend every 3 months)
Column							X	Change column (Recommend annually)

D=daily; W=Weekly; M=monthly; Q=Quarterly; SA=semi-annually; A=annually; AN=as needed

Troubleshooting
Troubleshooting should be documented as outlined above. If possible, troubleshooting is best performed in a step-wise manner to systematically isolate instrument components. Refer to the instrument manufacturer's guides for specific information and strategies. Enlist assistance from technical and/or department management as needed.

Contingency Plan
Maintenance contracts are carried for most instrumentation and close contact is maintained with service personnel to ensure optimal instrument functioning. An extensive spare parts inventory is maintained for routine repairs. Since instrumentation is standardized throughout the laboratory network, spare parts and components can be readily exchanged among the network.

In general, the laboratory has at least one backup unit for each critical unit. In the event of instrument failure, portions of the sample load may be diverted to duplicate instrumentation, the analytical technique switched to an alternate approved technique (such as manual colorimetric determination as opposed to automated colorimetric determination), or samples shipped to another properly certified or approved TestAmerica location.

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Attachment 5:
EPA 8260B SPCC and CCC Criteria

Calibration Check Compounds (CCCs)

Initial Calibration	Continuing Calibration
<=30% RSD	<=20% difference from initial calibration

System Performance Check Compounds (SPCCs)

SPCC	Minimum RRF
Chloromethane	0.10
1,1-Dichloroethane	0.10
Chlorobenzene	0.30
Bromoform	>0.10
1,1,2,2-Tetrachloroethane	0.30

Note: The CCC and SPCC criteria must be met even if the calibration curve option is used for quantitation. If the CCC and SPCC criteria do not pass, a new calibration curve must be prepared and analyzed.

Calibration Check Compounds (CCCs)
Vinyl chloride
1,1-Dichloroethene
Chloroform
1,2-Dichloropropane
Toluene
Ethylbenzene

System Performance Check Compounds (SPCCs)
Chloromethane
1,1-Dichloroethane
Chlorobenzene
Bromoform
1,1,2,2-Tetrachloroethane

Attachment 6:
BFB Tune Criteria

EPA 8260B

m/e	Abundance Criteria
50	8.0-40.0% of mass 95
75	30.0-66.0% of mass 95
95	Base peak, 100% relative abundance
96	5.0-9.0% of mass 95
173	< 2.0% of mass 174
174	50-120%% of mass 95
175	4.0-9.0% of mass 174
176	93.0-101.0% of mass 174
177	5.0-9.0% of mass 176

*8260 criteria taken from CLP OLMO4.0 (January 1998)

EPA 624 and SM6200B

m/e	Abundance Criteria
50	15.0-40.0% of mass 95
75	30.0-60.0% of mass 95
95	Base peak, 100% relative abundance
96	5.0-9.0% of mass 95
173	<2.0% of mass 174
174	>50% of mass 95
175	5.0-9.0% of mass 174
176	95.0-101.0% of mass 174
177	5.0-9.0% of mass 176

Attachment 7:
Target Compound Information: Ions and ISTDs

Analyte	Quant Ion	Secondary Ions		ISTD
1,1,1,2-Tetrachloroethane	131	133	119	3
1,1,1-Trichloroethane	97	99	61	2
1,1,2,2-Tetrachloroethane	83	85	168	3
1,1,2-Trichloro-1,2,2-trifluoroethane	101	151	103	1
1,1,2-Trichloroethane	83	97	99	2
1,1-Dichloroethane	63	65	83	1
1,1-Dichloroethene	96	61	98	1
1,1-Dichloropropene	75	110	77	2
1,2,3-Trichlorobenzene	180	182		3
1,2,3-Trichloropropane	110	112		3
1,2,4-Trichlorobenzene	180	182	145	3
1,2,4-Trimethylbenzene	105	120	77	3
1,2-Dibromo-3-Chloropropane	157	75	155	3
1,2-Dichlorobenzene	146	148	111	3
1,2-Dichloroethane	62	49	64	2
1,2-Dichloroethene, Total	Sum of cis and trans isomers			
1,2-Dichloropropane	63	76	65	2
1,3,5-Trimethylbenzene	105	120	77	3
1,3-Dichlorobenzene	146	148	111	3
1,3-Dichloropropane	76	78	41	2
1,3-Dichloropropene, Total	Sum of cis and trans isomers			
1,4-Dichlorobenzene	146	148	111	3
1-Chlorohexane	41	43		3
1-Methylnaphthalene	142	141		3
2,2-Dichloropropane	77	41		1
2-Butanone (MEK)	43	72		1
2-Chloro-1,3-butadiene	53	88		1
2-Chloroethyl vinyl ether	63	65	106	2
2-Chlorotoluene	126	91	63	3
2-Hexanone	43	58		3
2-Methylnaphthalene	142	141		3
3-Chloro-1-propene	76	41		1
3-Methylhexane	43	71		2
4-Chlorotoluene	126	91	63	3
4-Isopropyltoluene	119	134	91	3
4-Methyl-2-pentanone (MIBK)	43	57	58	2
Acetone	58	43		1
Acetonitrile	41	40		1
Acrolein	56	55		1
Acrylonitrile	53	52	51	1
Amyl acetate	70	61		3

Analyte	Quant Ion	Secondary Ions		ISTD
Benzene	78	50		2
Benzyl chloride	91	63		3
Bromobenzene	156	77	158	3
Bromoform	173	171	175	3
Bromomethane	96	94	79	1
Butadiene	54	39		1
Carbon disulfide	76	78		1
Carbon tetrachloride	117	119	121	2
Chlorobenzene	112	77	51	3
Chlorobromomethane	49	128	130	1
Chlorodibromomethane	129	127	131	3
Chloroethane	64	66		1
Chloroform	83	85	47	1
Chloromethane	50	52		1
Chloroprene	53	88		1
cis-1,2-Dichloroethene	96	61	98	1
cis-1,3-Dichloropropene	75	77	110	2
Cyclohexane	56	69	84	2
Cyclohexanone	55	42	98	3
Dibromomethane	93	174	95	2
Dichlorobromomethane	83	85	129	2
Dichlorodifluoromethane	85	87	101	1
Dichlorofluoromethane	67	69		1
Ethyl acetate	43	61	70	1
Ethyl acrylate	55	73		1
Ethyl ether (diethyl ether)	59	74	45	1
Ethyl methacrylate	69	41	39	3
Ethylbenzene	91	106	51	3
Ethylene Dibromide	107	109		2
Ethylene oxide	43	44		1
Furan	68	39		1
Hexachlorobutadiene	225	223	190	3
Hexane	57	41	43	1
Iodomethane	142	127		1
Isobutyl alcohol	43	41		2
Isopropyl acetate	61	59	87	1
Isopropyl ether	45	43		1
Isopropylbenzene	105	120	77	3
m,p-Xylene	106	91	77	3
Methacrylonitrile	67	52		1
Methyl acetate	43	74		1
Methyl acrylate	55	85		1
Methyl methacrylate	69	41		2

Analyte	Quant Ion	Secondary Ions		ISTD
Methyl styrene	117	115	91	3
Methyl tert-butyl ether	73	57		1
Methylcyclohexane	83	55	98	2
Methylene Chloride	84	49	86	1
Naphthalene	128	102	51	3
n-Butyl acetate	43	56		2
n-Butyl acrylate	55	56		2
n-Butylbenzene	91	92	134	3
n-Heptane	43	57	71	1
N-Propylbenzene	120	91	65	3
o-Xylene	106	91	77	3
Pentachloroethane	167	130		3
Propene oxide	58	43		1
Propionitrile	54	55		1
sec-Butylbenzene	105	134	91	3
Styrene	104	78	103	3
Tert-amyl methyl ether	73	43		1
Tert-butyl alcohol	59	41		1
tert-Butylbenzene	119	91	134	3
Tert-butyl ethyl ether	59	87		1
Tetrachloroethene	164	166	168	3
Tetrahydrofuran	42	71		1
Toluene	92	91	65	2
trans-1,2-Dichloroethene	96	61	98	1
trans-1,3-Dichloropropene	75	77	110	2
trans-1,4-Dichloro-2-butene	53	88	89	3
Trichloroethene	130	95	132	2
Trichlorofluoromethane	101	103	105	1
Trichlorotrifluoroethane (Freon 113)	101	151	103	1
Trihalomethanes, Total	Sum of chloroform, dichlorobromomethane, dibromochloromethane, and bromoform			
Vinyl acetate	43	86		1
Vinyl chloride	62	64		1
Xylenes, Total	Sum of m/p- and o- isomers			

Analyte	Quant Ion	Secondary Ions		ISTD
Surrogates				
Dibromofluoromethane	113	81	111	1
Toluene-d8	98	100	70	2
p-Bromofluorobenzene	95	174	176	3
1,2-Dichloroethane-d4	65	67	102	1
Internal Standards				
1,2-Dichloroethane-d4	65	67	102	1
1,4-Difluorobenzene	114	63	88	2
Chlorobenzene-d5	82	117	119	3

Note: For a complete list of target analytes for each method, refer to the LIMS Method Limit Groups (MLGs).

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Attachment 8:
Basic Instrument Configurations

System	GC	MS	P/T	Autosampler	Trap	GC/MS Data system	Methods
MSA	Agilent 6890	Agilent 5973	EST Encon (dual)	EST Centurion	Supelco VOCARB 3000	Agilent Chemstation	EPA 624 EPA 8260B (aqueous) SM6200B
MSB	Agilent 6890	Agilent 5973	Tekmar 3000	Tekmar Aquatek 70	Supelco VOCARB 3000	Agilent Chemstation	EPA 624 EPA 8260B (aqueous) SM6200B
MSL	Agilent 5890	Agilent 5972	Tekmar LSC 2000	Varian Archon	Supelco VOCARB 3000	Agilent Chemstation	EPA 8260B (soils)
MSM	Agilent 5890	Agilent 5972	Tekmar LSC 2000	Varian Archon	Supelco VOCARB 3000	Agilent Chemstation	EPA 8260B (soils)
MSO	Agilent 6890	Agilent 5973	EST Encon (dual)	EST Centurion	Supelco VOCARB 3000	Agilent Chemstation	EPA 624 EPA 8260B (aqueous) SM6200B
MSP	Agilent 6890	Agilent 5973	EST Encon (dual)	EST Centurion	Supelco VOCARB 3000	Agilent Chemstation	EPA 624 EPA 8260B (aqueous) SM6200B

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Attachment 9
Standard Information and Recipes

Store standards in glass vials fitted with Teflon-lined caps in standards-only refrigerator at <-10C. Choose a container volume that will have minimal headspace when standard is added. Mark the level on the outside of the container so that evaporation of the solvent will be apparent.

The expiration dates represent the maximum time a standard can be maintained. Standards that exhibit obvious signs of degradation must be replaced sooner.

Routine Target Compounds

Stock Standard Mixes

Stock/Mix	TALS ID	Vendor/Part Number	Concentration (ug/mL)
O2SI 8260 Additional Compounds	8260 ADD	O2SI 120267-03-02	2500-5000
O2Si Custom VOA 57-1	8260VOA	O2SI 120315-01-02	2500-7500
8260B Surrogates from O2SI	O2SI Surr	O2SI 120005-05-02	2500
O2SI Custom Gases	O2SI-Gases	O2SI 120326-01-02	2500
O2SI 8260 Custom ISTD	O2SI-ISTD	O2SI 120192-02-02	2500

Expiration:
Un-opened ampuls: manufacturer's expiration date
Opened ampuls: 1 month (Note: These ampuls are used to prepare the Working Standards and are typically consumed/disposed open opening.)

8260 Working ISTD
(TALS ID: 8260 ISTD)

Stock/Mix	Initial Volume (uL)	Final Volume (mL)	Final Concentration (ug/mL)
O2SI 8260 Custom ISTD	500	25	50

Solvent: P/T Methanol
Expiration: 1 Month

O2SI Primary MM + Butadiene/Methylstyrene
(Mega Mix Working Standard)
(TALS ID: O2SI MMix)

Stock/Mix	Initial Volume (uL)	Final Volume (mL)	Final Concentration (ug/mL)
O2SI 8260 Additional Compounds	500	25	50-100
O2Si Custom VOA 57-1	500		50-150
8260B Surrogates from O2SI	500		50
O2SI Custom Gases	500		50

Solvent: P/T Methanol
Expiration: 2 weeks from date prepared
(Note: The 25mL final volume is split between five 5mL Mini-nert vials. Due to the volatility of the gas analytes, each vial is assigned a 1-week expiration date from the date that vial was opened, not to exceed 14 days from the preparation date.)

Calibration Standards

Stock/Mix	1	2	3	4	5	6	7
	Aliquot (uL) to prepare CAL standard						
O2SI MMix	20	100	200	400	1000	2000	4000
8260 ISTD	100	100	100	100	100	100	100
Volume of water (mL)	100	100	100	100	100	100	100
Target Compounds (ng)	5	25	50	100	250	500	1000
Internal Standards (ng)	250	250	250	250	250	250	250

Transfer to 40mL VOA vial containing preservatives.
Expiration: 24 hours

Appendix IX Target Compounds

Stock Standard Mixes

Stock/Mix	TALS ID	Vendor/Part Number	Concentration (ug/mL)
Appendix 9 Compounds	o2siAP_9	o2si 120314-01-02	1250-50000
Chloroprene Solution	o2siCPS	o2si 020315-030-02	1250
Pentachloroethane	o2siPENTA	o2si 020052-03-02	2500
Acrolein / Acrylonitrile	o2siA/A	o2si 120014-02	1000
Tetrahydrofuran / DEE Mix	o2siT/D	o2si 120312-02-02	2500-25000
O2SI 8260 Custom ISTD	O2SI-ISTD	O2SI 120192-02-02	2500

8260 Working ISTD
(TALS ID: 8260 ISTD)

Stock/Mix	Aliquot Volume (uL)	Final Volume (mL)	Final Concentration (ug/mL)
O2SI 8260 Custom ISTD	500	25	50

Solvent: P/T Methanol
Expiration: 1 month

AP9 Working Standard (TC2)
(TALS ID: o2si_TC2)

Stock/Mix	Aliquot Volume (uL)	Final Volume (mL)	Final Concentration (ug/mL)
Appendix 9 Compounds	500	25	25-1000
Chloroprene Solution	500		25
Pentachloroethane	500		50

Solvent: P/T Methanol
Expiration: 1 month

THF/DEE Working Standard
(TALS ID: XXXXX)

Stock/Mix	Aliquot Volume (uL)	Final Volume (mL)	Final Concentration (ug/mL)
Appendix 9 Compounds	500	25	25-1000
Chloroprene Solution	500		25
Pentachloroethane	500		50

Solvent: P/T Methanol
Expiration: 1 month

Calibration Standards

Stock/Mix	1	2	3	4	5	6	7
	Aliquot (uL) to prepare CAL standard						
O2SI A/A	1	5	10	20	50	75	100
O2SI TC2	2	10	20	40	100	150	200
THF DEE	1	5	10	20	50	75	100
8260 ISTD	5	5	5	5	5	5	5
Volume of water (mL)	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Target Compounds (ng)	5	25	50	100	250	500	1000
Internal Standards (ng)	250	250	250	250	250	250	250

Note: Record calibration standard preparation in A/D batch.
Expiration: 24 hours

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Attachment 10
Poor Performers

As indicated in EPA 8260B and/or via assessment of laboratory control sample recoveries and control charts, the compounds listed below are poor performers and/or behave erratically. These compounds will not be included in the LCS/LCSD/MS/MSD marginal exceedance count, provided their %R is >10%.

Additionally, these analytes have exceptions to the routine ICV and CCV requirements as outlined in the applicable section of the SOP.

Note: An NCM must be initiated to denote this situation.

Poor Performer List
2-chloroethyl vinyl ether
Acrolein
Carbon disulfide
Methyl Acetate
Pentachloroethane
Vinyl Acetate

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Attachment 11
Procedures for Evaluation of Tentatively Identified Compounds (TICs)

Tentatively identified peaks (TICs) are defined by TestAmerica Savannah as:
1) a calibrated analyte that is not part of the list of analytes requested by the client; or
2) a non-calibrated analyte with a response of 10% or greater than the closest internal standard (ISTD).

The laboratory's default procedure is to report the top 20 TICs with the highest concentration.

Note: Internal standards or surrogates added to the sample, whether they are included in the ICAL or not, must not be identified as TICs. For example, the surrogate o-Terphenyl is added to the low-level 8270 surrogate spiking mix but is used as a surrogate only for LL PAH. This compound would be excluded as a TIC. Also, for semi-volatile analyses, routine target volatile analytes included on the EPA CLP OLM04.2 list (e.g., xylenes) are not included as TICs.

Data Evaluation Steps:
Identification of TICs is made by comparison of the mass spectrum to the reference spectrum (peaks with calibration) or by comparison of the mass spectrum to a reference library such as NIST (peaks without a calibration). Only after visual comparison between the sample spectra and the library-generated reference spectra will the mass spectral analyst assign tentative identification.

The unknown compounds are tentatively identified using a search of the reference library. If the library search produces a match at or above 85%, report that compound. If the library search produces more than one compound at or above 85%, report the first compound (the highest match quality). If the library search produces no matches at or above 85%, report the compound as unknown. If possible, provide a general classification of the unknown – for example, unknown aromatic, unknown hydrocarbon, etc.

TICs should be evaluated within the retention time range from the first eluting target or surrogate (whichever is first in the target list) to the elution of the last target compound.

Relative intensities of the major ions (masses) in the reference spectra (ions >10% of the most abundant ion) should be present in the sample spectrum. The relative intensities of the major ions should agree within approximately ±20%.

Molecular ions present in the reference spectrum should be present in the sample spectrum. Note, however, that differences in the spectra may be attributed to over-lapping or co-eluting peaks. If, in the opinion of the analyst, there is enough evidence to support the tentative identification of a compound even though the above criteria are not met exactly, the peak may be considered tentatively identified. The analyst should consult the Department Manager if there are any questions concerning interpretation of spectra.

The estimated concentration of the tentatively identified compound (TIC) is calculated using the total ion area of the tentatively identified peak and total ion area

of the nearest internal standard that has no interferences. The concentration of TICs with a calibration is the concentration from the calibration curve at the dilution that the target list is reported, even if the concentration is above the calibration range (an "E" value). The concentration of the non-calibrated TIC is as directed in the SOP and as calculated in the Target data system.

Data Processing Steps:

- Evaluate the peaks in the total ion chromatogram for:
  - correct integration
  - peaks that may not have been integrated, paying particular attention to large or odd-shaped peaks.
  - closely eluting peaks
- Manually integrate any peaks that were not detected by the data system and re-process the unknowns.
- Evaluate TICs in Target, as outlined above.
- Merge to TALS.
- Under the TIC tab, reject all "TGT" and "TIC" analytes.
- Right-click and select "Auto-Set TICs Primary". This should set the number of TICs and TGTs requested with the highest concentration to a "Primary" status.
- Highlight all TGT compounds (still under the TIC tab) and right-click.
- Choose "Result Conditions".
- Right-click and choose "Show Assigned Conditions".
- Uncheck all assigned conditions.
- Right-click and choose "Show Flag Suite Conditions".
- Select J, N, and T. Be sure to choose the J-flag defined as "Estimated Result TIC – Manual Flag".

Attachment 12
EPA 624 CCV and ICV Criteria
(Q Table)

Analyte	Criteria* (ug/L)
Benzene	12.8-27.2
Bromodichloromethane	13.1-26.9
Bromoform	14.2-25.8
Bromomethane	2.8-37.2
Carbon tetrachloride	14.6-25.4
Chlorobenzene	13.2-26.8
Chloroethane	7.6-32.4
2-chloroethyl vinyl ether	D-44.8*
Chloroform	13.5-26.5
Chloromethane	D-40.8
Dibromochloromethane	13.5-26.5
1,2-Dichlorobenzene	12.6-27.4
1,3-Dichlorobenzene	14.6-25.4
1,4-Dichlorobenzene	12.6-27.4
1,1-Dichloroethane	14.5-25.5
1,2-Dichloroethane	13.6-26.4
trans-1,2-Dichloroethene	13.9-26.1
1,1-Dichloroethene	10.1-29.9
1,2-Dichloropropane	6.8-33.2
cis-1,3-Dichloropropene	4.8-35.2
trans-1,3-Dichloropropene	10.0-30.0
Ethylbenzene	11.8-28.2
Methylene chloride	12.1-27.9
1,1,2,2-Tetrachloroethane	12.1-27.9
Tetrachloroethene	14.7-25.3
Toluene	14.9-25.1
1,1,1-Trichloroethane	15.-25.0
1,1,2-Trichloroethane	14.2-25.8
Trichloroethene	13.3-26.7
Trichlorotrifluoromethane	9.6-30.4
Vinyl chloride	0.8-39.2

*These values are given in ug/L (i.e., concentration ranges). The laboratory has converted these values into percent recovery limits to be used to assess CCV, ICV, LCS/LCSD, and MS/MSD.

18.0 Revision History

Summary of Changes from Previous Revision:

- Minor editorial, grammatical, and formatting changes made. Boilerplate text added.
- Added note that cut-resistant gloves should be worn, or other hand protection material used, when opening and closing VOA vials. Section 5.0
- Added section to describe analytical data system, software, and hardware. Section 6.2
- Added note that if an LCS and LCSD are performed, both QC items must be evaluated and reported. Acceptable recoveries (as well as %RPD) for both LCS and LCSD are required. Section 9.1.1 and Section 9.1.2
- Clarified matrix spike frequency for EPA 624 to illustrate 10% frequency (i.e., this equates to 1 MS and 1MSD for a batch of 10 or less samples or equates to 1 MS (from sample 1-10), 1 MS (from sample 11-20), and 1 MSD for a batch of 11-20 samples.) Section 9.1.2
- Added note that some programs and agencies do not allow the use of quadratic curves and to refer to the Project Requirement Summary and/or Project Plan to determine if this curve type is prohibited. Section 9.2.3.2.1
- Replaced reference to "Ottawa sand" with "blank sand". Section 7.2.2 and Section 10.1.4
- Clarified Example Analytical Sequence to include LCSD (if insufficient sample is provided for MS/MSD). Section 10.2.7 and Attachment 1
- Added reference to TALS Historical Data Tracker feature. Section 11.1.3
- Corrected equation for determination of final concentration. Note: this change simply corrects a typo in the SOP with regards to referencing % Solids versus % Moisture and does not reflect a change in procedure. Section 11.2.3
- Clarified requirements and frequency for RLVs, MDL Studies, and MDLVs to be consistent with SOP SA-QA-07 and to include the quarterly frequency as defined by DOD. Section 12.1 - 12.3 and Attachment 3
- Updated Method Modifications and Clarifications Section to include information on surrogates used by the laboratory. Section 16.2.13
- Revised expiration date for Gas Standards to be 1 week from the date of opening of each mini-Nert vial. Also added this information to Method Modifications and Clarifications Section. Attachment 9 and Section 16.2.12 (Corporate Internal Audit Finding, May 2010)
- Added note that unsupervised work must not begin until acceptable IDOC is obtained. Attachment 3
- Added section on troubleshooting. Attachment 4
- Updated TIC procedure for consistency with SOP SA-QA-08. Attachment 11
- Incorporated procedures and QC requirements for SM6200B.
- Removed the Instrument Blank section (9.2.5) from the SOP.

Laboratory Quantitation Limits

TestAmerica Savannah Quantitation Limits

Method Description	Method Code
Volatile Organic Compounds (GC/MS)	8260B
Closed System Purge and Trap	5035A_FP

Analyte Description	CAS Number	RL - Limit	LOD - Limit	MDL - Limit	Units
1,1,1-Trichloroethane	71-55-6	5	1	0.59	ug/Kg
1,1,2,2-Tetrachloroethane	79-34-5	5	1.6	1.6	ug/Kg
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	5	1.3	1.3	ug/Kg
1,1,2-Trichloroethane	79-00-5	5	1.3	1.3	ug/Kg
1,1-Dichloroethane	75-34-3	5	1.1	1.1	ug/Kg
1,1-Dichloroethene	75-35-4	5	1.5	1.5	ug/Kg
1,2,4-Trichlorobenzene	120-82-1	5	1	0.89	ug/Kg
1,2-Dibromo-3-Chloropropane	96-12-8	10	4.4	4.4	ug/Kg
1,2-Dibromoethane	106-93-4	5	1.5	1.5	ug/Kg
1,2-Dichlorobenzene	95-50-1	5	1.3	1.3	ug/Kg
1,2-Dichloroethane	107-06-2	5	1.1	1.1	ug/Kg
1,2-Dichloropropane	78-87-5	5	1	0.86	ug/Kg
1,3-Dichlorobenzene	541-73-1	5	1.6	1.6	ug/Kg
1,4-Dichlorobenzene	106-46-7	5	1	0.74	ug/Kg
2-Butanone	78-93-3	25	2.4	2.4	ug/Kg
2-Hexanone	591-78-6	25	3.3	3.3	ug/Kg
4-Bromofluorobenzene	460-00-4				ug/Kg
4-Methyl-2-pentanone	108-10-1	25	4.2	4.2	ug/Kg
Acetone	67-64-1	50	11	11	ug/Kg
Benzene	71-43-2	5	1	0.73	ug/Kg
Bromodichloromethane	75-27-4	5	1	0.97	ug/Kg
Bromoform	75-25-2	5	1.5	1.5	ug/Kg
Bromomethane	74-83-9	5	1.5	1.5	ug/Kg
Carbon disulfide	75-15-0	5	1.1	1.1	ug/Kg
Carbon tetrachloride	56-23-5	5	1	0.83	ug/Kg
Chlorobenzene	108-90-7	5	1	0.96	ug/Kg
Chloroethane	75-00-3	5	2.7	2.7	ug/Kg
Chloroform	67-66-3	5	1.1	1.1	ug/Kg
Chloromethane	74-87-3	5	2	1	ug/Kg
cis-1,2-Dichloroethene	156-59-2	5	1.4	1.4	ug/Kg
cis-1,3-Dichloropropene	10061-01-5	5	1	0.83	ug/Kg
Cyclohexane	110-82-7	10	1.3	1.3	ug/Kg
Dibromochloromethane	124-48-1	5	1.7	1.7	ug/Kg
Dibromofluoromethane	1868-53-7				ug/Kg
Dichlorodifluoromethane	75-71-8	5	1	0.94	ug/Kg
Ethylbenzene	100-41-4	5	1.3	1.3	ug/Kg
Isopropylbenzene	98-82-8	5	1.9	1.9	ug/Kg
Methyl acetate	79-20-9	10	5	5	ug/Kg
Methyl tert-butyl ether	1634-04-4	10	2	1	ug/Kg
Methylcyclohexane	108-87-2	10	1	0.86	ug/Kg
Methylene Chloride	75-09-2	5	1	0.98	ug/Kg
Styrene	100-42-5	5	1	0.93	ug/Kg
Tetrachloroethene	127-18-4	5	1.9	1.9	ug/Kg
Toluene	108-88-3	5	1	0.84	ug/Kg
Toluene-d8 (Surr)	2037-26-5				ug/Kg
trans-1,2-Dichloroethene	156-60-5	5	1	0.63	ug/Kg
trans-1,3-Dichloropropene	10061-02-6	5	1	0.87	ug/Kg
Trichloroethene	79-01-6	5	1.3	1.3	ug/Kg
Trichlorofluoromethane	75-69-4	5	1.2	1.2	ug/Kg
Vinyl chloride	75-01-4	5	1.5	1.5	ug/Kg
Xylenes, Total	1330-20-7	10	1.1	1.1	ug/Kg

TestAmerica Savannah Quantitation Limits

Method Description	Method Code
Semivolatile Organic Compounds by GCMS - Low Levels	8270C_LL
Microwave Extraction	3546

Analyte Description	CAS Number	RL - Limit	LOD - Limit	MDL - Limit	Units
1,1'-Biphenyl	92-52-4	33	7.2	7.2	ug/Kg
2,4,5-Trichlorophenol	95-95-4	33	7.6	7.6	ug/Kg
2,4,6-Tribromophenol (Surr)	118-79-6				ug/Kg
2,4,6-Trichlorophenol	88-06-2	33	7.9	7.9	ug/Kg
2,4-Dichlorophenol	120-83-2	33	7.2	7.2	ug/Kg
2,4-Dimethylphenol	105-67-9	66	7.6	7.6	ug/Kg
2,4-Dinitrophenol	51-28-5	330	42	17	ug/Kg
2,4-Dinitrotoluene	121-14-2	33	7.5	7.5	ug/Kg
2,6-Dinitrotoluene	606-20-2	33	7.9	7.9	ug/Kg
2-Chloronaphthalene	91-58-7	33	6	6	ug/Kg
2-Chlorophenol	95-57-8	33	5.3	5.3	ug/Kg
2-Fluorobiphenyl	321-60-8				ug/Kg
2-Fluorophenol (Surr)	367-12-4				ug/Kg
2-Methylnaphthalene	91-57-6	6.7	3.3	3.3	ug/Kg
2-Methylphenol	95-48-7	33	6.3	6.3	ug/Kg
2-Nitroaniline	88-74-4	170	7	7	ug/Kg
2-Nitrophenol	88-75-5	33	5.8	5.8	ug/Kg
3 & 4 Methylphenol	15831-10-4	33	7.3	7.3	ug/Kg
3,3'-Dichlorobenzidine	91-94-1	66	17	17	ug/Kg
3-Nitroaniline	99-09-2	170	6.7	6.7	ug/Kg
4,6-Dinitro-2-methylphenol	534-52-1	170	17	17	ug/Kg
4-Bromophenyl phenyl ether	101-55-3	33	6.9	6.9	ug/Kg
4-Chloro-3-methylphenol	59-50-7	33	7	7	ug/Kg
4-Chloroaniline	106-47-8	66	5.2	5.2	ug/Kg
4-Chlorophenyl phenyl ether	7005-72-3	33	6.4	6.4	ug/Kg
4-Nitroaniline	100-01-6	170	17	8.3	ug/Kg
4-Nitrophenol	100-02-7	170	73	73	ug/Kg
Acenaphthene	83-32-9	6.7	3.3	3.3	ug/Kg
Acenaphthylene	208-96-8	6.7	3.3	3.3	ug/Kg
Acetophenone	98-86-2	33	6.8	6.8	ug/Kg
Anthracene	120-12-7	6.7	3.3	3.3	ug/Kg
Atrazine	1912-24-9	33	7.6	7.6	ug/Kg
Benzaldehyde	100-52-7	33	9.9	9.9	ug/Kg
Benzo[a]anthracene	56-55-3	6.7	3.3	3.3	ug/Kg
Benzo[a]pyrene	50-32-8	6.7	3.3	1.2	ug/Kg
Benzo[b]fluoranthene	205-99-2	6.7	3.3	3.3	ug/Kg
Benzo[g,h,i]perylene	191-24-2	6.7	3.3	3.3	ug/Kg
Benzo[k]fluoranthene	207-08-9	6.7	3.3	2	ug/Kg
bis (2-chloroisopropyl) ether	108-60-1	33	7.2	7.2	ug/Kg
Bis(2-chloroethoxy)methane	111-91-1	33	6.5	6.5	ug/Kg
Bis(2-chloroethyl)ether	111-44-4	33	6.5	6.5	ug/Kg
Bis(2-ethylhexyl) phthalate	117-81-7	66	6	6	ug/Kg
Butyl benzyl phthalate	85-68-7	33	6.7	5.5	ug/Kg
Caprolactam	105-60-2	33	7	7	ug/Kg
Carbazole	86-74-8	33	6.7	6.7	ug/Kg
Chrysene	218-01-9	6.7	3.3	3.3	ug/Kg
Dibenz(a,h)anthracene	53-70-3	6.7	6.7	3.3	ug/Kg
Dibenzofuran	132-64-9	33	6.7	6.7	ug/Kg
Diethyl phthalate	84-66-2	33	7.4	7.4	ug/Kg
Dimethyl phthalate	131-11-3	33	7.5	7.5	ug/Kg
Di-n-butyl phthalate	84-74-2	170	17	17	ug/Kg
Di-n-octyl phthalate	117-84-0	33	6.7	3.6	ug/Kg
Fluoranthene	206-44-0	6.7	3.3	3.3	ug/Kg
Fluorene	86-73-7	6.7	3.3	3.3	ug/Kg
Hexachlorobenzene	118-74-1	33	7.6	7.6	ug/Kg
Hexachlorobutadiene	87-68-3	33	6.8	6.8	ug/Kg
Hexachlorocyclopentadiene	77-47-4	66	3.7	3.7	ug/Kg

TestAmerica Savannah Quantitation Limits

Method Description	Method Code
Semivolatile Organic Compounds by GCMS - Low Levels	8270C_LL
Microwave Extraction	3546

Analyte Description	CAS Number	RL - Limit	LOD - Limit	MDL - Limit	Units
Hexachloroethane	67-72-1	33	5.8	5.8	ug/Kg
Indeno[1,2,3-cd]pyrene	193-39-5	6.7	3.3	3.3	ug/Kg
Isophorone	78-59-1	33	7	7	ug/Kg
Naphthalene	91-20-3	6.7	3.3	3.3	ug/Kg
Nitrobenzene	98-95-3	33	6.6	6.6	ug/Kg
Nitrobenzene-d5 (Surr)	4165-60-0				ug/Kg
N-Nitrosodi-n-propylamine	621-64-7	33	7.5	7.5	ug/Kg
N-Nitrosodiphenylamine	86-30-6	33	6.1	6.1	ug/Kg
Pentachlorophenol	87-86-5	170	17	17	ug/Kg
Phenanthrene	85-01-8	6.7	6.7	2.4	ug/Kg
Phenol	108-95-2	33	6.5	6.5	ug/Kg
Phenol-d5 (Surr)	4165-62-2				ug/Kg
Pyrene	129-00-0	6.7	3.3	3.3	ug/Kg
Terphenyl-d14 (Surr)	1718-51-0				ug/Kg

Method Description	Method Code
Semivolatile Organic Compounds (GC/MS) Low level PAH	8270C_LL_PAH
Microwave Extraction	3546

Analyte Description	CAS Number	RL - Limit	LOD - Limit	MDL - Limit	Units
1-Methylnaphthalene	90-12-0	6.7	3.3	3.1	ug/Kg
2-Methylnaphthalene	91-57-6	6.7	3.3	3.3	ug/Kg
Acenaphthene	83-32-9	6.7	3.3	3.3	ug/Kg
Acenaphthylene	208-96-8	6.7	3.3	3.3	ug/Kg
Anthracene	120-12-7	6.7	3.3	3.3	ug/Kg
Benzo[a]anthracene	56-55-3	6.7	3.3	3.3	ug/Kg
Benzo[a]pyrene	50-32-8	6.7	3.3	1.2	ug/Kg
Benzo[b]fluoranthene	205-99-2	6.7	3.3	3.3	ug/Kg
Benzo[g,h,i]perylene	191-24-2	6.7	3.3	3.3	ug/Kg
Benzo[k]fluoranthene	207-08-9	6.7	3.3	2	ug/Kg
Chrysene	218-01-9	6.7	3.3	3.3	ug/Kg
Dibenz(a,h)anthracene	53-70-3	6.7	3.3	3.3	ug/Kg
Fluoranthene	206-44-0	6.7	3.3	3.3	ug/Kg
Fluorene	86-73-7	6.7	3.3	3.3	ug/Kg
Indeno[1,2,3-cd]pyrene	193-39-5	6.7	3.3	3.3	ug/Kg
Naphthalene	91-20-3	6.7	3.3	3.3	ug/Kg
Pyrene	129-00-0	6.7	3.3	3.3	ug/Kg
o-Terphenyl	84-15-1				ug/Kg
Phenanthrene	85-01-8	6.7	3.3	2.4	ug/Kg

Method Description	Method Code
Metals (ICP/MS)	6020A
Preparation, Metals	3050B

Analyte Description	CAS Number	RL - Limit	LOD - Limit	MDL - Limit	Units
Aluminum	7429-90-5	10	3.8	3.8	mg/Kg
Antimony	7440-36-0	1	0.5	0.5	mg/Kg
Arsenic	7440-38-2	0.25	0.13	0.1	mg/Kg
Barium	7440-39-3	0.5	0.13	0.13	mg/Kg
Beryllium	7440-41-7	0.05	0.025	0.025	mg/Kg
Cadmium	7440-43-9	0.05	0.025	0.012	mg/Kg
Calcium	7440-70-2	50	25	25	mg/Kg
Chromium	7440-47-3	0.5	0.25	0.25	mg/Kg
Cobalt	7440-48-4	0.05	0.015	0.015	mg/Kg
Copper	7440-50-8	0.5	0.25	0.2	mg/Kg
Iron	7439-89-6	25	10	10	mg/Kg
Lead	7439-92-1	0.2	0.1	0.1	mg/Kg

TestAmerica Savannah Quantitation Limits

Method Description	Method Code
Metals (ICP/MS)	6020A
Preparation, Metals	3050B

Analyte Description	CAS Number	RL - Limit	LOD - Limit	MDL - Limit	Units
Magnesium	7439-95-4	25	3	3	mg/Kg
Manganese	7439-96-5	1	0.5	0.5	mg/Kg
Nickel	7440-02-0	0.5	0.25	0.25	mg/Kg
Potassium	9/7/7440	25	15	15	mg/Kg
Selenium	7782-49-2	0.5	0.25	0.25	mg/Kg
Silver	7440-22-4	0.1	0.05	0.05	mg/Kg
Sodium	7440-23-5	25	16	16	mg/Kg
Thallium	7440-28-0	0.1	0.025	0.025	mg/Kg
Vanadium	7440-62-2	0.5	0.28	0.28	mg/Kg
Zinc	7440-66-6	2	1.5	0.55	mg/Kg

Method Description	Method Code
Mercury in Solid or Semisolid Waste (Manual Cold Vapor Technique)	7471B
Preparation, Mercury	7471B_Prep

Analyte Description	CAS Number	RL - Limit	LOD - Limit	MDL - Limit	Units
Mercury	7439-97-6	0.02	0.0088	0.0082	mg/Kg

LOD/SCREENING VALUE COMPARISON

APPENDIX B

NON-DETECT LOD VALUES COMPARED TO SCREENING VALUES - SURFACE AND SUBSURFACE SOIL
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte	Residential Soil RSLs [1]	Industrial Soil RSLs [1]	Ecological Screening Values	Number of Analyses	LOD Range	Number of ND/R Results	Number of ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values, Total Analyses
Volatile Organics (µg/kg)									
1,1,1,2-Tetrachloroethane	1,900	9,300	100	95	1.7 - 6	95	0	0%	0%
1,1,1-Trichloroethane	870,000	3,800,000	100	95	0.71 - 6	95	0	0%	0%
1,1,2,2-Tetrachloroethane	560	2,800	100	95	1.1 - 6	95	0	0%	0%
1,1,2-Trichloroethane	1,100	5,300	100	95	0.93 - 6	95	0	0%	0%
1,1-Dichloroethane	3,300	17,000	100	95	0.79 - 6	95	0	0%	0%
1,1-Dichloroethene	24,000	110,000	100	95	1.1 - 6	95	0	0%	0%
1,2,3-Trichloropropane	5	95	NE	95	1.7 - 6	95	15	16%	16%
1,2,4-Trichlorobenzene	22,000	99,000	20,000	22	0.71 - 1.4	22	0	0%	0%
1,2-Dibromo-3-chloropropane (DBCP)	5.4	69	NE	95	3.1 - 6.2	95	7	7%	7%
1,2-Dibromoethane (EDB)	34	170	300	95	1.1 - 6	95	0	0%	0%
1,2-Dichlorobenzene	190,000	980,000	3,003	22	0.93 - 1.8	22	0	0%	0%
1,2-Dichloroethane	430	2,200	402	95	0.79 - 6	95	0	0%	0%
1,2-Dichloroethene (trans)	15,000	69,000	100	95	0.71 - 6	95	0	0%	0%
1,2-Dichloropropane	940	4,700	700,000	95	0.71 - 6	95	0	0%	0%
1,3-Dichloropropene (cis)	1,700 [2]	8,300 [2]	100	95	0.71 - 6	95	0	0%	0%
1,3-Dichloropropene (trans)	1,700 [2]	8,300 [2]	100	95	0.71 - 6	95	0	0%	0%
1,4-Dichloro-2-butene (trans)	6.9	35	1,000,000	95	2.1 - 24	95	73	77%	77%
1,3-Dichlorobenzene	NE	NE	3,003	22	1.1 - 2.3	22	0	0%	0%
1,4-Dichlorobenzene	2,400	12,000	20,000	22	0.71 - 1.4	22	0	0%	0%
1,4-Dioxane (p-) *	4,900	17,000	NE	95	36 - 300	95	0	0%	0%
2-Butanone (MEK)	2,800,000	20,000,000	NE	95	1.7 - 16	95	0	0%	0%
2-Chloro-1,3-butadiene (Chloroprene)	NE	NE	NE	95	1.5 - 6	95	0	0%	0%
2-Hexanone (MBK)	21,000	140,000	NE	95	2.4 - 15	94	0	0%	0%
3-Chloropropene (Allyl Chloride)	680	3,400	NE	95	1.6 - 6	95	0	0%	0%
4-Methyl-2-pentanone (MIBK)	530,000	5,300,000	NE	95	3 - 15	95	0	0%	0%
Acetone	6,100,000	63,000,000	NE	95	7.9 - 190	82	0	0%	0%
Acetonitrile	87,000	370,000	NE	95	3.7 - 58	95	0	0%	0%
Acrolein	15	65	NE	95	17 - 34	22	22	100%	23%
Acrylonitrile	240	1,200	1,000,000	95	24 - 60	94	0	0%	0%
Benzene	1,100	5,400	101	95	0.71 - 6	88	0	0%	0%
Bromodichloromethane	270	1,400	NE	95	0.71 - 6	95	0	0%	0%
Bromoform	62,000	220,000	NE	95	1.1 - 35	95	0	0%	0%
Bromomethane	730	3,200	NE	95	1.1 - 6.3	88	0	0%	0%
Carbon Disulfide	82,000	370,000	NE	95	0.79 - 10	89	0	0%	0%
Carbon Tetrachloride	610	3,000	1,000,000	95	0.71 - 6	95	0	0%	0%
Chlorobenzene	29,000	140,000	40,000	95	0.71 - 6	95	0	0%	0%
Chloroethane	1,500,000	6,100,000	NE	95	1.9 - 6	95	0	0%	0%

APPENDIX B

NON-DETECT LOD VALUES COMPARED TO SCREENING VALUES - SURFACE AND SUBSURFACE SOIL
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte	Residential Soil RSLs [1]	Industrial Soil RSLs [1]	Ecological Screening Values	Number of Analyses	LOD Range	Number of ND/R Results	Number of ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values, Total Analyses
Volatile Organics (µg/kg) (cont.)									
Chloroform	290	1,500	1,002	95	0.79 - 6	95	0	0%	0%
Chloromethane	12,000	50,000	NE	95	1.4 - 6	84	0	0%	0%
Dibromochloromethane	680	3,300	NE	95	1.2 - 6	94	0	0%	0%
Dibromomethane	2,500	11,000	NE	95	1.2 - 6	95	0	0%	0%
Ethyl Methacrylate	150,000	750,000	NE	95	2.4 - 60	95	0	0%	0%
Ethylbenzene	5,400	27,000	5,003	95	0.93 - 6	95	0	0%	0%
Freon 11 (Trichlorofluoromethane)	79,000	340,000	NE	95	0.86 - 6	95	0	0%	0%
Freon-12 (Dichlorodifluoromethane)	9,400	40,000	NE	95	0.71 - 6	95	0	0%	0%
Hexachlorobutadiene	6,200	22,000	NE	22	2.2 - 4.4	22	0	0%	0%
Isobutyl Alcohol *	1,800,000	18,000,000	NE	95	37 - 300	95	0	0%	0%
Methyl Acrylonitrile	760	9,200	NE	95	16 - 60	94	0	0%	0%
Methyl Iodide	NE	NE	NE	95	1.3 - 21	88	0	0%	0%
Methyl Methacrylate	480,000	2,100,000	NE	95	3.2 - 6.3	22	0	0%	0%
Methylene Chloride	56,000	960,000	1,040	95	0.71 - 6	94	0	0%	0%
Pentachloroethane	5,400	19,000	NE	95	3.7 - 8.9	95	0	0%	0%
Propionitrile (Ethyl Cyanide)	NE	NE	NE	95	19 - 37	22	0	0%	0%
Styrene (Ethenylbenzene)	630,000	3,600,000	10,030	95	0.71 - 6	95	0	0%	0%
Tetrachloroethene (PCE)	22,000	110,000	400	95	1.4 - 6	95	0	0%	0%
Toluene	500,000	4,500,000	13,001	95	0.71 - 6	95	0	0%	0%
Trichloroethene (TCE)	910	6,400	6,010	95	0.93 - 6	95	0	0%	0%
Vinyl Acetate	97,000	410,000	NE	95	1.8 - 6	95	0	0%	0%
Vinyl Chloride	60	1,700	11	95	1.1 - 6	95	0	0%	0%
Xylene, m/p-	59,000 [3]	250,000 [3]	NE	73	7.4 - 12	58	0	0%	0%
Xylene, o-	69,000	300,000	NE	73	3.7 - 6	73	0	0%	0%
Xylenes, total	63,000	270,000	1,000	95	0.79 - 6	80	0	0%	0%
Semivolatile Organics (µg/kg)									
1,2,4,5-Tetrachlorobenzene	1,800	18,000	50	95	3.7 - 250	95	73	77%	77%
1,2,4-Trichlorobenzene	22,000	99,000	20,000	95	5.2 - 250	95	0	0%	0%
1,2-Dichlorobenzene (o-)	190,000	980,000	3,003	95	7.4 - 250	95	0	0%	0%
1,3,5-Trinitrobenzene (TNB)	220,000	2,700,000	40,000	95	19 - 250	95	0	0%	0%
1,3-Dichlorobenzene (m-)	NE	NE	3,003	95	6.3 - 250	95	0	0%	0%
1,3-Dinitrobenzene (m-)	610	6,200	40,000	95	19 - 250	95	0	0%	0%
1,4-Dichlorobenzene (p-)	2,400	12,000	20,000	95	5.9 - 250	95	0	0%	0%
1,4-Naphthoquinone	NE	NE	NE	95	3.7 - 250	95	0	0%	0%
1,4-Phenylenediamine	1,200,000	12,000,000	NE	95	940 - 12000	22	0	0%	0%
1-Naphthylamine	NE	NE	NE	95	19 - 250	94	0	0%	0%

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Analyte	Residential Soil RSLs [1]	Industrial Soil RSLs [1]	Ecological Screening Values	Number of Analyses	LOD Range	Number of ND/R Results	Number of ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values, Total Analyses
Semivolatile Organics (µg/kg) (cont.)									
2,2'-Oxybis[1-chloropropane]	4,600	22,000	NE	95	8.1 - 250	95	0	0%	0%
2,3,4,6-Tetrachlorophenol	180,000	1,800,000	1,001	95	3.7 - 480	95	0	0%	0%
2,4,5-Trichlorophenol	610,000	6,200,000	4,000	95	8.6 - 480	95	0	0%	0%
2,4,6-Trichlorophenol	44,000	160,000	10,000	95	8.9 - 480	95	0	0%	0%
2,4-Dichlorophenol	18,000	180,000	1,001	95	8.1 - 480	95	0	0%	0%
2,4-Dimethylphenol	120,000	1,200,000	10	95	8.6 - 480	94	80	85%	84%
2,4-Dinitrophenol	12,000	120,000	20,000	95	47 - 590	95	0	0%	0%
2,4-Dinitrotoluene (DNT)	1,600	5,500	NE	95	8.5 - 250	95	0	0%	0%
2,6-Dichlorophenol	NE	NE	1,001	95	3.7 - 480	95	0	0%	0%
2,6-Dinitrotoluene (DNT)	330	1,200	NE	95	8.9 - 250	95	0	0%	0%
2-Acetylaminofluorene	130	450	NE	95	37 - 460	95	77	81%	81%
2-Chloronaphthalene	630,000	8,200,000	NE	95	6.8 - 250	95	0	0%	0%
2-Chlorophenol	39,000	510,000	1,001	95	6 - 480	95	0	0%	0%
2-Methyl-5-nitroaniline	54,000	190,000	NE	95	19 - 250	95	0	0%	0%
2-Methylphenol (o-Cresol)	310,000	3,100,000	100	95	7.1 - 480	95	73	77%	77%
2-Naphthylamine	270	960	NE	95	19 - 250	94	0	0%	0%
2-Nitroaniline	61,000	600,000	NE	95	7.9 - 250	95	0	0%	0%
2-Nitrophenol	NE	NE	7,000	95	6.5 - 480	95	0	0%	0%
2-Picoline	NE	NE	NE	95	3.7 - 250	95	0	0%	0%
3 & 4 Methylphenol	NE	NE	NE	22	8.2 - 100	22	0	0%	0%
3,3'-Dichlorobenzidine	1,100	3,800	NE	95	19 - 250	95	0	0%	0%
3,3'-Dimethylbenzidine	44	160	NE	95	74 - 920	94	94	100%	99%
3-Methylcholanthrene	5.2	78	NE	95	37 - 460	95	95	100%	100%
3-Methylphenol (m-Cresol)	310,000	3,100,000	NE	73	260 - 370	73	0	0%	0%
3-Nitroaniline	NE	NE	NE	95	7.6 - 250	95	0	0%	0%
4,6-Dinitro-2-methylphenol	490	4,900	NE	95	19 - 480	95	0	0%	0%
4-Aminobiphenyl	23	82	NE	95	19 - 250	94	79	84%	83%
4-Bromophenyl-phenylether	NE	NE	NE	95	7.8 - 250	95	0	0%	0%
4-Chloro-3-methylphenol	610,000	6,200,000	NE	95	7.9 - 480	95	0	0%	0%
4-Chloroaniline	2,400	8,600	NE	95	5.9 - 250	95	0	0%	0%
4-Chlorophenyl-phenylether	NE	NE	NE	95	7.2 - 250	95	0	0%	0%
4-Dimethylaminoazobenzene (p-)	110	370	NE	95	19 - 250	95	74	78%	78%
4-Methylphenol (p-Cresol)	NE	NE	NE	73	260 - 370	73	0	0%	0%
4-Nitroaniline	24,000	86,000	NE	95	19 - 250	95	0	0%	0%
4-Nitrophenol	NE	NE	7,000	95	82 - 1000	95	0	0%	0%
4-Nitroquinoline-1-oxide	NE	NE	NE	95	47 - 590	95	0	0%	0%
7,12-Dimethylbenz(a)anthracene	0.43	6.2	NE	95	19 - 250	95	95	100%	100%

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Analyte	Residential Soil RSLs [1]	Industrial Soil RSLs [1]	Ecological Screening Values	Number of Analyses	LOD Range	Number of ND/R Results	Number of ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values, Total Analyses
Semivolatile Organics (µg/kg) (cont.)									
a,a-Dimethylphenethylamine	NE	NE	NE	95	360 - 4600	95	0	0%	0%
Acetophenone	780,000	10,000,000	NE	95	7.7 - 120	95	0	0%	0%
Aniline	85,000	300,000	NE	95	9.3 - 250	95	0	0%	0%
Aramite	19,000	69,000	NE	95	5.4 - 250	95	0	0%	0%
Benzyl Alcohol	610,000	6,200,000	NE	95	6.9 - 250	95	0	0%	0%
Bis(2-chloroethoxy)methane	18,000	180,000	NE	95	7.3 - 250	95	0	0%	0%
Bis(2-chloroethyl)ether	210	1,000	NE	95	7.3 - 250	95	23	24%	24%
Bis(2-ethylhexyl) Phthalate (BEHP)	35,000	120,000	6,010	95	7.5 - 250	73	0	0%	0%
Butyl Benzyl Phthalate	260,000	910,000	6,010	95	7.6 - 250	94	0	0%	0%
Diallate (cis)	NE	NE	NE	73	180 - 250	73	0	0%	0%
Diallate (trans)	NE	NE	NE	73	180 - 250	73	0	0%	0%
Diallate	8,000	28,000	NE	22	6.3 - 78	22	0	0%	0%
Dibenzofuran	7,800	100,000	NE	95	7.6 - 750	95	0	0%	0%
Diethyl Phthalate (DEP)	4,900,000	49,000,000	100,000	95	8.4 - 250	95	0	0%	0%
Dimethyl Phthalate	NE	NE	200,000	95	8.5 - 250	95	0	0%	0%
Di-n-butyl Phthalate (DBP)	610,000	6,200,000	200,000	95	19 - 250	95	0	0%	0%
Di-n-octyl Phthalate	61,000	620,000	6,010	95	7.6 - 250	94	0	0%	0%
Dinoseb	6,100	62,000	NE	64	7.6 - 240	64	31	48%	48%
Ethyl Methane Sulfonate (EMS)	NE	NE	NE	95	8.8 - 250	95	0	0%	0%
Hexachloro-1,3-butadiene	6,200	22,000	NE	95	7.7 - 250	95	0	0%	0%
Hexachlorobenzene	300	1,100	1,000,000	95	8.6 - 250	95	0	0%	0%
Hexachlorocyclopentadiene	37,000	370,000	10,000	95	4.2 - 250	95	0	0%	0%
Hexachloroethane	12,000	43,000	NE	95	6.5 - 250	95	0	0%	0%
Hexachloropropene	NE	NE	NE	95	6 - 250	95	0	0%	0%
Hexachlorophene	1,800	18,000	NE	22	2700 - 33000	22	22	100%	100%
Isophorone	510,000	1,800,000	NE	95	7.9 - 250	95	0	0%	0%
Isosafrole	NE	NE	NE	95	3.7 - 250	95	0	0%	0%
Methapyrilene	NE	NE	NE	95	76 - 930	88	0	0%	0%
Methyl Methane Sulfonate	4,900	17,000	NE	95	4.3 - 250	95	0	0%	0%
Nitrobenzene	4,800	24,000	40,000	95	7.4 - 250	95	0	0%	0%
n-Nitrosodiethylamine	0.77	11	20,000	95	3.7 - 250	95	95	100%	100%
n-Nitrosodimethylamine (NDMA)	2.3	34	20,000	95	21 - 270	95	95	100%	100%
n-Nitroso-di-n-butylamine	87	400	20,000	95	19 - 250	95	77	81%	81%
n-Nitrosodi-n-propylamine	69	250	20,000	95	8.5 - 250	95	74	78%	78%
n-Nitrosodiphenylamine	99,000	350,000	20,000	95	6.9 - 250	95	0	0%	0%
n-Nitrosomethylethylamine	22	78	20,000	95	3.7 - 250	95	74	78%	78%
n-Nitrosomorpholine	73	260	NE	95	5.1 - 250	95	73	77%	77%

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Analyte	Residential Soil RSLs [1]	Industrial Soil RSLs [1]	Ecological Screening Values	Number of Analyses	LOD Range	Number of ND/R Results	Number of ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values, Total Analyses
Semivolatile Organics (µg/kg) (cont.)									
n-Nitrosopiperidine	52	180	NE	95	3.8 - 250	95	73	77%	77%
n-Nitrosopyrrolidine	230	820	NE	95	4.1 - 250	95	6	6%	6%
o-Toluidine	NE	NE	NE	95	3.7 - 250	95	0	0%	0%
Pentachlorobenzene	4,900	49,000	1,150	95	3.7 - 250	94	0	0%	0%
Pentachloronitrobenzene	1,900	6,600	NE	95	19 - 250	95	0	0%	0%
Pentachlorophenol	890	2,700	5,000	95	19 - 480	95	0	0%	0%
Phenacetin	220,000	780,000	NE	95	19 - 250	95	0	0%	0%
Phenol	1,800,000	18,000,000	30,000	95	7.3 - 480	95	0	0%	0%
Pronamide	460,000	4,600,000	13.6	95	4.7 - 480	95	77	81%	81%
Pyridine	7,800	100,000	NE	95	23 - 280	95	0	0%	0%
Safrole	520	7,800	NE	95	3.7 - 250	95	0	0%	0%
LLPAHs (µg/kg)									
2-Methylnaphthalene	23,000	220,000	NE	95	3.7 - 46	89	0	0%	0%
Acenaphthene	340,000	3,300,000	NE	95	3.7 - 480	91	0	0%	0%
Acenaphthylene	340,000 [4]	3,300,000 [4]	NE	95	3.7 - 46	92	0	0%	0%
Anthracene	1,700,000	17,000,000	NE	95	3.7 - 690	86	0	0%	0%
Benzo(a)anthracene	150	2,100	NE	95	3.7 - 4600	84	1	1%	1%
Benzo(a)pyrene (BaP)	15	210	NE	95	3.7 - 580	90	5	6%	5%
Benzo(b)fluoranthene	150	2,100	NE	95	3.7 - 46	88	0	0%	0%
Benzo(g,h,i)perylene	170,000 [5]	1,700,000 [5]	NE	95	3.7 - 7000	86	0	0%	0%
Benzo(k)fluoranthene	1,500	21,000	NE	95	3.7 - 46	76	0	0%	0%
Chrysene	15,000	210,000	NE	95	3.7 - 390	84	0	0%	0%
Dibenz(a,h)anthracene	15	210	NE	95	7.6 - 750	83	6	7%	6%
Fluoranthene	230,000	2,200,000	NE	95	3.7 - 220	86	0	0%	0%
Fluorene	230,000	2,200,000	NE	95	3.7 - 730	82	0	0%	0%
Indeno(1,2,3-cd)pyrene	150	2,100	NE	95	3.7 - 1200	75	1	1%	1%
Naphthalene	3,600	18,000	NE	95	3.7 - 92	93	0	0%	0%
Phenanthrene	170,000 [5]	1,700,000 [5]	NE	95	7.6 - 240	85	0	0%	0%
Pyrene	170,000	1,700,000	NE	95	3.7 - 3000	77	0	0%	0%
Pesticides (µg/kg)									
4,4'-DDD	2,000	7,200	4.88	73	3.5 - 19	68	0	0%	0%
4,4'-DDE	1,400	5,100	3.16	73	3.5 - 160	61	0	0%	0%
4,4'-DDT	1,700	7,000	5.28	73	3.5 - 160	62	0	0%	0%
Aldrin	29	100	2.00	73	1.8 - 19	73	0	0%	0%

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Analyte	Residential Soil RSLs [1]	Industrial Soil RSLs [1]	Ecological Screening Values	Number of Analyses	LOD Range	Number of ND/R Results	Number of ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values, Total Analyses
Pesticides (µg/kg)									
BHC, alpha-	77	270	6.00	73	1.8 - 19	73	0	0%	0%
BHC, beta-	270	960	5.00	73	0.95 - 4.8	60	1	2%	1%
BHC, delta-	270 [6]	960 [6]	140	73	1.8 - 19	72	0	0%	0%
BHC, gamma- (Lindane)	520	2,100	2.37	73	1.8 - 19	73	2	3%	3%
Chlordane, alpha-	1,600 [7]	6,500 [7]	3.24	73	1.8 - 19	66	0	0%	0%
Chlordane, gamma-	1,600 [7]	6,500 [7]	3.24	73	1.8 - 9.7	71	0	0%	0%
Chlorobenzilate	4,400	16,000	NE	73	180 - 250	73	0	0%	0%
Dieldrin	30	110	1.90	73	3.5 - 37	73	1	1%	1%
Endosulfan I	37,000 [8]	370,000 [8]	100	73	1.8 - 19	73	0	0%	0%
Endosulfan II	37,000 [8]	370,000 [8]	100	73	3.5 - 37	73	0	0%	0%
Endosulfan Sulfate	37,000 [8]	370,000 [8]	100	73	3.5 - 37	70	0	0%	0%
Endrin	1,800	18,000	401	73	3.5 - 37	72	0	0%	0%
Endrin Aldehyde	1,800 [9]	18,000 [9]	100	73	3.5 - 37	59	0	0%	0%
Heptachlor	110	380	400	73	1.8 - 19	72	0	0%	0%
Heptachlor Epoxide	53	190	400	73	1.8 - 19	73	0	0%	0%
Isodrin	NE	NE	3.32	73	180 - 250	73	73	100%	100%
Kepone (Chlordecone)	49	170	100	73	180 - 240	33	33	100%	45%
Methoxychlor	31,000	310,000	100	73	18 - 190	72	1	1%	1%
Toxaphene	440	1,600	100	73	88 - 920	73	24	33%	33%
Metals (mg/kg)									
Antimony	3.1	41	78	95	0.55 - 7.3	79	38	48%	40%
Arsenic	0.61	2.4	18	95	0.53 - 5.5	60	51	85%	54%
Barium	1,500	19,000	330	95	5.8 - 198	37	0	0%	0%
Beryllium	16	200	40	95	0.65 - 3.6	26	0	0%	0%
Cadmium	7	80	32	95	0.034 - 5	24	0	0%	0%
Chromium	120,000 [10]	1,500,000 [10]	57	95	6.9 - 67.2	23	2	9%	2%
Cobalt	2.3	30	13	95	8.1 - 45.2	20	20	100%	21%
Copper	310	4,100	70	95	9.8 - 291	20	13	65%	14%
Lead	400 [11]	800 [11]	120	95	0.11 - 3.6	42	0	0%	0%
Mercury	1	4.3	0.1	95	0.0091 - 0.15	55	2	4%	2%
Nickel	150	2,000	38	95	5.2 - 47.3	53	2	4%	2%
Selenium	39	510	0.52	95	0.28 - 18.2	47	32	68%	34%
Silver	39	510	560	95	0.055 - 3.6	78	0	0%	0%
Thallium	0.078	1	1	95	0.028 - 3.6	72	55	76%	58%

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Metals (mg/kg)									
Tin	4,700	61,000	50	95	2.8 - 36.5	65	0	0%	0%
Vanadium	39	510	20	95	71.3 - 407	20	20	100%	21%
Zinc	2,300	31,000	120	95	39.3 - 747	41	9	22%	9%
Total for Soils	--	--	--	19,077	--	17,530	1,969	11.2%	10.3%

Notes:

% - Percent
* - All results for the chemical were rejected.
LLPAHs - Low Level Polynuclear Aromatic Hydrocarbons
LOD - Limit of Detection
µg/kg - microgram per kilogram
mg/kg - milligrams per kilogram
NA - Not Applicable
ND - Non Detect
R - Rejected
RSLs - Regional Screening Levels

[1] June 2013 USEPA RSLs; noncarcinogenic RSLs based on a target hazard quotient of 0.1 for conservative screening purposes
[2] Value for 1,3-Dichloropropene used as a surrogate.
[3] Value for Total Xylenes used as a surrogate.
[4] Value for Acenaphthene used as a surrogate.
[5] Value for Pyrene used as a surrogate.
[6] Value for Chlordane used as a surrogate.
[7] Value for Technical BHC used as a surrogate.
[8] Value for Endosulfan used as a surrogate.
[9] Value for Endrin used as a surrogate.
[10] Value for Chromium III used as a surrogate.
[11] USEPA MCL for Lead.

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Analyte	Tap Water RSLs [1]	MCL [1]/ PRWQS	Ecological Screening Values	Number of Analyses	LOD Range	Number of ND/R Results	Number of ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values, Total Analyses
Volatile Organics (µg/L)									
1,1,1,2-Tetrachloroethane	0.5	NE	200	11	0.5	11	0	0%	0%
1,1,1-Trichloroethane	750	200	312	11	0.5	11	0	0%	0%
1,1,2,2-Tetrachloroethane	0.066	1.7	90.2	11	0.5	11	11	100%	100%
1,1,2-Trichloroethane	0.24	5	340	11	0.5	11	11	100%	100%
1,1-Dichloroethane	2.4	NE	47	11	0.5	11	0	0%	0%
1,1-Dichloroethene	26	7	2,240	11	0.5	11	0	0%	0%
1,2,3-Trichloropropane	0.00065	NE	274	11	0.5	11	11	100%	100%
1,2-Dibromo-3-chloropropane (DBCP)	0.00032	0.2	100	11	0.5	11	11	100%	100%
1,2-Dibromoethane (EDB)	0.0065	0.05	48	11	0.5	11	11	100%	100%
1,2-Dichloroethane	0.15	3.8	1,130	11	0.5	11	11	100%	100%
1,2-Dichloroethene (trans)	8.6	100	4,480	11	0.5	11	0	0%	0%
1,2-Dichloropropane	0.38	5	2,400	11	0.5	11	11	100%	100%
1,3-Dichloropropene (cis)	0.41 [2]	3.4	7.9	11	0.5	11	11	100%	100%
1,3-Dichloropropene (trans)	0.41 [2]	3.4	7.9	11	0.5	11	11	100%	100%
1,4-Dichloro-2-butene (trans)	0.0012	NE	NE	11	2	11	11	100%	100%
1,4-Dioxane (p-) *	0.67	NE	67,000	11	25	11	11	100%	100%
2-Butanone (MEK) *	490	NE	13,333	11	2.5	11	0	0%	0%
2-Chloro-1,3-butadiene (Chloroprene)	NE	NE	NE	11	0.5	11	0	0%	0%
2-Hexanone (MBK)	3.4	NE	99	11	2.5	11	0	0%	0%
3-Chloropropene (Allyl Chloride)	0.63	NE	3.4	11	0.5	11	0	0%	0%
4-Methyl-2-pentanone (MIBK)	100	NE	170	11	2.5	11	0	0%	0%
Acetone *	1200	NE	1,000	11	2.5	11	0	0%	0%
Acetonitrile	13	NE	NE	11	0.5	11	0	0%	0%
Acrolein *	0.0041	190	0.55	11	5	11	11	100%	100%
Acrylonitrile *	0.045	0.51	58.1	11	5	11	11	100%	100%
Benzene	0.39	5	109	11	0.5	7	7	100%	64%
Bromodichloromethane	0.12	5.5	2,400	11	0.5	11	11	100%	100%
Bromoform	7.9	43	640	11	0.5	11	0	0%	0%
Bromomethane	0.7	47	120	11	0.5	11	0	0%	0%
Carbon Disulfide	72	NE	15	11	0.5	8	0	0%	0%
Carbon Tetrachloride	0.39	2.3	1,500	11	0.5	11	11	100%	100%
Chlorobenzene	7.2	100	105	11	0.5	11	0	0%	0%
Chloroethane	2,100	NE	NE	11	0.5	11	0	0%	0%
Chloroform	0.19	57	815	11	0.5	11	11	100%	100%
Chloromethane	19	NE	2,700	11	0.5	11	0	0%	0%
Dibromochloromethane	0.15	4	340	11	0.5	11	11	100%	100%
Dibromomethane	0.79	NE	1,280	11	0.5	11	0	0%	0%

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SWMU 59 - FORMER VEHICLE MAINTEANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte	Tap Water RSLs [1]	MCL [1]/ PRWQS	Ecological Screening Values	Number of Analyses	LOD Range	Number of ND/R Results	Number of ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values, Total Analyses
Volatile Organics (µg/L) (cont.)									
Ethyl Methacrylate	42	NE	18,000	11	5	11	0	0%	0%
Ethylbenzene	1.3	530	4.3	11	0.5	11	0	0%	0%
Freon 11 (Trichlorofluoromethane)	110	NE	1,280	11	0.5	11	0	0%	0%
Freon-12 (Dichlorodifluoromethane)	19	NE	1,280	11	0.5	11	0	0%	0%
Isobutyl Alcohol *	460	NE	10,000	11	25	11	0	0%	0%
Methyl Acrylonitrile	0.15	NE	NE	11	5	11	11	100%	100%
Methyl Iodide	NE	NE	NE	11	0.5	11	0	0%	0%
Methyl Methacrylate	140	NE	2,800	11	5	11	0	0%	0%
Methylene Chloride	9.9	5	2,560	11	0.5	11	0	0%	0%
Pentachloroethane	0.56	NE	56.2	11	0.5	11	0	0%	0%
Propionitrile (Ethyl Cyanide) *	NE	NE	15,200	11	25	11	0	0%	0%
Styrene (Ethenylbenzene)	110	100	170	11	0.5	11	0	0%	0%
Tetrachloroethene (PCE)	9.7	5	45	11	0.5	11	0	0%	0%
Toluene	86	1,000	37	11	0.5	11	0	0%	0%
Trichloroethene (TCE)	0.44	5	40	11	0.5	11	11	100%	100%
Vinyl Acetate	41	NE	100	11	1	11	0	0%	0%
Vinyl Chloride	0.015	0.25	930	11	0.5	11	11	100%	100%
Xylene, m/p-	19 [3]	NE	NE	11	1	11	0	0%	0%
Xylene, o-	19	NE	NE	11	0.5	11	0	0%	0%
Xylenes, total	19	10,000	27	11	0.5	11	0	0%	0%
Semivolatile Organics (µg/L)									
1,2,4,5-Tetrachlorobenzene	0.12	NE	10	11	5 - 5.3	11	11	100%	100%
1,2,4-Trichlorobenzene	0.99	35	4.5	11	5 - 5.3	11	11	100%	100%
1,2-Dichlorobenzene (o-)	28	420	19.7	11	5 - 5.3	11	0	0%	0%
1,3,5-Trinitrobenzene (TNB)	46	NE	80	11	5 - 5.3	11	0	0%	0%
1,3-Dichlorobenzene (m-)	NE	320	28.5	11	5 - 5.3	11	0	0%	0%
1,3-Dinitrobenzene (m-)	0.15	NE	22	11	5 - 5.3	11	11	100%	100%
1,4-Dichlorobenzene (p-)	0.42	63	19.9	11	5 - 5.3	11	11	100%	100%
1,4-Naphthoquinone	NE	NE	NE	11	5 - 5.3	11	0	0%	0%
1,4-Phenylenediamine *	300	NE	200	11	51 - 54	11	0	0%	0%
1-Naphthylamine	NE	NE	NE	11	5 - 5.3	11	0	0%	0%
2,2'-Oxybis[1-chloropropane]	0.31	1,400	NE	11	5 - 5.3	11	11	100%	100%
2,3,4,6-Tetrachlorophenol	17	NE	8.8	11	10	11	11	100%	100%
2,4,5-Trichlorophenol	89	NE	11	11	10	11	0	0%	0%
2,4,6-Trichlorophenol	3.5	14	12.1	11	10	11	11	100%	100%
2,4-Dichlorophenol	3.5	77	1.67	11	10	11	11	100%	100%

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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte	Tap Water RSLs [1]	MCL [1]/ PRWQS	Ecological Screening Values	Number of Analyses	LOD Range	Number of ND/R Results	Number of ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values, Total Analyses
Semivolatile Organics (µg/L) (cont.)									
2,4-Dimethylphenol	27	380	131	11	10	11	0	0%	0%
2,4-Dinitrophenol	3	69	48.5	11	10	11	11	100%	100%
2,4-Dinitrotoluene (DNT)	0.2	1.1	44	11	5 - 5.3	11	11	100%	100%
2,6-Dichlorophenol	NE	NE	54	11	10	11	0	0%	0%
2,6-Dinitrotoluene (DNT)	0.042	NE	81	11	5 - 5.3	11	11	100%	100%
2-Acetylaminofluorene	0.013	NE	20	11	5 - 5.3	11	11	100%	100%
2-Chloronaphthalene	55	1,000	0.15	11	5 - 5.3	11	11	100%	100%
2-Chlorophenol	7.1	81	53	11	10	11	11	100%	100%
2-Methyl-5-nitroaniline	7	NE	220	11	5 - 5.3	11	0	0%	0%
2-Methylphenol (o-Cresol)	72	NE	102	11	10	11	0	0%	0%
2-Naphthylamine	0.033	NE	NE	11	5 - 5.3	11	11	100%	100%
2-Nitroaniline	15	NE	48.9	11	5 - 5.3	11	0	0%	0%
2-Nitrophenol	NE	NE	10,000	11	10	11	0	0%	0%
2-Picoline	NE	NE	8,979	11	5 - 5.3	11	0	0%	0%
3,3'-Dichlorobenzidine	0.11	0.21	4.5	11	5 - 5.3	11	11	100%	100%
3,3'-Dimethylbenzidine	0.0056	NE	160	11	5 - 5.3	11	11	100%	100%
3-Methylcholanthrene	0.00098	NE	NE	11	5 - 5.3	11	11	100%	100%
3-Methylphenol (m-Cresol)	72	NE	NE	11	8 - 8.4	11	0	0%	0%
3-Nitroaniline	NE	NE	9.8	11	5 - 5.3	11	0	0%	0%
4,6-Dinitro-2-methylphenol	0.12	13	23	11	10	11	11	100%	100%
4-Aminobiphenyl	0.0026	NE	NE	11	5 - 5.3	11	11	100%	100%
4-Bromophenyl-phenylether	NE	NE	1.5	11	5 - 5.3	11	11	100%	100%
4-Chloro-3-methylphenol	110	NE	0.3	11	10	11	11	100%	100%
4-Chloroaniline	0.32	NE	10	11	5 - 5.3	11	11	100%	100%
4-Chlorophenyl-phenylether	NE	NE	7.3	11	5 - 5.3	11	0	0%	0%
4-Dimethylaminoazobenzene (p-)	0.0043	NE	NE	11	5 - 5.3	11	11	100%	100%
4-Methylphenol (p-Cresol)	NE	NE	NE	11	8 - 8.4	11	0	0%	0%
4-Nitroaniline	3.3	NE	170	11	5 - 5.3	11	11	100%	100%
4-Nitrophenol	NE	NE	71.7	11	10	11	0	0%	0%
4-Nitroquinoline-1-oxide	NE	NE	NE	11	5 - 5.3	11	0	0%	0%
7,12-Dimethylbenz(a)anthracene	0.000086	NE	6	11	5 - 5.3	11	11	100%	100%
a,a-Dimethylphenethylamine	NE	NE	NE	11	50 - 53	11	0	0%	0%
Acetophenone	150	NE	1,550	11	2.5 - 2.6	11	0	0%	0%
Aniline	12	NE	294	11	5 - 5.3	11	0	0%	0%
Aramite	1.1	NE	3.09	11	5 - 5.3	11	11	100%	100%
Benzyl Alcohol	150	NE	150	11	5 - 5.3	11	0	0%	0%
Bis(2-chloroethoxy)methane	4.6	NE	1,840	11	5 - 5.3	11	11	100%	100%

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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte	Tap Water RSLs [1]	MCL [1]/ PRWQS	Ecological Screening Values	Number of Analyses	LOD Range	Number of ND/R Results	Number of ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values, Total Analyses
Semivolatile Organics (µg/L) (cont.)									
Bis(2-chloroethyl)ether	0.012	0.3	2,380	11	5 - 5.3	11	11	100%	100%
Bis(2-ethylhexyl) Phthalate (BEHP)	4.8	6	360	11	5 - 5.3	10	10	100%	91%
Butyl Benzyl Phthalate	14	1,500	29.4	11	5 - 5.3	11	0	0%	0%
Diallate (cis)	NE	NE	NE	11	5 - 5.3	11	0	0%	0%
Diallate (trans)	NE	NE	NE	11	5 - 5.3	11	0	0%	0%
Dibenzofuran	0.58	NE	33.3	11	5 - 5.3	11	11	100%	100%
Diethyl Phthalate (DEP)	1,100	17,000	75.9	11	5 - 5.3	11	0	0%	0%
Dimethyl Phthalate	NE	270,000	580	11	5 - 5.3	11	0	0%	0%
Di-n-butyl Phthalate (DBP)	67	2,000	3.4	11	5 - 5.3	11	11	100%	100%
Di-n-octyl Phthalate	16	NE	1,150	11	5 - 5.3	11	0	0%	0%
Dinoseb	1.1	7	1.7	11	5 - 5.3	11	11	100%	100%
Ethyl Methane Sulfonate (EMS)	NE	NE	40	11	5 - 5.3	11	0	0%	0%
Hexachloro-1,3-butadiene	0.26	4.4	0.32	11	5 - 5.3	11	11	100%	100%
Hexachlorobenzene	0.042	0.0028	0.077	11	5 - 5.3	11	11	100%	100%
Hexachlorocyclopentadiene	2.2	40	0.07	11	5 - 5.3	11	11	100%	100%
Hexachloroethane	0.79	14	9.4	11	5 - 5.3	11	11	100%	100%
Hexachloropropene	NE	NE	NE	11	5 - 5.3	11	0	0%	0%
Isophorone	67	350	129	11	5 - 5.3	11	0	0%	0%
Isosafrole	NE	NE	NE	11	5 - 5.3	11	0	0%	0%
Methapyrilene	NE	NE	NE	11	5 - 5.3	11	0	0%	0%
Methyl Methane Sulfonate	0.68	NE	NE	11	5 - 5.3	11	11	100%	100%
Nitrobenzene	0.12	17	66.8	11	5 - 5.3	11	11	100%	100%
n-Nitrosodiethylamine	0.00014	NE	768	11	5 - 5.3	11	11	100%	100%
n-Nitrosodimethylamine (NDMA)	0.00042	0.0069	25	11	5 - 5.3	11	11	100%	100%
n-Nitroso-di-n-butylamine	0.0024	NE	25	11	5 - 5.3	11	11	100%	100%
n-Nitrosodi-n-propylamine	0.0093	0.05	25	11	5 - 5.3	11	11	100%	100%
n-Nitrosodiphenylamine	10	33	25	11	5 - 5.3	11	0	0%	0%
n-Nitrosomethylethylamine	0.003	NE	25	11	5 - 5.3	11	11	100%	100%
n-Nitrosomorpholine	0.01	NE	NE	11	5 - 5.3	11	11	100%	100%
n-Nitrosopiperidine	0.0071	NE	NE	11	5 - 5.3	11	11	100%	100%
n-Nitrosopyrrolidine	0.032	NE	NE	11	5 - 5.3	11	11	100%	100%
o-Toluidine	NE	NE	5.2	11	5 - 5.3	11	1	9%	9%
Pentachlorobenzene	0.23	NE	129	11	5 - 5.3	11	11	100%	100%
Pentachloronitrobenzene	0.1	NE	0.12	11	5 - 5.3	11	11	100%	100%
Pentachlorophenol	0.035	1	7.9	11	10	11	11	100%	100%
Phenacetin	30	NE	NE	11	5 - 5.3	11	0	0%	0%
Phenol	450	21,000	58	11	10	11	0	0%	0%

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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte	Tap Water RSLs [1]	MCL [1]/ PRWQS	Ecological Screening Values	Number of Analyses	LOD Range	Number of ND/R Results	Number of ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values, Total Analyses
Semivolatile Organics (µg/L) (cont.)									
Pronamide	90	NE	35	11	5 - 5.3	11	0	0%	0%
Pyridine	1.5	NE	500	11	5 - 5.3	11	11	100%	100%
Safrole	0.083	NE	NE	11	5 - 5.3	11	11	100%	100%
LLPAHs (µg/L)									
2-Methylnaphthalene	2.7	NE	6	11	0.2 - 0.21	11	0	0%	0%
Acenaphthene	40	670	9.7	11	0.2 - 0.21	11	0	0%	0%
Acenaphthylene	40 [4]	670	6	11	0.2 - 0.21	11	0	0%	0%
Anthracene	130	8,300	5.35	11	0.2 - 0.21	11	0	0%	0%
Benzo(a)anthracene	0.029	0.038	0.025	11	0.2 - 0.21	11	11	100%	100%
Benzo(a)pyrene (BaP)	0.0029	0.038	10	11	0.2 - 0.21	11	11	100%	100%
Benzo(b)fluoranthene	0.029	0.038	6	11	0.2 - 0.21	11	11	100%	100%
Benzo(g,h,i)perylene	8.7 [5]	830	6	11	0.2 - 0.21	11	0	0%	0%
Benzo(k)fluoranthene	0.29	0.038	6	11	0.2 - 0.21	11	11	100%	100%
Chrysene	2.9	0.038	10	11	0.2 - 0.21	11	11	100%	100%
Dibenz(a,h)anthracene	0.0029	0.038	6	11	0.2 - 0.21	11	11	100%	100%
Fluoranthene	63	130	11	11	0.2 - 0.21	11	0	0%	0%
Fluorene	22	1,100	10	11	0.2 - 0.21	11	0	0%	0%
Indeno(1,2,3-cd)pyrene	0.029	0.038	6	11	0.2 - 0.21	11	11	100%	100%
Naphthalene	0.14	NE	23.5	11	0.2 - 0.21	10	10	100%	91%
Phenanthrene	8.7 [5]	830	8.3	11	0.2 - 0.21	10	0	0%	0%
Pyrene	8.7	830	0.248	11	0.2 - 0.21	9	0	0%	0%
Pesticides (µg/L)									
4,4'-DDD	0.027	NE	0.001	11	0.1 - 0.11	11	11	100%	100%
4,4'-DDE	0.2	NE	0.001	11	0.1 - 0.11	11	11	100%	100%
4,4'-DDT	0.2	0.0022	0.001	11	0.1 - 0.11	11	11	100%	100%
Aldrin	0.004	0.00049	0.13	11	0.05 - 0.056	11	11	100%	100%
BHC, alpha-	0.0062	0.026	2.3	11	0.05 - 0.056	11	11	100%	100%
BHC, beta-	0.022	0.091	32	11	0.05 - 0.056	11	11	100%	100%
BHC, delta-	0.022 [6]	NE	0.125	11	0.05 - 0.056	11	11	100%	100%
BHC, gamma- (Lindane)	0.036	0.2	0.016	11	0.05 - 0.056	11	11	100%	100%
Chlordane, alpha-	0.19 [7]	0.008	0.004	11	0.05 - 0.056	10	10	100%	91%
Chlordane, gamma-	0.19 [7]	0.008	0.004	11	0.05 - 0.056	11	11	100%	100%
Chlorobenzilate	0.27	NE	0.025	11	5 - 5.3	11	11	100%	100%
Dieldrin	0.0015	0.00052	0.0019	11	0.1 - 0.11	11	11	100%	100%

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Analyte	Tap Water RSLs [1]	MCL [1]/ PRWQS	Ecological Screening Values	Number of Analyses	LOD Range	Number of ND/R Results	Number of ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values, Total Analyses
Pesticides (µg/L) (cont.)									
Endosulfan I	7.8 [8]	62	0.0087	11	0.05 - 0.056	11	11	100%	100%
Endosulfan II	7.8 [8]	62	0.0087	11	0.1 - 0.11	11	11	100%	100%
Endosulfan Sulfate	7.8 [8]	62	0.92	11	0.1 - 0.11	11	0	0%	0%
Endrin	0.17	0.059	0.0023	11	0.1 - 0.11	11	11	100%	100%
Endrin Aldehyde	0.17 [9]	0.29	0.0023	11	0.1 - 0.11	11	11	100%	100%
Heptachlor	0.0018	0.00079	0.0036	11	0.05 - 0.056	11	11	100%	100%
Heptachlor Epoxide	0.0033	0.2	0.0036	11	0.05 - 0.056	11	11	100%	100%
Isodrin	NE	NE	0.12	11	5 - 5.3	11	11	100%	100%
Kepone (Chlordecone)	0.003	NE	0.094	11	5 - 5.3	11	11	100%	100%
Methoxychlor	2.7	40	0.03	11	0.5 - 0.56	11	11	100%	100%
Toxaphene	0.013	0.0028	0.0002	11	2.5 - 2.8	11	11	100%	100%
Total Metals (µg/L)									
Antimony	0.6	5.6	500	11	2	5	5	100%	45%
Arsenic	0.045	10	36	11	*All results detected*	NA	NA	NA	NA
Barium	290	2,000	16,667	11	*All results detected*	NA	NA	NA	NA
Beryllium	1.6	4	167	11	1	10	0	0%	0%
Cadmium	0.69	5	8.85	11	1	4	4	100%	36%
Chromium	16,000 [10]	100	50.4	11	*All results detected*	NA	NA	NA	NA
Cobalt	0.47	NE	45	11	*All results detected*	NA	NA	NA	NA
Copper	62	1300	3.73	11	*All results detected*	NA	NA	NA	NA
Lead	15 [11]	15	8.52	11	1	9	0	0%	0%
Mercury *	0.063	0.05	1.11	11	0.2	11	11	100%	100%
Nickel	30	610	8.28	11	1	1	0	0%	0%
Selenium	7.8	50	71.1	11	*All results detected*	NA	NA	NA	NA
Silver	7.1	NE	2.24	11	1	5	0	0%	0%
Thallium	0.016	0.24	21.3	11	1	6	6	100%	55%
Tin	930	NE	180	11	20	11	0	0%	0%
Vanadium	6.3	NE	12	11	*All results detected*	NA	NA	NA	NA
Zinc *	470	NE	85.6	11	2	11	0	0%	0%
Dissolved Metals (µg/L)									
Antimony	0.6	5.6	500	11	2	4	4	100%	36%
Arsenic	0.045	10	36	11	*All results detected*	NA	NA	NA	NA
Barium	290	2,000	16,667	11	*All results detected*	NA	NA	NA	NA
Beryllium	1.6	4	310	11	1	11	0	0%	0%

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Dissolved Metals (µg/L) (cont.)									
Cadmium	0.69	5	8.8	11	1	7	7	100%	64%
Chromium	16,000 [10]	100	50	11	2	1	0	0%	0%
Cobalt	0.47	NE	45	11	*All results detected*	NA	NA	NA	NA
Copper	62	1,300	3.1	11	*All results detected*	NA	NA	NA	NA
Lead	15 [11]	15	8.1	11	1	11	0	0%	0%
Mercury *	0.063	0.05	0.94	11	0.2	11	11	100%	100%
Nickel	30	610	8.2	11	1	3	0	0%	0%
Selenium	7.8	50	71	11	*All results detected*	NA	NA	NA	NA
Silver	7.1	NE	0.23	11	1	9	9	100%	82%
Thallium	0.016	0.24	21.3	11	1	6	6	100%	55%
Tin	930	NE	180	11	20	11	0	0%	0%
Vanadium	6.3	NE	12	11	*All results detected*	NA	NA	NA	NA
Zinc	470	NE	81	11	2	4	0	0%	0%
Total for Groundwater	--	--	--	2,453	--	2,217	1,190	53.7%	48.5%

Notes:

% - percent
* - All results for the chemical were rejected.
LLPAHs - Low Level Polynuclear Aromatic Hydrocarbons
LOD - Limit of Detection
MCL - Maximum Contaminant Level
µg/L - microgram per liter
NA - Not Analyzed
ND - Non Detected
NE - Not Established
PRWQS - Puerto Rico Water Quality Standards
R - Rejected
RSLs - Regional Screening Levels

[1] June 2013 USEPA RSLs; noncarcinogenic RSLs based on a target hazard quotient of 0.1 for conservative screening purposes
[2] Value for 1,3-Dichloropropene used as a surrogate.
[3] Value for Total Xylenes used as a surrogate.
[4] Value for Acenaphthene used as a surrogate.
[5] Value for Pyrene used as a surrogate.
[6] Value for Chlordane used as a surrogate.
[7] Value for Technical BHC used as a surrogate.
[8] Value for Endosulfan used as a surrogate.
[9] Value for Endrin used as a surrogate.
[10] Value for Chromium III used as a surrogate.
[11] USEPA MCL for Lead.

APPENDIX B

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte	Tap Water RSLs [1]	MCL [1]/ PRWQS	Ecological Screening Values	Number of Analyses	LOD Range	Number of ND/R Results	Number of ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values, Total Analyses
Volatile Organics (µg/L)									
1,1,1,2-Tetrachloroethane	0.5	NE	200	3	0.5	3	0	0%	0%
1,1,1-Trichloroethane	750	200	76	3	0.5	3	0	0%	0%
1,1,2,2-Tetrachloroethane	0.066	1.7	240	3	0.5	3	3	100%	100%
1,1,2-Trichloroethane	0.24	5	500	3	0.5	3	3	100%	100%
1,1-Dichloroethane	2.4	NE	47	3	0.5	3	0	0%	0%
1,1-Dichloroethene	26	7	65	3	0.5	3	0	0%	0%
1,2,3-Trichloropropane	0.00065	NE	274	3	0.5	3	3	100%	100%
1,2-Dibromo-3-chloropropane (DBCP)	0.00032	0.2	200	3	0.5	3	3	100%	100%
1,2-Dibromoethane (EDB)	0.0065	0.05	150	3	0.5	3	3	100%	100%
1,2-Dichloroethane	0.15	3.8	910	3	0.5	3	3	100%	100%
1,2-Dichloroethene (trans)	8.6	100	970	3	0.5	3	0	0%	0%
1,2-Dichloropropane	0.38	5	360	3	0.5	3	3	100%	100%
1,3-Dichloropropene (cis)	0.41 [2]	3.4	24.4	3	0.5	3	3	100%	100%
1,3-Dichloropropene (trans)	0.41 [2]	3.4	24.4	3	0.5	3	3	100%	100%
1,4-Dichloro-2-butene (trans)	0.0012	NE	NE	3	2	3	3	100%	100%
1,4-Dioxane (p-) *	0.67	NE	22,000	3	25	3	3	100%	100%
2-Butanone (MEK) *	490	NE	2,200	3	2.5	3	0	0%	0%
2-Chloro-1,3-butadiene (Chloroprene)	NE	NE	NE	3	0.5	3	0	0%	0%
2-Hexanone (MBK)	3.4	NE	99	3	2.5	3	0	0%	0%
3-Chloropropene (Allyl Chloride)	0.63	NE	3.4	3	0.5	3	0	0%	0%
4-Methyl-2-pentanone (MIBK)	100	NE	170	3	2.5	3	0	0%	0%
Acetone *	1,200	NE	1,700	3	2.5	3	0	0%	0%
Acetonitrile	13	NE	12,000	3	0.5	3	0	0%	0%
Acrolein *	0.0041	190	3	3	5	3	3	100%	100%
Acrylonitrile *	0.045	0.51	66	3	5	3	3	100%	100%
Benzene	0.39	5	53	3	0.5	3	3	100%	100%
Bromodichloromethane	0.12	5.5	2,400	3	0.5	2	2	100%	67%
Bromoform	7.9	43	230	3	0.5	3	0	0%	0%
Bromomethane	0.7	47	16	3	0.5	3	0	0%	0%
Carbon Disulfide	72	NE	15	3	0.5	2	0	0%	0%
Carbon Tetrachloride	0.39	2.3	240	3	0.5	3	3	100%	100%
Chlorobenzene	7.2	100	47	3	0.5	3	0	0%	0%
Chloroethane	2,100	NE	NE	3	0.5	3	0	0%	0%
Chloroform	0.19	57	140	3	0.5	2	2	100%	67%
Chloromethane	19	NE	5,500	3	0.5	3	0	0%	0%
Dibromochloromethane	0.15	4	340	3	0.5	2	2	100%	67%
Dibromomethane	0.79	NE	220	3	0.5	3	0	0%	0%

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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte	Tap Water RSLs [1]	MCL [1]/ PRWQS	Ecological Screening Values	Number of Analyses	LOD Range	Number of ND/R Results	Number of ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values, Total Analyses
Volatile Organics (µg/L) (cont.)									
Ethyl Methacrylate	42	NE	18,000	3	5	3	0	0%	0%
Ethylbenzene	1.3	530	14	3	0.5	3	0	0%	0%
Freon 11 (Trichlorofluoromethane)	110	NE	220	3	0.5	3	0	0%	0%
Freon-12 (Dichlorodifluoromethane)	19	NE	220	3	0.5	3	0	0%	0%
Isobutyl Alcohol *	460	NE	4,000	3	25	3	0	0%	0%
Methyl Acrylonitrile	0.15	NE	NE	3	5	3	3	100%	100%
Methyl Iodide	NE	NE	NE	3	0.5	3	0	0%	0%
Methyl Methacrylate	140	NE	2,800	3	5	3	0	0%	0%
Methylene Chloride	9.9	5	159	3	0.5	3	0	0%	0%
Pentachloroethane	0.56	NE	56.4	3	0.5	3	0	0%	0%
Propionitrile (Ethyl Cyanide) *	NE	NE	15,200	3	25	3	0	0%	0%
Styrene (Ethenylbenzene)	110	100	32	3	0.5	3	0	0%	0%
Tetrachloroethene (PCE)	9.7	5	45	3	0.5	3	0	0%	0%
Toluene	86	1,000	175	3	0.5	3	0	0%	0%
Trichloroethene (TCE)	0.44	5	47	3	0.5	3	3	100%	100%
Vinyl Acetate	41	NE	248	3	1	3	0	0%	0%
Vinyl Chloride	0.015	0.25	930	3	0.5	3	3	100%	100%
Xylene, m/p-	19 [3]	NE	NE	3	1	3	0	0%	0%
Xylene, o-	19	NE	NE	3	0.5	3	0	0%	0%
Xylenes, total	19	10,000	27	3	0.5	3	0	0%	0%
Semivolatile Organics (µg/L)									
1,2,4,5-Tetrachlorobenzene	0.12	NE	3	3	5 - 5.1	3	3	100%	100%
1,2,4-Trichlorobenzene	0.99	35	30	3	5 - 5.1	3	3	100%	100%
1,2-Dichlorobenzene (o-)	28	420	14	3	5 - 5.1	3	0	0%	0%
1,3,5-Trinitrobenzene (TNB)	46	NE	80	3	5 - 5.1	3	0	0%	0%
1,3-Dichlorobenzene (m-)	NE	320	38	3	5 - 5.1	3	0	0%	0%
1,3-Dinitrobenzene (m-)	0.15	NE	22	3	5 - 5.1	3	3	100%	100%
1,4-Dichlorobenzene (p-)	0.42	63	9.4	3	5 - 5.1	3	3	100%	100%
1,4-Naphthoquinone	NE	NE	0.4	3	5 - 5.1	3	3	100%	100%
1,4-Phenylenediamine *	300	NE	200	3	51 - 52	3	0	0%	0%
1-Naphthylamine	NE	NE	NE	3	5 - 5.1	3	0	0%	0%
2,2'-Oxybis[1-chloropropane]	0.31	1,400	NE	3	5 - 5.1	3	3	100%	100%
2,3,4,6-Tetrachlorophenol	17	NE	1.2	3	10	3	3	100%	100%
2,4,5-Trichlorophenol	89	NE	62.5	3	10	3	0	0%	0%
2,4,6-Trichlorophenol	3.5	14	4.9	3	10	3	3	100%	100%
2,4-Dichlorophenol	3.5	77	11	3	10	3	3	100%	100%

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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte	Tap Water RSLs [1]	MCL [1]/ PRWQS	Ecological Screening Values	Number of Analyses	LOD Range	Number of ND/R Results	Number of ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values, Total Analyses
Semivolatile Organics (µg/L) (cont.)									
2,4-Dimethylphenol	27	380	21.2	3	10	3	0	0%	0%
2,4-Dinitrophenol	3	69	6.2	3	10	3	3	100%	100%
2,4-Dinitrotoluene (DNT)	0.2	1.1	44	3	5 - 5.1	3	3	100%	100%
2,6-Dichlorophenol	NE	NE	34	3	10	3	0	0%	0%
2,6-Dinitrotoluene (DNT)	0.042	NE	81	3	5 - 5.1	3	3	100%	100%
2-Acetylaminofluorene	0.013	NE	20	3	5 - 5.1	3	3	100%	100%
2-Chloronaphthalene	55	1,000	32	3	5 - 5.1	3	0	0%	0%
2-Chlorophenol	7.1	81	24	3	10	3	3	100%	100%
2-Methyl-5-nitroaniline	7	NE	220	3	5 - 5.1	3	0	0%	0%
2-Methylphenol (o-Cresol)	72	NE	67	3	10	3	0	0%	0%
2-Naphthylamine	0.033	NE	NE	3	5 - 5.1	3	3	100%	100%
2-Nitroaniline	15	NE	48.9	3	5 - 5.1	3	0	0%	0%
2-Nitrophenol	NE	NE	3,500	3	10	3	0	0%	0%
2-Picoline	NE	NE	8,970	3	5 - 5.1	3	0	0%	0%
3,3'-Dichlorobenzidine	0.11	0.21	4.5	3	5 - 5.1	3	3	100%	100%
3,3'-Dimethylbenzidine	0.0056	NE	160	3	5 - 5.1	3	3	100%	100%
3-Methylcholanthrene	0.00098	NE	NE	3	5 - 5.1	3	3	100%	100%
3-Methylphenol (m-Cresol)	72	NE	NE	3	8 - 8.2	3	0	0%	0%
3-Nitroaniline	NE	NE	9.8	3	5 - 5.1	3	0	0%	0%
4,6-Dinitro-2-methylphenol	0.12	13	23	3	10	3	3	100%	100%
4-Aminobiphenyl	0.0026	NE	NE	3	5 - 5.1	3	3	100%	100%
4-Bromophenyl-phenylether	NE	NE	1.5	3	5 - 5.1	3	3	100%	100%
4-Chloro-3-methylphenol	110	NE	0.3	3	10	3	3	100%	100%
4-Chloroaniline	0.32	NE	232	3	5 - 5.1	3	3	100%	100%
4-Chlorophenyl-phenylether	NE	NE	7.3	3	5 - 5.1	3	0	0%	0%
4-Dimethylaminoazobenzene (p-)	0.0043	NE	NE	3	5 - 5.1	3	3	100%	100%
4-Methylphenol (p-Cresol)	NE	NE	NE	3	8 - 8.2	3	0	0%	0%
4-Nitroaniline	3.3	NE	170	3	5 - 5.1	3	3	100%	100%
4-Nitrophenol	NE	NE	60	3	10	3	0	0%	0%
4-Nitroquinoline-1-oxide	NE	NE	NE	3	5 - 5.1	3	0	0%	0%
7,12-Dimethylbenz(a)anthracene	0.000086	NE	6	3	5 - 5.1	3	3	100%	100%
a,a-Dimethylphenethylamine	NE	NE	NE	3	50 - 51	3	0	0%	0%
Acetophenone	150	NE	1,550	3	2.5 - 2.6	3	0	0%	0%
Aniline	12	NE	4.1	3	5 - 5.1	3	3	100%	100%
Aramite	1.1	NE	3.09	3	5 - 5.1	3	3	100%	100%
Benzyl Alcohol	150	NE	8.6	3	5 - 5.1	3	0	0%	0%
Bis(2-chloroethoxy)methane	4.6	NE	1,840	3	5 - 5.1	3	3	100%	100%

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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte	Tap Water RSLs [1]	MCL [1]/ PRWQS	Ecological Screening Values	Number of Analyses	LOD Range	Number of ND/R Results	Number of ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values, Total Analyses
Semivolatile Organics (µg/L) (cont.)									
Bis(2-chloroethyl)ether	0.012	0.3	2,380	3	5 - 5.1	3	3	100%	100%
Bis(2-ethylhexyl) Phthalate (BEHP)	4.8	6	0.3	3	5 - 5.1	3	3	100%	100%
Butyl Benzyl Phthalate	14	1,500	22	3	5 - 5.1	3	0	0%	0%
Diallate (cis)	NE	NE	NE	3	5 - 5.1	3	0	0%	0%
Diallate (trans)	NE	NE	NE	3	5 - 5.1	3	0	0%	0%
Dibenzofuran	0.58	NE	4	3	5 - 5.1	3	3	100%	100%
Diethyl Phthalate (DEP)	1,100	17,000	110	3	5 - 5.1	3	0	0%	0%
Dimethyl Phthalate	NE	270,000	330	3	5 - 5.1	3	0	0%	0%
Di-n-butyl Phthalate (DBP)	67	2,000	9.4	3	5 - 5.1	3	0	0%	0%
Di-n-octyl Phthalate	16	NE	30	3	5 - 5.1	3	0	0%	0%
Dinoseb	1.1	7	0.48	2	5 - 5.1	2	2	100%	100%
Ethyl Methane Sulfonate (EMS)	NE	NE	40	3	5 - 5.1	3	0	0%	0%
Hexachloro-1,3-butadiene	0.26	4.4	0.93	3	5 - 5.1	3	3	100%	100%
Hexachlorobenzene	0.042	0.0028	0.13	3	5 - 5.1	3	3	100%	100%
Hexachlorocyclopentadiene	2.2	40	0.07	3	5 - 5.1	3	3	100%	100%
Hexachloroethane	0.79	14	8	3	5 - 5.1	3	3	100%	100%
Hexachloropropene	NE	NE	NE	3	5 - 5.1	3	0	0%	0%
Isophorone	67	350	920	3	5 - 5.1	3	0	0%	0%
Isosafrole	NE	NE	NE	3	5 - 5.1	3	0	0%	0%
Methapyrilene	NE	NE	NE	3	5 - 5.1	3	0	0%	0%
Methyl Methane Sulfonate	0.68	NE	NE	3	5 - 5.1	3	3	100%	100%
Nitrobenzene	0.12	17	220	3	5 - 5.1	3	3	100%	100%
n-Nitrosodiethylamine	0.00014	NE	768	3	5 - 5.1	3	3	100%	100%
n-Nitrosodimethylamine (NDMA)	0.00042	0.0069	NE	3	5 - 5.1	3	3	100%	100%
n-Nitroso-di-n-butylamine	0.0024	NE	NE	3	5 - 5.1	3	3	100%	100%
n-Nitrosodi-n-propylamine	0.0093	0.05	NE	3	5 - 5.1	3	3	100%	100%
n-Nitrosodiphenylamine	10	33	NE	3	5 - 5.1	3	0	0%	0%
n-Nitrosomethylethylamine	0.003	NE	NE	3	5 - 5.1	3	3	100%	100%
n-Nitrosomorpholine	0.01	NE	NE	3	5 - 5.1	3	3	100%	100%
n-Nitrosopiperidine	0.0071	NE	NE	3	5 - 5.1	3	3	100%	100%
n-Nitrosopyrrolidine	0.032	NE	NE	3	5 - 5.1	3	3	100%	100%
o-Toluidine	NE	NE	5.2	3	5 - 5.1	3	0	0%	0%
Pentachlorobenzene	0.23	NE	0.019	3	5 - 5.1	3	3	100%	100%
Pentachloronitrobenzene	0.1	NE	1	3	5 - 5.1	3	3	100%	100%
Pentachlorophenol	0.035	1	15	3	10	3	3	100%	100%
Phenacetin	30	NE	NE	3	5 - 5.1	3	0	0%	0%
Phenol	450	21,000	180	3	10	3	0	0%	0%

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Analyte	Tap Water RSLs [1]	MCL [1]/ PRWQS	Ecological Screening Values	Number of Analyses	LOD Range	Number of ND/R Results	Number of ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values, Total Analyses
Semivolatile Organics (µg/L) (cont.)									
Pronamide	90	NE	7.6	3	5 - 10	3	1	33%	33%
Pyridine	1.5	NE	2,380	3	5 - 5.1	3	3	100%	100%
Safrole	0.083	NE	NE	3	5 - 5.1	3	3	100%	100%
LLPAHs (µg/L)									
2-Methylnaphthalene	2.7	NE	14.56	3	0.2 - 0.21	3	0	0%	0%
Acenaphthene	40	670	23	3	0.2 - 0.21	3	0	0%	0%
Acenaphthylene	40 [4]	670	6	3	0.2 - 0.21	3	0	0%	0%
Anthracene	130	8,300	0.035	3	0.2 - 0.21	3	3	100%	100%
Benzo(a)anthracene	0.029	0.038	0.025	3	0.2 - 0.21	3	3	100%	100%
Benzo(a)pyrene (BaP)	0.0029	0.038	0.014	3	0.2 - 0.21	3	3	100%	100%
Benzo(b)fluoranthene	0.029	0.038	6	3	0.2 - 0.21	3	3	100%	100%
Benzo(g,h,i)perylene	8.7 [5]	830	6	3	0.2 - 0.21	3	0	0%	0%
Benzo(k)fluoranthene	0.29	0.038	6	3	0.2 - 0.21	3	3	100%	100%
Chrysene	2.9	0.038	10	3	0.2 - 0.21	3	3	100%	100%
Dibenz(a,h)anthracene	0.0029	0.038	6	3	0.2 - 0.21	3	3	100%	100%
Fluoranthene	63	130	8.1	3	0.2	1	0	0%	0%
Fluorene	22	1100	19	3	0.2 - 0.21	3	0	0%	0%
Indeno(1,2,3-cd)pyrene	0.029	0.038	6	3	0.2 - 0.21	3	3	100%	100%
Naphthalene	0.14	NE	13	3	0.2 - 0.21	3	3	100%	100%
Phenanthrene	8.7 [5]	830	6.3	3	0.2 - 0.21	3	0	0%	0%
Pyrene	8.7	830	0.3	3	0.2	1	0	0%	0%
Pesticides (µg/L)									
4,4'-DDD	0.027	NE	0.001	3	0.1	3	3	100%	100%
4,4'-DDE	0.2	NE	0.001	3	0.1	2	2	100%	67%
4,4'-DDT	0.2	0.0022	0.001	3	0.1	2	2	100%	67%
Aldrin	0.004	0.00049	0.017	3	0.05 - 0.051	3	3	100%	100%
BHC, alpha-	0.0062	0.026	2.3	3	0.05 - 0.051	3	3	100%	100%
BHC, beta-	0.022	0.091	32	3	0.05 - 0.051	3	3	100%	100%
BHC, delta-	0.022 [6]	NE	1.2	3	0.05 - 0.051	3	3	100%	100%
BHC, gamma- (Lindane)	0.036	0.2	0.026	3	0.05 - 0.051	3	3	100%	100%
Chlordane, alpha-	0.19 [7]	0.008	0.0043	3	0.05 - 0.051	3	3	100%	100%
Chlordane, gamma-	0.19 [7]	0.008	0.0043	3	0.05 - 0.051	3	3	100%	100%
Chlorobenzilate	0.27	NE	20	3	5 - 5.1	3	3	100%	100%
Dieldrin	0.0015	0.00052	0.056	3	0.1	3	3	100%	100%

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Analyte	Tap Water RSLs [1]	MCL [1]/ PRWQS	Ecological Screening Values	Number of Analyses	LOD Range	Number of ND/R Results	Number of ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values, Total Analyses
Pesticides (µg/L) (cont.)									
Endosulfan I	7.8 [8]	62	0.056	3	0.05 - 0.051	3	0	0%	0%
Endosulfan II	7.8 [8]	62	0.056	3	0.1	3	3	100%	100%
Endosulfan Sulfate	7.8 [8]	62	0.92	3	0.1	3	0	0%	0%
Endrin	0.17	0.059	0.036	3	0.1	3	3	100%	100%
Endrin Aldehyde	0.17 [9]	0.29	0.036	3	0.1	3	3	100%	100%
Heptachlor	0.0018	0.00079	0.0038	3	0.05 - 0.051	3	3	100%	100%
Heptachlor Epoxide	0.0033	0.2	0.0038	3	0.05 - 0.051	3	3	100%	100%
Isodrin	NE	NE	0.12	3	5 - 5.1	3	3	100%	100%
Kepone (Chlordecone)	0.003	NE	11.2	3	5 - 5.1	3	3	100%	100%
Methoxychlor	2.7	40	0.03	3	0.5 - 0.51	3	3	100%	100%
Toxaphene	0.013	0.0028	0.0002	3	2.5 - 2.6	3	3	100%	100%
Total Metals (µg/L)									
Antimony	0.6	5.6	80	3	2	1	1	100%	33%
Arsenic	0.045	10	150	3	*All results detected*	NA	NA	NA	NA
Barium	290	2,000	220	3	*All results detected*	NA	NA	NA	NA
Beryllium	1.6	4	1.69	3	1	3	0	0%	0%
Cadmium	0.69	5	0.11	3	1	3	3	100%	100%
Calcium	NE	NE	NE	1	*All results detected*	NA	NA	NA	NA
Chromium	16,000 [10]	100	33.3	3	*All results detected*	NA	NA	NA	NA
Cobalt	0.47	NE	24	3	*All results detected*	NA	NA	NA	NA
Copper	62	1,300	3.46	3	*All results detected*	NA	NA	NA	NA
Lead	15 [11]	15	0.73	3	1	3	3	100%	100%
Magnesium	NE	NE	NE	1	5000	1	0	0%	0%
Mercury	0.063	0.05	0.91	3	0.2	3	3	100%	100%
Nickel	30	610	19.55	3	1	3	0	0%	0%
Selenium	7.8	50	5	3	*All results detected*	NA	NA	NA	NA
Silver	7.1	NE	0.51	3	1	3	3	100%	100%
Thallium	0.016	0.24	4	3	1	3	3	100%	100%
Tin	930	NE	180	3	20	3	0	0%	0%
Vanadium	6.3	NE	12	3	*All results detected*	NA	NA	NA	NA
Zinc	470	NE	44.8	3	2	2	0	0%	0%
Dissolved Metals (µg/L)									
Antimony	0.6	5.6	80	3	2	1	1	100%	33%
Arsenic	0.045	10	150	3	*All results detected*	NA	NA	NA	NA

APPENDIX B

NON-DETECT LOD VALUES COMPARED TO SCREENING VALUES - SURFACE WATER
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte	Tap Water RSLs [1]	MCL [1]/ PRWQS	Ecological Screening Values	Number of Analyses	LOD Range	Number of ND/R Results	Number of ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values, Total Analyses
Dissolved Metals (µg/L) (cont.)									
Barium	290	2,000	220	3	*All results detected*	NA	NA	NA	NA
Beryllium	1.6	4	1.83	3	1	3	0	0%	0%
Cadmium	0.69	5	0.11	3	1	3	3	100%	100%
Chromium	16,000 [10]	100	29.8	3	*All results detected*	NA	NA	NA	NA
Cobalt	0.47	NE	24	3	*All results detected*	NA	NA	NA	NA
Copper	62	1,300	3.46	3	*All results detected*	NA	NA	NA	NA
Lead	15 [11]	15	0.74	3	1	3	3	100%	100%
Mercury	0.063	0.05	0.77	3	0.2	3	3	100%	100%
Nickel	30	610	20.3	3	1	3	0	0%	0%
Selenium	7.8	50	4.61	3	*All results detected*	NA	NA	NA	NA
Silver	7.1	NE	0.47	3	1	3	3	100%	100%
Thallium	0.016	0.24	4	3	1	3	3	100%	100%
Tin	930	NE	180	3	20	3	0	0%	0%
Vanadium	6.3	NE	12	3	*All results detected*	NA	NA	NA	NA
Zinc	470	NE	46	3	*All results detected*	NA	NA	NA	NA
Total for Groundwater	--	--	--	670	--	609	336	55.2%	50.1%

Notes:

% - percent
* - All results for the chemical were rejected.
LLPAHs - Low Level Polynuclear Aromatic Hydrocarbons
LOD - Limit of Detection
MCL - Maximum Contaminant Level
µg/L - microgram per liter

NA - Not Analyzed
ND - Non Detected
NE - Not Established
PRWQS - Puerto Rico Water Quality Standards
RSLs - Regional Screening Levels

[1] June 2013 USEPA RSLs; noncarcinogenic RSLs based on a target hazard quotient of 0.1 for conservative screening purposes
[2] Value for 1,3-Dichloropropene used as a surrogate.
[3] Value for Total Xylenes used as a surrogate.
[4] Value for Acenaphthene used as a surrogate.
[5] Value for Pyrene used as a surrogate.
[6] Value for Chlordane used as a surrogate.
[7] Value for Technical BHC used as a surrogate.
[8] Value for Endosulfan used as a surrogate.
[9] Value for Endrin used as a surrogate.
[10] Value for Chromium III used as a surrogate.
[11] USEPA MCL for Lead.

APPENDIX B

NON-DETECT LOD VALUES COMPARED TO SCREENING VALUES - SEDIMENT
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte	Residential Soil RSLs [1]	Industrial Soil RSLs [1]	Ecological Screening Values	Number of Analyses	LOD Range	Number of ND/R Results	Number of ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values, Total Analyses
Volatile Organics (µg/kg)									
1,1,1,2-Tetrachloroethane	1,900	9,300	1,617	3	6.7 - 12	3	0	0%	0%
1,1,1-Trichloroethane	870,000	3,800,000	438	3	6.7 - 12	3	0	0%	0%
1,1,2,2-Tetrachloroethane	560	2,800	1,127	3	6.7 - 12	3	0	0%	0%
1,1,2-Trichloroethane	1,100	5,300	1,088	3	6.7 - 12	3	0	0%	0%
1,1-Dichloroethane	3,300	17,000	56.8	3	6.7 - 12	3	0	0%	0%
1,1-Dichloroethene	24,000	110,000	170	3	6.7 - 12	3	0	0%	0%
1,2,3-Trichloropropane	5	95	938	3	6.7 - 12	3	3	100%	100%
1,2-Dibromo-3-chloropropane (DBCP)	5.4	69	839	3	6.7 - 12	3	3	100%	100%
1,2-Dibromoethane (EDB)	34	170	291	3	6.7 - 12	3	0	0%	0%
1,2-Dichloroethane	430	2,200	533	3	6.7 - 12	3	0	0%	0%
1,2-Dichloroethene (trans)	15,000	69,000	2,208	3	6.7 - 12	3	0	0%	0%
1,2-Dichloropropane	940	4,700	654	3	6.7 - 12	3	0	0%	0%
1,3-Dichloropropene (cis)	1,700 [2]	8,300 [2]	54.3	3	6.7 - 12	3	0	0%	0%
1,3-Dichloropropene (trans)	1,700 [2]	8,300 [2]	50.7	3	6.7 - 12	3	0	0%	0%
1,4-Dichloro-2-butene (trans)	6.9	35	NE	3	27 - 47	3	3	100%	100%
1,4-Dioxane (p-) *	4,900	17,000	251	3	340 - 590	3	3	100%	100%
2-Butanone (MEK)	2,800,000	20,000,000	87.1	3	17 - 29	3	0	0%	0%
2-Chloro-1,3-butadiene (Chloroprene)	NE	NE	NE	3	6.7 - 12	3	0	0%	0%
2-Hexanone (MBK)	21,000	140,000	47.3	3	17 - 29	3	0	0%	0%
3-Chloropropene (Allyl Chloride)	680	3,400	5.64	3	6.7 - 12	3	3	100%	100%
4-Methyl-2-pentanone (MIBK)	530,000	5,300,000	69.3	3	17 - 29	3	0	0%	0%
Acetone	6,100,000	63,000,000	20.8	3	26	1	1	100%	33.3%
Acetonitrile	87,000	370,000	117	3	6.7 - 12	3	0	0%	0%
Acrolein *	15	65	0.062	3	67 - 120	3	3	100%	100%
Acrylonitrile	240	1,200	2.44	3	67 - 120	3	3	100%	100%
Benzene	1,100	5,400	138	3	6.7 - 12	3	0	0%	0%
Bromodichloromethane	270	1,400	5,848	3	6.7 - 12	3	0	0%	0%
Bromoform	62,000	220,000	987	3	6.7 - 12	3	0	0%	0%
Bromomethane	730	3,200	4.97	3	6.7 - 12	3	3	100%	100%
Carbon Disulfide	82,000	370,000	29.1	3	6.7 - 12	2	0	0%	0%
Carbon Tetrachloride	610	3,000	2,434	3	6.7 - 12	3	0	0%	0%
Chlorobenzene	29,000	140,000	640	3	6.7 - 12	3	0	0%	0%
Chloroethane	1,500,000	6,100,000	6,070	3	6.7 - 12	3	0	0%	0%
Chloroform	290	1,500	227	3	6.7 - 12	3	0	0%	0%
Chloromethane	12,000	50,000	907	3	6.7 - 12	3	0	0%	0%
Dibromochloromethane	680	3,300	971	3	6.7 - 12	3	0	0%	0%
Dibromomethane	2,500	11,000	147	3	6.7 - 12	3	0	0%	0%

APPENDIX B

NON-DETECT LOD VALUES COMPARED TO SCREENING VALUES - SEDIMENT
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte	Residential Soil RSLs [1]	Industrial Soil RSLs [1]	Ecological Screening Values	Number of Analyses	LOD Range	Number of ND/R Results	Number of ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values, Total Analyses
Volatile Organics (µg/kg) (cont.)									
Ethyl Methacrylate	150,000	750,000	13,827	3	67 - 120	3	0	0%	0%
Ethylbenzene	5,400	27,000	4.00	3	6.7 - 12	3	3	100%	100%
Freon 11 (Trichlorofluoromethane)	79,000	340,000	1,419	3	6.7 - 12	3	0	0%	0%
Freon-12 (Dichlorodifluoromethane)	9,400	40,000	614	3	6.7 - 12	3	0	0%	0%
Isobutyl Alcohol *	1,800,000	18,000,000	459	3	340 - 590	3	2	66.7%	66.7%
Methyl Acrylonitrile	760	9,200	NE	3	67 - 120	3	0	0%	0%
Methyl Iodide	NE	NE	NE	3	6.7 - 12	3	0	0%	0%
Methyl Methacrylate	480,000	2,100,000	1,337	3	67 - 120	3	0	0%	0%
Methylene Chloride	56,000	960,000	56.6	3	6.7 - 12	3	0	0%	0%
Pentachloroethane	5,400	19,000	1,207	3	6.7 - 12	3	0	0%	0%
Propionitrile (Ethyl Cyanide) *	NE	NE	459	3	340 - 590	3	2	66.7%	66.7%
Styrene (Ethenylbenzene)	630,000	3,600,000	522	3	6.7 - 12	3	0	0%	0%
Tetrachloroethene (PCE)	22,000	110,000	57.0	3	6.7 - 12	3	0	0%	0%
Toluene	500,000	4,500,000	1,857	3	6.7 - 12	3	0	0%	0%
Trichloroethene (TCE)	910	6,400	456	3	6.7 - 12	3	0	0%	0%
Vinyl Acetate	97,000	410,000	27.2	3	6.7 - 12	3	0	0%	0%
Vinyl Chloride	60	1,700	583	3	6.7 - 12	3	0	0%	0%
Xylene, m/p-	59,000 [3]	250,000 [3]	NE	3	13 - 24	2	0	0%	0%
Xylene, o-	69,000	300,000	NE	3	6.7 - 12	3	0	0%	0%
Xylenes, total	63,000	270,000	4.00	3	6.7 - 12	2	2	100%	66.7%
Semivolatile Organics (µg/kg)									
1,2,4,5-Tetrachlorobenzene	1,800	18,000	2,295	3	310 - 360	3	0	0%	0%
1,2,4-Trichlorobenzene	22,000	99,000	4.80	3	310 - 360	3	3	100%	100%
1,2-Dichlorobenzene (o-)	190,000	980,000	13.0	3	310 - 360	3	3	100%	100%
1,3,5-Trinitrobenzene (TNB)	220,000	2,700,000	24.3	3	310 - 360	3	3	100%	100%
1,3-Dichlorobenzene (m-)	NE	NE	2,761	3	310 - 360	3	0	0%	0%
1,3-Dinitrobenzene (m-)	610	6,200	13.8	3	310 - 360	3	3	100%	100%
1,4-Dichlorobenzene (p-)	2,400	12,000	110	3	310 - 360	3	3	100%	100%
1,4-Naphthoquinone	NE	NE	0.40	3	310 - 360	3	3	100%	100%
1,4-Phenylenediamine *	1,200,000	12,000,000	2.14	3	3100 - 3600	3	3	100%	100%
1-Naphthylamine	NE	NE	NE	3	310 - 360	3	0	0%	0%
2,2'-Oxybis[1-chloropropane]	4,600	22,000	NE	3	310 - 360	3	0	0%	0%
2,3,4,6-Tetrachlorophenol	180,000	1,800,000	597	3	600 - 700	3	3	100%	100%
2,4,5-Trichlorophenol	610,000	6,200,000	3.00	3	600 - 700	3	3	100%	100%
2,4,6-Trichlorophenol	44,000	160,000	6.00	3	600 - 700	3	3	100%	100%
2,4-Dichlorophenol	18,000	180,000	0.21	3	600 - 700	3	3	100%	100%

APPENDIX B

NON-DETECT LOD VALUES COMPARED TO SCREENING VALUES - SEDIMENT
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte	Residential Soil RSLs (1)	Industrial Soil RSLs (1)	Ecological Screening Values	Number of Analyses	LOD Range	Number of ND/R Results	Number of ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values, Total Analyses
Semivolatile Organics (µg/kg) (cont.)									
2,4-Dimethylphenol	120,000	1,200,000	18.0	3	600 - 700	3	3	100%	100%
2,4-Dinitrophenol	12,000	120,000	4.35	3	600 - 700	3	3	100%	100%
2,4-Dinitrotoluene (DNT)	1,600	5,500	87.5	3	310 - 360	3	3	100%	100%
2,6-Dichlorophenol	NE	NE	361	3	600 - 700	3	3	100%	100%
2,6-Dinitrotoluene (DNT)	330	1,200	117	3	310 - 360	3	3	100%	100%
2-Acetylaminofluorene	130	450	490	3	310 - 360	3	3	100%	100%
2-Chloronaphthalene	630,000	8,200,000	1,413	3	310 - 360	3	0	0%	0%
2-Chlorophenol	39,000	510,000	0.33	3	600 - 700	3	3	100%	100%
2-Methyl-5-nitroaniline	54,000	190,000	318	3	310 - 360	3	2	66.7%	66.7%
2-Methylphenol (o-Cresol)	310,000	3,100,000	8.00	3	600 - 700	3	3	100%	100%
2-Naphthylamine	270	960	NE	3	310 - 360	3	3	100%	100%
2-Nitroaniline	61,000	600,000	67.7	3	310 - 360	3	3	100%	100%
2-Nitrophenol	NE	NE	4,228	3	600 - 700	3	0	0%	0%
2-Picoline	NE	NE	2,325	3	310 - 360	3	0	0%	0%
3,3'-Dichlorobenzidine	1,100	3,800	267	3	310 - 360	3	3	100%	100%
3,3'-Dimethylbenzidine	44	160	1,449	3	310 - 360	3	3	100%	100%
3-Methylcholanthrene	5.2	78	NE	3	310 - 360	3	3	100%	100%
3-Methylphenol (m-Cresol)	310,000	3,100,000	NE	3	450 - 530	3	0	0%	0%
3-Nitroaniline	NE	NE	4.58	3	310 - 360	3	3	100%	100%
4,6-Dinitro-2-methylphenol	490	4,900	58.6	3	600 - 700	3	3	100%	100%
4-Aminobiphenyl	23	82	NE	3	310 - 360	3	3	100%	100%
4-Bromophenyl-phenylether	NE	NE	656	3	310 - 360	3	0	0%	0%
4-Chloro-3-methylphenol	610,000	6,200,000	7.03	3	600 - 700	3	3	100%	100%
4-Chloroaniline	2,400	8,600	321	3	310 - 360	3	2	66.7%	66.7%
4-Chlorophenyl-phenylether	NE	NE	602	3	310 - 360	3	0	0%	0%
4-Dimethylaminoazobenzene (p-)	110	370	NE	3	310 - 360	3	3	100%	100%
4-Methylphenol (p-Cresol)	NE	NE	NE	3	450 - 530	3	0	0%	0%
4-Nitroaniline	24,000	86,000	83.0	3	310 - 360	3	3	100%	100%
4-Nitrophenol	NE	NE	95.1	3	600 - 700	3	3	100%	100%
4-Nitroquinoline-1-oxide	NE	NE	NE	3	310 - 360	3	0	0%	0%
7,12-Dimethylbenz(a)anthracene	0.43	6.2	405,612	3	310 - 360	3	3	100%	100%
a,a-Dimethylphenethylamine	NE	NE	NE	3	690 - 1000	3	0	0%	0%
Acetophenone	780,000	10,000,000	1,333	3	150 - 180	3	0	0%	0%
Aniline	85,000	300,000	0.79	3	310 - 360	3	3	100%	100%
Aramite	19,000	69,000	3,552	3	310 - 360	3	0	0%	0%
Benzyl Alcohol	610,000	6,200,000	52.0	3	310 - 360	3	3	100%	100%
Bis(2-chloroethoxy)methane	18,000	180,000	211	3	310 - 360	3	3	100%	100%

APPENDIX B

NON-DETECT LOD VALUES COMPARED TO SCREENING VALUES - SEDIMENT
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte	Residential Soil RSLs (1)	Industrial Soil RSLs (1)	Ecological Screening Values	Number of Analyses	LOD Range	Number of ND/R Results	Number of ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values, Total Analyses
Semivolatile Organics (µg/kg) (cont.)									
Bis(2-chloroethyl)ether	210	1,000	774	3	310 - 360	3	3	100%	100%
Bis(2-ethylhexyl) Phthalate (BEHP)	35,000	120,000	180	3	*All results detected*	NA	NA	NA	NA
Butyl Benzyl Phthalate	260,000	910,000	63.0	3	310 - 360	2	2	100%	66.7%
Diallate (cis)	NE	NE	NE	3	310 - 360	3	0	0%	0%
Diallate (trans)	NE	NE	NE	3	310 - 360	3	0	0%	0%
Dibenzofuran	7,800	100,000	110	3	310 - 360	3	3	100%	100%
Diethyl Phthalate (DEP)	4,900,000	49,000,000	630	3	310 - 360	3	0	0%	0%
Dimethyl Phthalate	NE	NE	6.00	3	310 - 360	3	3	100%	100%
Di-n-butyl Phthalate (DBP)	610,000	6,200,000	58.0	3	310 - 360	3	3	100%	100%
Di-n-octyl Phthalate	61,000	620,000	61.0	3	310 - 360	3	3	100%	100%
Dinoseb	6,100	62,000	42.8	2	310 - 360	2	2	100%	100%
Ethyl Methane Sulfonate (EMS)	NE	NE	0.94	3	310 - 360	3	3	100%	100%
Hexachloro-1,3-butadiene	6,200	22,000	55.0	3	310 - 360	3	3	100%	100%
Hexachlorobenzene	300	1,100	20.0	3	310 - 360	3	3	100%	100%
Hexachlorocyclopentadiene	37,000	370,000	292	3	310 - 360	3	3	100%	100%
Hexachloroethane	12,000	43,000	73.0	3	310 - 360	3	3	100%	100%
Hexachloropropene	NE	NE	NE	3	310 - 360	3	0	0%	0%
Isophorone	510,000	1,800,000	907	3	310 - 360	3	0	0%	0%
Isosafrole	NE	NE	NE	3	310 - 360	3	0	0%	0%
Methapyrilene	NE	NE	NE	3	310 - 360	3	0	0%	0%
Methyl Methane Sulfonate	4,900	17,000	NE	3	310 - 360	3	0	0%	0%
Nitrobenzene	4,800	24,000	21.0	3	310 - 360	3	3	100.0%	100.0%
n-Nitrosodiethylamine	0.77	11	47.8	3	310 - 360	3	3	100.0%	100.0%
n-Nitrosodimethylamine (NDMA)	2.3	34	0.14	3	310 - 360	3	3	100.0%	100.0%
n-Nitroso-di-n-butylamine	87	400	123	3	310 - 360	3	3	100.0%	100.0%
n-Nitrosodi-n-propylamine	69	250	12.5	3	310 - 360	3	3	100.0%	100.0%
n-Nitrosodiphenylamine	99,000	350,000	28.0	3	310 - 360	3	3	100.0%	100.0%
n-Nitrosomethylethylamine	22	78	0.40	3	310 - 360	3	3	100.0%	100.0%
n-Nitrosomorpholine	73	260	NE	3	310 - 360	3	3	100.0%	100.0%
n-Nitrosopiperidine	52	180	NE	3	310 - 360	3	3	100.0%	100.0%
n-Nitrosopyrrolidine	230	820	NE	3	310 - 360	3	3	100.0%	100.0%
o-Toluidine	NE	NE	2.17	3	310 - 360	3	3	100.0%	100.0%
Pentachlorobenzene	4,900	49,000	59.1	3	310 - 360	3	3	100.0%	100.0%
Pentachloronitrobenzene	1,900	6,600	765	3	310 - 360	3	0	0%	0%
Pentachlorophenol	890	2,700	17.0	3	600 - 700	3	3	100.0%	100.0%
Phenacetin	220,000	780,000	NE	3	310 - 360	3	0	0%	0%
Phenol	1,800,000	18,000,000	130	3	600 - 700	3	3	100.0%	100.0%

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NON-DETECT LOD VALUES COMPARED TO SCREENING VALUES - SEDIMENT
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte	Residential Soil RSLs [1]	Industrial Soil RSLs [1]	Ecological Screening Values	Number of Analyses	LOD Range	Number of ND/R Results	Number of ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values, Total Analyses
Semivolatile Organics (µg/kg) (cont.)									
Pronamide	460,000	4,600,000	450	3	310 - 690	3	1	33.3%	33.3%
Pyridine	7,800	100,000	228	3	310 - 360	3	3	100.0%	100.0%
Safrole	520	7,800	NE	3	310 - 360	3	0	0%	0%
LLPAHs (µg/kg)									
2-Methylnaphthalene	23,000	220,000	20.2	3	310 - 360	2	2	100.0%	66.7%
Acenaphthene	340,000	3,300,000	6.7	3	17 - 360	3	3	100.0%	100%
Acenaphthylene	340,000 [4]	3,300,000 [4]	5.9	3	310 - 360	2	2	100.0%	66.7%
Anthracene	1,700,000	17,000,000	57.2	3	310 - 360	2	2	100.0%	66.7%
Benzo(a)anthracene	150	2,100	108	3	310 - 360	2	2	100.0%	66.7%
Benzo(a)pyrene (BaP)	15	210	150	3	17 - 360	3	3	100.0%	100%
Benzo(b)fluoranthene	150	2,100	1,800	3	17 - 360	3	2	66.7%	66.7%
Benzo(g,h,i)perylene	170,000 [5]	1,700,000 [5]	170	3	17 - 360	3	2	66.7%	66.7%
Benzo(k)fluoranthene	1,500	21,000	240	3	17 - 360	3	2	66.7%	66.7%
Chrysene	15,000	210,000	166	3	310 - 360	2	2	100.0%	66.7%
Dibenz(a,h)anthracene	15	210	33.0	3	17 - 360	3	3	100.0%	100%
Fluoranthene	230,000	2,200,000	423	3	360	1	0	0%	0%
Fluorene	230,000	2,200,000	77.4	3	310 - 360	2	2	100.0%	66.7%
Indeno(1,2,3-cd)pyrene	150	2,100	200	3	310 - 360	2	2	100.0%	66.7%
Naphthalene	3,600	18,000	176	3	17 - 360	3	2	66.7%	66.7%
Phenanthrene	170,000 [5]	1,700,000 [5]	204	3	310 - 360	2	2	100.0%	66.7%
Pyrene	170,000	1,700,000	195	3	360	1	1	100%	33.3%
Pesticides (µg/kg)									
4,4'-DDD	2,000	7,200	4.88	3	*All results detected*	NA	NA	NA	NA
4,4'-DDE	1,400	5,100	3.16	3	*All results detected*	NA	NA	NA	NA
4,4'-DDT	1,700	7,000	5.28	3	6 - 7	2	2	100.0%	66.7%
Aldrin	29	100	2.00	3	3.5 - 3.6	2	2	100%	66.7%
BHC, alpha-	77	270	6.00	3	3.1 - 3.6	3	0	0%	0%
BHC, beta-	270	960	5.00	3	1.5 - 1.8	3	0	0%	0%
BHC, delta-	270 [6]	960 [6]	140	3	3.1 - 3.6	3	0	0%	0%
BHC, gamma- (Lindane)	520	2,100	2.37	3	3.1 - 3.6	3	3	100.0%	100.0%
Chlordane, alpha-	1,600 [7]	6,500 [7]	3.24	3	3.1	1	0	0%	0%
Chlordane, gamma-	1,600 [7]	6,500 [7]	3.24	3	3.1	1	0	0%	0%
Chlorobenzilate	4,400	16,000	NE	3	310 - 360	3	0	0%	0%
Dieldrin	30	110	1.90	3	6 - 7	2	2	100.0%	66.7%

APPENDIX B

NON-DETECT LOD VALUES COMPARED TO SCREENING VALUES - SEDIMENT
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analyte	Residential Soil RSLs [1]	Industrial Soil RSLs [1]	Ecological Screening Values	Number of Analyses	LOD Range	Number of ND/R Results	Number of ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values	% ND/R Results Exceeding Screening Values, Total Analyses
Pesticides (µg/kg) (cont.)									
Endosulfan I	37,000 [8]	370,000 [8]	12.6	3	3.1 - 3.6	3	0	0%	0%
Endosulfan II	37,000 [8]	370,000 [8]	12.6	3	6 - 7	3	0	0%	0%
Endosulfan Sulfate	37,000 [8]	370,000 [8]	76.6	3	6 - 7	3	0	0%	0%
Endrin	1,800	18,000	2.22	3	6 - 7	3	3	100.0%	100.0%
Endrin Aldehyde	1,800 [9]	18,000 [9]	2.22	3	6	1	1	100%	33.3%
Heptachlor	110	380	0.30	3	3.1 - 3.5	2	2	100.0%	66.7%
Heptachlor Epoxide	53	190	2.47	3	3.1 - 3.6	3	3	100.0%	100.0%
Isodrin	NE	NE	6,183	3	310 - 360	3	0	0%	0%
Kepone (Chlordecone)	49	170	38,161	3	310 - 360	3	3	100.0%	100.0%
Methoxychlor	31,000	310,000	62.1	3	31 - 36	3	0	0%	0%
Toxaphene	440	1,600	0.10	3	150 - 180	3	3	100.0%	100.0%
Metals (mg/kg)									
Antimony	3.1	41	2.00	3	2.1	1	1	100%	33.3%
Arsenic	0.61	2.4	9.79	3	*All results detected*	NA	NA	NA	NA
Barium	1,500	19,000	20.0	3	*All results detected*	NA	NA	NA	NA
Beryllium	16	200	NE	3	*All results detected*	NA	NA	NA	NA
Cadmium	7	80	0.99	3	*All results detected*	NA	NA	NA	NA
Chromium	120,000 [10]	1,500,000 [10]	43.4	3	*All results detected*	NA	NA	NA	NA
Cobalt	2.3	30	50.0	3	*All results detected*	NA	NA	NA	NA
Copper	310	4,100	31.6	13	*All results detected*	NA	NA	NA	NA
Lead	400 [11]	800 [11]	35.8	13	0.81 - 1.1	2	0	0%	0%
Mercury	1	4.3	0.18	3	*All results detected*	NA	NA	NA	NA
Nickel	150	2,000	22.7	3	*All results detected*	NA	NA	NA	NA
Selenium	39	510	2.00	3	*All results detected*	NA	NA	NA	NA
Silver	39	510	1.00	3	*All results detected*	NA	NA	NA	NA
Thallium	0.078	1	NE	3	1	1	1	100%	33.3%
Tin	4,700	61,000	3.40	3	8.1 - 10.5	3	3	100.0%	100.0%
Vanadium	39	510	57.0	3	*All results detected*	NA	NA	NA	NA
Zinc	2,300	31,000	121	13	*All results detected*	NA	NA	NA	NA
TOC (mg/kg)									
Total Organic Carbon	NE	NE	NE	3	*All results detected*	NA	NA	NA	NA
Total for Soils	--	--	--	650	--	536	286	53.4%	44.0%

APPENDIX B

NON-DETECT LOD VALUES COMPARED TO SCREENING VALUES - SEDIMENT
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Notes:

% - percent
* - All results for the chemical were rejected.
LLPAHs - Low Level Polynuclear Aromatic Hydrocarbons
LOD - Limit of Detection
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram
NA - Not Applicable
ND - Non Detected
NE - Not Established
RSLs - Regional Screening Levels

(1) June 2013 USEPA RSLs; noncarcinogenic RSLs based on a target hazard quotient of 0.1 for conservative screening purposes
(2) Value for 1,3-Dichloropropene used as a surrogate.
(3) Value for Total Xylenes used as a surrogate.
(4) Value for Acenaphthene used as a surrogate.
(5) Value for Pyrene used as a surrogate.
(6) Value for Chlordane used as a surrogate.
(7) Value for Technical BHC used as a surrogate.
(8) Value for Endosulfan used as a surrogate.
(9) Value for Endrin used as a surrogate.
(10) Value for Chromium III used as a surrogate.
(11) USEPA MCL for Lead.

APPENDIX C
DATA VALIDATION REPORT SUMMARIES

DataQual

Environmental Services, LLC

Michael Baker, Jr., Inc.
Airside Business Park
100 Airside Drive
Moon Township, PA 15108

October 4, 2010

SDG# R1002745, CompuChem
NAPR SWMU 59; Ceiba, Puerto Rico

Dear Mr. Kimes,

The following Data Validation report is provided as requested for the parameters noted in the table below for SDG # R1002745. The data validation was performed in accordance with the SW-846 methods utilized by the laboratory and professional judgment. Region II has not developed a validation checklist SOP for the methods used to assess the inorganic methods in this SDG (SW-846 method 6010B and the lab SOP for AVS/SEM). Therefore, alternative worksheets were provided. Region II flagging conventions were used. All areas of concern are discussed in the body of the report and a summary of data qualification is provided.

Sample ID	Lab ID	Matrix	AVS/SEM
59SD02	R1002745-001	sediment	X
59SD03	R1002745-002	sediment	X

There were no quality control samples provided with this SDG. The samples were evaluated based on the following criteria:

- Data Completeness *
- Sample Condition *
- Technical Holding Times *
- Initial/Continuing Calibrations *
- ICSA/ICSAB Standards *
- CRDL Standards *
- Blanks *
- Laboratory Control Samples *
- Matrix Spike Recoveries *
- Matrix Duplicate RPDs *
- Serial Dilutions
- Field Duplicates *
- Identification/Quantitation *
- Reporting Limits *

* - indicates that qualifications were not required based on this criteria

Overall Evaluation of Data/Potential Usability Issues

A summary of qualifications applied to the sample results are noted below for the fractions validated. Specific details regarding qualification of the data are addressed in the Specific Evaluation section of this narrative. If an issue is not addressed there were no actions required based on unmet quality criteria. When more than one qualifier is associated with a compound/analyte the validator has chosen the qualifier that best indicates possible bias in the results and flagged the data accordingly. However, information regarding all quality control issues is provided in the body of the report and on the qualification summary page.

AVS/SEM

The serial dilution analysis exhibited a non-compliant %D for lead. Results for lead were qualified as estimated J/UJ.

Specific Evaluation of Data

Data Completeness

The SDG was received complete and intact. Resubmissions were not required.

Technical Holding Times

According to chain of custody records, sampling was performed on 5/20/10 and samples were received at the laboratory 5/21/10. All sample preparation and analysis was performed within Region II and/or method holding time requirements.

Serial Dilution

AVS/SEM

All results for lead were qualified as estimated J/UJ due to a serial dilution %D greater than 10% (14%).

A summary of qualifications required is provided on the following page. Please do not hesitate to contact DataQual ES with any questions regarding this validation report.

Sincerely,

Jacqueline Cleveland

Jacqueline Cleveland
Vice-President

Summary of Data Qualifications

AVS/SEM

Sample ID	Analyte	Results	Q flag
all samples	lead	+/-	J/UJ

Glossary of Qualification Flags and Abbreviations

Qualification Flags (Q-Flags)

U	not detected above the reported sample quantitation limit
J	estimated value
UJ	reported quantitation limit is qualified as estimated
N	analyte has been tentatively identified
JN	analyte has been tentatively identified, estimated value
R	result is rejected; the presence or absence of the analyte cannot be verified

Method/Preparation/Field QC Blank Qualification Flags (Q-Flags)

Organic Methods

NA	The sample result for the blank contaminant is greater than the RL (2X sample RL for common laboratory contaminants) when the blank value is less than the RL. The sample result for the blank contaminant is not qualified with any blank qualifiers.
U*	The sample result for the blank contaminant is less than the RL (2X sample RL for common laboratory contaminants) but greater than the MDL when the blank value is less than the RL. The sample result for the blank contaminant is qualified as non-detect U at the reported concentration.
RL**	The sample result for the blank contaminant is less than the RL (2X sample RL for common laboratory contaminants) but greater than the MDL when the blank value is less than the RL. The sample result for the blank contaminant is changed to the RL and qualified as non-detect U.

* This guideline is used when the laboratory is reporting non-detects to the MDL. ** This guideline is used when the laboratory is reporting non-detects to the RL.

Inorganic Methods

ICB/CCB/PB Action:

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U*/ RL** -	The sample result is greater than or equal to the MDL but less than or equal to the RL, result is reported as non-detect at the reported concentration or at the RL, when the FB result is less or greater than the RL.

Glossary of Qualification Flags and Abbreviations, continued

R -	Sample result is greater than the RL and less than the ICB/CCB/PB value when the ICB/CCB/PB value is greater than the RL.
J -	Sample result is greater than the ICB/CCB/PB value but less than 10X the ICB/CCB/PB value when ICB/CCB/PB value is greater than the RL.
J/UJ -	Sample result is less than 10X RL when blank result is below the negative RL.

Field QC Blank action:

Note – Use field blanks to qualify data only if field blank results are greater than prep blank results.
Do not use rinsate blank associated with soils to qualify water samples and vice versa.

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U* / RL** -	The sample result is greater than or equal to the MDL but less than or equal to the RL, result is reported as non-detect at the reported concentration or at the RL, when the FB result is less or greater than the RL.
R -	Sample result is greater than the RL and less than the FB value when the FB value is greater than the RL.
J -	Sample result is greater than the FB value but less than 10X the FB value when FB value is greater than the RL.

* This guideline is used when the laboratory is reporting non-detects to the MDL. ** This guideline is used when the laboratory is reporting non-detects to the RL.

General Abbreviations

RL	reporting limit
IDL	instrument detection limit
MDL	method detection limit
CRDL	contract required detection limit
CRQL	contract required quantitation limit
+	positive result
-	non-detect result

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	Compuchem	**Service Request:**	R1002745
Project:	SWMU 59/Puerto Rico	**Date Collected:**	5/20/10 1130
Sample Matrix:	Soil	**Date Received:**	5/21/10
		Pre-Prep Date:	6/1/10
Sample Name:	59SD02		
Lab Code:	R1002745-001	**Basis:**	Dry
		Percent Solids:	50.3

Acid Volatile Sulfide and Selected Simultaneously Extractable Metals in Sediment Draft 1991
Inorganic Parameters

Pre-Prep Method: 821/R-91-100

Analyte Name	Method	Result	Q	Units	MRL	Dilution Factor	Date Extracted	Date Analyzed
Cadmium	6010B	0.00305		µMole/g	0.00086	1	6/ 3/10	6/7/10 15:30
Copper	6010B	0.588		µMole/g	0.0061	1	6/ 3/10	6/7/10 15:30
Lead	6010B	0.0710	J	µMole/g	0.0047	1	6/ 3/10	6/7/10 15:30
Nickel	6010B	0.075		µMole/g	0.013	1	6/ 3/10	6/7/10 15:30
Silver	6010B	0.0018	U	µMole/g	0.0018	1	6/ 3/10	6/7/10 15:30
Zinc	6010B	0.92		µMole/g	0.30	5	6/ 3/10	6/7/10 15:06

10/10

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	Compuchem	**Service Request:**	R1002745
Project:	SWMU 59/Puerto Rico	**Date Collected:**	5/20/10 1130
Sample Matrix:	Soil	**Date Received:**	5/21/10
		Pre-Prep Date:	6/1/10
Sample Name:	59SD02		
Lab Code:	R1002745-001	**Basis:**	Dry
		Percent Solids:	50.3

Acid Volatile Sulfide and Selected Simultaneously Extractable Metals in Sediment Draft 1991
General Chemistry Parameters

Pre-Prep Method: 821/R-91-100

Analyte Name	Method	Result	Q	Units	MRL	Dilution Factor	Date Extracted	Date Analyzed
Sulfide, Acid-Volatile	821/R-91-100	0.17	U	µMole/g	0.17	1	NA	6/1/10 09:00

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	Compuchem	**Service Request:**	R1002745
Project:	SWMU 59/Puerto Rico	**Date Collected:**	5/20/10 1150
Sample Matrix:	Soil	**Date Received:**	5/21/10
		Pre-Prep Date:	6/1/10
Sample Name:	59SD03		
Lab Code:	R1002745-002	**Basis:**	Dry
		Percent Solids:	62.5

Acid Volatile Sulfide and Selected Simultaneously Extractable Metals in Sediment Draft 1991
Inorganic Parameters

Pre-Prep Method: 821/R-91-100

Analyte Name	Method	Result	Q	Units	MRL	Dilution Factor	Date Extracted	Date Analyzed
Cadmium	6010B	0.00269		µMole/g	0.00069	1	6/ 3/10	6/7/10 16:04
Copper	6010B	0.339		µMole/g	0.0049	1	6/ 3/10	6/7/10 16:04
Lead	6010B	0.0485	J	µMole/g	0.0037	1	6/ 3/10	6/7/10 16:04
Nickel	6010B	0.066		µMole/g	0.011	1	6/ 3/10	6/7/10 16:04
Silver	6010B	0.0014	U	µMole/g	0.0014	1	6/ 3/10	6/7/10 16:04
Zinc	6010B	1.12		µMole/g	0.47	10	6/ 3/10	6/7/10 15:40

J.C. 10.10

Comments:

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	Compuchem	**Service Request:**	R1002745
Project:	SWMU 59/Puerto Rico	**Date Collected:**	5/20/10 1150
Sample Matrix:	Soil	**Date Received:**	5/21/10
		Pre-Prep Date:	6/1/10
Sample Name:	59SD03		
Lab Code:	R1002745-002	**Basis:**	Dry
		Percent Solids:	62.5

Acid Volatile Sulfide and Selected Simultaneously Extractable Metals in Sediment Draft 1991
General Chemistry Parameters

Pre-Prep Method: 821/R-91-100

Analyte Name	Method	Result	Q	Units	MRL	Dilution Factor	Date Extracted	Date Analyzed
Sulfide, Acid-Volatile	821/R-91-100	0.15		µMole/g	0.14	1	NA	6/1/10 09:00

Comments:

DataQual

Environmental Services, LLC

Michael Baker, Jr., Inc.
Airside Business Park
100 Airside Drive
Moon Township, PA 15108

September 7, 2010

SDG# 1004193, CompuChem
NAPR SWMU 59; Ceiba, Puerto Rico

Dear Mr. Kimes,

The following Data Validation report is provided as requested for the parameters noted in the table below for SDG # 1004193. The data validation was performed in accordance with the SW-846 methods utilized by the laboratory, the Region II Standard Operating Procedures for the Validation of Organic Data Acquired Using SW-846 Methods (8260B-Rev 2, January 2006- SOP #HW-24, 8270D-Rev 3, October 2006-SOP #HW-22, 8081B SOP # HW-44, Rev 1 October 2006) and professional judgment. Region II has not developed a validation checklist SOP for the methods used to assess the inorganic methods in this SDG (SW-846 methods 6010B, 6020 and 7471A). Therefore, alternative worksheets were provided. Region II flagging conventions were used. All areas of concern are discussed in the body of the report and a summary of data qualification is provided.

Sample ID	Lab ID	Matrix	VOA App IX	SVOA App IX w/ LL PAH	Pesticides	Metals, ICP-MS	Select Metals 6010B
59ER01	1004193-03	water	X	X	X	X	X
59ER02	1004193-05	water	X	X	X	X	X
59ER03	1004193-06	water	X	X	X	X	X
59ER04	1004193-07	water	X	X	X	X	X
59FB01	1004193-02	water	X	X	X	X	X
59SW01	1004193-01	water	X	X	X	X	X
59TB01	1004193-04	water	X				
59TB02	1004193-08	water	X				
59TB03	1004193-09	water	X				

The following quality control samples were provided with this SDG: samples 59ER01, 59ER02, 59ER03, 59ER04-equipment blanks; sample 59FB01-field blank; and samples 59TB01, 59TB02 and 59TB03-trip blanks.

The samples were evaluated based on the following criteria:

- Data Completeness *
- Sample Condition *
- Technical Holding Times *
- GC/MS Tuning *

• ICP-MS Tuning	*
• GC Performance	*
• Initial/Continuing Calibrations	
• ICSA/ICSAB Standards	*
• CRDL Standards	*
• Blanks	
• GC/MS Internal Standards	*
• ICP-MS Internal Standards	*
• Surrogate Recoveries	*
• Laboratory Control Samples	
• Matrix Spike Recoveries	NA
• Matrix Duplicate RPDs	NA
• Serial Dilutions	*
• Field Duplicates	NA
• Identification/Quantitation	
• Reporting Limits	*
• Tentatively Identified Compounds	NA

* - indicates that qualifications were not required based on this criteria

Overall Evaluation of Data/Potential Usability Issues

A summary of qualifications applied to the sample results are noted below for the fractions validated. Specific details regarding qualification of the data are addressed in the Specific Evaluation section of this narrative. If an issue is not addressed there were no actions required based on unmet quality criteria. When more than one qualifier is associated with a compound/analyte the validator has chosen the qualifier that best indicates possible bias in the results and flagged the data accordingly. However, information regarding all quality control issues is provided in the body of the report and on the qualification summary page.

VOA

The initial and continuing calibrations exhibited some compounds with low RRF values, which resulted in qualifying non-detected values as rejected for these compounds. Due to high %D values, in the continuing calibration, some compounds were qualified as estimated.

Blank contamination was noted in the method and/or QC blanks associated with samples in this batch. Qualifications were added to the data.

Due to below low recoveries for LCS samples, the associated sample results were qualified for one or more compounds.

SVOA

Due to high %RSDs and %D values, in the initial and continuing calibrations, some compounds were qualified as estimated.

Due to below low recoveries for LCS samples, the associated sample results were qualified for one or more compounds.

Pesticides

The associated LCS exhibited low recoveries for one compound which was rejected based on Region II guidelines.

All results that exhibited column quantitation %Ds greater than 25% were qualified based on Region II guidelines.

Metals by 6020 & 7471

Blank contamination was noted and qualification was required in the samples in this SDG.

All results reported at concentrations between the method detection limit and the reporting limits (B flagged by the laboratory) were qualified as estimated J.

Select Metals by 6010B

Blank contamination was noted and qualification was required in the samples in this SDG.

All results reported at concentrations between the method detection limit and the reporting limits (B flagged by the laboratory) were qualified as estimated J.

Specific Evaluation of Data

Data Completeness

The SDG was received complete and intact. Resubmissions were not required.

Technical Holding Times

According to chain of custody records, sampling was performed on 4/19-22/10 and samples were received at the laboratory 4/21-24/10. All sample preparation and analysis was performed within Region II and/or method holding time requirements.

Initial/Continuing Calibration

VOA

Calibration standards exhibited %Ds and RRF values that were non-compliant. A summary of these non-compliances and affected samples are noted in the following table. Sample results are qualified as indicated.

Standard ID	Compound(s)	RRF, %RSD, %D	Samples	Q Flag
IC 4/28/10	acrolein acrylonitrile 2-butanone propionitrile isobutyl alcohol	0.019 0.031 0.048 0.010 0.003	all samples	J/R
CC 4/30/10	acetone 1,4-dioxane	0.023 0.0007	59SW01, 59FB01, 59ER01, 59TB01, 59ER02, 59ER03, 59TB02, 59TB03	J/R
	acetonitrile vinyl acetate methacrylonitrile trichloroethene 4-methyl-2-pentanone 1,1,2-trichloroethane ethylmethacrylate 2-hexanone 1,2-dibromoethane 1,2,3-trichloropropane 1,1,2,2-tetrachloroethane trans-1,4-dichloro-2-butene 1,2-dibromo-3-chloropropane	-25.69 -30.48 -30.25 31.47 -42.36 -21.84 -21.68 -42.96 -23.02 -22.60 -20.96 -32.12 -36.90		J/UJ
CC 5/03/10	trichlorofluoromethane acetonitrile pentachloroethane trichloroethene 4-methyl-2-pentanone 2-hexanone 1,2-dibromoethane trans-1,4-dichloro-2-butene	-38.44 -23.54 -26.24 35.72 -32.78 -29.39 -20.67 -27.63	59ER04	J/UJ

SVOA

Calibration standards exhibited %RSDs and %D values that were non-compliant. A summary of these non-compliances and affected samples are noted in the following table. Sample results are qualified as indicated.

Standard ID	Compound(s)	RRF, %RSD, %D	Samples	Q Flag
IC full scan 5/21/10	benzyl alcohol p-phenylenediamine 2,4-dinitrophenol 1,3,5-trinitrophenol a,a-dimethylphenethylamine	19.093 41.224 16.534 16.247 25.651	all samples	J/UJ

Standard ID	Compound(s)	RRF, %RSD, %D	Samples	Q Flag
CC SIM 5/05/10 5/05/10	2-methylnaphthalene	-22.36/-28.33	PAH SIM: all samples	J/UJ
CC SIM 5/05/10	benzo(k)fluoranthene	22.50	PAH SIM: 59SW01, 59FB01, 59ER01, 59ER02	J/UJ
CC SIM 5/05/10	naphthalene fluorene chrysene benzo(g,h,i)perylene	-22.06 -20.21 -27.44 -27.01	PAH SIM: 59ER03, 59ER04	J/UJ

Blanks

VOA

The associated method and/or QC blanks exhibited contamination as noted in the following table. Compounds for which there was no action required, are not included in the following table, see worksheets for full list of compounds.

Blank ID	Compound	Concentration	Reporting Limit
VBLKKH	methylene chloride	0.23J ug/L	0.5 ug/L
	toluene	0.044J	0.5
59TB01	methylene chloride	0.19J	0.5
	toluene	0.041J	0.5
59ER01	acetone	3.4	2.5
	methylene chloride	4.6	0.5
	2-butanone	1.1J	2.5
	chloroform	0.086J	0.5
	toluene	1.8	0.5
	chlorobenzene	0.27J	0.5
59FB01	acetone	3	2.5
	methylene chloride	5.5	0.5
	2-butanone	1.2J	2..5
	chloroform	0.12J	0.5
	toluene	2.4	0.5
	chlorobenzene	0.34J	0.5

Associated samples and required qualifications are noted in the following table.

Sample ID	Compound	Q Flag
59SW01	methylene chloride	U at RL
59SW01	toluene	U at RL
59SW01	acetone	U at RL

Metals by 6020 & 7471

Associated blanks exhibited contamination as noted in the following table. Please see the Glossary of Qualification Flags and Abbreviations for details.

Blank ID	Analyte	Concentration	Action Level	Q Flag
PBW	lead	0.072B ug/L	RL	U at RL
ICB	antimony	0.253B ug/L	RL	U at RL
59ER01	nickel	0.12B ug/L	RL	U at RL
59FB01	zinc	2.2 ug/L	10X blank level	J

Associated samples and required qualifications are noted in the following table.

Sample ID	Analyte	Q Flag
59SW01	lead	U at RL
	antimony	U at RL
	nickel	U at RL
59SW01	zinc	J

Select Metals by 6010B

Associated blanks exhibited contamination as noted in the following table. Please see the Glossary of Qualification Flags and Abbreviations for details.

Blank ID	Analyte	Concentration	Action Level	Q Flag
CCB	magnesium	36.7B ug/L	RL	U at RL

Associated samples and required qualifications are noted in the following table.

Sample ID	Analyte	Q Flag
59SW01	magnesium	U at RL

Laboratory Control Sample

VOA

The LCS samples associated with all samples exhibited low recoveries for 1, 2-dibromoethane at 78% and 79% (QC limit 80-120%); therefore results for this compound were qualified as estimated (J/UJ).

SVOA

The submitted LCS/LSCD associated with all samples exhibited zero percent recovery for p-phenylenediamine; therefore all non-detected results for this compound were qualified as rejected (R).

Pesticides

The submitted LCS/LSCD associated with all samples exhibited recoveries below the QC limit (50/53) for endrin aldehyde; therefore all non-detected results for this compound were rejected R based on Region II guidelines.

Identification/Quantitation

Pesticides

Several positive results were reported with P flags to indicate that the column quantitation %D was greater than 25%. These results were qualified based on Region II guidelines. Specific results and flags are noted in the following table.

Sample ID	Compound	%D	Flag
59ER01	dieldrin	171	U at RL
59ER04	dieldrin	139.4	U at RL
59SW01	gamma-BHC	60.5	U at RL
	4,4'-DDT	37.5	J

Metals by 6020 & 7471

All results reported at concentrations between the method detection limit and the reporting limit (B flagged by the laboratory) were qualified as estimated J.

Select Metals by 6010B

All results reported at concentrations between the method detection limit and the reporting limit (B flagged by the laboratory) were qualified as estimated J.

A summary of qualifications required is provided on the following page. Please do not hesitate to contact DataQual ES with any questions regarding this validation report.

Sincerely,

Laura Maschhoff
President

Jacqueline Cleveland
Vice-President

Summary of Data Qualifications

VOA

Sample ID	Compound	Results	Q flag
all samples	acrolein acrylonitrile 2-butanone propionitrile isobutyl alcohol	+/-	J/R
59SW01, 59FB01, 59ER01, 59TB01, 59ER02, 59ER03, 59TB02, 59TB03	acetone 1,4-dioxane	+/-	J/R
59SW01, 59FB01, 59ER01, 59TB01, 59ER02, 59ER03, 59TB02, 59TB03	acetonitrile vinyl acetate methacrylonitrile trichloroethene 4-methyl-2-pentanone 1,1,2-trichloroethane ethylmethacrylate 2-hexanone 1,2-dibromoethane 1,2,3-trichloropropane 1,1,2,2-tetrachloroethane trans-1,4-dichloro-2-butene 1,2-dibromo-3-chloropropane	+/-	J/UJ
59ER04	trichlorofluoromethane acetonitrile pentachloroethane trichloroethene 4-methyl-2-pentanone 2-hexanone 1,2-dibromoethane trans-1,4-dichloro-2-butene	+/-	J/UJ
59SW01	methylene chloride	+	U at RL
59SW01	toluene	+	U at RL
59SW01	acetone	+	U at RL
all samples	1,2-dibromoethane	+/-	J/UJ

SVOA

Sample ID	Compound	Results	Q flag
all samples	benzyl alcohol p-phenylenediamine 2,4-dinitrophenol 1,3,5-trinitrophenol a,a-dimethylphenethylamine	+/-	J/UJ
PAH SIM: all samples	2-methylnaphthalene	+/-	J/UJ
PAH SIM: 59SW01, 59FB01, 59ER01, 59ER02	benzo(k)fluoranthene	+/-	J/UJ
PAH SIM: 59ER03, 59ER04	naphthalene fluorene chrysene benzo(g,h,i)perylene	+/-	J/UJ
all samples	p-phenylenediamine	+/-	J/R

Summary of Data Qualifications

Pesticides

Sample ID	Compound	Results	Q flag
all samples	endrin aldehyde	-	R
59ER01	dieldrin	+JP	U at RL
59ER04	dieldrin	+JP	U at RL
59SW01	gamma-BHC	+JP	U at RL
	4,4'-DDT	+J	J

Metals by 6020 & 7471

Sample ID	Analyte	Results	Q flag
59SW01	lead	+B	U at RL
	antimony	+B	U at RL
	nickel	+B	U at RL
59SW01	zinc	>RL up to 10x blank level	J
all samples	all analytes	+B	J

Select Metals by 6010B

Sample ID	Analyte	Results	Q flag
59SW01	magnesium	+B	U at RL
all samples	all analytes	+B	J

Glossary of Qualification Flags and Abbreviations

Qualification Flags (Q-Flags)

U	not detected above the reported sample quantitation limit
J	estimated value
UJ	reported quantitation limit is qualified as estimated
N	analyte has been tentatively identified
JN	analyte has been tentatively identified, estimated value
R	result is rejected; the presence or absence of the analyte cannot be verified

Method/Preparation/Field QC Blank Qualification Flags (Q-Flags)

Organic Methods

NA	The sample result for the blank contaminant is greater than the RL (2X sample RL for common laboratory contaminants) when the blank value is less than the RL. The sample result for the blank contaminant is not qualified with any blank qualifiers.
U*	The sample result for the blank contaminant is less than the RL (2X sample RL for common laboratory contaminants) but greater than the MDL when the blank value is less than the RL. The sample result for the blank contaminant is qualified as non-detect U at the reported concentration.
RL**	The sample result for the blank contaminant is less than the RL (2X sample RL for common laboratory contaminants) but greater than the MDL when the blank value is less than the RL. The sample result for the blank contaminant is changed to the RL and qualified as non-detect U.

* This guideline is used when the laboratory is reporting non-detects to the MDL. ** This guideline is used when the laboratory is reporting non-detects to the RL.

Inorganic Methods

ICB/CCB/PB Action:

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U -	The sample result is greater than or equal to the MDL but less than or equal to the RL, result is reported as non-detect at the reported concentration, when the ICB/CCB/PB result is less or greater than the RL.

Glossary of Qualification Flags and Abbreviations, continued

R -	Sample result is greater than the RL and less than the ICB/CCB/PB value when the ICB/CCB/PB value is greater than the RL.
J -	Sample result is greater than the ICB/CCB/PB value but less than 10X the ICB/CCB/PB value when ICB/CCB/PB value is greater than the RL.
J/UJ -	Sample result is less than 10X RL when blank result is below the negative RL.

Field QC Blank action:

Note – Use field blanks to qualify data only if field blank results are greater than prep blank results.

Do not use rinsate blank associated with waters to qualify water samples and vice versa.

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U -	The sample result is greater than or equal to the MDL but less than or equal to the RL, result is reported as non-detect at the reported concentration, when the FB result is less or greater than the RL.
R -	Sample result is greater than the RL and less than the FB value when the FB value is greater than the RL.
J -	Sample result is greater than the FB value but less than 10X the FB value when FB value is greater than the RL.

General Abbreviations

RL	reporting limit
IDL	instrument detection limit
MDL	method detection limit
CRDL	contract required detection limit
CRQL	contract required quantitation limit
+	positive result
-	non-detect result

1AWC
VOLATILE ORGANICS ANALYSIS DATA SHEET

Client Project ID:
Client SDG No: 1004193
Client Sample ID: 59ER01

Lab Project Number:
Method: 8260B
Date Collected: 04/19/10

Lab Sample ID: 1004193-03
Sample wt/vol: 25 (g/ml) ML
Level: (low/med) LOW

Date Received: 04/21/10
Lab File ID: 1004193-0371
Analyst: JAO

% Moisture: not dec. _____
GC Column: SPB-624 ID: 0.32 (mm)

Date Analyzed: 04/30/10
Dilution Factor: 1.0

Soil Extract Volume: _____ (uL)
Method Blank: 0043003-BLK1

Soil Aliquot Volume: _____ (uL)

CAS NO.	COMPOUND	MDL	Reporting Limit UG/L	Results UG/L	Q	
75-71-8	Dichlorodifluoromethane	0.030	0.5	ND	U	
74-87-3	Chloromethane	0.11	0.5	ND	U	
75-01-4	Vinyl Chloride	0.070	0.5	ND	U	
74-83-9	Bromomethane	0.11	0.5	ND	U	
75-00-3	Chloroethane	0.20	0.5	ND	U	
75-69-4	Trichlorofluoromethane	0.060	0.5	ND	U	
107-02-8	Acrolein	1.0	5	ND	~~U~~	R
75-35-4	1,1-Dichloroethene	0.040	0.5	ND	U	
74-88-4	Iodomethane	0.030	0.5	ND	U	
75-15-0	Carbon disulfide	0.020	0.5	ND	U	
67-64-1	Acetone	0.44	2.5	3.4		J
107-05-1	3-Chloropropene	0.050	0.5	ND	U	
75-05-8	Acetonitrile	0.030	0.5	ND	~~U~~	UJ
75-09-2	Methylene Chloride	0.020	0.5	4.6	~~B~~	
156-60-5	trans-1,2-Dichloroethene	0.050	0.5	ND	U	
107-13-1	Acrylonitrile	0.36	5	ND	~~U~~	R
75-34-3	1,1-Dichloroethane	0.020	0.5	ND	U	
108-05-4	Vinyl acetate	0.060	1	ND	~~U~~	UJ
78-93-3	2-butanone	0.28	2.5	1.1	~~J~~	J
107-12-0	Propionitrile	1.4	25	ND	~~U~~	R
126-98-7	Methacrylonitrile	0.39	5	ND	~~U~~	UJ
67-66-3	Chloroform	0.030	0.5	0.086	J	
71-55-6	1,1,1-Trichloroethane	0.020	0.5	ND	U	
56-23-5	Carbon Tetrachloride	0.030	0.5	ND	U	
76-01-7	Pentachloroethane	0.070	0.5	ND	U	
71-43-2	Benzene	0.030	0.5	ND	U	
107-06-2	1,2-Dichloroethane	0.030	0.5	ND	U	
78-83-1	Isobutyl alcohol	5.9	25	ND	~~U~~	R
79-01-6	Trichloroethene	0.030	0.5	ND	~~U~~	UJ
78-87-5	1,2-Dichloropropane	0.12	0.5	ND	U	
74-95-3	Dibromomethane	0.030	0.5	ND	U	
123-91-1	1,4-dioxane	5.4	25	ND	~~U~~	R
80-62-6	Methylmethacrylate	0.56	5	ND	U	

ND = Not Detected
Q = Qualifier

FORM I VOA

MM 090210

012

1AWC
VOLATILE ORGANICS ANALYSIS DATA SHEET

Client Project ID:
Client SDG No: 1004193
Client Sample ID: 59ER01

Lab Project Number:
Method: 8260B
Date Collected: 04/19/10

Lab Sample ID: 1004193-03
Sample wt/vol: 25 (g/ml) ML
Level: (low/med) LOW

Date Received: 04/21/10
Lab File ID: 1004193-0371
Analyst: JAO

% Moisture: not dec. _____
GC Column: SPB-624 ID: 0.32 (mm)

Date Analyzed: 04/30/10
Dilution Factor: 1.0

Soil Extract Volume: _____ (uL)
Method Blank: 0043003-BLK1

Soil Aliquot Volume: _____ (uL)

CAS NO.	COMPOUND	MDL	Reporting Limit UG/L	Results UG/L	Q	
75-27-4	Bromodichloromethane	0.030	0.5	ND	U	
10061-01-5	cis-1,3-Dichloropropene	0.040	0.5	ND	U	
108-10-1	4-Methyl-2-pentanone	0.42	2.5	ND	~~U~~	UJ
108-88-3	Toluene	0.030	0.5	1.8	~~B~~	
10061-02-6	trans-1,3-Dichloropropene	0.050	0.5	ND	U	
79-00-5	1,1,2-Trichloroethane	0.040	0.5	ND	~~U~~	UJ
97-63-2	Ethylmethacrylate	0.41	5	ND	~~U~~	UJ
127-18-4	Tetrachloroethene	0.060	0.5	ND	U	
591-78-6	2-hexanone	0.51	2.5	ND	~~U~~	UJ
124-48-1	Dibromochloromethane	0.040	0.5	ND	U	
106-93-4	1,2-Dibromoethane	0.040	0.5	ND	~~U~~	UJ
108-90-7	Chlorobenzene	0.020	0.5	0.27	J	
630-20-6	1,1,1,2-Tetrachloroethane	0.020	0.5	ND	U	
100-41-4	Ethylbenzene	0.040	0.5	ND	U	
108-38-3	m,p-Xylene	0.080	1	ND	U	
95-47-6	o-Xylene	0.030	0.5	ND	U	
100-42-5	Styrene	0.020	0.5	ND	U	
75-25-2	Bromoform	0.030	0.5	ND	U	
96-18-4	1,2,3-Trichloropropane	0.090	0.5	ND	~~U~~	UJ
79-34-5	1,1,2,2-Tetrachloroethane	0.050	0.5	ND	~~U~~	
110-57-6	trans-1,4-dichloro-2-butene	0.33	2	ND	~~U~~	
96-12-8	1,2-Dibromo-3-Chloropropane	0.25	0.5	ND	~~U~~	
1330-20-7	Xylene (total)	0.030	0.5	ND	U	
126-99-8	Chloroprene	0.020	0.5	ND	U	

ND = Not Detected
Q = Qualifier

FORM I VOA

MM 050210

DataQual

Environmental Services, LLC

Michael Baker, Jr., Inc.
Airside Business Park
100 Airside Drive
Moon Township, PA 15108

September 7, 2010

SDG# 1004194, CompuChem
NAPR SWMU 59; Ceiba, Puerto Rico

Dear Mr. Kimes,

The following Data Validation report is provided as requested for the parameters noted in the table below for SDG # 1004194. The data validation was performed in accordance with the SW-846 methods utilized by the laboratory, the Region II Standard Operating Procedures for the Validation of Organic Data Acquired Using SW-846 Methods (8260B-Rev 2, January 2006- SOP #HW-24, 8270D-Rev 3, October 2006-SOP #HW-22, 8081B SOP # HW-44, Rev 1 October 2006) and professional judgment. Region II has not developed a validation checklist SOP for the methods used to assess the inorganic methods in this SDG (SW-846 methods 6010B, 6020 and 7471A). Therefore, alternative worksheets were provided. Region II flagging conventions were used. All areas of concern are discussed in the body of the report and a summary of data qualification is provided.

Sample ID	Lab ID	Matrix	VOA App IX	SVOA App IX w/ LL PAH	Pesticides	Metals	Tin
59SB01-00	1004194-02	soil	X	X	X	X	X
59SB01-00D	1004194-03	soil	X	X	X	X	X
59SB02-00	1004194-01	soil	X	X	X	X	X
59SB03-00	1004194-04	soil	X	X	X	X	X
59SB04-00	1004194-09	soil	X	X	X	X	X
59SB04-01	1004194-10	soil	X	X	X	X	X
59SB04-05	1004194-11	soil	X	X	X	X	X
59SB06-00	1004194-05	soil	X	X	X	X	X
59SB07-00	1004194-06	soil	X	X	X	X	X
59SB08-00	1004194-07	soil	X	X	X	X	X
59SB09-00	1004194-08	soil	X	X	X	X	X
59SB02-00 MS	1004194-01MS	soil	X	X	X	X	X
59SB02-00 MSD	1004194-01MSD	soil	X	X	X	X	X

The following quality control samples were provided with this SDG: sample 59SB01-00D -field duplicate of sample 59SB01-00.

The samples were evaluated based on the following criteria:

- Data Completeness *
- Sample Condition *

- Technical Holding Times *
- GC/MS Tuning *
- ICP-MS Tuning *
- GC Performance *
- Initial/Continuing Calibrations
- ICSA/ICSAB Standards *
- CRDL Standards *
- Blanks
- GC/MS Internal Standards
- ICP-MS Internal Standards *
- Surrogate Recoveries
- Laboratory Control Samples
- Matrix Spike Recoveries
- Matrix Duplicate RPDs
- Serial Dilutions
- Field Duplicates
- Identification/Quantitation
- Reporting Limits *
- Tentatively Identified Compounds NA

* - indicates that qualifications were not required based on this criteria

Overall Evaluation of Data/Potential Usability Issues

A summary of qualifications applied to the sample results are noted below for the fractions validated. Specific details regarding qualification of the data are addressed in the Specific Evaluation section of this narrative. If an issue is not addressed there were no actions required based on unmet quality criteria. When more than one qualifier is associated with a compound/analyte the validator has chosen the qualifier that best indicates possible bias in the results and flagged the data accordingly. However, information regarding all quality control issues is provided in the body of the report and on the qualification summary page.

VOA

The initial and continuing calibrations exhibited some compounds with low RRF values, which resulted in qualifying non-detected values as rejected for these compounds. Due to high %Ds values, in the continuing calibration, some compounds were qualified as estimated.

Blank contamination was noted in the method and/or QC blanks associated with samples in this batch. Qualifications were added to the data.

SVOA

Due to high %RSDs and %D values, in the initial and continuing calibrations, some compounds were qualified as estimated. Low RRF values were exhibited in the continuing calibration which resulted in qualifying non-detected results as rejected.

Blank contamination was noted in the method and/or QC blanks associated with samples in this batch. Qualifications were added to the data.

One sample exhibited high internal standard area recoveries which resulted in qualifying associated compound positive results as estimated.

Due to below low recoveries for LCS samples, the associated sample results were qualified for one or more compounds.

The matrix spike and matrix spike duplicate exhibited below 10% recoveries that resulted in qualifying six compound results as rejected in the associated sample.

Due to non-comparable results in the field duplicate pair, one compound result was qualified as estimated.

One sample required a dilution to obtain results within the calibration range.

Pesticides by 8081B

Three samples required qualifications due to low surrogate recoveries.

The associated laboratory control sample exhibited a low recovery that required rejection in the field samples.

The MS/MSD pair exhibited low recoveries that required qualification in the native sample.

All results that exhibited column quantitation %Ds greater than 25% were qualified based on Region II guidelines.

One sample was diluted due to a result above the linear range on both columns.

Metals by 6020 & 7471

Blank contamination was noted and qualification was required in the samples in this SDG.

The matrix spikes pair submitted in this SDG exhibited non-compliant recoveries in both the MS and the MSD for two analytes for which qualifications were required.
The matrix duplicate submitted in this SDG exhibited a non-compliant %D >35% for one analyte for which qualifications were required.

The field duplicate pair of sample 59SB01-00/59SB01-00D exhibited several analytes with non-compliant RPDs. These analytes were flagged based on Region II guidance in the field duplicate pair only.

The serial dilution exhibited non-compliant %D and qualifications were required.

All results reported at concentrations between the method detection limit and the reporting limits (B flagged by the laboratory) were qualified as estimated J.

Tin by 6010B

All results reported at concentrations between the method detection limit and the reporting limits (B flagged by the laboratory) were qualified as estimated J.

Specific Evaluation of Data

Data Completeness

The SDG was received complete and intact. Resubmissions were not required.

Technical Holding Times

According to chain of custody records, sampling was performed on 4/19-22/10 and samples were received at the laboratory 4/20-24/10. All sample preparation and analysis was performed within Region II and/or method holding time requirements.

Initial/Continuing Calibration

VOA

Calibration standards exhibited %Ds and RRF values that were non-compliant. A summary of these non-compliances and affected samples are noted in the following table. Sample results are qualified as indicated.

Standard ID	Compound(s)	RRF, %RSD, %D	Samples	Q Flag
IC 4/29/10	acrolein propionitrile isobutyl alcohol 1,4-dioxane methylmethacrylate	0.035 0.022 0.007 0.001 0.043	all samples	J/R
CC 4/30/10	bromomethane acetone 2-butanone 4-methyl-2-pentanone 2-hexanone	21.20 44.35 31.50 25.50 021.75	all samples	J/UJ

SVOA

Calibration standards exhibited %RSDs and %D values that were non-compliant. A summary of these non-compliances and affected samples are noted in the following table. Sample results are qualified as indicated.

Standard ID	Compound(s)	RRF, %RSD, %D	Samples	Q Flag
IC full scan 5/21/10	benzyl alcohol p-phenylenediamine 2,4-dinitrophenol 1,3,5-trinitrobenzene a,a-dimethylphenethylamine	19.093 41.224 16.534 16.247 25.651	all samples	J/UJ
CC full scan 5/27/10	4-nitroquinoline-1-oxide methapyrilene aramite	-20.93 -46.85 -22.90	59SB01-00, 59SB01-00D	J/UJ
CC full scan 5/28/10	4-aminobiphenyl 4-nitroquinoline-1-oxide aramite	-24.42 -26.16 -26.83	59SB03-00	J/UJ
CC full scan 5/28/10 5/30/10	p-phenylenediamine	0.049/0.035	59SB02-00, 59SB06-00, 59SB08-00, 59SB04-00, 59SB04-01, 59SB04-05, 59SB09-00, 59SB07-00	J/R
CC full scan 5/28/10 5/30/10	1-naphthylamine	-21.13/-21.08	59SB02-00, 59SB06-00, 59SB08-00, 59SB04-00, 59SB04-01, 59SB04-05, 59SB09-00, 59SB07-00	J/UJ
CC kepone 5/24/10	kepone	-40.14	kepone: all samples	J/UJ
IC SIM 4/26/10	indeno(1,2,3-cd)pyrene	15.549	PAH SIM: all samples	J/UJ
CC SIM 5/09/10	2-methylnaphthalene benzo(k)fluoranthene benzo(g,h,i)perylene	-26.00 35.79 -23.55	PAH SIM: 59SB02-00, 59SB01-00, 59SB03-00, 59SB06-00, 59SB07-00, 59SB09-00, 59SB04-00	J/UJ
CC SIM 5/10/10	benzo(k)fluoranthene dibenzo(a,h)anthracene benzo(g,h,i)perylene	22.81 31.88 22.69	PAH SIM: 59SB04-05, 59SB01-00D, 59SB08-00RE, 59SB04-01RE	J/UJ

Blanks

VOA

The associated method and/or QC blanks exhibited contamination as noted in the following table. Compounds for which there was no action required, are not included in the following table, see worksheets for full list of compounds.

Blank ID	Compound	Concentration	Reporting Limit
59TB01	methylene chloride	0.19J ug/L	5 ug/L
	toluene	0.041J	5
59TB02	methylene chloride	0.18J	5
	toluene	0.045J	5
59TB03	methylene chloride	0.19J	5
	toluene	0.041J	5

Blank ID	Compound	Concentration	Reporting Limit
59ER01	acetone	3.4	2.5
	methylene chloride	4.6	0.5
	2-butanone	1.1J	2.5
	chloroform	0.086J	0.5
	toluene	1.8	0.5
	chlorobenzene	0.27J	0.5
59ER03	acetone	3.6	2.5
	methylene chloride	3.4	0.5
	2-butanone	1.3J	2.5
	chloroform	0.053J	0.5
	toluene	0.51	0.5
	chlorobenzene	0.061J	0.5
59ER04	acetone	0.71J	2.5
	methylene chloride	0.34J	0.5
	toluene	0.085J	0.5
59FB01	acetone	3	2.5
	methylene chloride	5.5	0.5
	2-butanone	1.2J	2.5
	chloroform	0.12J	0.5
	toluene	2.4	0.5
	chlorobenzene	0.34J	0.5

Associated samples and required qualifications are noted in the following table.

Sample ID	Compound	Q Flag
59SB02-00, 59SB04-00	methylene chloride	U at RL
59SB04-00	toluene	U at RL
59SB07-00, 59SB09-00	2-butanone	U at RL
59SB01-00, 59SB01-00D, 59SB08-00	acetone	U at RL
59SB02-00, 59SB04-01, 59SB06-00	acetone	U at value

SVOA

The associated method and/or QC blanks exhibited contamination as noted in the following table. Compounds for which there was no action required, are not included in the following table, see worksheets for full list of compounds.

Blank ID	Compound	Concentration	Reporting Limit
SBLKXY	di-n-butylphthalate	19J ug/Kg	170 ug/Kg
SBLKXY-SIM	naphthalene	0.95J	8.3
59ER01-SIM	naphthalene	0.045J ug/L	0.21 ug/L
59ER03-SIM	naphthalene	0.089J	0.21
	2-methylnaphthalene	0.032J	0.21
59FB01-SIM	naphthalene	0.048J	0.21

Associated samples and required qualifications are noted in the following table.

Sample ID	Compound	Q Flag
59SB01-00	di-n-butylphthalate	U at RL
PAH SIM: 59SB02-00, 59SB03-00, 59SB06-00, 59SB07-00, 59SB09-00, 59SB04-00, 59SB04-05, 59SB01-00D, 59SB08-00RE, 59SB04-01RE	naphthalene	U at RL
PAH SIM: 59SB09-00	2-methylnaphthalene	U at RL

Metals by 6020 & 7471

Associated blanks exhibited contamination as noted in the following table. Please see the Glossary of Qualification Flags and Abbreviations for details.

Blank ID	Analyte	Concentration	Action Level	Q Flag
PBS	silver	0.048B mg/Kg	RL	U at RL
	thallium	0.031B mg/Kg	RL	U at RL
ICB	antimony	0.395B mg/Kg	RL	U at RL
CCB	lead	0.060B mg/Kg	RL	U at RL

Associated samples and required qualifications are noted in the following table.

Sample ID	Analyte	Q Flag
all samples >MDL up to RL except 67SD01	silver	U at RL
	thallium	U at RL
	antimony	U at RL
59SB04-01	lead	U at RL

Surrogates

Pesticides

Three samples exhibited low recoveries as noted in the following table. Results are qualified according to Region II guidance.

Sample ID	Surrogate Compound	%R	Affected Compounds	Q Flag
59SB01-00D	TCX	64/63	all compounds	J/UJ
59SB08-00	TCX	63/62		
59SB04-00	TCX	66/65		

Internal Standards

SVOA

The PAH SIM analysis of sample 59SB08-00 exhibited three non-compliant internal standard area recoveries. The sample was re-analyzed with fewer non-compliant recoveries and therefore was the analysis that was used. Sample 59SB08-00RE exhibited high recoveries for internal standard phenanthrene-d10; therefore all positive result compounds associated with this standard were qualified as estimated.

Laboratory Control Sample

SVOA

The submitted LCS associated with all samples exhibited zero percent recovery for p-phenylenediamine; therefore all non-detected results for this compound were qualified as rejected (R). Also low recovery was exhibited for ethyl methanesulfonate at 41% (50-150%); therefore all results were qualified as estimated (J/UJ).

Pesticides

The submitted LCS associated with the samples exhibited a recovery for endrin aldehyde (27%) that was below the lower QC limit. Based on Region II requirements all reported positive results were qualified as estimated J and all reported non-detect results for this compound were rejected R for endrin aldehyde.

Matrix Spike

SVOA

The submitted matrix spike and matrix spike duplicate exhibited non-compliant recoveries requiring qualification or rejection in the associated sample. A summary of these non-compliances and affected samples are noted in the following table.

MS/MSD Associated Sample ID	Compounds	MS %Rec	MSD % Rec	QC Limit	Q Flag
59SB02-00	p-phenylenediamine	0	0	20-150	J/R
	1-naphthylamine	3	6	20-150	
	2-naphthylamine	5	4	20-150	
	4-aminobiphenyl	8	5	20-150	
	methapyrilene	0	0	20-150	
	3,3'-dimethylbenzidine	0	0	20-150	

Pesticides

The submitted matrix spike and matrix spike duplicate exhibited non-compliant recoveries requiring qualification or rejection in the associated sample. A summary of these non-compliances and affected samples are noted in the following table.

MS/MSD	Analytes	Samples	%R	Q Flag
59SB02-00	endrin aldehyde	all samples	30/33	J/UJ

Metals by 6020 & 7471

The matrix spike analysis submitted in this SDG exhibited non-compliant %Rs for two analytes. A summary of these non-compliances and affected samples and actions are noted in the following table.

MS/MSD	Analytes	Samples	%R	Q Flag
59SB02-00	antimony	all samples	36/35	J/UJ
	lead		49/30	

Matrix Duplicates

Metals 6020 & 7471

The matrix duplicate analysis submitted in this SDG exhibited a non-compliant RPD >35% for one analyte, requiring qualification in the field samples. A summary of these non-compliances and affected samples are noted in the following table.

SD	Analytes	Samples	%D	Q Flag
59SB02-00	barium	all samples	48	J/UJ

Serial Dilutions

Metals 6020 & 7471

The serial dilution analysis submitted in this SDG exhibited non-compliant %Ds for five analytes, requiring qualification in the field samples. A summary of these non-compliances and affected samples are noted in the following table.

SD	Analytes	Samples	%D	Q Flag
59SB02-00	chromium	all samples	13	J/UJ
	cobalt		12	
	copper		19	
	vanadium		16	
	zinc		25	

Field Duplicates

SVOA

Sample 59SB01-00 and duplicate 59SB01-00D did not exhibit comparable results for bis (2-ethylhexyl) phthalate with 200% RPD: therefore results for this compound were qualified as estimated (J/UJ).

Metals by 6020 & 7471

The field duplicate pair exhibited non-compliant field duplicate reproducibility for the following analytes. These field duplicate pairs and analytes were flagged as noted in the table below based on Region II guidelines.

Sample ID	Analyte	RPD or Absolute Difference	Q Flag
59SB01-00, 59SB01-00D	barium	84	J
	chromium	60	
	cobalt	48	
	lead	97	
	vanadium	58	

Identification/Quantitation

SVOA

PAH SIM samples 59SB08-00 and 59SB04-01 was not used, in favor of the re-analysis, due to non-compliant internal standard area recoveries.

Sample 59SB04-01 was re-analyzed due to high internal standard area recoveries. The re-analysis exhibited similar results and therefore were not used in favor of the initial analysis. Due to no positive results exhibited in the initial analysis, there were no qualifications required due to this non-compliance.

Sample 59SB04-00 was analyzed at a dilution to obtain results within the calibration range. For this sample, the E-flagged results in the initial analysis were rejected in favor of the corresponding D-flagged results in the diluted analysis.

PAH SIM sample 59SB04-00 reported several results above the calibration range. This sample was not analyzed at a dilution as the compounds were also analyzed in the full scan analysis with results within the calibration range exhibited. Therefore the E-flagged results in the PAH SIM analysis were rejected and in favor of the results in the full scan analysis for these compounds.

Pesticides

Several positive results were reported with P flags to indicate that the column quantitation %D was greater than 25%. These results were qualified based on Region II guidelines. Some compound results were flagged as presumptively present at an estimated concentration due to the disparity of results between the two columns (one result was well above the RL and the other was below the RL – with an elevated baseline) rather than as U at the RL. Specific results and flags are noted in the following table.

Sample ID	Compound	%D	Flag
59SB01-00	gamma-chlordane	80	U at RL
59SB03-00	heptachlor	95.6	U at RL
	alpha-chlordane	45.2	J
59SB04-00	aldrin	145.3	U at RL
	beta-BHC	177.4	R
	delta-BHC	82.4	U at RL
	4,4'-DDE	94.1	U at RL
	endosulfan I	52.4	U at RL
	heptachlor epoxide	121	U at RL
	gamma-chlordane	51.4	U at RL
59SB04-01	beta-BHC	150.6	U at RL
	endrin	45.5	J
59SB04-05	beta-BHC	27.3	J
59SB06-00	gamma-chlordane	49	J
59SB07-00	4,4'-DDT	35	J
	dieldrin	73.8	U at RL
	endosulfan I	104.2	U at RL
	heptachlor	141.7	U at RL
	heptachlor epoxide	144.8	U at RL
	alpha-chlordane	28.6	J
59SB09-00	heptachlor	117.2	U at RL
	gamma-chlordane	114	U at RL
	alpha-chlordane	156.8	U at RL

Sample 59SB09-00 was reanalyzed at a dilution of 1:5 due to a result above the linear range on at least one of the analytical columns. For sample 59SB09-00, the reported E-flagged result for 4, 4'-DDE is rejected in favor of the D-flagged result reported from the dilution analysis. All other results in the dilution analysis are rejected in favor of the results reported from the undiluted analysis.

Metals by 6020 & 7471

All results reported at concentrations between the method detection limit and the reporting limit (B flagged by the laboratory) were qualified as estimated J.

Tin by 6010B

All results reported at concentrations between the method detection limit and the reporting limit (B flagged by the laboratory) were qualified as estimated J.

A summary of qualifications required is provided on the following page. Please do not hesitate to contact DataQual ES with any questions regarding this validation report.

Sincerely,

Laura Maschhoff
President

Jacqueline Cleveland
Vice-President

Summary of Data Qualifications

VOA

Sample ID	Compound	Results	Q flag
all samples	acrolein propionitrile isobutyl alcohol 1,4-dioxane methylmethacrylate	+/-	J/R
all samples	bromomethane acetone 2-butanone 4-methyl-2-pentanone 2-hexanone	+/-	J/UJ
59SB02-00, 59SB04-00	methylene chloride	+/-	U at RL
59SB04-00	toluene	+/-	U at RL
59SB07-00, 59SB09-00	2-butanone	+/-	U at RL
59SB01-00, 59SB01-00D, 59SB08-00	acetone	+/-	U at RL
59SB02-00, 59SB04-01, 59SB06-00	acetone	+/-	U at value

SVOA

Sample ID	Compound	Results	Q flag
all samples	benzyl alcohol p-phenylenediamine 2,4-dinitrophenol 1,3,5-trinitrobenzene a,a-dimethylphenethylamine	+/-	J/UJ
59SB01-00, 59SB01-00D	4-nitroquinoline-1-oxide methapyrilene aramite	+/-	J/UJ
59SB03-00	4-aminobiphenyl 4-nitroquinoline-1-oxide aramite	+/-	J/UJ
59SB02-00, 59SB06-00, 59SB08-00, 59SB04-00, 59SB04-01, 59SB04-05, 59SB09-00, 59SB07-00	p-phenylenediamine	+/-	J/R
59SB02-00, 59SB06-00, 59SB08-00, 59SB04-00, 59SB04-01, 59SB04-05, 59SB09-00, 59SB07-00	1-naphthylamine	+/-	J/UJ
kepone: all samples	kepone	+/-	J/UJ
PAH SIM: all samples	indeno(1,2,3-cd)pyrene	+/-	J/UJ
PAH SIM: 59SB02-00, 59SB01-00, 59SB03-00, 59SB06-00, 59SB07-00, 59SB09-00, 59SB04-00	2-methylnaphthalene benzo(k)fluoranthene benzo(g,h,i)perylene	+/-	J/UJ
PAH SIM: 59SB04-05, 59SB01-00D, 59SB08-00RE, 59SB04-01RE	benzo(k)fluoranthene dibenzo(a,h)anthracene benzo(g,h,i)perylene	+/-	J/UJ
59SB01-00	di-n-butylphthalate	+	U at RL
59SB02-00, 59SB03-00, 59SB06-00, 59SB07-00, 59SB09-00, 59SB04-00, 59SB04-05, 59SB01-00D, 59SB08-00RE, 59SB04-01RE	naphthalene	+	U at RL
59SB09-00	2-methylnaphthalene	+	U at RL

Summary of Data Qualifications

SVOA, continued

Sample ID	Compound	Results	Q flag
PAH SIM: 59SB08-00RE	all samples associated with: phenanthrene-d10	+/-	J/UJ
all samples	p-phenylenediamine	+/-	J/R
all samples	ethyl methanesulfonate	+/-	J/UJ
59SB02-00	p-phenylenediamine 1-naphthylamine 2-naphthylamine 4-aminobiphenyl methapyrilene 3,3'-dimethylbenzidine	+/-	J/R
59SB01-00, 59SB01-00D	bis(2-ethylhexyl)phthalate	+/-	J/UJ
PAH SIM: 59SB08-00, 59SB04-01	all results	+/-	R
59SB04-01RE	all results	+/-	R
59SB04-00	all E-flagged results	+	R
59SB04-00DL	all resulted except D-flagged compounds	+/-	R
PAH SIM: 59SB04-00	all E-flagged compounds	+	R

Pesticides

Sample ID	Compound	Results	Q flag
59SB01-00D, 59SB08-00, 59SB04-00	all compounds	+/-	J/UJ
all samples	endrin aldehyde	+/-	J/R
59SB02-00	endrin aldehyde	+/-	J/UJ
59SB01-00	gamma-chlordane	+JP	U at RL
59SB03-00	heptachlor	+JP	U at RL
	alpha-chlordane	+JP	J
59SB04-00	aldrin	+JP	U at RL
	beta-BHC	+P	R
	delta-BHC	+JP	U at RL
	4,4'-DDE	+JP	U at RL
	endosulfan I	+JP	U at RL
	heptachlor epoxide	+JP	U at RL
	gamma-chlordane	+JP	U at RL
59SB04-01	beta-BHC	+JP	U at RL
	endrin	+JP	J
59SB04-05	beta-BHC	+J	J
59SB06-00	gamma-chlordane	+JP	J
59SB07-00	4,4'-DDT	+J	J
	dieldrin	+JP	U at RL
	endosulfan I	+JP	U at RL
	heptachlor	+JP	U at RL
	heptachlor epoxide	+JP	U at RL
	alpha-chlordane	+J	J

Summary of Data Qualifications

Pesticides, continued

Sample ID	Compound	Results	Q flag
59SB09-00	heptachlor	+JP	U at RL
	gamma-chlordane	+JP	U at RL
	alpha-chlordane	+JP	U at RL
59SB09-00	4,4'-DDE	+E	R
59SB09-00DL	all compounds except 4,4'-DDE	+/-	R

Metals by 6020 & 7471

Sample ID	Analyte	Results	Q flag
all samples >MDL up to RL	silver	+J	U at RL
	thallium	+J	U at RL
	antimony	+J	U at RL
59SB04-01	lead	+J	U at RL
all samples	antimony lead	+/-	J/UJ
all samples	barium	+/-	J/UJ
all samples	chromium cobalt copper vanadium zinc	+/-	J/UJ
59SB01-00/59SB01-00D	barium chromium cobalt lead vanadium	+	J
all samples	all analytes	+B	J

Tin by 6020

Sample ID	Analyte	Results	Q flag
all samples	all analytes	+B	J

Glossary of Qualification Flags and Abbreviations

Qualification Flags (Q-Flags)

U	not detected above the reported sample quantitation limit
J	estimated value
UJ	reported quantitation limit is qualified as estimated
N	analyte has been tentatively identified
JN	analyte has been tentatively identified, estimated value
R	result is rejected; the presence or absence of the analyte cannot be verified

Method/Preparation/Field QC Blank Qualification Flags (Q-Flags)

Organic Methods

NA	The sample result for the blank contaminant is greater than the RL (2X sample RL for common laboratory contaminants) when the blank value is less than the RL. The sample result for the blank contaminant is not qualified with any blank qualifiers.
U*	The sample result for the blank contaminant is less than the RL (2X sample RL for common laboratory contaminants) but greater than the MDL when the blank value is less than the RL. The sample result for the blank contaminant is qualified as non-detect U at the reported concentration.
RL**	The sample result for the blank contaminant is less than the RL (2X sample RL for common laboratory contaminants) but greater than the MDL when the blank value is less than the RL. The sample result for the blank contaminant is changed to the RL and qualified as non-detect U.

* This guideline is used when the laboratory is reporting non-detects to the MDL. ** This guideline is used when the laboratory is reporting non-detects to the RL.

Inorganic Methods

ICB/CCB/PB Action:

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U*/ RL** -	The sample result is greater than or equal to the MDL but less than or equal to the RL, result is reported as non-detect at the reported concentration or at the RL, when the FB result is less or greater than the RL.

Glossary of Qualification Flags and Abbreviations, continued

R -	Sample result is greater than the RL and less than the ICB/CCB/PB value when the ICB/CCB/PB value is greater than the RL.
J -	Sample result is greater than the ICB/CCB/PB value but less than 10X the ICB/CCB/PB value when ICB/CCB/PB value is greater than the RL.
J/UJ -	Sample result is less than 10X RL when blank result is below the negative RL.

Field QC Blank action:

Note – Use field blanks to qualify data only if field blank results are greater than prep blank results.

Do not use rinsate blank associated with soils to qualify water samples and vice versa.

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U* / RL** -	The sample result is greater than or equal to the MDL but less than or equal to the RL, result is reported as non-detect at the reported concentration or at the RL, when the FB result is less or greater than the RL.
R -	Sample result is greater than the RL and less than the FB value when the FB value is greater than the RL.
J -	Sample result is greater than the FB value but less than 10X the FB value when FB value is greater than the RL.

* This guideline is used when the laboratory is reporting non-detects to the MDL. ** This guideline is used when the laboratory is reporting non-detects to the RL.

General Abbreviations

RL	reporting limit
IDL	instrument detection limit
MDL	method detection limit
CRDL	contract required detection limit
CRQL	contract required quantitation limit
+	positive result
-	non-detect result

DataQual

Environmental Services, LLC

Michael Baker, Jr., Inc.
Airside Business Park
100 Airside Drive
Moon Township, PA 15108

September 7, 2010

SDG# 1004195, CompuChem
NAPR SWMU 59; Ceiba, Puerto Rico

Dear Mr. Kimes,

The following Data Validation report is provided as requested for the parameters noted in the table below for SDG # 1004195. The data validation was performed in accordance with the SW-846 methods utilized by the laboratory, the Region II Standard Operating Procedures for the Validation of Organic Data Acquired Using SW-846 Methods (8260B-Rev 2, January 2006- SOP #HW-24, 8270D-Rev 3, October 2006-SOP #HW-22, 8081B SOP # HW-44, Rev 1 October 2006) and professional judgment. Region II has not developed a validation checklist SOP for the methods used to assess the inorganic methods in this SDG (SW-846 methods 6010B, 6020 and 7471A). Therefore, alternative worksheets were provided. Region II flagging conventions were used. All areas of concern are discussed in the body of the report and a summary of data qualification is provided.

Sample ID	Lab ID	Matrix	VOA App IX	SVOA App IX w/ LL PAH	Pesticides	Metals	Tin
59SB01-01	1004195-03	soil	X	X	X	X	X
59SB01-03	1004195-04	soil	X	X	X	X	X
59SB02-01	1004195-01	soil	X	X	X	X	X
59SB02-01D	1004195-09	soil	X	X	X	X	X
59SB02-04	1004195-04	soil	X	X	X	X	X
59SB03-01	1004195-05	soil	X	X	X	X	X
59SB03-04	1004195-06	soil	X	X	X	X	X
59SB05-01	1004195-19	soil	X	X	X	X	X
59SB05-05	1004195-20	soil	X	X	X	X	X
59SB06-01	1004195-07	soil	X	X	X	X	X
59SB06-03	1004195-08	soil	X	X	X	X	X
59SB07-01	1004195-10	soil	X	X	X	X	X
59SB07-01D	1004195-11	soil	X	X	X	X	X
59SB07-05	1004195-12	soil	X	X	X	X	X
59SB08-01	1004195-13	soil	X	X	X	X	X
59SB08-05	1004195-14	soil	X	X	X	X	X
59SB09-01	1004195-17	soil	X	X	X	X	X
59SB09-05	1004195-18	soil	X	X	X	X	X
59SB10-01	1004195-15	soil	X	X	X	X	X
59SB10-05	1004195-16	soil	X	X	X	X	X
59SB02-01 MS	1004195-01MS	soil	X	X	X	X	X
59SB02-01 MSD	1004195-01MSD	soil	X	X	X	X	X

The following quality control samples were provided with this SDG: sample 59SB02-01D-field duplicate of sample 59SB02-01; and sample 59SB07-01D-field duplicate of sample 59SB07-01D.

The samples were evaluated based on the following criteria:

• Data Completeness	*
• Sample Condition	*
• Technical Holding Times	*
• GC/MS Tuning	*
• ICP-MS Tuning	*
• GC Performance	*
• Initial/Continuing Calibrations	
• ICSA/ICSAB Standards	*
• CRDL Standards	*
• Blanks	
• GC/MS Internal Standards	*
• ICP-MS Internal Standards	*
• Surrogate Recoveries	*
• Laboratory Control Samples	
• Matrix Spike Recoveries	
• Matrix Duplicate RPDs	
• Serial Dilutions	
• Field Duplicates	
• Identification/Quantitation	
• Reporting Limits	*
• Tentatively Identified Compounds	NA

* - indicates that qualifications were not required based on this criteria

Overall Evaluation of Data/Potential Usability Issues

A summary of qualifications applied to the sample results are noted below for the fractions validated. Specific details regarding qualification of the data are addressed in the Specific Evaluation section of this narrative. If an issue is not addressed there were no actions required based on unmet quality criteria. When more than one qualifier is associated with a compound/analyte the validator has chosen the qualifier that best indicates possible bias in the results and flagged the data accordingly. However, information regarding all quality control issues is provided in the body of the report and on the qualification summary page.

VOA

The initial and continuing calibrations exhibited some compounds with low RRF values, which resulted in qualifying non-detected values as rejected for these compounds. Due to high %Ds values, in the continuing calibration, some compounds were qualified as estimated.

Blank contamination was noted in the method and/or QC blanks associated with samples in this batch. Qualifications were added to the data.

Four samples exhibited high surrogate recoveries that resulted in qualifying all positive results as estimated. Samples were re-analyzed out of holding time and therefore were not used in favor of the initial analysis.

SVOA

Due to high %RSDs and %D values, in the initial and continuing calibrations, some compounds were qualified as estimated. Low RRFs were exhibited in the continuing calibrations which resulted in qualifying non-detected results as rejected.

Blank contamination was noted in the method and/or QC blanks associated with samples in this batch. Qualifications were added to the data.

Due to below low and high recoveries for LCS samples, the associated sample results were qualified for one or more compounds.

The matrix spike and matrix spike duplicate exhibited below 10% recoveries that resulted in qualifying one compound result as rejected in the associated sample. One compound was also qualified as estimated due to low recoveries.

One of the field duplicate pairs did not exhibit comparable results for one compound that resulted in qualifying the results as estimated.

Three samples exhibited high internal standard area recoveries; there were no positive results therefore no qualifications required. The samples were re-analyzed with similar results; therefore the re-analysis was rejected in favor of the initial analysis.

Pesticides

All results that exhibited column quantitation %Ds greater than 25% were qualified based on Region II guidelines.

Metals by 6020 & 7471

Blank contamination was noted and qualification was required in the samples in this SDG.

The matrix spikes pair submitted in this SDG exhibited non-compliant recoveries in both the MS and the MSD for six analytes for which qualifications were required.

The matrix duplicate submitted in this SDG exhibited non-compliant RPDs >35% for seven analytes for which qualifications/rejections were required.

The serial dilution submitted in this SDG exhibited non-compliant %Ds for three analytes for which qualifications were required.

The field duplicate pairs exhibited several analytes with non-compliant RPDs or absolute value results. These analytes were flagged based on Region II guidance in the field duplicate pairs only.

All results reported at concentrations between the method detection limit and the reporting limits (B flagged by the laboratory) were qualified as estimated J.

Tin by 6010B

All results reported at concentrations between the method detection limit and the reporting limits (B flagged by the laboratory) were qualified as estimated J.

Specific Evaluation of Data

Data Completeness

The SDG was received complete and intact. Resubmissions were not required.

Technical Holding Times

According to chain of custody records, sampling was performed on 4/19-22/10 and samples were received at the laboratory 4/21-23/10. All sample preparation and analysis was performed within Region II and/or method holding time requirements.

Initial/Continuing Calibration

VOA

Calibration standards exhibited %Ds and RRF values that were non-compliant. A summary of these non-compliances and affected samples are noted in the following table. Sample results are qualified as indicated.

Standard ID	Compound(s)	RRF, %RSD, %D	Samples	Q Flag
IC 4/29/10	acrolein propionitrile isobutyl alcohol 1,4-dioxane methylmethacrylate	0.035 0.022 0.007 0.001 0.043	all samples	J/R
CC 5/04/10	chloromethane iodomethane vinyl acetate dibromomethane 2-hexanone trans-1,4-dichloro-2-butene	-22.33 28.84 -25.19 23.08 -25.08 -30.06	59SB06-01, 59SB06-03, 59SB02-01D, 59SB05-01, 59SB05-05, 59SB07-01, 59SB07-01D, 59SB07-05, 58SB08-01, 59SB08-05, 59SB10-01, 59SB10-05, 59SB09-01, 59SB09-05	J/UJ

SVOA

Calibration standards exhibited %RSDs, %D and RRF values that were non-compliant. A summary of these non-compliances and affected samples are noted in the following table. Sample results are qualified as indicated.

Standard ID	Compound(s)	RRF, %RSD, %D	Samples	Q Flag
IC 5/21/10 full scan	benzyl alcohol p-phenylenediamine 2,4-dinitrophenol 1,3,5-trinitrobenzene a,a-dimethylphenethylamine	19.093 41.224 16.534 16.247 25.651	all samples	J/UJ
CC 5/31/10 full scan	n-nitroso-di-n-butylamine	25.02	59SB02-01, 59SB02-04, 59SB01-01, 59SB01-03, 59SB03-01, 59SB03-04, 59SB06-01, 59SB06-03, 59SB02-01D, 59SB07-01, 59SB07-01D	J/UJ
	p-phenylenediamine	0.012		J/R
CC 5/31/10 full scan	2-picoline n-nitrosodiethylamine aniline n-nitrosopyrrolidine n-nitroso-di-n-propylamine n-nitrosomorpholine n-nitroso-di-n-butylamine methapyrilene indeno(1,2,3-cd)pyrene benzo(g,h,i)perylene	21.22 21.06 21.70 31.39 25.22 25.85 33.55 -25.82 -23.61 -25.00	59SB07-05, 59SB08-05, 59SB10-01, 59SB10-05, 59SB09-01, 59SB09-05, 59SB05-01, 59SB05-05, 59SB08-01	J/UJ
	p-phenylenediamine	0.029		J/R
CC 5/24/10 kepone	kepone	-40.14	59SB01-01, 59SB03-01, 59SB07-01D, 59SB08-01, 59SB10-01	J/UJ
IC 4/26/10 SIM	indeno(1,2,3-cd)pyrene	15.549	all PAH samples	J/UJ

Standard ID	Compound(s)	RRF, %RSD, %D	Samples	Q Flag
CC 5/06/10 SIM	2-methylnaphthalene fluorene chrysene benzo(k)fluoranthene	-25.70 -25.94 -26.35 24.02	PAH SIM: 59SB02-01, 59SB02-04, 59SB01-01, 59SB01-03	J/UJ
CC 5/07/10 SIM	2-methylnaphthalene fluorene chrysene benzo(b)fluoranthene benzo(g,h,i)perylene	-31.93 -23.64 -22.17 -22.66 -28.65	PAH SIM: 59SB03-01, 59SB03-04, 59SB06-01, 59SB06-03, 59SB02-01D, 59SB07-01, 59SB07-01D, 59SB07-05, 59SB08-01, 59SB08-05, 59SB10-05, 59SB09-01, 59SB09-05, 59SB05-01, 59SB05-05	J/UJ
CC 5/08/10 SIM	2-methylnaphthalene chrysene benzo(g,h,i)perylene	-30.37 -20.50 -26.64	PAH SIM: 59SB10-01	J/UJ

Blanks

VOA

The associated method and/or QC blanks exhibited contamination as noted in the following table. Compounds for which there was no action required, are not included in the following table, see worksheets for full list of compounds.

Blank ID	Compound	Concentration	Reporting Limit
VBLKKL	methylene chloride	1.7J ug/Kg	5 ug/Kg
	toluene	0.49	5
VBLKKO	methylene chloride	2.7	5
	toluene	0.53	5
59TB01	methylene chloride	0.19J ug/L	5 ug/L
	toluene	0.041J	5
59TB02	methylene chloride	0.18J	5
	toluene	0.045J	5
59TB03	methylene chloride	0.19J	5
	toluene	0.041J	5
59ER01	acetone	3.4	2.5
	methylene chloride	4.6	0.5
	2-butanone	1.1J	2.5
	chloroform	0.086J	0.5
	toluene	1.8	0.5
	chlorobenzene	0.27J	0.5
59ER03	acetone	3.6	2.5
	methylene chloride	3.4	0.5
	2-butanone	1.3J	2.5
	chloroform	0.053J	0.5
	toluene	0.51	0.5
	chlorobenzene	0.061J	0.5

Blank ID	Compound	Concentration	Reporting Limit
59ER04	acetone	0.71J	2.5
	methylene chloride	0.34J	0.5
	toluene	0.085J	0.5
59FB01	acetone	3	2.5
	methylene chloride	5.5	0.5
	2-butanone	1.2J	2.5
	chloroform	0.12J	0.5
	toluene	2.4	0.5
	chlorobenzene	0.34J	0.5

Associated samples and required qualifications are noted in the following table.

Sample ID	Compound	Q Flag
59SB02-04, 59SB03-01, 59SB03-04, 59SB06-01, 59SB06-03, 59SB02-01D, 59SB05-01, 59SB05-05, 59SB07-01, 59SB07-01D, 59SB07-05, 59SB08-01, 59SB08-05, 59SB10-01, 59SB10-05, 59SB09-01, 59SB09-05	methylene chloride	U at RL
59SB06-01, , 59SB06-03, 59SB02-01D, 59SB05-01, 59SB05-05, 59SB07-01, 59SB07-05, 59SB08-01, 59SB08-05, 59SB10-01, 59SB09-01, 59SB09-05	toluene	U at RL
59SB02-01, 59SB02-01D, 59SB09-01	2-butanone	U at RL
59SB02-01	chloroform	U at RL
59SB06-01, 59SB06-03, 59SB10-01	acetone	U at RL

SVOA

The associated method and/or QC blanks exhibited contamination as noted in the following table. Compounds for which there was no action required, are not included in the following table, see worksheets for full list of compounds.

Blank ID	Compound	Concentration	Reporting Limit
59ER01-SIM	naphthalene	0.045J ug/L	0.21 ug/L
59ER03-SIM	naphthalene	0.089J	0.21
	2-methylnaphthalene	0.032J	0.21
59FB01-SIM	naphthalene	0.048J	0.21

Associated samples and required qualifications are noted in the following table.

Sample ID	Compound	Q Flag
PAH SIM: 59SB01-03, 59SB03-01, 59SB05-01, 59SB07-01D, 59SB07-05, 59SB08-01, 59SB08-05, 59SB10-05	naphthalene	U at RL

Metals by 6020 & 7471

Associated blanks exhibited contamination as noted in the following table. Please see the Glossary of Qualification Flags and Abbreviations for details.

Blank ID	Analyte	Concentration	Action Level	Q Flag
CCB3	lead	0.066B ug/L	RL	U at RL
CCB5	lead	0.058B ug/L	RL	U at RL
CCB3	silver	0.048B ug/L	RL	U at RL

Associated samples and required qualifications are noted in the following table.

Sample ID	Analyte	Q Flag
all samples >MDL up to RL	lead	U at RL
59SB02-01D, 59SD03-01, 59SB03-04, 59SB05-01, 59SB05-05, 59SB07-01D, 59SB08-05, 59SB09-05, 59SB10-05	silver	U at RL

Surrogates

VOA

Four samples exhibited non-compliant surrogate recoveries requiring qualifications. A summary of these non-compliances are noted in the following table.

Sample ID	Non-Compliant Surrogate	% Recovery	QC Limit	Qualifier
59SB01-01 59SB01-03 59SB03-01	1,2-dichloroethane-d4	142 146 155	70-139	J
59SB03-04	1,2-dichloroethane-d4 bromofluorobenzene	155 122	70-139 85-120	J

Laboratory Control Sample

SVOA

The submitted LCS associated with all samples exhibited zero percent reeovery for p-phenylenediamine and 9% recovery for kepone (QC limit 20-150%); therefore all non-detected results for these compounds were qualified as rejected (R).

High recoveries were exhibited in the LCS associated with all PAH SIM samples for naphthalene at 112% (QC limit 40-105%), 2-methylnaphthalene at 130% (QC limit 45-105%), acenaphthene at 122% (QC limit 45-110%), fluorene at 113% (QC limit 50-110%), phenanthrene at 199% (QC limit 50-110%), anthracene at 122% (QC limit 55-105%), fluoranthene at 134% (QC limit 55-115%), benzo(a)anthracene at 120% (QC limit 50-110%) and benzo(k)fluoranthene at 130% (QC limit 45-125%); therefore all positive results were qualified as estimated (J).

Matrix Spike

SVOA

A matrix spike and matrix spike duplicate was submitted for sample 59SB02-01which exhibited zero percent recoveries for p-phenylenediamine and methapyrilene; therefore all non-detected results for these compounds were qualified as rejected (R) in the associated sample.

Metals by 6020 & 7471

The matrix spike analysis submitted in this SDG exhibited non-compliant %Rs for six analytes. A summary of these non-compliances and affected samples and actions are noted in the following table.

MS/MSD	Analytes	Samples	%R	Q Flag
59SB02-01	antimony	all samples	25/23	J/UJ
	arsenic		67/64	
	barium		72/67	
	lead		28/6	
	selenium		65/56	
	vanadium		54/49	

Matrix Duplicates

Metals by 6020 & 7471

The matrix duplicate analysis submitted in this SDG exhibited non-compliant RPDs for seven analytes. A summary of these non-compliances and affected samples and actions are noted in the following table.

MD	Analytes	Samples	RPD	Q Flag
59SB02-01	chromium	all samples	42	J/UJ
	copper		42	
	lead		37	
	nickel		51	
	vanadium		46	
	zinc		38	
	barium		126	R

Serial Dilutions

Metals by 6020 & 7471

The serial dilution analysis submitted in this SDG exhibited non-compliant %Ds for three analytes, requiring qualification in the field samples. A summary of these non-compliances and affected samples are noted in the following table.

SD	Analytes	Samples	%D	Q Flag
59SB02-01	cobalt	all samples	11	J/UJ
	copper		16	
	nickel		12	

Field Duplicates

SVOA

Sample 59SB02-01-SIM and duplicate sample 59SB02-01D-SIM exhibited non-comparable results for phenanthrene with 200% RPD; therefore results were qualified as estimated (J/UJ) for this compound.

Metals by 6020 & 7471

The field duplicate pairs exhibited non-compliant field duplicate reproducibility for the following analytes. These field duplicate pairs and analytes were flagged as noted in the table below based on Region II guidelines.

Sample ID	Analyte	RPD or Absolute Difference	Q Flag
59SB07-01/59SB07-01D	lead	-1.9	J
59SB02-01/59SB02-01D	barium nickel vanadium zinc	79 39 47 37	J

Identification/Quantitation

VOA

Samples 59SB01-01, 59SB01-03, 59SB03-01 and 59SB03-04 were re-analyzed due to high surrogate recoveries. These samples were re-analyzed out of holding time by one day; therefore the re-analysis was not used in favor of the initial analysis.

SVOA

Samples 59SB06-01, 59SB02-01D and 59SB07-05 were re-analyzed due to high internal standard area recoveries. The re-analysis exhibited similar results and therefore were not used in favor of the initial analysis. Due to no positive results exhibited in the initial analysis, there were no qualifications required due to this non-compliance.

Pesticides

Several positive results were reported with P flags to indicate that the column quantitation %D was greater than 25%. These results were qualified based on Region II guidelines. Specific results and flags are noted in the following table.

Sample ID	Compound	%D	Flag
59SB01-01	beta-BHC	61.5	U at RL
59SB01-03	beta-BHC	27.5	J
59SB02-04	heptachlor epoxide	91.7	U at RL
	gamma-chlordane	97.1	U at RL
59SB03-01	beta-BHC	122.6	U at RL
59SB03-04	beta-BHC	120.0	U at RL
	heptachlor	170.4	U at RL
59SB05-01	gamma-chlordane	183	U at RL
59SB06-01	beta-BHC	45.6	J
59SB06-03	gamma-chlordane	130.2	U at RL
59SB09-01	beta-BHC	104.6	U at RL
59SB09-05	beta-BHC	137.5	U at RL
	endrin aldehyde	111	U at RL

Metals by 6020 & 7471

All results reported at concentrations between the method detection limit and the reporting limit (B flagged by the laboratory) were qualified as estimated J.

Tin by 6010B

All results reported at concentrations between the method detection limit and the reporting limit (B flagged by the laboratory) were qualified as estimated J.

A summary of qualifications required is provided on the following page. Please do not hesitate to contact DataQual ES with any questions regarding this validation report.

Sincerely,

Laura Maschhoff
President

Jacqueline Cleveland
Vice-President

Summary of Data Qualifications

VOA

Sample ID	Compound	Results	Q flag
all samples	acrolein propionitrile isobutyl alcohol 1,4-dioxane methylmethacrylate	+/-	J/R
59SB06-01, 59SB06-03, 59SB02-01D, 59SB05-01, 59SB05-05, 59SB07-01, 59SB07-01D, 59SB07-05, 58SB08-01, 59SB08-05, 59SB10-01, 59SB10-05, 59SB09-01, 59SB09-05	chloromethane iodomethane vinyl acetate dibromomethane 2-hexanone trans-1,4-dichloro-2-butene	+/-	J/UJ
59SB02-04, 59SB03-01, 59SB03-04, 59SB06-01, 59SB06-03, 59SB02-01D, 59SB05-01, 59SB05-05, 59SB07-01, 59SB07-01D, 59SB07-05, 59SB08-01, 59SB08-05, 59SB10-01, 59SB10-05, 59SB09-01, 59SB09-05	methylene chloride	+	U at RL
59SB06-01, , 59SB06-03, 59SB02-01D, 59SB05-01, 59SB05-05, 59SB07-01, 59SB07-05, 59SB08-01, 59SB08-05, 59SB10-01, 59SB09-01, 59SB09-05	toluene	+	U at RL
59SB02-01, 59SB02-01D, 59SB09-01	2-butanone	+	U at RL
59SB02-01	chloroform	+	U at RL
59SB06-01, 59SB06-03, 59SB10-01	acetone	+	U at RL
59SB01-01RE, 59SB01-03RE, 59SB03-01RE, 59SB03-04RE	all results	+/-	R

SVOA

Sample ID	Compound	Results	Q flag
all samples	benzyl alcohol p-phenylenediamine 2,4-dinitrophenol 1,3,5-trinitrobenzene a,a-dimethylphenethylamine	+/-	J/UJ
59SB02-01, 59SB02-04, 59SB01-01, 59SB01-03, 59SB03-01, 59SB03-04, 59SB06-01, 59SB06-03, 59SB02-01D, 59SB07-01, 59SB07-01D	n-nitroso-di-n-butylamine	+/-	J/UJ
59SB02-01, 59SB02-04, 59SB01-01, 59SB01-03, 59SB03-01, 59SB03-04, 59SB06-01, 59SB06-03, 59SB02-01D, 59SB07-01, 59SB07-01D	p-phenylenediamine	+/-	J/R
59SB07-05, 59SB08-05, 59SB10-01, 59SB10-05, 59SB09-01, 59SB09-05, 59SB05-01, 59SB05-05, 59SB08-01	2-picoline n-nitrosodiethylamine aniline n-nitrosopyrrolidine n-nitroso-di-n-propylamine n-nitrosomorpholine n-nitroso-di-n-butylamine methapyrilene indeno(1,2,3-cd)pyrene benzo(g,h,i)perylene	+/-	J/UJ

Summary of Data Qualifications

SVOA, continued

Sample ID	Compound	Results	Q flag
59SB07-05, 59SB08-05, 59SB10-01, 59SB10-05, 59SB09-01, 59SB09-05, 59SB05-01, 59SB05-05, 59SB08-01	p-phenylenediamine	+/-	J/R
59SB01-01, 59SB03-01, 59SB07-01D, 59SB08-01, 59SB10-01	kepone	+/-	J/UJ
all PAH samples	indeno(1,2,3-cd)pyrene	+/-	J/UJ
PAH SIM: 59SB02-01, 59SB02-04, 59SB01-01, 59SB01-03	2-methylnaphthalene fluorene chrysene benzo(k)fluoranthene	+/-	J/UJ
PAH SIM: 59SB03-01, 59SB03-04, 59SB06-01, 59SB06-03, 59SB02-01D, 59SB07-01, 59SB07-01D, 59SB07-05, 59SB08-01, 59SB08-05, 59SB10-05, 59SB09-01, 59SB09-05, 59SB05-01, 59SB05-05	2-methylnaphthalene fluorene chrysene benzo(b)fluoranthene benzo(g,h,i)perylene	+/-	J/UJ
PAH SIM: 59SB10-01	2-methylnaphthalene chrysene benzo(g,h,i)perylene	+/-	J/UJ
PAH SIM: 59SB01-03, 59SB03-01, 59SB05-01, 59SB07-01D, 59SB07-05, 59SB08-01, 59SB08-05, 59SB10-05	naphthalene	+	U at RL
all samples	p-phenylenediamine, kepone	+/-	J/R
all PAH samples	naphthalene 2-methylnaphthalene acenaphthene fluorene phenanthrene anthracene fluoranthene benzo(a)anthracene benzo(k)fluoranthene	+	J
59SB02-01	p-phenylenediamine methapyrilene	+/-	J/R
PAH SIM: 59SB02-01, 59SB02-01D	phenanthrene	+/-	J/UJ
59SB06-01RE, 59SB02-01DRE, 59SB07-05RE	all results	+/-	R

Pesticides

Sample ID	Compound	Results	Q flag
59SB01-01	beta-BHC	+JP	U at RL
59SB01-03	beta-BHC	+J	J
59SB02-04	heptachlor epoxide	+JP	U at RL
	gamma-chlordane	+JP	U at RL
59SB03-01	beta-BHC	+JP	U at RL

Summary of Data Qualifications

Pesticides, continued

Sample ID	Compound	Results	Q flag
59SB03-04	beta-BHC	+JP	U at RL
	heptachlor	+JP	U at RL
59SB05-01	gamma-chlordane	+JP	U at RL
59SB06-01	beta-BHC	+JP	J
59SB06-03	gamma-chlordane	+JP	U at RL
59SB09-01	beta-BHC	+JP	U at RL
59SB09-05	beta-BHC	+JP	U at RL
	endrin aldehyde	+JP	U at RL

Metals by 6020 & 7471

Sample ID	Analyte	Results	Q flag
all samples >MDL up to RL	lead	+B	U at RL
59SB02-01D, 59SD03-01, 59SB03-04, 59SB05-01, 59SB05-05, 59SB07-01D, 59SB08-05, 59SB09-05, 59SB10-05	silver	+B	U at RL
all samples	antimony arsenic barium lead selenium vanadium	+/-	J/UJ
all samples	chromium copper lead nickel vanadium zinc	+/-	J/UJ
all samples	barium	+/-	R
all samples	cobalt copper nickel	+/-	J/UJ
59SB02-01, 59SB02-01D	barium nickel vanadium zinc	+	J
59SB07-01, 59SB07-01D	lead	+	J
all samples	all analytes	+B	J

Tin by 6020

Sample ID	Analyte	Results	Q flag
all samples	all analytes	+B	J

Glossary of Qualification Flags and Abbreviations

Qualification Flags (Q-Flags)

U	not detected above the reported sample quantitation limit
J	estimated value
UJ	reported quantitation limit is qualified as estimated
N	analyte has been tentatively identified
JN	analyte has been tentatively identified, estimated value
R	result is rejected; the presence or absence of the analyte cannot be verified

Method/Preparation/Field QC Blank Qualification Flags (Q-Flags)

Organic Methods

NA	The sample result for the blank contaminant is greater than the RL (2X sample RL for common laboratory contaminants) when the blank value is less than the RL. The sample result for the blank contaminant is not qualified with any blank qualifiers.
U*	The sample result for the blank contaminant is less than the RL (2X sample RL for common laboratory contaminants) but greater than the MDL when the blank value is less than the RL. The sample result for the blank contaminant is qualified as non-detect U at the reported concentration.
RL**	The sample result for the blank contaminant is less than the RL (2X sample RL for common laboratory contaminants) but greater than the MDL when the blank value is less than the RL. The sample result for the blank contaminant is changed to the RL and qualified as non-detect U.

* This guideline is used when the laboratory is reporting non-detects to the MDL. ** This guideline is used when the laboratory is reporting non-detects to the RL.

Inorganic Methods

ICB/CCB/PB Action:

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U*/ RL** -	The sample result is greater than or equal to the MDL but less than or equal to the RL, result is reported as non-detect at the reported concentration or at the RL, when the FB result is less or greater than the RL.

Glossary of Qualification Flags and Abbreviations, continued

R -	Sample result is greater than the RL and less than the ICB/CCB/PB value when the ICB/CCB/PB value is greater than the RL.
J -	Sample result is greater than the ICB/CCB/PB value but less than 10X the ICB/CCB/PB value when ICB/CCB/PB value is greater than the RL.
J/UJ -	Sample result is less than 10X RL when blank result is below the negative RL.

Field QC Blank action:

Note – Use field blanks to qualify data only if field blank results are greater than prep blank results.

Do not use rinsate blank associated with soils to qualify water samples and vice versa.

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U* / RL** -	The sample result is greater than or equal to the MDL but less than or equal to the RL, result is reported as non-detect at the reported concentration or at the RL, when the FB result is less or greater than the RL.
R -	Sample result is greater than the RL and less than the FB value when the FB value is greater than the RL.
J -	Sample result is greater than the FB value but less than 10X the FB value when FB value is greater than the RL.

* This guideline is used when the laboratory is reporting non-detects to the MDL. ** This guideline is used when the laboratory is reporting non-detects to the RL.

General Abbreviations

RL	reporting limit
IDL	instrument detection limit
MDL	method detection limit
CRDL	contract required detection limit
CRQL	contract required quantitation limit
+	positive result
-	non-detect result

DataQual

Environmental Services, LLC

Michael Baker, Jr., Inc.
Airside Business Park
100 Airside Drive
Moon Township, PA 15108

September 4, 2010

SDG# 1004196, CompuChem
NAPR SWMU 59; Ceiba, Puerto Rico

Dear Mr. Kimes,

The following Data Validation report is provided as requested for the parameters noted in the table below for SDG # 1004196. The data validation was performed in accordance with the SW-846 methods utilized by the laboratory and professional judgment. Region II has not developed a validation checklist SOP for the methods used to assess the inorganic methods in this SDG (SW-846 methods 6010B, 6020 and 7471A). Therefore, alternative worksheets were provided. Region II flagging conventions were used. All areas of concern are discussed in the body of the report and a summary of data qualification is provided.

Sample ID	Lab ID	Matrix	Dissolved Metals	Dissolved Tin
59SW01	1004196-01	water	X	X

There were no quality control samples provided with this SDG.

The samples were evaluated based on the following criteria:

- Data Completeness *
- Sample Condition *
- Technical Holding Times *
- ICP/MS Tuning *
- Initial/Continuing Calibrations *
- ICSA/ICSAB Standards *
- CRDL Standards *
- Blanks
- Internal Standards *
- Laboratory Control Samples *
- Matrix Spike Recoveries *
- Matrix Duplicate RPDs *
- Serial Dilutions *
- Field Duplicates *
- Identification/Quantitation

- Reporting Limits *

* - indicates that qualifications were not required based on this criteria

Overall Evaluation of Data/Potential Usability Issues

A summary of qualifications applied to the sample results are noted below for the fractions validated. Specific details regarding qualification of the data are addressed in the Specific Evaluation section of this narrative. If an issue is not addressed there were no actions required based on unmet quality criteria. When more than one qualifier is associated with a compound/analyte the validator has chosen the qualifier that best indicates possible bias in the results and flagged the data accordingly. However, information regarding all quality control issues is provided in the body of the report and on the qualification summary page.

Dissolved Metals by 6020 & 7470B

Blank contamination was noted and qualification was required in the samples in this SDG.

All results reported at concentrations between the method detection limit and the reporting limits (B flagged by the laboratory) were qualified as estimated J.

Dissolved Tin by 6010B

No qualifications to the data were required.

Specific Evaluation of Data

Data Completeness

The SDG was received complete and intact. Resubmissions were not required.

Technical Holding Times

According to chain of custody records, sampling was performed on 4/19/10 and samples were received at the laboratory 4/21/10. All sample preparation and analysis was performed within Region II and/or method holding time requirements.

Blanks

Dissolved Metals by 6020 & 7471

Associated blanks exhibited contamination as noted in the following table. Please see the Glossary of Qualification Flags and Abbreviations for details.

Blank ID	Analyte	Concentration	Action Level	Q Flag
ICB	0.253B ug/L	antimony	RL	U at RL
59FB01	2.2 ug/L	zinc	>RL up to 10X blank concentration	J
59ER01	0.11B ug/L	lead	RL	U at RL
	0.12B ug/L	nickel	RL	U at RL

Associated samples and required qualifications are noted in the following table.

Sample ID	Analyte	Q Flag
59SW01	antimony	U at RL
59SW01	zinc	J
59SW01	lead	U at RL
59SW01	nickel	U at RL

Identification/Quantitation

Dissolved Metals by 6020 & 7471

All results reported at concentrations between the method detection limit and the reporting limit (B flagged by the laboratory) were qualified as estimated J.

A summary of qualifications required is provided on the following page. Please do not hesitate to contact DataQual ES with any questions regarding this validation report.

Sincerely,

Jacqueline Cleveland

Jacqueline Cleveland
Vice-President

Summary of Data Qualifications

Dissolved Metals by 6020 & 7471

Sample ID	Analyte	Results	Q flag
59SW01	antimony	+B	U at RL
59SW01	zinc	+ >RL < 10X blank level	J
59SW01	lead	+B	U at RL
59SW01	nickel	+B	U at RL
all samples	all analytes	+B	J

Dissolved Tin by 6020

Sample ID	Analyte	Results	Q flag
No qualifications were required			

Glossary of Qualification Flags and Abbreviations

Qualification Flags (Q-Flags)

U	not detected above the reported sample quantitation limit
J	estimated value
UJ	reported quantitation limit is qualified as estimated
N	analyte has been tentatively identified
JN	analyte has been tentatively identified, estimated value
R	result is rejected; the presence or absence of the analyte cannot be verified

Method/Preparation/Field QC Blank Qualification Flags (Q-Flags)

Organic Methods

NA	The sample result for the blank contaminant is greater than the RL (2X sample RL for common laboratory contaminants) when the blank value is less than the RL. The sample result for the blank contaminant is not qualified with any blank qualifiers.
U*	The sample result for the blank contaminant is less than the RL (2X sample RL for common laboratory contaminants) but greater than the MDL when the blank value is less than the RL. The sample result for the blank contaminant is qualified as non-detect U at the reported concentration.
RL**	The sample result for the blank contaminant is less than the RL (2X sample RL for common laboratory contaminants) but greater than the MDL when the blank value is less than the RL. The sample result for the blank contaminant is changed to the RL and qualified as non-detect U.

* This guideline is used when the laboratory is reporting non-detects to the MDL. ** This guideline is used when the laboratory is reporting non-detects to the RL.

Inorganic Methods

ICB/CCB/PB Action:

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U*/ RL** -	The sample result is greater than or equal to the MDL but less than or equal to the RL, result is reported as non-detect at the reported concentration or at the RL, when the FB result is less or greater than the RL.

Glossary of Qualification Flags and Abbreviations, continued

R -	Sample result is greater than the RL and less than the ICB/CCB/PB value when the ICB/CCB/PB value is greater than the RL.
J -	Sample result is greater than the ICB/CCB/PB value but less than 10X the ICB/CCB/PB value when ICB/CCB/PB value is greater than the RL.
J/UJ -	Sample result is less than 10X RL when blank result is below the negative RL.

Field QC Blank action:

Note – Use field blanks to qualify data only if field blank results are greater than prep blank results.

Do not use rinsate blank associated with soils to qualify water samples and vice versa.

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U* / RL** -	The sample result is greater than or equal to the MDL but less than or equal to the RL, result is reported as non-detect at the reported concentration or at the RL, when the FB result is less or greater than the RL.
R -	Sample result is greater than the RL and less than the FB value when the FB value is greater than the RL.
J -	Sample result is greater than the FB value but less than 10X the FB value when FB value is greater than the RL.

* This guideline is used when the laboratory is reporting non-detects to the MDL. ** This guideline is used when the laboratory is reporting non-detects to the RL.

General Abbreviations

RL	reporting limit
IDL	instrument detection limit
MDL	method detection limit
CRDL	contract required detection limit
CRQL	contract required quantitation limit
+	positive result
-	non-detect result

COMPUCHEM SDG 1004208

DataQual

Environmental Services, LLC

Michael Baker, Jr., Inc.
Airside Business Park
100 Airside Drive
Moon Township, PA 15108

September 7, 2010

SDG# 1004208, CompuChem
NAPR SWMU 59; Ceiba, Puerto Rico

Dear Mr. Kimes,

The following Data Validation report is provided as requested for the parameters noted in the table below for SDG # 1004208. The data validation was performed in accordance with the SW-846 methods utilized by the laboratory, the Region II Standard Operating Procedures for the Validation of Organic Data Acquired Using SW-846 Methods (8260B-Rev 2, January 2006- SOP #HW-24, 8270D-Rev 3, October 2006-SOP #HW-22, 8081B SOP # HW-44, Rev 1 October 2006) and professional judgment. Region II has not developed a validation checklist SOP for the methods used to assess the inorganic methods in this SDG (SW-846 methods 6010B, 6020 and 7471A). Therefore, alternative worksheets were provided. Region II flagging conventions were used. All areas of concern are discussed in the body of the report and a summary of data qualification is provided.

Sample ID	Lab ID	Matrix	VOA App IX	SVOA App IX w/ LL PAH	Pesticides	Metals	Tin
59SD01	1004208-01	soil	X	X	X	X	X

The samples were evaluated based on the following criteria:

- Data Completeness *
- Sample Condition
- Technical Holding Times *
- GC/MS Tuning *
- ICP-MS Tuning *
- GC Performance *
- Initial/Continuing Calibrations
- ICSA/ICSAB Standards *
- CRDL Standards *
- Blanks
- GC/MS Internal Standards *
- ICP-MS Internal Standards *
- Surrogate Recoveries
- Laboratory Control Samples

- Matrix Spike Recoveries NA
- Matrix Duplicate RPDs NA
- Serial Dilutions
- Field Duplicates NA
- Identification/Quantitation
- Reporting Limits *
- Tentatively Identified Compounds NA

* - indicates that qualifications were not required based on this criteria

Overall Evaluation of Data/Potential Usability Issues

A summary of qualifications applied to the sample results are noted below for the fractions validated. Specific details regarding qualification of the data are addressed in the Specific Evaluation section of this narrative. If an issue is not addressed there were no actions required based on unmet quality criteria. When more than one qualifier is associated with a compound/analyte the validator has chosen the qualifier that best indicates possible bias in the results and flagged the data accordingly. However, information regarding all quality control issues is provided in the body of the report and on the qualification summary page.

VOA

The sample associated with this data package contained 50-90% water that resulted in qualifying the data results as estimated.

The initial and continuing calibrations exhibited some compounds with low RRF values, which resulted in qualifying non-detected values as rejected for these compounds. Due to high %Ds values, in the continuing calibration, some compounds were qualified as estimated.

Blank contamination was noted in the method and/or QC blanks associated with samples in this batch. Qualifications were added to the data.

SVOA

The sample associated with this data package contained 50-90% water that resulted in qualifying the data results as estimated.

Due to high %RSDs and %D values, in the initial and continuing calibrations, some compounds were qualified as estimated.

Blank contamination was noted in the method and/or QC blanks associated with samples in this batch. Qualifications were added to the data.

Due to low recoveries for LCS samples, the associated sample results were qualified for one or more compounds.

Pesticides

The field sample exhibited a %moisture level that was greater than 50%. All reported results in the sample were qualified as estimated.

The surrogate compound TCX exhibited low recoveries in the field sample. All reported results in the sample were qualified as estimated.

All results that exhibited column quantitation %Ds greater than 25% were qualified based on Region II guidelines.

Metals by 6020 & 7471

The field sample exhibited a %moisture level that was greater than 50%. All reported results in the sample were qualified as estimated.

Blank contamination was noted and qualification was required in the samples in this SDG.

All results reported at concentrations between the method detection limit and the reporting limits (B flagged by the laboratory) were qualified as estimated J.

Tin by 6010B

The field sample exhibited a %moisture level that was greater than 50%. All reported results in the sample were qualified as estimated.

Blank contamination was noted and qualification was required in the samples in this SDG.

Specific Evaluation of Data

Data Completeness

The SDG was received complete and intact. Resubmissions were not required.

Sample Condition

ALL FRACTIONS

Soil sample 59SD01 contained >50% moisture (52%). This required the qualification of all reported results as estimated (J/UJ).

Technical Holding Times

According to chain of custody records, sampling was performed on 4/22/10 and samples were received at the laboratory 4/23/10. All sample preparation and analysis was performed within Region II and/or method holding time requirements.

Initial/Continuing Calibration

VOA

Calibration standards exhibited %Ds and RRF values that were non-compliant. A summary of these non-compliances and affected samples are noted in the following table. Sample results are qualified as indicated.

Standard ID	Compound(s)	RRF, %RSD, %D	Samples	Q Flag
IC 4/29/10	acrolein propionitrile isobutyl alcohol 1,4-dioxane	0.035 0.022 0.077 0.001	all samples	J/R
CC 5/05/10	acetone acrylonitrile	0.048 0.047	all samples	J/R
	trichlorofluoromethane iodomethane vinyl acetate 4-methyl-2-pentanone 2-hexanone trans-1,4-dichloro-2-butene	25.15 27.03 -32.29 -25.57 -27.97 -21.63		J/UJ

SVOA

Calibration standards exhibited %RSDs and %D values that were non-compliant. A summary of these non-compliances and affected samples are noted in the following table. Sample results are qualified as indicated.

Standard ID	Compound(s)	RRF, %RSD, %D	Samples	Q Flag
IC full scan 5/21/10	benzyl alcohol p-phenylenediamine 2,4-dinitrophenol 1,3,5-trinitrophenol a,a-dimethylphenethylamine	19.093 41.224 16.534 16.247 25.651	all samples	J/UJ
IC SIM 4/26/10	indeno(1,2,3-cd)pyrene	15.549	PAH SIM: all samples	J/UJ
CC SIM 5/05/10	2-methylnaphthalene benzo(k)fluoranthene	-22.36 22.50	PAH SIM: all samples	J/UJ

Blanks

VOA

The associated method and/or QC blanks exhibited contamination as noted in the following table. Compounds for which there was no action required, are not included in the following table, see worksheets for full list of compounds.

Blank ID	Compound	Concentration	Reporting Limit
VBLKKR	methylene chloride	2.5J ug/Kg	5 ug/Kg
	toluene	0.36J	5
59TB02	methylene chloride	0.18J ug/L	5 ug/L
	toluene	0.045J	5
59ER04	acetone	0.71J	2.5
	methylene chloride	0.34J	0.5
	toluene	0.085J	0.5
59FB01	acetone	3	2.5
	methylene chloride	5.5	0.5
	toluene	2.4	0.5

Associated samples and required qualifications are noted in the following table.

Sample ID	Compound	Q Flag
59SD01	methylene chloride	U at RL
59SD01	toluene	U at RL
59SD01	acetone	U at value

SVOA

The associated method and/or QC blanks exhibited contamination as noted in the following table. Compounds for which there was no action required, are not included in the following table, see worksheets for full list of compounds.

Blank ID	Compound	Concentration	Reporting Limit
SBLKYI-SIM	naphthalene	0.76JJ ug/Kg	8.3 ug/Kg

Associated samples and required qualifications are noted in the following table.

Sample ID	Compound	Q Flag
PAH SIM: 59SD01	naphthalene	U at RL

Metals by 6020 & 7471

Associated blanks exhibited contamination as noted in the following table. Please see the Glossary of Qualification Flags and Abbreviations for details.

Blank ID	Analyte	Concentration	Action Level	Q Flag
ICB	antimony	0.395B ug/L	RL	U at RL
CCB	thallium	0.051B ug/L	RL	U at RL

Associated samples and required qualifications are noted in the following table.

Sample ID	Analyte	Q Flag
59SD01	antimony	U at RL
	thallium	U at RL

Tin by 6010B

Associated blanks exhibited contamination as noted in the following table. Please see the Glossary of Qualification Flags and Abbreviations for details.

Blank ID	Analyte	Concentration	Action Level	Q Flag
PBS	tin	0.688B mg/Kg	RL	U at RL

Associated samples and required qualifications are noted in the following table.

Sample ID	Analyte	Q Flag
59SD01	tin	U at RL

Surrogate Recoveries

Pesticides

The surrogate compound TCX was recovered below the QC limits (68/69) in sample 59SD01. All reported results in the sample were qualified as estimated J/UJ.

Laboratory Control Sample

SVOA

The submitted LCS/LSCD associated with all samples exhibited zero percent recovery for p-phenylenediamine; therefore all non-detected results for this compound were qualified as rejected (R).

Serial Dilutions

Metals by 6020 & 7471

The serial dilution analysis submitted in this SDG exhibited non-compliant %Ds for three analytes, requiring qualification in the field samples. A summary of these non-compliances and affected samples are noted in the following table.

SD	Analytes	Samples	%D	Q Flag
67SD01	cobalt copper lead vanadium	all samples	16 13 20 14	J/UJ

Identification/Quantitation

SVOA

Sample 59SD01-kepone was re-analyzed due to high internal standard area recoveries. The re-analysis exhibited similar results and therefore was not used in favor of the initial analysis. Due to no positive results exhibited in the initial analysis, there were no qualifications required due to this non-compliance.

Pesticides

Several positive results were reported with P flags to indicate that the column quantitation %D was greater than 25%. These results were qualified based on Region II guidelines. Specific results and flags are noted in the following table. Please note that alpha-chlordane was flagged as presumptively present at an estimated concentration NJ because the result on one column was less than the RL but on the other column the result was well above the RL – indicating the presence of possible interference.

Sample ID	Compound	%D	Flag
59SD01	aldrin	85.7	U at RL
	4,4'-DDT	42.4	J
	dieldrin	28.6	J
	endosulfan I	121	U at RL
	endosulfan II	78.7	U at RL
	heptachlor epoxide	100.5	U at RL
	alpha-chlordane	144.4	NJ

Metals by 6020 & 7471

All results reported at concentrations between the method detection limit and the reporting limit (B flagged by the laboratory) were qualified as estimated J.

A summary of qualifications required is provided on the following page. Please do not hesitate to contact DataQual ES with any questions regarding this validation report.

Sincerely,

Laura Maschhoff
President

Jacqueline Cleveland
Vice-President

Summary of Data Qualifications

VOA

Sample ID	Compound	Results	Q flag
59SD01	all results	+/-	J/UJ
all samples	acrolein propionitrile isobutyl alcohol 1,4-dioxane	+/-	J/R
all samples	acetone acrylonitrile	+/-	J/R
all samples	trichlorofluoromethane iodomethane vinyl acetate 4-methyl-2-pentanone 2-hexanone trans-1,4-dichloro-2-butene	+/-	J/UJ
59SD01	methylene chloride	+	U at RL
59SD01	toluene	+	U at RL
59SD01	acetone	+	U at value

SVOA

Sample ID	Compound	Results	Q flag
59SD01	all results	+/-	J/UJ
all samples	benzyl alcohol p-phenylenediamine 2,4-dinitrophenol 1,3,5-trinitrophenol a,a-dimethylphenethylamine	+/-	J/UJ
PAH SIM: all samples	indeno(1,2,3-cd)pyrene	+/-	J/UJ
PAH SIM: all samples	2-methylnaphthalene benzo(k)fluoranthene	+/-	J/UJ
PAH SIM: 59SD01	naphthalene	+	U at RL
all samples	p-phenylenediamine	+/-	J/R
kepone: 59SD01RE	kepone	+/-	R

Pesticides

Sample ID	Compound	Results	Q flag
59SD01	all compounds	+/-	J/UJ
59SD01	all compounds	+/-	J/UJ
59SD01	aldrin	+JP	U at RL
	4,4'-DDT	+J	J
	dieldrin	+J	J
	endosulfan I	+JP	U at RL
	endosulfan II	+JP	U at RL
	heptachlor epoxide	+JP	U at RL
	alpha-chlordane	+JP	NJ

Summary of Data Qualifications

Metals by 6020 & 7471

Sample ID	Analyte	Results	Q flag
59SD01	all results	+/-	J/UJ
59SD01	antimony	+B	U at RL
	thallium	+B	U at RL
59SD01	cobalt copper lead vanadium	+/-	J/UJ
all samples	all analytes	+B	J

Tin by 6020

Sample ID	Analyte	Results	Q flag
59SD01	tin	+/-	J/UJ
59SD01	tin	+B	U at RL

Glossary of Qualification Flags and Abbreviations

Qualification Flags (Q-Flags)

U	not detected above the reported sample quantitation limit
J	estimated value
UJ	reported quantitation limit is qualified as estimated
N	analyte has been tentatively identified
JN	analyte has been tentatively identified, estimated value
R	result is rejected; the presence or absence of the analyte cannot be verified

Method/Preparation/Field QC Blank Qualification Flags (Q-Flags)

Organic Methods

NA	The sample result for the blank contaminant is greater than the RL (2X sample RL for common laboratory contaminants) when the blank value is less than the RL. The sample result for the blank contaminant is not qualified with any blank qualifiers.
U*	The sample result for the blank contaminant is less than the RL (2X sample RL for common laboratory contaminants) but greater than the MDL when the blank value is less than the RL. The sample result for the blank contaminant is qualified as non-detect U at the reported concentration.
RL**	The sample result for the blank contaminant is less than the RL (2X sample RL for common laboratory contaminants) but greater than the MDL when the blank value is less than the RL. The sample result for the blank contaminant is changed to the RL and qualified as non-detect U.

* This guideline is used when the laboratory is reporting non-detects to the MDL. ** This guideline is used when the laboratory is reporting non-detects to the RL.

Inorganic Methods

ICB/CCB/PB Action:

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U*/ RL** -	The sample result is greater than or equal to the MDL but less than or equal to the RL, result is reported as non-detect at the reported concentration or at the RL, when the FB result is less or greater than the RL.

Glossary of Qualification Flags and Abbreviations, continued

R -	Sample result is greater than the RL and less than the ICB/CCB/PB value when the ICB/CCB/PB value is greater than the RL.
J -	Sample result is greater than the ICB/CCB/PB value but less than 10X the ICB/CCB/PB value when ICB/CCB/PB value is greater than the RL.
J/UJ -	Sample result is less than 10X RL when blank result is below the negative RL.

Field QC Blank action:

Note – Use field blanks to qualify data only if field blank results are greater than prep blank results.

Do not use rinsate blank associated with soils to qualify water samples and vice versa.

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U* / RL** -	The sample result is greater than or equal to the MDL but less than or equal to the RL, result is reported as non-detect at the reported concentration or at the RL, when the FB result is less or greater than the RL.
R -	Sample result is greater than the RL and less than the FB value when the FB value is greater than the RL.
J -	Sample result is greater than the FB value but less than 10X the FB value when FB value is greater than the RL.

* This guideline is used when the laboratory is reporting non-detects to the MDL. ** This guideline is used when the laboratory is reporting non-detects to the RL.

General Abbreviations

RL	reporting limit
IDL	instrument detection limit
MDL	method detection limit
CRDL	contract required detection limit
CRQL	contract required quantitation limit
+	positive result
-	non-detect result

DataQual

Environmental Services, LLC

Michael Baker, Jr., Inc.
Airside Business Park
100 Airside Drive
Moon Township, PA 15108

September 7, 2010

SDG# 1005175, CompuChem
NAPR SWMU 59; Ceiba, Puerto Rico

Dear Mr. Kimes,

The following Data Validation report is provided as requested for the parameters noted in the table below for SDG # 1005175. The data validation was performed in accordance with the SW-846 methods utilized by the laboratory, the Region II Standard Operating Procedures for the Validation of Organic Data Acquired Using SW-846 Methods (8260B-Rev 2, January 2006- SOP #HW-24, 8270D-Rev 3, October 2006-SOP #HW-22, 8081B SOP # HW-44, Rev 1 October 2006) and professional judgment. Region II has not developed a validation checklist SOP for the methods used to assess the inorganic methods in this SDG (SW-846 methods 6010B, 6020 and 7470A). Therefore, alternative worksheets were provided. Region II flagging conventions were used. All areas of concern are discussed in the body of the report and a summary of data qualification is provided.

Sample ID	Lab ID	Matrix	VOA App IX	SVOA App IX w/ LL PAH	Pesticides	Metals	Tin
59ER05	1005175-02	water	X	X	X	X	X
59ER06	1005175-03	water	X	X	X	X	X
59ER07	1005175-08	water	X	X	X	X	X
59ER08	1005175-09	water	X	X	X	X	X
59ER09	1005175-21	water	X	X	X	X	X
59ER10	1005175-22	water	X	X	X	X	X
59FB02	1005175-01	water	X	X	X	X	X
59GW01	1005175-19	water	X	X	X	X	X
59GW02	1005175-15	water	X	X	X	X	X
59GW02D	1005175-17	water	X	X	X	X	X
59GW03	1005175-13	water	X	X	X	X	X
59GW04	1005175-16	water	X	X	X	X	X
59GW05	1005175-20	water	X	X	X	X	X
59GW06	1005175-18	water	X	X	X	X	X
59GW07	1005175-07	water	X	X	X	X	X
59GW08	1005175-14	water	X	X	X	X	X
59GW09	1005175-11	water	X	X	X	X	X
59GW10	1005175-12	water	X	X	X	X	X
59SW02	1005175-04	water	X	X	X	X	X
59SW03	1005175-05	water	X	X	X	X	X
59TB04	1005175-06	water	X				
59TB05	1005175-10	water					
59GW02 MS	1005175-15MS	water	X	X	X	X	X
59GW02 MSD	1005175-15MSD	water	X	X	X	X	X

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The following quality control samples were provided with this SDG: sample 59GW02D-field duplicate of sample 59GW02; sample 59TB04 and 59TB05-trip blanks; samples 59ER05, 59ER06, 59ER07, 59ER08, 59ER09 and 59ER10-equipment blanks; and sample 59FB02-field blank.

The samples were evaluated based on the following criteria:

• Data Completeness	*
• Sample Condition	*
• Technical Holding Times	
• GC/MS Tuning	*
• ICP-MS Tuning	*
• GC Performance	*
• Initial/Continuing Calibrations	
• ICSA/ICSAB Standards	*
• CRDL Standards	*
• Blanks	
• GC/MS Internal Standards	*
• ICP-MS Internal Standards	*
• Surrogate Recoveries	*
• Laboratory Control Samples	
• Matrix Spike Recoveries	
• Matrix Duplicate RPDs	
• Serial Dilutions	
• Field Duplicates	
• Identification/Quantitation	
• Reporting Limits	*
• Tentatively Identified Compounds	NA

* - indicates that qualifications were not required based on this criteria

Overall Evaluation of Data/Potential Usability Issues

A summary of qualifications applied to the sample results are noted below for the fractions validated. Specific details regarding qualification of the data are addressed in the Specific Evaluation section of this narrative. If an issue is not addressed there were no actions required based on unmet quality criteria. When more than one qualifier is associated with a compound/analyte the validator has chosen the qualifier that best indicates possible bias in the results and flagged the data accordingly. However, information regarding all quality control issues is provided in the body of the report and on the qualification summary page.

VOA

The initial and continuing calibrations exhibited some compounds with low RRF values, which resulted in qualifying non-detected values as rejected for these compounds. Due to high %Ds values, in the continuing calibration, some compounds were qualified as estimated.

Blank contamination was noted in the method and/or QC blanks associated with samples in this batch. Qualifications were added to the data.

SVOA

All samples were qualified as estimated due to exceeded analysis holding time.

Due to high %RSDs and %D values, in the initial and continuing calibrations, some compounds were qualified as estimated. Some compounds exhibited low RRF values that resulted in non-detected results qualified as rejected.

Blank contamination was noted in the method and/or QC blanks associated with samples in this batch. Qualifications were added to the data.

Four samples exhibited high internal standard area recoveries; there were no positive results therefore no qualifications required. These samples were re-analyzed with similar results; therefore the re-analysis was rejected in favor of the initial analysis.

Due to below low recoveries for LCS samples, the associated sample results were qualified for one or more compounds.

The matrix spike and matrix spike duplicate exhibited below 10% recoveries that resulted in qualifying two compound results as rejected in the associated sample. Two compounds were also qualified as estimated due to low recoveries.

Pesticides by 8081B

The associated field blank exhibited contamination that required qualification in the field samples.

The MS/MSD pair exhibited low recoveries for one compound which was qualified in the native sample and field duplicate only.

One sample was analyzed at a dilution. Results for this analysis were rejected in favor of the results reported from the undiluted analysis.

All results that exhibited column quantitation %Ds greater than 25% were qualified based on Region II guidelines.

Metals by 6020 & 7471

Blank contamination was noted and qualification was required in the samples in this SDG.

The matrix spikes pair submitted in this SDG exhibited non-compliant recoveries in both the MS and the MSD for two analytes for which qualification/rejection were required.

The matrix duplicate exhibited one analyte with a RPD >120%. The analyte was rejected in the field samples.

The serial dilution exhibited a non-compliant %D for one analyte. Results for this analyte were qualified as estimated J/UJ in the field samples.

The field duplicate pair of sample 59GW02/59GW02D exhibited one analyte with a non-compliant RPD greater than 120%. This analyte was rejected based on Region II guidance in the field duplicate pair only.

The %Ds between the total and dissolved metals results were non-compliant for four analytes in 4 samples. These results were qualified as estimated in both the total and dissolved samples. Please note that the dissolved sample results were reported in SDG 1005179.

All results reported at concentrations between the method detection limit and the reporting limits (B flagged by the laboratory) were qualified as estimated J.

Tin by 6010B

No qualification to the analytical data was required.

Specific Evaluation of Data

Data Completeness

The SDG was received complete and intact. Resubmissions were not required. An inquiry into noted baseline issues in the Pesticide analysis was sent to the laboratory. The laboratory acknowledged the early eluting high baseline and attributed it to possible matrix effects. Chromatography was reviewed with this in mind and reported results are accepted with the qualifications noted in this report.

Technical Holding Times

According to chain of custody records, sampling was performed on 5/18-23/10 and samples were received at the laboratory 5/21-25/10. All sample preparation and analysis

was performed within Region II and/or method holding time requirements with the following exceptions.

SVOA

The SVOA analysis of full scan, SIM PAH and kepone were analyzed out of the 40-day analysis by 2-13 days for all samples; therefore the results for all samples were qualified as estimated (J/UJ).

Initial/Continuing Calibration

VOA

Calibration standards exhibited %Ds and RRF values that were non-compliant. A summary of these non-compliances and affected samples are noted in the following table. Sample results are qualified as indicated.

Standard ID	Compound(s)	RRF, %RSD, %D	Samples	Q Flag
IC 5/24/10	acrolein acrylonitrile 2-butanone propionitrile isobutyl alcohol 1,4-dioxane	0.009 0.016 0.036 0.006 0.002 0.0008	all samples	J/R
CC 5/26/10	acetone	0.030/.034	all samples	J/R
CC 5/25/10	trichlorofluoromethane	27.12/28.20		J/UJ
CC 5/26/10	dichlorodifluoromethane bromomethane iodomethane 3-chloropropene	31.08 -56.26 -48.84 -20.96	59GW09, 59GW10, 59GW03, 59GW08, 59GW02, 59GW04, 59GW02D, 59GW06, 59GW01, 59GW05, 59ER09, 59ER10	J/UJ

SVOA

Calibration standards exhibited %RSDs and %D values that were non-compliant. A summary of these non-compliances and affected samples are noted in the following table. Sample results are qualified as indicated.

Standard ID	Compound(s)	RRF, %RSD, %D	Samples	Q Flag
IC full scan 6/24/10	n-nitroso-di-n-butylamine	16.506	59FB02	J/UJ
CC full scan 7/06/10	hexachlorocyclopentadiene 2,4-dinitrophenol 2-naphthylamine hexachlorobenzene	24.25 -20.75 -20.41 25.35	59FB02	J/UJ

Standard ID	Compound(s)	RRF, %RSD, %D	Samples	Q Flag
IC full scan 7/10/10	p-phenylenediamine 4-nitroaniline phenacetin 4-aminobiphenyl methapyrilene	44.989 16.589 18.357 18.549 21.092	59ER05, 59ER06, 59SW02, 59SW03, 59GW07, 59ER07, 59GW09, 59GW03, 59ER08, 59GW10, 59GW08, 59GW02, 59GW04, 59GW02D, 59GW06, 59GW01, 59ER09, 59ER10	J/UJ
full scan CC 7/14/10 CC 7/13/10 CC 7/15/10	4-nitroquinoline-1-oxide	0.355/0.0466/ 0.045	59GW09, 59GW03, 59ER05, 59ER06, 59SW02, 59SW03, 59GW07, 59ER07, 59GW10, 59GW08, 59GW02, 59GW04, 59GW02D, 59GW06, 59GW01	J/R
CC full scan 7/14/10	a,a-dimethylphenethylamine	-47.02	59GW09, 59GW03	J/UJ
CC full scan 7/13/10	chlorobenzilate	20.80	59ER05, 59ER06, 59SW02, 59SW03, 59GW07, 59ER07	J/UJ
IC full scan 7/17/10	n-nitroso-di-n-butylamine p-phenylenediamine	16.276 16.946	59GW05	J/UJ
CC full scan 7/19/10	methapyrilene	22.28	59GW05	J/UJ
CC kepone 7/6/10	kepone	-28.64	59FB02	J/UJ
IC kepone 7/13/10	kepone	15.898	59ER05, 59ER06, 59SW02, 59SW03, 59GW07, 59ER07	J/UJ
CC kepone 7/14/10	kepone	29.72	59GW03	J/UJ
CC kepone 7/15/10	kepone	50.34	59GW09, 59GW10, 59GW08, 59GW02, 59GW04, 59GW02D, 59GW06, 59GW01	J/UJ
CC kepone 7/16/10	kepone	44.92	59ER09, 59ER10	J/UJ

Blanks

VOA

The associated method and/or QC blanks exhibited contamination as noted in the following table. Compounds for which there was no action required, are not included in the following table, see worksheets for full list of compounds.

Blank ID	Compound	Concentration	Reporting Limit
VBLKLR	acetone	0.47J ug/L	2.5 ug/L
	methylene chloride	0.27J	0.5
	toluene	0.1J	0.5
VBLKLU	methylene chloride	0.25J	0.5
	toluene	0.14J	0.5
59TB04	methylene chloride	0.22J	0.5
	toluene	0.13J	0.5

Blank ID	Compound	Concentration	Reporting Limit
59TB05	acetone	1.3J	2.5
	methylene chloride	0.2J	0.5
	toluene	0.13J	0.5
59ER07	acetone	82	2.5
	methylene chloride	4.7	0.5
	2-butanone	1.1J	2.5
	chloroform	0.28J	0.5
	toluene	1.7	0.5
	chlorobenzene	0.33J	0.5
	m,p-xylene	0.095J	1.0
	o-xylene	0.057J	0.5
	xylene (total)	0.1J	0.5
59ER08	acetone	88	2.5
	methylene chloride	4.6	0.5
	2-butanone	1.4J	2.5
	chloroform	0.3J	0.5
	toluene	1.4	0.5
	chlorobenzene	0.27J	0.5
	o-xylene	0.048J	0.5
59ER09	carbon disulfide	0.055J	0.5
	acetone	100	2.5
	methylene chloride	4.6	0.5
	2-butanone	1.2J	2.5
	chloroform	0.22J	0.5
	toluene	0.8	0.5
	chlorobenzene	0.13J	0.5
	o-xylene	0.033J	0.5
59ER10	carbon disulfide	0.029J	0.5
	acetone	90	2.5
	methylene chloride	2.7	0.5
	chloroform	0.12J	0.5
	toluene	0.3J	0.5
	chlorobenzene	0.029J	0.5
59FB02	acetone	5	2.5
	methylene chloride	0.16J	0.5
	toluene	0.19J	0.5

Associated samples and required qualifications are noted in the following table.

Sample ID	Compound	Q Flag
59GW01, 59GW02D, 59GW03, 59GW04, 59GW05, 59GW08, 59GW10	carbon disulfide	U at RL
59GW01, 59SW02, 59SW03	acetone	U at value
59GW02, 59GW03, 59GW05, 59GW06, 59GW07, 59GW09, 59GW10	acetone	U at RL
59GW01, 59GW02, 59GW02D, 59GW04, 59GW05, 59GW06, 59GW07, 59GW08, 59GW09, 59GW10, 59SW02, 59SW03	methylene chloride	U at RL
59GW01, 59GW03, 59GW04, 59GW05, 59GW07, 59GW09	chloroform	U at RL

Sample ID	Compound	Q Flag
59GW01, 59GW02, 59GW02D, 59GW03, 59GW04, 59GW05, 59GW06, 59GW07, 59GW08, 59GW09, 59GW10, 59SW02, 59SW03	toluene	U at RL

SVOA

The associated method and/or QC blanks exhibited contamination as noted in the following table. Compounds for which there was no action required, are not included in the following table, see worksheets for full list of compounds.

Blank ID	Compound	Concentration	Reporting Limit
SBLKDA-SIM	anthracene	0.12J ug/L	0.20
	benzo(a)anthracene	0.16J	0.20
59ER07-SIM	naphthalene	0.048J	0.20
59ER08-SIM	naphthalene	0.042J	0.20
59ER09-SIM	naphthalene	0.041J	0.21
59ER10-SIM	naphthalene	0.040J	0.21

Associated samples and required qualifications are noted in the following table.

Sample ID	Compound	Q Flag
PAH SIM: 59GW09	anthracene	U at RL
PAH SIM: 59GW03, 59GW08, 59GW02	benzo(a)anthracene	U at RL
PAH SIM: 59GW01	naphthalene	U at RL

Pesticides

The associated field blank exhibited contamination as noted in the following table.

Blank ID	Compound	Concentration	Action Level
59FB02	beta-BHC	0.12J ug/L	RL

Associated samples and required qualifications are noted in the following table.

Sample ID	Compound	Q Flag
59GW05, 59GW09	beta-BHC	U at RL

Metals by 6020 & 7471

Associated blanks exhibited contamination as noted in the following table. Please see the Glossary of Qualification Flags and Abbreviations for details.

Blank ID	Analyte	Concentration	Action Level	Q Flag
PBW	nickel	0.281B ug/L	RL	U at RL
59FB02	lead	0.089B ug/L	RL	U at RL

Associated samples and required qualifications are noted in the following table.

Sample ID	Analyte	Q Flag
all samples >MDL up to RL	nickel	U at RL
	lead	U at RL

Laboratory Control Sample

SVOA

All submitted LCS associated with all samples exhibited zero percent recovery for p-phenylenediamine; therefore all non-detected results for this compound were qualified as rejected (R).

One of the LCS samples submitted for kepone exhibited low recovery at 15% (QC limit 20-150%); therefore results for the associated samples (59GW03, 59GW09, 59GW10, 59GW08, 59GW02, 59GW04, 59GW02D, 59GW06, 59GW01, 59ER09 and 59ER10) were qualified as estimated (J/UJ).

Matrix Spike

SVOA

The submitted matrix spike and matrix spike duplicate exhibited non-compliant recoveries requiring qualification or rejection in the associated sample. A summary of these non-compliances and affected samples are noted in the following table.

MS/MSD Associated Sample ID	Compounds	MS %Rec	MSD % Rec	QC Limit	Q Flag
59GW02, 59GW02D	p-phenylenediamine	0	0	20-150	J/R
	pronamide	0	0	20-150	
	1-naphthylamine	19	8	20-150	J/UJ
	3,3'-dimethylbenzidine	52	0	20-150	

Pesticides

The matrix spike analysis submitted in this SDG exhibited non-compliant %Rs for one compound. A summary of this non-compliance and affected samples and actions are noted in the following table.

MS/MSD	Compound	Samples	%R	Q Flag
59GW02	endrin aldehyde	59GW02, 59GW02D	50/50	J/UJ

Metals by 6020 & 7471

The matrix spike analysis submitted in this SDG exhibited non-compliant %Rs for three analytes. A summary of these non-compliances and affected samples and actions are noted in the following table.

MS/MSD	Analytes	Samples	%R	Q Flag
59GW02	mercury	all field samples	0/0	R
	silver		65/59	J/UJ

Matrix Duplicates

Metals by 6020 & 7471

The matrix duplicate analysis submitted in this SDG exhibited a non-compliant RPD for one analyte. A summary of this non-compliances and affected samples and actions are noted in the following table.

MS/MSD	Analytes	Samples	RPD	Q Flag
59GW02	zinc	all field samples	125	R

Serial Dilutions

Metals by 6020 & 7471

The serial dilution analysis submitted in this SDG exhibited a non-compliant %D for one analyte, requiring qualification in the field samples. A summary of this non-compliance and affected samples are noted in the following table.

SD	Analytes	Samples	%D	Q Flag
59GW02	zinc	all field samples	15	J/UJ

Field Duplicates

Metals by 6020 & 7471

The field duplicate pair exhibited non-compliant field duplicate reproducibility for the one analyte. Qualification was made as noted in the table below based on Region II guidelines.

Sample ID	Analyte	RPD or Absolute Difference	Q Flag
59GW02, 59GW02D	zinc	156	R

Identification/Quantitation

SVOA

Samples 59ER05, 59ER06, 59SW02 and 59ER07 were re-analyzed due to high internal standard area recoveries. The re-analysis exhibited similar results and therefore were not used in favor of the initial analysis. Due to no positive results exhibited in the initial analysis, there were no qualifications required due to this non-compliance.

Pesticide

Several positive results were reported with P flags to indicate that the column quantitation %D was greater than 25%. These results were qualified based on Region II guidelines. One compound result was flagged as presumptively present at an estimated concentration due to the disparity of results between the two columns (one result was well above the RL and the other was below the RL – with an elevated baseline) rather than as U at the RL. Specific results and flags are noted in the following table.

Sample ID	Compound	%D	Flag
59GW01	dieldrin	85.7	U at RL
	alpha-chlordane	155.6	U at RL
59GW04	alpha-chlordane	197.7	NJ
59GW05	beta-BHC	66.7	U at RL
	4,4'-DDD	66.7	U at RL
	dieldrin	101.4	U at RL
	endrin	129	U at RL
59GW09	beta-BHC	109.4	U at RL
	alpha-chlordane	155.6	U at RL
59GW10	endrin	58.1	U at RL

Sample 59GW04 was re-analyzed at a dilution due to a positive detection above the RL on one column. The DL run was rejected in favor of the results reported from the undiluted analysis of the sample.

Metals by 6020 & 7471

The %Ds calculated between the total and dissolved analyses were within criteria except for the following exceptions. The noted samples/analytes were flagged as noted in the table below based on Region II guidelines.

Sample ID	Analyte	%D	Q Flag
59GW02	copper	23	J
59GW02D	zinc	23	J
59GW04	thallium	45	J
59GW09	vanadium	33	J

All results reported at concentrations between the method detection limit and the reporting limit (B flagged by the laboratory) were qualified as estimated J.

A summary of qualifications required is provided on the following page. Please do not hesitate to contact DataQual ES with any questions regarding this validation report.

Sincerely,

Laura Maschhoff
President

Jacqueline Cleveland
Vice-President

Summary of Data Qualifications

VOA

Sample ID	Compound	Results	Q flag
all samples	acrolein acrylonitrile 2-butanone propionitrile isobutyl alcohol 1,4-dioxane	+/-	J/R
all samples	acetone	+/-	J/R
all samples	trichlorofluoromethane	+/-	J/UJ
59GW09, 59GW10, 59GW03, 59GW08, 59GW02, 59GW04, 59GW02D, 59GW06, 59GW01, 59GW05, 59ER09, 59ER10	dichlorodifluoromethane bromomethane iodomethane 3-chloropropene	+/-	J/UJ
59GW01, 59GW02D, 59GW03, 59GW04, 59GW05, 59GW08, 59GW10	carbon disulfide	+	U at RL
59GW01, 59SW02, 59SW03	acetone	+	U at value
59GW02, 59GW03, 59GW05, 59GW06, 59GW07, 59GW09, 59GW10	acetone	+	U at RL
59GW01, 59GW02, 59GW02D, 59GW04, 59GW05, 59GW06, 59GW07, 59GW08, 59GW09, 59GW10, 59SW02, 59SW03	methylene chloride	+	U at RL
59GW01, 59GW03, 59GW04, 59GW05, 59GW07, 59GW09	chloroform	+	U at RL
59GW01, 59GW02, 59GW02D, 59GW03, 59GW04, 59GW05, 59GW06, 59GW07, 59GW08, 59GW09, 59GW10, 59SW02, 59SW03	toluene	+	U at RL

SVOA

Sample ID	Compound	Results	Q flag
all samples	all results	+/-	J/UJ
59FB02	n-nitroso-di-n-butylamine	+/-	J/UJ
59FB02	hexachlorocyclopentadiene 2,4-dinitrophenol 2-naphthylamine hexachlorobenzene	+/-	J/UJ
59ER05, 59ER06, 59SW02, 59SW03, 59GW07, 59ER07, 59GW09, 59GW03, 59ER08, 59GW10, 59GW08, 59GW02, 59GW04, 59GW02D, 59GW06, 59GW01, 59ER09, 59ER10	p-phenylenediamine 4-nitroaniline phenacetin 4-aminobiphenyl methapyrilene	+/-	J/UJ
59GW09, 59GW03, 59ER05, 59ER06, 59SW02, 59SW03, 59GW07, 59ER07, 59GW10, 59GW08, 59GW02, 59GW04, 59GW02D, 59GW06, 59GW01	4-nitroquinoline-1-oxide	+/-	J/R
59GW09, 59GW03	a,a-dimethylphenethylamine	+/-	J/UJ
59ER05, 59ER06, 59SW02, 59SW03, 59GW07, 59ER07	chlorobenzilate	+/-	J/UJ
59GW05	n-nitroso-di-n-butylamine p-phenylenediamine	+/-	J/UJ
59GW05	methapyrilene	+/-	J/UJ

Summary of Data Qualifications

SVOA

Sample ID	Compound	Results	Q flag
59FB02	kepone	+/-	J/UJ
59ER05, 59ER06, 59SW02, 59SW03, 59GW07, 59ER07	kepone	+/-	J/UJ
59GW03	kepone	+/-	J/UJ
59GW09, 59GW10, 59GW08, 59GW02, 59GW04, 59GW02D, 59GW06, 59GW01	kepone	+/-	J/UJ
59ER09, 59ER10	kepone	+/-	J/UJ
PAH SIM: 59GW09	anthracene	+	U at RL
PAH SIM: 59GW03, 59GW08, 59GW02	benzo(a)anthracene	+	U at RL
PAH SIM: 59GW01	naphthalene	+	U at RL
all samples	p-phenylenediamine	+/-	J/R
59GW03, 59GW09, 59GW10, 59GW08, 59GW02, 59GW04, 59GW02D, 59GW06, 59GW01, 59ER09, 59ER10	kepone	+/-	J/UJ
59GW02, 59GW02D	p-phenylenediamine pronamide	+/-	J/R
59GW02, 59GW02D	1-naphthylamine 3,3'-dimethylbenzidine	+/-	J/UJ
59ER05RE, 59ER06RE, 59SW02RE, 59ER07RE	all results	+/-	R

Pesticides

Sample ID	Compound	Results	Q flag
all samples >MDL but <RL	beta-BHC	+J	U at RL
59GW02, 59GW02D	endrin aldehyde	+/-	J/UJ
59GW04DL	all compounds	+/-	R
59GW01	dieldrin	+JP	U at RL
	alpha-chlordane	+JP	U at RL
59GW04	alpha-chlordane	+JP	NJ
59GW05	beta-BHC	+JP	U at RL
	4,4'-DDD	+JP	U at RL
	dieldrin	+JP	U at RL
	endrin	+JP	U at RL
59GW09	beta-BHC	+JP	U at RL
	alpha-chlordane	+JP	U at RL
59GW10	endrin	+JP	U at RL

Summary of Data Qualifications

Metals by 6020 & 7471

Sample ID	Analyte	Results	Q flag
all samples >MDL up to RL	nickel	+J	U at RL
	lead	+J	U at RL
all field samples	mercury	+/-	R
all field samples	silver	+/-	J/UJ
all field samples	zinc	+/-	R
all field samples	zinc	+/-	J/UJ
59GW02	copper	+	J
59GW02D	zinc	+	J
59GW04	thallium	+	J
59GW09	vanadium	+	J
all samples	all analytes	+B	J

Tin by 6020

Sample ID	Analyte	Results	Q flag
No qualifications were required			

Glossary of Qualification Flags and Abbreviations

Qualification Flags (Q-Flags)

U	not detected above the reported sample quantitation limit
J	estimated value
UJ	reported quantitation limit is qualified as estimated
N	analyte has been tentatively identified
JN	analyte has been tentatively identified, estimated value
R	result is rejected; the presence or absence of the analyte cannot be verified

Method/Preparation/Field QC Blank Qualification Flags (Q-Flags)

Organic Methods

NA	The sample result for the blank contaminant is greater than the RL (2X sample RL for common laboratory contaminants) when the blank value is less than the RL. The sample result for the blank contaminant is not qualified with any blank qualifiers.
U*	The sample result for the blank contaminant is less than the RL (2X sample RL for common laboratory contaminants) but greater than the MDL when the blank value is less than the RL. The sample result for the blank contaminant is qualified as non-detect U at the reported concentration.
RL**	The sample result for the blank contaminant is less than the RL (2X sample RL for common laboratory contaminants) but greater than the MDL when the blank value is less than the RL. The sample result for the blank contaminant is changed to the RL and qualified as non-detect U.

* This guideline is used when the laboratory is reporting non-detects to the MDL. ** This guideline is used when the laboratory is reporting non-detects to the RL.

Inorganic Methods

ICB/CCB/PB Action:

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U*/ RL** -	The sample result is greater than or equal to the MDL but less than or equal to the RL, result is reported as non-detect at the reported concentration or at the RL, when the FB result is less or greater than the RL.

Glossary of Qualification Flags and Abbreviations, continued

R -	Sample result is greater than the RL and less than the ICB/CCB/PB value when the ICB/CCB/PB value is greater than the RL.
J -	Sample result is greater than the ICB/CCB/PB value but less than 10X the ICB/CCB/PB value when ICB/CCB/PB value is greater than the RL.
J/UJ -	Sample result is less than 10X RL when blank result is below the negative RL.

Field QC Blank action:

Note – Use field blanks to qualify data only if field blank results are greater than prep blank results.

Do not use rinsate blank associated with soils to qualify water samples and vice versa.

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U* / RL** -	The sample result is greater than or equal to the MDL but less than or equal to the RL, result is reported as non-detect at the reported concentration or at the RL, when the FB result is less or greater than the RL.
R -	Sample result is greater than the RL and less than the FB value when the FB value is greater than the RL.
J -	Sample result is greater than the FB value but less than 10X the FB value when FB value is greater than the RL.

* This guideline is used when the laboratory is reporting non-detects to the MDL. ** This guideline is used when the laboratory is reporting non-detects to the RL.

General Abbreviations

RL	reporting limit
IDL	instrument detection limit
MDL	method detection limit
CRDL	contract required detection limit
CRQL	contract required quantitation limit
+	positive result
-	non-detect result

DataQual

Environmental Services, LLC

Michael Baker, Jr., Inc.
Airside Business Park
100 Airside Drive
Moon Township, PA 15108

September 8, 2010

SDG# 1005176, CompuChem
NAPR SWMU 59; Ceiba, Puerto Rico

Dear Mr. Kimes,

The following Data Validation report is provided as requested for the parameters noted in the table below for SDG # 1005176. The data validation was performed in accordance with the SW-846 methods utilized by the laboratory, the Region II Standard Operating Procedures for the Validation of Organic Data Acquired Using SW-846 Methods (8260B-Rev 2, January 2006- SOP #HW-24, 8270D-Rev 3, October 2006-SOP #HW-22, 8081B SOP # HW-44, Rev 1 October 2006) and professional judgment. Region II has not developed a validation checklist SOP for the methods used to assess the inorganic methods in this SDG (SW-846 methods 6010B, 6020 and 7471A). Therefore, alternative worksheets were provided. Region II flagging conventions were used. All areas of concern are discussed in the body of the report and a summary of data qualification is provided.

Sample ID	Lab ID	Matrix	VOA App IX	SVOA App IX w/ LL PAH	Pesticides	Metals	Tin
59SB11-00	1005176-02	soil	X	X	X	X	X
59SB11-00D	1005176-03	soil	X	X	X	X	X
59SB11-01	1005176-01	soil	X	X	X	X	X
59SB11-01D	1005176-04	soil	X	X	X	X	X
59SB11-02	1005176-21	soil	X	X	X	X	X
59SB12-00	1005176-06	soil	X	X	X	X	X
59SB12-01	1005176-07	soil	X	X	X	X	X
59SB12-05	1005176-08	soil	X	X	X	X	X
59SB14-00	1005176-09	soil	X	X	X	X	X
59SB14-01	1005176-10	soil	X	X	X	X	X
59SB14-05	1005176-11	soil	X	X	X	X	X
59SB15-00	1005176-12	soil	X	X	X	X	X
59SB15-01	1005176-13	soil	X	X	X	X	X
59SB15-05	1005176-14	soil	X	X	X	X	X
59SB16-01	1005176-15	soil	X	X	X	X	X
59SB16-05	1005176-16	soil	X	X	X	X	X
59SB17-00	1005176-17	soil	X	X	X	X	X
59SB17-00D	1005176-18	soil	X	X	X	X	X
59SB17-01	1005176-19	soil	X	X	X	X	X
59SB17-05	1005176-20	soil	X	X	X	X	X
59SB11-01 MS	1005176-01MS	soil	X	X	X	X	X
59SB11-01 MSD	1005176-01MSD	soil	X	X	X	X	X

The following quality control samples were provided with this SDG: sample 59SB11-00D-field duplicate of sample 59SB11-00; sample 59SB11-01D-field duplicate of sample 59SB11-01; and sample 59SB17-00D- field duplicate of sample 59SB17-00.

The samples were evaluated based on the following criteria:

• Data Completeness	*
• Sample Condition	*
• Technical Holding Times	*
• GC/MS Tuning	*
• ICP-MS Tuning	*
• GC Performance	*
• Initial/Continuing Calibrations	
• ICSA/ICSAB Standards	*
• CRDL Standards	*
• Blanks	
• GC/MS Internal Standards	*
• ICP-MS Internal Standards	*
• Surrogate Recoveries	
• Laboratory Control Samples	*
• Matrix Spike Recoveries	
• Matrix Duplicate RPDs	
• Serial Dilutions	*
• Field Duplicates	
• Identification/Quantitation	
• Reporting Limits	*
• Tentatively Identified Compounds	NA

* - indicates that qualifications were not required based on this criteria

Overall Evaluation of Data/Potential Usability Issues

A summary of qualifications applied to the sample results are noted below for the fractions validated. Specific details regarding qualification of the data are addressed in the Specific Evaluation section of this narrative. If an issue is not addressed there were no actions required based on unmet quality criteria. When more than one qualifier is associated with a compound/analyte the validator has chosen the qualifier that best indicates possible bias in the results and flagged the data accordingly. However, information regarding all quality control issues is provided in the body of the report and on the qualification summary page.

VOA

The initial and continuing calibrations exhibited some compounds with low RRF values, which resulted in qualifying non-detected values as rejected for these compounds. The continuing calibrations exhibited high %Ds that resulted in qualifying some compounds as estimated.

Blank contamination was noted in the method and/or QC blanks associated with samples in this batch. Qualifications were added to the data.

Two samples exhibited high surrogate recoveries that resulted in qualifying positive results as estimated.

SVOA

All samples were qualified as estimated due to exceeded analysis holding time.

Blank contamination was noted in the method and/or QC blanks associated with samples in this batch. Qualifications were added to the data.

Four samples exhibited high internal standard area recoveries which resulted in qualifying associated positive results as estimated.

Due to below low recoveries for LCS samples, the associated sample results were qualified for one or more compounds.

The matrix spike and matrix spike duplicate exhibited below 10% recoveries that resulted in qualifying two compound results as rejected in the associated sample. Two compounds were also qualified as estimated due to low recoveries.

Pesticides

Blank contamination was noted in the method blank associated with samples in this batch. Qualifications were added to the data.

Three samples were qualified due to non-compliant surrogate recoveries.

Results for beta-BHC were qualified/rejected due to significant disparity in the results noted between the two analytical columns. Four samples were diluted because the compound was detected at concentrations greater than the RL on one column. In these samples beta-BHC was reported from the dilution and flagged presumptively present at an estimated concentration NJ.

Reported results were qualified based on Region II guidelines for column quantitation %Ds >25%.

Metals by 6020 & 7471

Blank contamination was noted and qualification was required in the samples in this SDG.

The matrix spikes pair submitted in this SDG exhibited non-compliant recoveries in both the MS and the MSD for one analyte for which qualifications were required.

The matrix duplicate submitted in this SDG exhibited a non-compliant RPD >35% for one analyte. All results for this analyte were qualified as estimated J/UJ in the metals samples.

The field duplicate pairs of samples 59SB11-01/59SB11-01D AND 59SB11-00/59SB11-00D exhibited non-compliant RPDs. These analytes were flagged based on Region II guidance in the field duplicate pairs only.

All results reported at concentrations between the method detection limit and the reporting limits (B flagged by the laboratory) were qualified as estimated J.

Tin by 6010B

Blank contamination was noted and qualification was required in the samples in this SDG.

Specific Evaluation of Data

Data Completeness

The SDG was received complete and intact. Resubmissions were required. Clarification regarding the dilution runs was requested from the laboratory. A response was received. Resubmission was required for one sample which was initially reported incorrectly. Copies of all e-mail correspondence are included in the validation worksheets.

Technical Holding Times

According to chain of custody records, sampling was performed on 5/18-19/10 and samples were received at the laboratory 5/21/10. All sample preparation and analysis was performed within Region II and/or method holding time requirements with the following exceptions.

SVOA

The SVOA analysis of full scan, SIM PAH and kepone were analyzed out of the 40-day analysis by 4-14 days for all samples; therefore the results for all samples were qualified as estimated (J/UJ).

Initial/Continuing Calibration

VOA

Calibration standards exhibited %Ds and RRF values that were non-compliant. A summary of these non-compliances and affected samples are noted in the following table. Sample results are qualified as indicated.

Standard ID	Compound(s)	RRF, %RSD, %D	Samples	Q Flag
IC 5/25/10	acrolein propionitrile isobutyl alcohol 1,4-dioxane methylmethacrylate	0.038 0.025 0.009 0.001 0.040	all samples	J/R
CC 5/26/10	chloroethane	21.65	all samples except 59SB11-02	J/UJ

Blanks

VOA

The associated method and/or QC blanks exhibited contamination as noted in the following table. Compounds for which there was no action required, are not included in the following table, see worksheets for full list of compounds.

Blank ID	Compound	Concentration	Reporting Limit
VBLKLV	acetone	6.4J ug/Kg	13 ug/Kg
	methylene chloride	0.93J	5
	toluene	1.6J	5
VBLKHA	methylene chloride	2.5J	5
	toluene	1.3J	5
59TB04	methylene chloride	0.22J ug/L	0.5 ug/L
	toluene	0.13J	0.5
59ER05	acetone	3.4	2.5
	methylene chloride	1.2	0.5
	2-butanone	1.1J	2.5
	chloroform	0.043J	0.5
	toluene	0.22J	0.5
59ER06	acetone	3.9	2.5
	methylene chloride	1.2	0.5
	2-butanone	1J	2.5
	chloroform	0.041J	0.5
	toluene	0.16J	0.5
59FB02	acetone	5	2.5
	methylene chloride	0.16J	0.5
	toluene	0.19J	0.5

Associated samples and required qualifications are noted in the following table.

Sample ID	Compound	Q Flag
59SB11-00, 59SB11-00D, 59SB11-01, 59SB11-02, 59SB12-00RE, 59SB12-01, 59SB12-05, 59SB14-00, 59SB14-01, 59SB14-05, 59SB15-01, 59SB15-00, 59SB15-05, 59SB16-01, 59SB16-05, 59SB17-00, 59SB17-00D, 59SB17-01, 59SB17-05	methylene chloride	U at RL
59SB11-00, 59SB11-00D, 59SB11-01, 59SB11-01D59SB12-00RE, 59SB12-01, 59SB12-05, 59SB14-00, 59SB14-01, 59SB14-05, 59SB15-00, 59SB15-01, 59SB15-05, 59SB16-01, 59SB16-05, 59SB17-00, 59SB17-00D, 59SB17-01, 59SB17-05	toluene	U at RL
59SB11-01, 59SB12-05, 59SB14-05, 59SB15-05, 59SB16-05, 59SB17-05	acetone	U at RL
59SB11-01D, 59SB12-01, 59SB14-00, 59SB14-01, 59SB15-01, 59SB16-01, 59SB11-02	acetone	U at value
59SB11-00D, 59SB12-01, 59SB14-01, 59SB15-00, 59SB17-00, 59SB17-00D, 59SB17-01	2-butanone	U at RL
59SB11-00, 59SB12-00RE	2-butanone	U at value

SVOA

The associated method and/or QC blanks exhibited contamination as noted in the following table. Compounds for which there was no action required, are not included in the following table, see worksheets for full list of compounds.

Blank ID	Compound	Concentration	Reporting Limit
SBLKDE	bis(2-ethylhexyl)phthalate	47J ug/Kg	170 ug/Kg
	di-n-octyl phthalate	61J	170
SBLKDE-SIM	naphthalene	0.77J	8.3
	phenanthrene	1.7J	8.3
	pyrene	1.2J	8.3
	indeno(1,2,3-cd)pyrene	5.0J	8.3
SBLKED	phenanthrene	1.7J	8.3
	pyrene	0.94J	8.3

Associated samples and required qualifications are noted in the following table.

Sample ID	Compound	Q Flag
59SB11-00, 59SB11-00D, 59SB11-01RE, 59SB11-01D, 59SB11-02, 59SB12-00, 59SB12-01, 59SB12-05, 59SB14-00, 59SB14-01, 59SB14-05, 59SB15-01, 59SB15-05, 59SB16-01, 59SB16-05, 59SB17-00, 59SB17-00D, 59SB17-01, 59SB17-05	bis(2-ethylhexyl)phthalate	U at RL
59SB17-01	di-n-octyl phthalate	U at RL
PAH SIM: 59SB11-00, 59SB11-00D, 59SB11-01	naphthalene	U at RL
PAH SIM: 59SB11-00, 59SB11-00D, 59SB14-00, 59SB14-01, 59SB15-05, 59SB17-00, 59SB17-00D	pyrene	U at RL
PAH SIM: 59SB11-00D, 59SB11-02, 59SB12-00RE, 59SB15-00	phenanthrene	U at RL
PAH SIM: 59SB11-00D	indeno(1,2,3-cd)pyrene	U at RL

Pesticides

The associated field blank exhibited contamination as noted in the following table.

Blank ID	Compound	Concentration	Action Limit
PBLKDG	delta-BHC	0.56JP ug/Kg	RL
	heptachlor	0.17JP ug/Kg	RL
59FB02	beta-BHC	0.12J ug/L	RL

Associated samples and required qualifications are noted in the following table.

Sample ID	Compound	Q Flag
all samples >MDL <RL	delta-BHC heptachlor beta-BHC	U at RL

Metals by 6020 & 7471

Associated blanks exhibited contamination as noted in the following table. Please see the Glossary of Qualification Flags and Abbreviations for details.

Blank ID	Analyte	Concentration	Action Level	Q Flag
PBS	chromium	0.155B mg/Kg	RL	U at RL
	silver	0.050B mg/Kg	RL	U at RL
59FB02	lead	0.089B ug/L	RL	U at RL

Associated samples and required qualifications are noted in the following table.

Sample ID	Analyte	Q Flag
all samples >MDL up to RL	chromium silver lead	U at RL

Tin by 6010B

Associated blanks exhibited contamination as noted in the following table. Please see the Glossary of Qualification Flags and Abbreviations for details.

Blank ID	Analyte	Concentration	Action Level	Q Flag
PBS	tin	1.597B mg/Kg	RL	U at RL

Associated samples and required qualifications are noted in the following table.

Sample ID	Analyte	Q Flag
all samples >MDL up to RL	tin	U at RL

Surrogates

VOA

Sample 59SB15-00 exhibited high results for surrogate bromofluorobenzene at 139% (QC limit 85-120%); therefore all positive results were qualified as estimated (J). This sample was re-analyzed with similar results.

Sample 59SB12-00 exhibited high results for surrogates toluene-d8 and bromofluorobenzene. The sample was re-analyzed with less non-compliant results with high recoveries for only bromofluorobenzene at 122% (QC limit 85-120%); therefore positive results qualified as estimated (J).

Pesticides

Sample 59SB11-00D exhibited variable non-compliant TCX recoveries (140/66). All positive and non-detect results were qualified as estimated J/UJ.

Sample 59SB11-02 exhibited low recoveries for DCB on one column and TCX on both columns (43/47/42). All positive and non-detect results were qualified as estimated J/UJ.

Sample 59SB15-00 exhibited high recoveries for DCB on one column and for TCX on the other column (178/190). All positive results were qualified as estimated J.

Internal Standards

SVOA

Sample 59SB11-01RE exhibited high recovery for perylene-d12, sample 59SB16-01 and 59SB17-05 for standard chrysene-d12; therefore all positive results associated with these standards were qualified as estimated (J).

Sample 59SB12-00-SIM exhibited low recoveries for chrysene-d12 and perylene-d12. The sample was re-analyzed and exhibited low recovery for perylene-d12; therefore the re-analysis was used and associated compounds with this standard were qualified as estimated (J/UJ).

Laboratory Control Sample

SVOA

The submitted LCS associated with all samples exhibited zero percent recovery for p-phenylenediamine and kepone; therefore all non-detected results for this compound were qualified as rejected (R). Also low recovery was exhibited for 2, 4-dichlorophenol at 39% (42-119%); therefore all results were qualified as estimated (J/UJ).

Matrix Spike

SVOA

The submitted matrix spike and matrix spike duplicate exhibited non-compliant recoveries requiring qualification or rejection in the associated sample. A summary of these non-compliances and affected samples are noted in the following table.

MS/MSD Associated Sample ID	Compounds	MS %Rec	MSD % Rec	QC Limit	Q Flag
59SB11-01, 59SB11-01D	p-phenylenediamine	0	0	20-150	J/R
	methapyrilene	0	0	20-150	
	kepone	0	0	20-150	
	2,4-dichlorophenol	40	41	42-119	J/UJ
	1-naphthylamine	18	19	20-150	

Metals by 6020 & 7471

The matrix spike analysis submitted in this SDG exhibited non-compliant %Rs for one analyte. A summary of this non-compliance and affected samples and actions are noted in the following table.

MS/MSD	Analytes	Samples	%R	Q Flag
59SB11-01	antimony	all samples	30/31	J/UJ

Matrix Duplicates

Metals by 6020 & 7471

The matrix duplicate analysis submitted in this SDG exhibited a non-compliant RPD >35% for one analyte, requiring qualification in the field samples. A summary of this non-compliance and affected samples are noted in the following table.

SD	Analytes	Samples	%D	Q Flag
59SB11-01	chromium	all samples	47	J/UJ

Field Duplicates

Metals by 6020 & 7471

The field duplicate pairs exhibited non-compliant field duplicate reproducibility for the following analytes. These field duplicate pairs and analytes were flagged as noted in the table below based on Region II guidelines.

Sample ID	Analyte	RPD or Absolute Difference	Q Flag
59SB11-01, 59SB11-01D	chromium	35	J
59SB11-00, 59SB11-00D	chromium lead	48 45	J

Identification/Quantitation

VOA

Samples 59SB12-00 and 59SB15-00RE were not used due to non compliant surrogate results.

SVOA

Samples 59SB12-00-SIM, 59SB11-01, 59SB16-01RE and 59SB17-05RE were not used due to non-compliant internal standards area recoveries.

Pesticides

Samples 59SB12-05, 59SB15-01 and 59SB17-00D were reanalyzed at dilutions of 1:5 due to results above the linear range on at least one of the analytical columns. For these samples, reported results for beta-BHC are rejected in the undiluted analyses in favor of the beta-BHC results in the dilution analysis. Results in the dilution analyses are qualified as presumptively present at an estimated concentration NJ due to the disparity in the concentrations of the results on the two analytical columns. All other results in the dilution analyses are rejected in favor of the results reported from the undiluted analyses.

For sample 59SB11-00D, the reported results from the undiluted analysis are rejected in favor of the results reported from the dilution analysis. All positive results in the dilution analysis are qualified as presumptively present at an estimated concentration NJ and all non-detect results are qualified as estimated UJ due to the disparity in the concentrations of the results on the two analytical columns.

For sample 59SB15-00, the reported results from the undiluted analysis are rejected in favor of the results reported from the dilution analysis. Positive results from the DL analysis are qualified based on Region II criteria for column quantitation %Ds >25%.

Other positive results were reported with P flags to indicate that the column quantitation %D was greater than 25%. These results were qualified based on Region II guidelines. Specific results and flags are noted in the following table.

Sample ID	Compound	%D	Flag
59SB12-00	4,4'-DDE	89.8	U at RL
	4,4'-DDT	48.9	J
	endosulfan sulfate	43.6	J
	alpha-chlordane	27.6	J
59SB12-05	alpha-BHC	83.6	U at RL
59SB15-00DL	beta-BHC	100.6	NJ
	gamma-chlordane	52.6	J
59SB15-01	4,4'-DDT	68.2	U at RL

Metals by 6020 & 7471

All results reported at concentrations between the method detection limit and the reporting limit (B flagged by the laboratory) were qualified as estimated J.

A summary of qualifications required is provided on the following page. Please do not hesitate to contact DataQual ES with any questions regarding this validation report.

Sincerely,

Laura Maschhoff
President

Jacqueline Cleveland
Vice-President

Summary of Data Qualifications

VOA

Sample ID	Compound	Results	Q flag
all samples	acrolein propionitrile isobutyl alcohol 1,4-dioxane methylmethacrylate	+/-	J/R
all samples except 59SB11-02	chloroethane	+/-	J/UJ
59SB11-00, 59SB11-00D, 59SB11-01, 59SB11-02, 59SB12-00RE, 59SB12-01, 59SB12-05, 59SB14-00, 59SB14-01, 59SB14-05, 59SB15-01, 59SB15-00, 59SB15-05, 59SB16-01, 59SB16-05, 59SB17-00, 59SB17-00D, 59SB17-01, 59SB17-05	methylene chloride	+	U at RL
59SB11-00, 59SB11-00D, 59SB11-01, 59SB11-01D59SB12-00RE, 59SB12-01, 59SB12-05, 59SB14-00, 59SB14-01, 59SB14-05, 59SB15-00, 59SB15-01, 59SB15-05, 59SB16-01, 59SB16-05, 59SB17-00, 59SB17-00D, 59SB17-01, 59SB17-05	toluene	+	U at RL
59SB11-01, 59SB12-05, 59SB14-05, 59SB15-05, 59SB16-05, 59SB17-05	acetone	+	U at RL
59SB11-01D, 59SB12-01, 59SB14-00, 59SB14-01, 59SB15-01, 59SB16-01, 59SB11-02	acetone	+	U at value
59SB11-00D, 59SB12-01, 59SB14-01, 59SB15-00, 59SB17-00, 59SB17-00D, 59SB17-01	2-butanone	+	U at RL
59SB11-00, 59SB12-00RE	2-butanone	+	U at value
59SB15-00, 59SB12-00RE	all positive results	+	J
59SB12-00, 59SB15-00RE	all results	+/-	R

SVOA

Sample ID	Compound	Results	Q flag
all samples	all results	+/-	J/UJ
59SB11-00, 59SB11-00D, 59SB11-01RE, 59SB11-01D, 59SB11-02, 59SB12-00, 59SB12-01, 59SB12-05, 59SB14-00, 59SB14-01, 59SB14-05, 59SB15-01, 59SB15-05, 59SB16-01, 59SB16-05, 59SB17-00, 59SB17-00D, 59SB17-01, 59SB17-05	bis(2-ethylhexyl)phthalate	+	U at RL
59SB17-01	di-n-octyl phthalate	+	U at RL
PAH SIM: 59SB11-00, 59SB11-00D, 59SB11-01	naphthalene	+	U at RL
PAH SIM: 59SB11-00, 59SB11-00D, 59SB14-00, 59SB15-05, 59SB17-001	pyrene	+	U at RL
PAH SIM: 59SB11-00D, 59SB11-02, 59SB12-00RE, 59SB15-00, 59SB17-00, 59SB17-00D	phenanthrene	+	U at RL
PAH SIM: 59SB11-00D	indeno(1,2,3-cd)pyrene	+	U at RL
59SB11-01RE	all compounds associated with: perylene-d12	+	J
59SB16-01, 59SB17-05	all compounds associated with: chrysene-d12	+	J
PAH SIM: 59SB12-00	all compounds associated with: perylene-d12 chrysene-d12	+	J

Summary of Data Qualifications

SVOA, continued

Sample ID	Compound	Results	Q flag
all samples	p-phenylenediamine kepone	+/-	J/R
all samples	2,4-dichlorophenol	+/-	J/UJ
59SB11-01, 59SB11-01D	p-phenylenediamine methapyrilene kepone	+/-	J/R
59SB11-01, 59SB11-01D	2,4-dichlorophenol 1-naphthylamine	+/-	J/UJ
59SB12-00-SIM, 59SB11-01, 59SB16-01RE, 59SB17-05RE	all results	+/-	R

Pesticides

Sample ID	Compound	Results	Q flag
all samples	delta-BHC heptachlor beta-BHC	+J	U at RL
59SB11-00D, 59SB11-02	all compounds	+/-	J/UJ
59SB15-00	all compounds	+	J
59SB12-05, 59SB15-01, 59SB17-00D	beta-BHC	+P, +JP	R
59SB12-05DL, 59SB15-01DL, 59SB17-00DDL	beta-BHC	+	NJ
59SB12-05DL, 59SB15-01DL, 59SB17-00DDL	all results except beta-BHC	+/-	R
59SB15-00, 59SB11-00D	all compounds	+/-	R
59SB11-00DDL	all compounds	+/-	NJ/UJ
59SB12-00	4,4'-DDE	+JP	U at RL
	4,4'-DDT	+JP	J
	endosulfan sulfate	+JP	J
	alpha-chlordane	+J	J
59SB12-05	alpha-BHC	+JP	U at RL
59SB15-00DL	beta-BHC	+DJP	NJ
	gamma-chlordane	+DJP	J
59SB15-01	4,4'-DDT	+JP	U at RL

Summary of Data Qualifications

Metals by 6020 & 7471

Sample ID	Analyte	Results	Q flag
all samples >MDL up to RL	chromium	+J	U at RL
	silver lead	+J	U at RL
all samples	antimony	+/-	J/UJ
all samples	chromium	+/-	J/UJ
59SB11-01, 59SB11-01D	chromium	+	J
59SB11-00, 59SB11-00D	chromium lead	+	J
all samples	all analytes	+B	J

Tin by 6020

Sample ID	Analyte	Results	Q flag
all samples >MDL up to RL	tin	+J	U at RL

Glossary of Qualification Flags and Abbreviations

Qualification Flags (Q-Flags)

U	not detected above the reported sample quantitation limit
J	estimated value
UJ	reported quantitation limit is qualified as estimated
N	analyte has been tentatively identified
JN	analyte has been tentatively identified, estimated value
R	result is rejected; the presence or absence of the analyte cannot be verified

Method/Preparation/Field QC Blank Qualification Flags (Q-Flags)

Organic Methods

NA	The sample result for the blank contaminant is greater than the RL (2X sample RL for common laboratory contaminants) when the blank value is less than the RL. The sample result for the blank contaminant is not qualified with any blank qualifiers.
U*	The sample result for the blank contaminant is less than the RL (2X sample RL for common laboratory contaminants) but greater than the MDL when the blank value is less than the RL. The sample result for the blank contaminant is qualified as non-detect U at the reported concentration.
RL**	The sample result for the blank contaminant is less than the RL (2X sample RL for common laboratory contaminants) but greater than the MDL when the blank value is less than the RL. The sample result for the blank contaminant is changed to the RL and qualified as non-detect U.

* This guideline is used when the laboratory is reporting non-detects to the MDL. ** This guideline is used when the laboratory is reporting non-detects to the RL.

Inorganic Methods

ICB/CCB/PB Action:

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U*/ RL** -	The sample result is greater than or equal to the MDL but less than or equal to the RL, result is reported as non-detect at the reported concentration or at the RL, when the FB result is less or greater than the RL.

Glossary of Qualification Flags and Abbreviations, continued

R -	Sample result is greater than the RL and less than the ICB/CCB/PB value when the ICB/CCB/PB value is greater than the RL.
J -	Sample result is greater than the ICB/CCB/PB value but less than 10X the ICB/CCB/PB value when ICB/CCB/PB value is greater than the RL.
J/UJ -	Sample result is less than 10X RL when blank result is below the negative RL.

Field QC Blank action:

Note – Use field blanks to qualify data only if field blank results are greater than prep blank results.

Do not use rinsate blank associated with soils to qualify water samples and vice versa.

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U* / RL** -	The sample result is greater than or equal to the MDL but less than or equal to the RL, result is reported as non-detect at the reported concentration or at the RL, when the FB result is less or greater than the RL.
R -	Sample result is greater than the RL and less than the FB value when the FB value is greater than the RL.
J -	Sample result is greater than the FB value but less than 10X the FB value when FB value is greater than the RL.

* This guideline is used when the laboratory is reporting non-detects to the MDL. ** This guideline is used when the laboratory is reporting non-detects to the RL.

General Abbreviations

RL	reporting limit
IDL	instrument detection limit
MDL	method detection limit
CRDL	contract required detection limit
CRQL	contract required quantitation limit
+	positive result
-	non-detect result

DataQual

Environmental Services, LLC

Michael Baker, Jr., Inc.
Airside Business Park
100 Airside Drive
Moon Township, PA 15108

September 7, 2010

SDG# 1005177, CompuChem
NAPR SWMU 59; Ceiba, Puerto Rico

Dear Mr. Kimes,

The following Data Validation report is provided as requested for the parameters noted in the table below for SDG # 1005177. The data validation was performed in accordance with the SW-846 methods utilized by the laboratory, the Region II Standard Operating Procedures for the Validation of Organic Data Acquired Using SW-846 Methods (8260B-Rev 2, January 2006- SOP #HW-24, 8270D-Rev 3, October 2006-SOP #HW-22, 8081B SOP # HW-44, Rev 1 October 2006) and professional judgment. Region II has not developed a validation checklist SOP for the methods used to assess the inorganic methods in this SDG (SW-846 methods 6010B, 6020 and 7471A). Therefore, alternative worksheets were provided. Region II flagging conventions were used. All areas of concern are discussed in the body of the report and a summary of data qualification is provided.

Sample ID	Lab ID	Matrix	VOA App IX	SVOA App IX w/ LL PAH	Pesticides	Metals	Tin
59SB13-00	1005177-01	soil	X	X	X	X	X
59SB18-00	1005177-02	soil	X	X	X	X	X
59SB18-01	1005177-03	soil	X	X	X	X	X
59SB18-02	1005177-04	soil	X	X	X	X	X
59SB19-01	1005177-05	soil	X	X	X	X	X
59SB19-05	1005177-06	soil	X	X	X	X	X
59SB20-00	1005177-07	soil	X	X	X	X	X
59SB20-01	1005177-08	soil	X	X	X	X	X
59SB20-05	1005177-09	soil	X	X	X	X	X
59SB21-00	1005177-10	soil	X	X	X	X	X
59SB21-01	1005177-11	soil	X	X	X	X	X
59SB21-01D	1005177-16	soil	X	X	X	X	X
59SB21-05	1005177-12	soil	X	X	X	X	X
59SB22-00	1005177-13	soil	X	X	X	X	X
59SB22-01	1005177-14	soil	X	X	X	X	X
59SB22-05	1005177-15	soil	X	X	X	X	X
59SB23-00	1005177-17	soil	X	X	X	X	X
59SB23-01	1005177-18	soil	X	X	X	X	X
59SB23-05	1005177-19	soil	X	X	X	X	X
59SB13-00 MS	1005177-01MS	soil	X	X	X	X	X
59SB13-00 MSD	1005177-01MSD	soil	X	X	X	X	X

The following quality control samples were provided with this SDG: sample 59SB21-01D-field duplicate of sample 59SB21-01.

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The samples were evaluated based on the following criteria:

- Data Completeness *
- Sample Condition *
- Technical Holding Times *
- GC/MS Tuning *
- ICP-MS Tuning *
- GC Performance *
- Initial/Continuing Calibrations
- ICSA/ICSAB Standards *
- CRDL Standards *
- Blanks
- GC/MS Internal Standards *
- ICP-MS Internal Standards *
- Surrogate Recoveries
- Laboratory Control Samples
- Matrix Spike Recoveries
- Matrix Duplicate RPDs *
- Serial Dilutions
- Field Duplicates
- Identification/Quantitation
- Reporting Limits *
- Tentatively Identified Compounds NA

* - indicates that qualifications were not required based on this criteria

Overall Evaluation of Data/Potential Usability Issues

A summary of qualifications applied to the sample results are noted below for the fractions validated. Specific details regarding qualification of the data are addressed in the Specific Evaluation section of this narrative. If an issue is not addressed there were no actions required based on unmet quality criteria. When more than one qualifier is associated with a compound/analyte the validator has chosen the qualifier that best indicates possible bias in the results and flagged the data accordingly. However, information regarding all quality control issues is provided in the body of the report and on the qualification summary page.

VOA

The initial and continuing calibrations exhibited some compounds with low RRF values, which resulted in qualifying non-detected values as rejected for these compounds. Due to high %Ds values, in the continuing calibration, some compounds were qualified as estimated.

Blank contamination was noted in the method and/or QC blanks associated with samples in this batch. Qualifications were added to the data.

SVOA

Due to high %RSDs and %D values, in the initial and continuing calibrations, some compounds were qualified as estimated.

Blank contamination was noted in the method and/or QC blanks associated with samples in this batch. Qualifications were added to the data.

One sample exhibited low surrogate recoveries that resulted in qualifying all acid fraction compounds as estimated.

One sample exhibited high internal standard area recoveries; there were no positive results therefore no qualifications required. The sample was re-analyzed with similar results; therefore the re-analysis was rejected in favor of the initial analysis.

Due to below low recoveries for LCS samples, the associated sample results were qualified for one or more compounds.

The matrix spike and matrix spike duplicate exhibited below 10% recoveries that resulted in qualifying two compound results as rejected in the associated sample. One compound was also qualified as estimated due to low recoveries.

Pesticides by 8081B

Three samples required qualifications due to low surrogate recoveries.

The associated method blank and field blank exhibited contamination that required qualification in the field samples.

All results that exhibited column quantitation %Ds greater than 25% were qualified based on Region II guidelines.

Metals by 6020 & 7471

Blank contamination was noted and qualification was required in the samples in this SDG.

The matrix spike pair submitted in this SDG exhibited non-compliant recoveries in both the MS and the MSD for one analyte for which qualifications were required.

The serial dilution submitted in this SDG exhibited non-compliant %Ds for three analytes for which qualifications were required.

The field duplicate pair of sample 59SB21-01/59SB21-01D exhibited one analyte with a non-compliant RPD greater than 35% but <120%. This analyte was qualified based on Region II guidance in the field duplicate pair only.

All results reported at concentrations between the method detection limit and the reporting limits (B flagged by the laboratory) were qualified as estimated J.

Tin by 6010B

Blank contamination was noted and qualification was required in the samples in this SDG.

The matrix spike pair submitted in this SDG exhibited non-compliant recoveries in both the MS and the MSD for one analyte for which qualifications were required.

Specific Evaluation of Data

Data Completeness

The SDG was received complete and intact. Resubmissions were required. Corrected Form 7s were required and received from the lab. A copy of all e-mail correspondence is included in the validation worksheets.

Technical Holding Times

According to chain of custody records, sampling was performed on 5/18-19/10 and samples were received at the laboratory 5/21/10. All sample preparation and analysis was performed within Region II and/or method holding time requirements.

Initial/Continuing Calibration

VOA

Calibration standards exhibited %Ds and RRF values that were non-compliant. A summary of these non-compliances and affected samples are noted in the following table. Sample results are qualified as indicated.

Standard ID	Compound(s)	RRF, %RSD, %D	Samples	Q Flag
IC 5/25/10	acrolein propionitrile isobutyl alcohol 1,4-dioxane methylmethacrylate	0.038 0.025 0.009 0.001 0.040	all samples	J/R

Standard ID	Compound(s)	RRF, %RSD, %D	Samples	Q Flag
CC 5/27/10	vinyl acetate	-23.65	59SB18-02, 59SB19-01, 59SB19-05, 59SB20-00, 59SB20-01, 59SB20-05, 59SB21-00, 59SB21-01, 59SB21-05, 59SB22-00, 59SB22-01, 59SB22-05, 59SB21-01D, 59SB23-00, 59SB23-01, 59SB23-05, 59SB18-01	J/UJ

SVOA

Calibration standards exhibited %RSDs and %D values that were non-compliant. A summary of these non-compliances and affected samples are noted in the following table. Sample results are qualified as indicated.

Standard ID	Compound(s)	RRF, %RSD, %D	Samples	Q Flag
IC full scan 6/24/10/10	n-nitroso-di-n-butylamine	16.506	all samples	J/UJ
CC full scan 6/26/10	p-phenylenediamine	36.09	59SB13-00, 59-SB18-01, 59SB18-02, 59SB19-01	J/UJ
CC full scan 6/29/10	benzyl alcohol a,a-dimethylphenethylamine	-68.99 29.34	59SB19-05, 59SB21-01	J/UJ
CC full scan 6/30/10	n-nitrosopyrrolidine 3,3'-dimethylbenzidine 2-acetylaminofluorene 3-methylcholananthrene a,a-dimethylphenethylamine	21.36 23.86 22.49 21.00 34.74	59SB18-00, 59SB20-00, 59SB21-05, 59SB22-00, 59SB22-01, 59SB22-05, 59SB21-01D	J/UJ
CC-kepone 6/29/10	kepone	31.79	59SB18-00, 59SB19-05, 59SB20-00, 59SB20-01, 59SB20-05, 59SB21-00, 59SB21-01, 59SB21-05, 59SB22-00, 59SB22-01, 59SB22-05	J/UJ

Blanks

VOA

The associated method and/or QC blanks exhibited contamination as noted in the following table. Compounds for which there was no action required, are not included in the following table, see worksheets for full list of compounds.

Blank ID	Compound	Concentration	Reporting Limit
VBLKLX	methylene chloride	4.3J ug/Kg	5 ug/Kg
	toluene	0.44J	5
VBLKHA	methylene chloride	2.5J	5
	toluene	1.3J	5
59TB04	methylene chloride	0.22J ug/L	0.5 ug/L
	toluene	0.13J	0.5

Blank ID	Compound	Concentration	Reporting Limit
59ER05	acetone	3.4	2.5
	methylene chloride	1.2	0.5
	2-butanone	1.1J	2.5
	chloroform	0.043J	0.5
	toluene	0.22J	0.5
59ER06	acetone	3.9	2.5
	methylene chloride	1.2	0.5
	2-butanone	1J	2.5
	chloroform	0.041J	0.5
	toluene	0.16J	0.5
59FB02	acetone	5	2.5
	methylene chloride	0.16J	0.5
	toluene	0.19J	0.5

Associated samples and required qualifications are noted in the following table.

Sample ID	Compound	Q Flag
59SB13-00,59SB18-00, 59SB18-01, 59SB18-02, 59SB19-01, 59SB19-05, 59SB20-00, 59SB20-01, 59SB20-05, 59SB21-00, 59SB21-0159SB21-01D, 59SB21-05, 59SB22-00, 59SB22-01, 59SB22-05, 59SB23-00, 59SB23-01, 59SB23-05	methylene chloride	U at RL
59SB18-00, 59SB18-01, 59SB19-01, 59SB20-00, 59SB20-01, 59SB20-05, 59SB21-00, 59SB21-01, 59SB21-01D, 59SB21-05, 59SB22-00, 59SB22-01, 59SB22-05, 59SB23-00, 59SB23-01, 59SB23-05	toluene	U at RL
59SB18-02, 59SB19-01, 59SB19-05, 59SB20-01, 59SB20-05, 59SB21-01, 59SB21-01D, 59SB22-05, 59SB23-01	acetone	U at RL
59SB13-00, 59SB18-01, 59SB23-05	acetone	U at value
59SB21-01D, 59SB22-01, 59SB23-00	2-butanone	U at RL
50SB19-01, 59SB19-05	chloroform	U at RL

SVOA

The associated method and/or QC blanks exhibited contamination as noted in the following table. Compounds for which there was no action required, are not included in the following table, see worksheets for full list of compounds.

Blank ID	Compound	Concentration	Reporting Limit
SBLKDS-SIM	naphthalene	1.5J ug/Kg	8.3 ug/Kg
	2-methylnaphthalene	0.74J	8.3
	fluorene	0.55J	8.3
	anthracene	0.50J	8.3
	benzo(a)anthracene	0.67J	8.3
	benzo(b)fluoranthene	0.72J	8.3
	benzo(k)fluoranthene	0.77J	8.3
	benzo(a)pyrene	0.67J	8.3
	indeno(1,2,3-cd)pyrene	0.54J	8.3
	dibenzo(a,h)anthracene	0.52J	8.3
	benzo(g,h,i)perylene	0.57J	8.3

Associated samples and required qualifications are noted in the following table.

Sample ID	Compound	Q Flag
PAH SIM: 59SB13-00, 59SB18-00, 59SB18-01, 59SB18-02, 59SB19-01, 59SB20-00, 59SB20-05, 59SB21-00, 59SB21-01, 59SB21-01D, 59SB22-01, 59SB22-05, 59SB23-00, 59SB23-01, 59SB23-05	naphthalene	U at RL
PAH SIM: 59SB18-00, 59SB22-01	benzo(a)anthracene	U at RL
PAH SIM: 59SB18-01, 59SB20-00	anthracene	U at RL
PAH SIM: 59SB18-01	indeno(1,2,3-cd)pyrene	U at RL

Pesticides

The associated method blank and field blank exhibited contamination as noted in the following table. Compounds for which there was no action required, are not included in the following table, see worksheets for full list of compounds.

Blank ID	Compound	Concentration	Reporting Limit
PBLKDQ	heptachlor	0.21JP ug/L	RL
59FB02	beta-BHC	0.12J ug/L	RL

Associated samples and required qualifications are noted in the following table.

Sample ID	Compound	Q Flag
all samples >MDL but <RL	heptachlor	U at RL
all samples >MDL but < RL except 59SB13-00	beta-BHC	U at RL

Metals by 6020 & 7471

Associated blanks exhibited contamination as noted in the following table. Please see the Glossary of Qualification Flags and Abbreviations for details.

Blank ID	Analyte	Concentration	Action Level	Q Flag
59FB02	lead	0.089B ug/L	RL	U at RL

Associated samples and required qualifications are noted in the following table.

Sample ID	Analyte	Q Flag
all samples >MDL up to RL	lead	U at RL

Tin by 6010B

Associated blanks exhibited contamination as noted in the following table. Please see the Glossary of Qualification Flags and Abbreviations for details.

Blank ID	Analyte	Concentration	Action Level	Q Flag
PBS	tin	3.201B mg/Kg	RL	U at RL

Associated samples and required qualifications are noted in the following table.

Sample ID	Analyte	Q Flag
all samples >MDL up to RL	tin	U at RL

Surrogates

SVOA

Sample 59SB22-01 exhibited low recoveries for 2-fluorophenol at 38% (QC limit 45-105%) and phenol-d5 at 37% (QC limit 40-100%); therefore results for all acid fraction compound were qualified as estimated (J/UJ). According to method 8270C section 8.5 refers to section 8.6.2.4 of method 8000B this sample should have been re-extracted and re-analyzed. The laboratory did not re-extract and re-analyze this sample; therefore this was a contractual non-compliance.

Pesticides

Three samples exhibited low recoveries as noted in the following table. Results are qualified according to Region II guidance.

Sample ID	Surrogate Compound	%R	Affected Compounds	Q Flag
59SB13-00	DCB TCX	54/54 50	all compounds	J/UJ
59SB19-05	TCX	65/56		
59SB22-05	TCX	68/66		

Laboratory Control Sample

SVOA

The submitted LCS associated with all samples exhibited zero percent recovery for p-phenylenediamine; therefore all non-detected results for this compound were qualified as rejected (R). Also low recovery was exhibited for ethyl methanesulfonate at 44% (50-150%); therefore all results were qualified as estimated (J/UJ).

Matrix Spike

SVOA

The submitted matrix spike and matrix spike duplicate exhibited non-compliant recoveries requiring qualification or rejection in the associated sample. A summary of these non-compliances and affected samples are noted in the following table.

MS/MSD Associated Sample ID	Compounds	MS %Rec	MSD % Rec	QC Limit	Q Flag
59SB13-00	p-phenylenediamine methapyrilene	0 0	0 0	20-150 20-150	J/R
	1-naphthylamine	15	19	20-150	J/UJ

Metals by 6020 & 7471

The matrix spike analysis submitted in this SDG exhibited non-compliant %Rs for one analyte. A summary of these non-compliances and affected samples and actions are noted in the following table.

MS/MSD	Analytes	Samples	%R	Q Flag
59SB13-00	antimony	all samples	20/24	J/UJ

Tin by 6010B

The matrix spike analysis submitted in this SDG exhibited non-compliant %Rs for one analyte. A summary of these non-compliances and affected samples and actions are noted in the following table.

MS/MSD	Analytes	Samples	%R	Q Flag
59SB13-00	tin	all samples	71/72	J/UJ

Serial Dilutions

Metals by 6020 & 7471

The serial dilution analysis submitted in this SDG exhibited non-compliant %Ds for three analytes, requiring qualification in the field samples. A summary of these non-compliances and affected samples are noted in the following table.

SD	Analytes	Samples	%D	Q Flag
59SB13-00	cobalt copper vanadium	all samples	18 21 18	J/UJ

Field Duplicates

Metals by 6020 & 7471

The field duplicate pair exhibited non-compliant field duplicate reproducibility for the following analyte. These field duplicate pair and analyte were flagged as noted in the table below based on Region II guidelines.

Sample ID	Analyte	RPD or Absolute Difference	Q Flag
59SB21-01/59SB21-01D	chromium	51	J

Identification/Quantitation

SVOA

Sample 59SB21-01RE was not used, in favor of the initial analysis, due to non-compliant internal standard area recoveries.

Pesticides

Several positive results were reported with P flags to indicate that the column quantitation %D was greater than 25%. These results were qualified based on Region II guidelines. Some compound results were flagged as presumptively present at an estimated concentration due to the disparity of results between the two columns (one result was well above the RL and the other was below the RL – with an elevated baseline) rather than as U at the RL. Specific results and flags are noted in the following table.

Sample ID	Compound	%D	Flag
59SB13-00	beta-BHC	165.6	NJ
59SB18-00	4,4'-DDT	36.4	J
	endosulfan I	151.6	U at RL
	heptachlor	37.5	J
	gamma-chlordane	173.2	U
59SB19-05	beta-BHC	54.5	U at RL
59SB21-01D	beta-BHC	35	J
59SB22-00	4,4'-DDE	34.1	J
	heptachlor	75	U at RL
	alpha-chlordane	34.8	J
59SB22-01	beta-BHC	50	J
59SB23-00	4,4'-DDE	43.9	J

Metals by 6020 & 7471

All results reported at concentrations between the method detection limit and the reporting limit (B flagged by the laboratory) were qualified as estimated J.

A summary of qualifications required is provided on the following page. Please do not hesitate to contact DataQual ES with any questions regarding this validation report.

Sincerely,

Laura Maschhoff
President

Jacqueline Cleveland
Vice-President

Summary of Data Qualifications

VOA

Sample ID	Compound	Results	Q flag
all samples	acrolein propionitrile isobutyl alcohol 1,4-dioxane methylmethacrylate	+/-	J/R
59SB18-02, 59SB19-01, 59SB19-05, 59SB20-00, 59SB20-01, 59SB20-05, 59SB21-00, 59SB21-01, 59SB21-05, 59SB22-00, 59SB22-01, 59SB22-05, 59SB21-01D, 59SB23-00, 59SB23-01, 59SB23-05, 59SB18-01	vinyl acetate	+/-	J/UJ
59SB13-00,59SB18-00, 59SB18-01, 59SB18-02, 59SB19-01, 59SB19-05, 59SB20-00, 59SB20-01, 59SB20-05, 59SB21-00, 59SB21-0159SB21-01D, 59SB21-05, 59SB22-00, 59SB22-01, 59SB22-05, 59SB23-00, 59SB23-01, 59SB23-05	methylene chloride	+	U at RL
59SB18-00, 59SB18-01, 59SB19-01, 59SB20-00, 59SB20-01, 59SB20-05, 59SB21-00, 59SB21-01, 59SB21-01D, 59SB21-05, 59SB22-00, 59SB22-01, 59SB22-05, 59SB23-00, 59SB23-01, 59SB23-05	toluene	+	U at RL
59SB18-02, 59SB19-01, 59SB19-05, 59SB20-01, 59SB20-05, 59SB21-01, 59SB21-01D, 59SB22-05, 59SB23-01	acetone	+	U at RL
59SB13-00, 59SB18-01, 59SB23-05	acetone	+	U at value
59SB21-01D, 59SB22-01, 59SB23-00	2-butanone	+	U at RL
50SB19-01, 59SB19-05	chloroform	+	U at RL

SVOA

Sample ID	Compound	Results	Q flag
all samples	n-nitroso-di-n-butylamine	+/-	J/UJ
59SB13-00, 59-SB18-01, 59SB18-02, 59SB19-01	p-phenylenediamine	+/-	J/UJ
59SB19-05, 59SB21-01	benzyl alcohol a,a-dimethylphenethylamine	+/-	J/UJ
59SB18-00, 59SB20-00, 59SB21-05, 59SB22-00, 59SB22-01, 59SB22-05, 59SB21-01D	n-nitrosopyrrolidine 3,3'-dimethylbenzidine 2-acetylaminofluorene 3-methylcholananthrene a,a-dimethylphenethylamine	+/-	J/UJ
59SB18-00, 59SB19-05, 59SB20-00, 59SB20-01, 59SB20-05, 59SB21-00, 59SB21-01, 59SB21-05, 59SB22-00, 59SB22-01, 59SB22-05	kepone	+/-	J/UJ
PAH SIM: 59SB13-00, 59SB18-00, 59SB18-01, 59SB18-02, 59SB19-01, 59SB20-00, 59SB20-05, 59SB21-00, 59SB21-01, 59SB21-01D, 59SB22-01, 59SB22-05, 59SB23-00, 59SB23-01, 59SB23-05	naphthalene	+	U at RL
PAH SIM: 59SB18-00, 59SB22-01	benzo(a)anthracene	+	U at RL
PAH SIM: 59SB18-01, 59SB20-00	anthracene	+	U at RL
PAH SIM: 59SB18-01	indeno(1,2,3-cd)pyrene	+	U at RL

Summary of Data Qualifications

SVOA, continued

Sample ID	Compound	Results	Q flag
59SB22-01	acid fraction compounds	+/-	J/UJ
all samples	p-phenylenediamine	+/-	J/R
all samples	ethyl methanesulfonate	+/-	J/UJ
59SB13-00	p-phenylenediamine methapyrilene	+/-	J/R
59SB13-00	1-naphthylamine	+/-	J/UJ
59SB21-01RE	all results	+/-	R

Pesticides

Sample ID	Compound	Results	Q flag
all samples >MDL but <RL	heptachlor	+J	U at RL
all samples >MDL but <RL except 59SB13-00	beta-BHC	+J	U at RL
59SB13-00, 59SB19-05, 59SB22-05	all compounds	+/-	J/UJ
59SB13-00	beta-BHC	+JP	NJ
59SB18-00	4,4'-DDT	+J	J
	endosulfan I	+JP	U at RL
	heptachlor *	+BJ	J
	gamma-chlordane	+JP	U
59SB19-05	beta-BHC *	+JP	U at RL
59SB21-01D	beta-BHC *	+J	J
59SB22-00	4,4'-DDE	+J	J
	heptachlor *	+BJP	U at RL
	alpha-chlordane	+J	J
59SB22-01	beta-BHC *	+JP	J
59SB23-00	4,4'-DDE	+JP	J

*Please note that beta-BHC and heptachlor in these samples were flagged as non-detect at the compound RLs due to blank contamination.

Metals by 6020 & 7471

Sample ID	Analyte	Results	Q flag
all samples >MDL up to RL	lead	+B	U at RL
all samples	antimony	+/-	J/UJ
all samples	cobalt copper vanadium	+/-	J/UJ
59SB21-01, 59SB21-01D	chromium	+	J
all samples	all analytes	+B	J

Summary of Data Qualifications

Tin by 6020

Sample ID	Analyte	Results	Q flag
all samples >MDL up to RL	tin	+B	U at RL
all samples	all results	+/-	J/UJ

Glossary of Qualification Flags and Abbreviations

Qualification Flags (Q-Flags)

U	not detected above the reported sample quantitation limit
J	estimated value
UJ	reported quantitation limit is qualified as estimated
N	analyte has been tentatively identified
JN	analyte has been tentatively identified, estimated value
R	result is rejected; the presence or absence of the analyte cannot be verified

Method/Preparation/Field QC Blank Qualification Flags (Q-Flags)

Organic Methods

NA	The sample result for the blank contaminant is greater than the RL (2X sample RL for common laboratory contaminants) when the blank value is less than the RL. The sample result for the blank contaminant is not qualified with any blank qualifiers.
U*	The sample result for the blank contaminant is less than the RL (2X sample RL for common laboratory contaminants) but greater than the MDL when the blank value is less than the RL. The sample result for the blank contaminant is qualified as non-detect U at the reported concentration.
RL**	The sample result for the blank contaminant is less than the RL (2X sample RL for common laboratory contaminants) but greater than the MDL when the blank value is less than the RL. The sample result for the blank contaminant is changed to the RL and qualified as non-detect U.

* This guideline is used when the laboratory is reporting non-detects to the MDL. ** This guideline is used when the laboratory is reporting non-detects to the RL.

Inorganic Methods

ICB/CCB/PB Action:

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U*/ RL** -	The sample result is greater than or equal to the MDL but less than or equal to the RL, result is reported as non-detect at the reported concentration or at the RL, when the FB result is less or greater than the RL.

Glossary of Qualification Flags and Abbreviations, continued

R -	Sample result is greater than the RL and less than the ICB/CCB/PB value when the ICB/CCB/PB value is greater than the RL.
J -	Sample result is greater than the ICB/CCB/PB value but less than 10X the ICB/CCB/PB value when ICB/CCB/PB value is greater than the RL.
J/UJ -	Sample result is less than 10X RL when blank result is below the negative RL.

Field QC Blank action:

Note – Use field blanks to qualify data only if field blank results are greater than prep blank results.

Do not use rinsate blank associated with soils to qualify water samples and vice versa.

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U* / RL** -	The sample result is greater than or equal to the MDL but less than or equal to the RL, result is reported as non-detect at the reported concentration or at the RL, when the FB result is less or greater than the RL.
R -	Sample result is greater than the RL and less than the FB value when the FB value is greater than the RL.
J -	Sample result is greater than the FB value but less than 10X the FB value when FB value is greater than the RL.

* This guideline is used when the laboratory is reporting non-detects to the MDL. ** This guideline is used when the laboratory is reporting non-detects to the RL.

General Abbreviations

RL	reporting limit
IDL	instrument detection limit
MDL	method detection limit
CRDL	contract required detection limit
CRQL	contract required quantitation limit
+	positive result
-	non-detect result

DataQual

Environmental Services, LLC

Michael Baker, Jr., Inc.
Airside Business Park
100 Airside Drive
Moon Township, PA 15108

September 7, 2010

SDG# 1005178, CompuChem
NAPR SWMU 59; Ceiba, Puerto Rico

Dear Mr. Kimes,

The following Data Validation report is provided as requested for the parameters noted in the table below for SDG # 1005178. The data validation was performed in accordance with the SW-846 methods utilized by the laboratory, the Region II Standard Operating Procedures for the Validation of Organic Data Acquired Using SW-846 Methods (8260B-Rev 2, January 2006- SOP #HW-24, 8270D-Rev 3, October 2006-SOP #HW-22, 8081B SOP # HW-44, Rev 1 October 2006) and professional judgment. Region II has not developed a validation checklist SOP for the methods used to assess the inorganic methods in this SDG (SW-846 methods 6010B, 6020 and 7471A). Therefore, alternative worksheets were provided. Region II flagging conventions were used. All areas of concern are discussed in the body of the report and a summary of data qualification is provided.

Sample ID	Lab ID	Matrix	VOA App IX	SVOA App IX w/ LL PAH	Pesticides	Metals	Tin
59SB13-01	1005178-01	soil	X	X	X	X	X
59SB13-01D	1005178-02	soil	X	X	X	X	X
59SB13-05	1005178-03	soil	X	X	X	X	X
59SD02	1005178-04	soil	X	X*	X	X	X
59SD03	1005178-05	soil	X	X*	X	X	X
59SB13-01MS	1005178-01MS	soil	X	X	X	X	X
59SB13-01MSD	1005178-01MSD	soil	X	X	X	X	X

**only SVOA APP IX*

The following quality control samples were provided with this SDG: sample 59SB13-01D-field duplicate of sample 59SB13-01.

The samples were evaluated based on the following criteria:

- Data Completeness *
- Sample Condition
- Technical Holding Times *
- GC/MS Tuning *
- GC Performance *
- ICP-MS Tuning *

- Initial/Continuing Calibrations
- ICSA/ICSAB Standards *
- CRDL Standards *
- Blanks
- GC/MS Internal Standards *
- ICP-MS Internal Standards *
- Surrogate Recoveries
- Laboratory Control Samples *
- Matrix Spike Recoveries
- Matrix Duplicate RPDs *
- Serial Dilutions
- Field Duplicates
- Identification/Quantitation
- Reporting Limits *
- Tentatively Identified Compounds NA

* - indicates that qualifications were not required based on this criteria

Overall Evaluation of Data/Potential Usability Issues

A summary of qualifications applied to the sample results are noted below for the fractions validated. Specific details regarding qualification of the data are addressed in the Specific Evaluation section of this narrative. If an issue is not addressed there were no actions required based on unmet quality criteria. When more than one qualifier is associated with a compound/analyte the validator has chosen the qualifier that best indicates possible bias in the results and flagged the data accordingly. However, information regarding all quality control issues is provided in the body of the report and on the qualification summary page.

VOA

One sample contained 50-90% water that resulted in qualifying the data results as estimated.

The initial and continuing calibrations exhibited some compounds with low RRF values, which resulted in qualifying non-detected values as rejected for these compounds.

Blank contamination was noted in the method and/or QC blanks associated with samples in this batch. Qualifications were added to the data.

SVOA

One sample contained 50-90% water that resulted in qualifying the data results as estimated.

Due to high %RSDs and %D values, in the initial and continuing calibrations, some compounds were qualified as estimated.

Blank contamination was noted in the method and/or QC blanks associated with samples in this batch. Qualifications were added to the data.

Two full scan samples exhibited high internal standard area recoveries; the samples were re-analyzed with more compliant results exhibited. The initial analyses of these samples were rejected in favor of the re-analysis.

One kepone sample exhibited high internal standard area results; the sample was re-analyzed with similar results. The initial analysis was used. Due to no positive results exhibited in the initial analysis, there were no qualifications required due to this non-compliance.

Due to below low recoveries for LCS samples, the associated sample results were qualified for one or more compounds.

The matrix spike and matrix spike duplicate exhibited below 10% recoveries that resulted in qualifying two compound results as rejected in the associated sample. Two compounds were also qualified as estimated due to low recoveries.

Pesticides by 8081B

One sample contained 50-90% water that resulted in the qualification of the data results as estimated.

One sample required qualifications due to low surrogate recoveries.

The associated field blank exhibited contamination for one compound that required qualification in one field sample.

Two samples were diluted due to compound results above the linear range on at least one of the analytical columns. The chromatography was reviewed and the validator determined the appropriate result to report based on that review and column quantitation results.

All results that exhibited column quantitation %Ds greater than 25% were qualified based on Region II guidelines.

Metals by 6020 & 7471

One sample contained 50-90% water that resulted in the qualification of the data results as estimated.

The matrix spikes pair submitted in this SDG exhibited non-compliant recoveries in both the MS and the MSD for four analytes for which qualifications/rejection were required.

The serial dilution submitted in this SDG exhibited non-compliant %Ds for five analytes. All results for these analytes were qualified as estimated J/UJ in the samples.

The field duplicate pair of sample 59SB13-01/59SB13-01D exhibited three analytes with non-compliant RPDs greater than 35% but <120%. These analytes were flagged based on Region II guidance in the field duplicate pair only.

All results reported at concentrations between the method detection limit and the reporting limits (B flagged by the laboratory) were qualified as estimated J.

Tin by 6010B

One sample contained 50-90% water that resulted in the qualification of the data results as estimated.

Blank contamination was noted and qualification was required in the samples in this SDG.

Specific Evaluation of Data

Data Completeness

The SDG was received complete and intact. Resubmissions were required. Clarification regarding the dilution runs was requested from the laboratory. A response was received. Corrected Form 7s were required and received from the lab. A copy of all e-mail correspondence is included in the validation worksheets.

Sample Condition

ALL FRACTIONS

Soil sample 59SD02 contained >50% moisture (53%). This required the qualification of all reported results as estimated (J/UJ).

Technical Holding Times

According to chain of custody records, sampling was performed on 5/18-20/10 and samples were received at the laboratory 5/21/10. All sample preparation and analysis was performed within Region II and/or method holding time requirements.

Initial/Continuing Calibration

VOA

Calibration standards exhibited %Ds and RRF values that were non-compliant. A summary of these non-compliances and affected samples are noted in the following table. Sample results are qualified as indicated.

Standard ID	Compound(s)	RRF, %RSD, %D	Samples	Q Flag
IC 5/25/10	acrolein propionitrile isobutyl alcohol 1,4-dioxane methylmethacrylate	0.038 0.025 0.009 0.001 0.040	all samples	J/R

SVOA

Calibration standards exhibited %RSDs and %D values that were non-compliant. A summary of these non-compliances and affected samples are noted in the following table. Sample results are qualified as indicated.

Standard ID	Compound(s)	RRF, %RSD, %D	Samples	Q Flag
IC full scan 6/06/10	n-nitroso-di-n-butylamine p-phenylenediamine diallate (trans isomer)	16.389 23.234 17.519	59SB13-01, 59SB13-01D, 59SB13-05, 59SD02RE, 59SD03RE	J/UJ
CC full scan 6/08/10	benzo(k)fluoranthene a,a-dimethylphenethylamine	20.19 -29.98	59SB13-01, 59SB13-01D	J/UJ
CC full scan 6/10/10	7,12-dimethylbenz(a)anthracene benzo(k)fluoranthene	29.98 31.72	59SB13-05, 59SD02RE, 59SD03RE	J/UJ
CC SIM 7/10/10	pyrene benzo(b)fluoranthene benzo(k)fluoranthene benzo(g,h,i)perylene	24.06 26.26 24.96 22.66	PAH SIM: 59SB13-01D, 59SB13-05	J/UJ

Blanks

VOA

The associated method and/or QC blanks exhibited contamination as noted in the following table. Compounds for which there was no action required, are not included in the following table, see worksheets for full list of compounds.

Blank ID	Compound	Concentration	Reporting Limit
VBLKHA	methylene chloride	2.5J ug/Kg	5 ug/Kg
	toluene	1.3J	5
59TB04	methylene chloride	0.22J ug/L	0.5 ug/L
	toluene	0.13J	0.5

Blank ID	Compound	Concentration	Reporting Limit
59ER07	acetone	82	2.5
	methylene chloride	4.7	0.5
	2-butanone	1.1J	2.5
	chloroform	0.28J	0.5
	toluene	1.7	0.5
	chlorobenzene	0.33J	0.5
	m,p-xylene	0.095J	1.0
	o-xylene	0.057J	0.5
	xylene (total)	0.1J	0.5
59ER05	acetone	3.4	2.5
	methylene chloride	1.2	0.5
	2-butanone	1.1J	2.5
	chloroform	0.043J	0.5
	toluene	0.22J	0.5
59FB02	acetone	5	2.5
	methylene chloride	0.16J	0.5
	toluene	0.19J	0.5

Associated samples and required qualifications are noted in the following table.

Sample ID	Compound	Q Flag
59SB13-01, 59SB13-01D	acetone	U at value
59SB13-05	acetone	U at RL
59SB13-01, 59SB13-01D, 59SB13-05, 59SD02	methylene chloride	U at RL
59SD02	toluene	U at RL

SVOA

The associated method and/or QC blanks exhibited contamination as noted in the following table. Compounds for which there was no action required, are not included in the following table, see worksheets for full list of compounds.

Blank ID	Compound	Concentration	Reporting Limit
SBLKDU-SIM	naphthalene	0.87J ug/Kg	8.3 ug/Kg

Associated samples and required qualifications are noted in the following table.

Sample ID	Compound	Q Flag
PAH SIM: 59SB13-01, 59SB13-01D	naphthalene	U at RL

Pesticides

The associated field blank exhibited contamination as noted in the following table. Compounds for which there was no action required, are not included in the following table, see worksheets for full list of compounds.

Blank ID	Compound	Concentration	Reporting Limit
59FB02	beta-BHC	0.12J ug/L	RL

Associated samples and required qualifications are noted in the following table.

Sample ID	Compound	Q Flag
59SB13-01D	beta-BHC	U at RL

Tin by 6010B

Associated blanks exhibited contamination as noted in the following table. Please see the Glossary of Qualification Flags and Abbreviations for details.

Blank ID	Analyte	Concentration	Action Level	Q Flag
PBS	tin	1.644B mg/Kg	RL	U at RL

Associated samples and required qualifications are noted in the following table.

Sample ID	Analyte	Q Flag
all samples >MDL up to RL	tin	U at RL

Internal Standards

SVOA

Sample 59SD02RE exhibited high results for internal standards 1, 4-dichlorobenzene-d4, naphthalene-d8, acenaphthene-d10, phenanthrene-d10 and perylene-d12; therefore all compound positive results associated with these standards were qualified as estimated (J).

Sample 59SD03RE exhibited high results for internal standards acenaphthene-d10, phenanthrene-d10 and perylene-d12; therefore all compound positive results associated with these standards were qualified as estimated (J).

Surrogate Recoveries

Pesticides

Sample 59SD02 exhibited non-compliant recoveries for TCX on both columns (66/65). All reported positive and non-detect results for all compounds were qualified as estimated J/UJ.

Laboratory Control Sample

SVOA

The submitted LCS associated with all samples exhibited zero percent recovery for p-phenylenediamine; therefore all non-detected results for this compound were qualified as rejected (R). Also low recovery was exhibited for 2-methylphenol at 23% (42-110%); therefore all results were qualified as estimated (J/UJ). For PAH SIM LCS a low recovery was exhibited for anthracene at 49% (QC limit 55-105%); therefore all results were qualified as estimated (J/UJ) for all PAH SIM samples.

Matrix Spikes

SVOA

The submitted matrix spike and matrix spike duplicate exhibited non-compliant recoveries requiring qualification or rejection in the associated sample. A summary of these non-compliances and affected samples are noted in the following table.

MS/MSD Associated Sample ID	Compounds	MS %Rec	MSD % Rec	QC Limit	Q Flag
59SB13-01, 59SB13-01D	p-phenylenediamine	0	0	20-150	J/R
	methapyrilene	0	0	20-150	
	1-naphthylamine	12	15	20-150	J/UJ
	kepone	18	16	20-150	

Metals by 6020 & 7471

The matrix spike analysis submitted in this SDG exhibited non-compliant %Rs for four analytes. A summary of these non-compliances and affected samples and actions are noted in the following table.

MS/MSD	Analytes	Samples	%R	Q Flag
59SB13-01	antimony	all samples	44/41	J/UJ
	cadmium		148/147	J
	thallium		132/132	
	lead		222/233	R

Serial Dilutions

Metals by 6020 & 7471

The serial dilution analysis submitted in this SDG exhibited non-compliant %Ds for five analytes, requiring qualification in the field samples. A summary of these non-compliances and affected samples are noted in the following table. Please note that lead was rejected due to %Rs in the associated MS/MSD >200%.

SD	Analytes	Samples	%D	Q Flag
59SB13-01	barium cobalt copper lead vanadium	all samples	20 14 11 18 14	J/UJ

Field Duplicates

Metals by 6020 & 7471

The field duplicate pair exhibited non-compliant field duplicate reproducibility for the following analytes. These field duplicate pairs and analytes were flagged as noted in the table below based on Region II guidelines.

Sample ID	Analyte	RPD or Absolute Difference	Q Flag
59SB13-01, 59SB13-01D	barium cobalt lead	60 43 87	J

Identification/Quantitation

SVOA

Sample 59SD03-kepone was re-analyzed due to high internal standard area recoveries. The re-analysis exhibited similar results and therefore was not used in favor of the initial analysis. Due to no positive results exhibited in the initial analysis, there were no qualifications required due to this non-compliance.

Samples 59SD02 and 59SB03 were not used in favor of the re-analysis due to non-compliant internal standard area recoveries.

Pesticides

Samples 59SD02 and 59SD03 were reanalyzed at dilutions of 1:5 due to results above the linear range on at least one of the analytical columns. For sample 59SD03, the reported E-flagged result for 4, 4'-DDE is rejected in favor of the D-flagged result reported from the dilution analysis. All other results in the dilution analysis are rejected in favor of the results reported from the undiluted analysis. For sample 59SD02, the reported results for alpha-chlordane and gamma-chlordane are rejected in favor of the D-flagged results reported from the dilution analysis due to the disparity in the reported results in the undiluted run. All other results from the dilution run are rejected in favor of the results reported from the undiluted sample analysis.

Several positive results were reported with P flags to indicate that the column quantitation %D was greater than 25%. These results were qualified based on Region II guidelines. Specific results and flags are noted in the following table.

Sample ID	Compound	%D	Flag
59SB13-01D	beta-BHC	56.4	U at RL
	heptachlor	45.6	J
59SB13-05	gamma-chlordane	72.0	U at RL
59SD02	4, 4'-DDT	90.2	U at RL
	endrin aldehyde	39.6	J
	heptachlor	50	J
59SD02DL	alpha-chlordane	119.4	NJ
59SD03	4, 4'-DDT	100.0	U at RL
	endrin aldehyde	121	U at RL
	heptachlor	65.7	U at RL
	heptachlor epoxide	184.5	U at RL
	gamma-chlordane	152.3	U at RL
	alpha-chlordane	114.8	U at RL

Metals by 6020 & 7471

All results reported at concentrations between the method detection limit and the reporting limit (B flagged by the laboratory) were qualified as estimated J.

A summary of qualifications required is provided on the following page. Please do not hesitate to contact DataQual ES with any questions regarding this validation report.

Sincerely,

Laura Maschhoff
President

Jacqueline Cleveland
Vice-President

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Summary of Data Qualifications

VOA

Sample ID	Compound	Results	Q flag
59SD02	all results	+/-	J/UJ
all samples	acrolein propionitrile isobutyl alcohol 1,4-dioxane methylmethacrylate	+/-	J/R
59SB13-01, 59SB13-01D	acetone	+	U at value
59SB13-05	acetone	+	U at RL
59SB13-01, 59SB13-01D, 59SB13-05, 59SD02	methylene chloride	+	U at RL
59SD02	toluene	+	U at RL

SVOA

Sample ID	Compound	Results	Q flag
59SD02	all results	+/-	J/UJ
59SB13-01, 59SB13-01D, 59SB13-05, 59SD02RE, 59SD03RE	n-nitroso-di-n-butylamine p-phenylenediamine diallate (trans isomer)	+/-	J/UJ
59SB13-01, 59SB13-01D	a,a-dimethylphenethylamine	+/-	J/UJ
59SB13-05, 59SD02RE, 59SD03RE	7,12-dimethylbenz(a)anthracene	+/-	J/UJ
PAH SIM: 59SB13-01D, 59SB13-05	pyrene benzo(b)fluoranthene benzo(k)fluoranthene benzo(g,h,i)perylene	+/-	J/UJ
PAH SIM: 59SB13-01, 59SB13-01D	naphthalene	+	U at RL
59SD02RE	all compounds associated with: 1,4-dichlorobenzene-d4, naphthalene-d8, acenaphthene-d10, phenanthrene-d10, perylene-d12	+	J
59SD03RE	all compounds associated with: acenaphthene-d10, phenanthrene-d10, perylene-d12	+	J
all samples	p-phenylenediamine	+/-	J/R
all samples	2-methylphenol	+/-	J/UJ
PAH SIM: all samples	anthracene	+/-	J/UJ
59SB13-01, 59SB13-01D	p-phenylenediamine methapyrilene	+/-	J/R
59SB13-01, 59SB13-01D	1-naphthylamine kepone	+/-	J/UJ
59SD03RE	kepone	+/-	R
59SD02, 59SB03	all results	+/-	R

Summary of Data Qualifications

Pesticides

Sample ID	Compound	Results	Q flag
59SD02	all results	+/-	J/UJ
59SB13-01D	beta-BHC	+J	U at RL
59SD02	all compounds	+/-	J/UJ
59SB13-01D	beta-BHC	+JP	U at RL
	heptachlor		J
59SB13-05	gamma-chlordane	+JP	U at RL
59SD02	4, 4'-DDT	+JP	U at RL
	endrin aldehyde		J
	heptachlor		J
59SD02DL	alpha-chlordane	+DP	NJ
59SD03	4,4'-DDT	+JP	U at RL
	endrin aldehyde		U at RL
	heptachlor		U at RL
	heptachlor epoxide		U at RL
	gamma-chlordane		U at RL
	alpha-chlordane		U at RL
59SD02	gamma-chlordane alpha-chlordane	+	R
59SD02DL	all compounds except gamma-chlordane and alpha chlordane	+/-	R
59SD03	4,4'-DDE	+E	R
59SD03DL	all compounds except 4,4'-DDE	+/-	R

Metals by 6020 & 7471

Sample ID	Analyte	Results	Q flag
59SD02	all results	+/-	J/UJ
all samples	antimony	+/-	J/UJ
all samples	cadmium thallium	+	J/UJ
all samples	lead	+	R
all samples	barium cobalt copper lead vanadium	+/-	J/UJ
59SB13-01, 59SB13-01D	barium cobalt lead	+	J
all samples	all analytes	+B	J

Tin by 6020

Sample ID	Analyte	Results	Q flag
59SD02	all results	+/-	J/UJ
all samples >MDL up to RL	tin	+B	U at RL

Glossary of Qualification Flags and Abbreviations

Qualification Flags (Q-Flags)

U	not detected above the reported sample quantitation limit
J	estimated value
UJ	reported quantitation limit is qualified as estimated
N	analyte has been tentatively identified
JN	analyte has been tentatively identified, estimated value
R	result is rejected; the presence or absence of the analyte cannot be verified

Method/Preparation/Field QC Blank Qualification Flags (Q-Flags)

Organic Methods

NA	The sample result for the blank contaminant is greater than the RL (2X sample RL for common laboratory contaminants) when the blank value is less than the RL. The sample result for the blank contaminant is not qualified with any blank qualifiers.
U*	The sample result for the blank contaminant is less than the RL (2X sample RL for common laboratory contaminants) but greater than the MDL when the blank value is less than the RL. The sample result for the blank contaminant is qualified as non-detect U at the reported concentration.
RL**	The sample result for the blank contaminant is less than the RL (2X sample RL for common laboratory contaminants) but greater than the MDL when the blank value is less than the RL. The sample result for the blank contaminant is changed to the RL and qualified as non-detect U.

* This guideline is used when the laboratory is reporting non-detects to the MDL. ** This guideline is used when the laboratory is reporting non-detects to the RL.

Inorganic Methods

ICB/CCB/PB Action:

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U*/ RL** -	The sample result is greater than or equal to the MDL but less than or equal to the RL, result is reported as non-detect at the reported concentration or at the RL, when the FB result is less or greater than the RL.

Glossary of Qualification Flags and Abbreviations, continued

R -	Sample result is greater than the RL and less than the ICB/CCB/PB value when the ICB/CCB/PB value is greater than the RL.
J -	Sample result is greater than the ICB/CCB/PB value but less than 10X the ICB/CCB/PB value when ICB/CCB/PB value is greater than the RL.
J/UJ -	Sample result is less than 10X RL when blank result is below the negative RL.

Field QC Blank action:

Note – Use field blanks to qualify data only if field blank results are greater than prep blank results.

Do not use rinsate blank associated with soils to qualify water samples and vice versa.

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U* / RL** -	The sample result is greater than or equal to the MDL but less than or equal to the RL, result is reported as non-detect at the reported concentration or at the RL, when the FB result is less or greater than the RL.
R -	Sample result is greater than the RL and less than the FB value when the FB value is greater than the RL.
J -	Sample result is greater than the FB value but less than 10X the FB value when FB value is greater than the RL.

* This guideline is used when the laboratory is reporting non-detects to the MDL. ** This guideline is used when the laboratory is reporting non-detects to the RL.

General Abbreviations

RL	reporting limit
IDL	instrument detection limit
MDL	method detection limit
CRDL	contract required detection limit
CRQL	contract required quantitation limit
+	positive result
-	non-detect result

DataQual

Environmental Services, LLC

Michael Baker, Jr., Inc.
Airside Business Park
100 Airside Drive
Moon Township, PA 15108

September 4, 2010

SDG# 1005179, CompuChem
NAPR SWMU 59; Ceiba, Puerto Rico

Dear Mr. Kimes,

The following Data Validation report is provided as requested for the parameters noted in the table below for SDG # 1005179. The data validation was performed in accordance with the SW-846 methods utilized by the laboratory and professional judgment. Region II has not developed a validation checklist SOP for the methods used to assess the inorganic methods in this SDG (SW-846 methods 6010B, 6020 and 7471A). Therefore, alternative worksheets were provided. Region II flagging conventions were used. All areas of concern are discussed in the body of the report and a summary of data qualification is provided.

Sample ID	Lab ID	Matrix	Dissolved Metals	Dissolved Tin
59GW01	1005179-12	water	X	X
59GW02	1005179-08	water	X	X
59GW02D	1005179-10	water	X	X
59GW03	1005179-06	water	X	X
59GW04	1005179-09	water	X	X
59GW05	1005179-13	water	X	X
59GW06	1005179-11	water	X	X
59GW07	1005179-03	water	X	X
59GW08	1005179-07	water	X	X
59GW09	1005179-04	water	X	X
59GW05	1005179-10	water	X	X
59SW02	1005179-01	water	X	X
59SW03	1005179-02	water	X	X
59GW02MS	1005179-08MS	water	X	X
59GW02MSD	1005179-08MSD	water	X	X

The following quality control samples were provided with this SDG: sample 59GW02D-field duplicate of sample 59GW02.

The samples were evaluated based on the following criteria:

- Data Completeness *
- Sample Condition *
- Technical Holding Times *
- ICP/MS Tuning *

- Initial/Continuing Calibrations *
- ICSA/ICSAB Standards *
- CRDL Standards *
- Blanks
- Internal Standards *
- Laboratory Control Samples *
- Matrix Spike Recoveries
- Matrix Duplicate RPDs
- Serial Dilutions *
- Field Duplicates
- Identification/Quantitation
- Reporting Limits *

* - indicates that qualifications were not required based on this criteria

Overall Evaluation of Data/Potential Usability Issues

A summary of qualifications applied to the sample results are noted below for the fractions validated. Specific details regarding qualification of the data are addressed in the Specific Evaluation section of this narrative. If an issue is not addressed there were no actions required based on unmet quality criteria. When more than one qualifier is associated with a compound/analyte the validator has chosen the qualifier that best indicates possible bias in the results and flagged the data accordingly. However, information regarding all quality control issues is provided in the body of the report and on the qualification summary page.

Dissolved Metals by 6020 & 7470B

Blank contamination was noted and qualification was required in the field samples in this SDG.

The matrix spike pair exhibited non-compliant recoveries that required rejection of one analyte in the field samples.

The matrix duplicate exhibited one analyte with a non-compliant RPD. This required the qualification of the analyte as estimated in the field samples.

The field duplicate pair exhibited one analyte with an absolute difference greater than four times the RL. This analyte was rejected in the field duplicate pair.

The %Ds between the total and dissolved metals results were non-compliant for four analytes in 4 samples. These results were qualified as estimated in both the total and dissolved samples. Please note that the total sample results were reported in SDG 1005175.

All results reported at concentrations between the method detection limit and the reporting limits (B flagged by the laboratory) were qualified as estimated J.

Dissolved Tin by 6010B

No qualifications to the data were required.

Specific Evaluation of Data

Data Completeness

The SDG was received complete and intact. Resubmissions were not required.

Technical Holding Times

According to chain of custody records, sampling was performed on 5/20-22/10 and samples were received at the laboratory 5/24/10. All sample preparation and analysis was performed within Region II and/or method holding time requirements.

Blanks

Dissolved Metals by 6020 & 7471

Associated blanks exhibited contamination as noted in the following table. Please see the Glossary of Qualification Flags and Abbreviations for details.

Blank ID	Analyte	Concentration	Action Level
PBW	nickel	0.540B ug/L	RL
59FB02	zinc	1.3B ug/L	RL
	lead	0.089B ug/L	RL

Associated samples and required qualifications are noted in the following table.

Sample ID	Analyte	Q Flag
all field samples >MDL but <RL	nickel	U at RL
all field samples >MDL but <RL	zinc	U at RL
all field samples >MDL but <RL	lead	U at RL

Matrix Spike Recoveries

Dissolved Metals by 6020 & 7471

The matrix spike analysis submitted in this SDG exhibited non-compliant %Rs for one analyte. A summary of this non-compliance and affected samples and actions are noted in the following table.

MS/MSD	Analytes	Samples	%R	Q Flag
59GW02	mercury	all field samples	0/0	R

Matrix Duplicates

Dissolved Metals by 6020 & 7471

The matrix duplicate analysis submitted in this SDG exhibited a non-compliant RPD for one analyte. A summary of this non-compliance and affected samples and actions are noted in the following table.

MD	Analytes	Samples	RPD	Q Flag
59GW02	zinc	all field samples	50	J/UJ

Field Duplicates

Dissolved Metals by 6020 & 7471

The field duplicate pairs exhibited non-compliant field duplicate reproducibility for the following analytes. These field duplicate pairs and analytes were flagged as noted in the table below based on Region II guidelines.

Sample ID	Analyte	RPD or Absolute Difference	Q Flag
59GW02/59GW02D	zinc	8.4 (RL is 2)	R

Identification/Quantitation

Dissolved Metals by 6020 & 7471

The %Ds calculated between the total and dissolved analyses were within criteria except for the following exceptions. The noted samples/analytes were flagged as noted in the table below based on Region II guidelines.

Sample ID	Analyte	%D	Q Flag
59GW02	copper	23	J
59GW02D	zinc	23	J
59GW04	thallium	45	J
59GW09	vanadium	33	J

Dissolved Metals by 6020 & 7471

All results reported at concentrations between the method detection limit and the reporting limit (B flagged by the laboratory) were qualified as estimated J.

A summary of qualifications required is provided on the following page. Please do not hesitate to contact DataQual ES with any questions regarding this validation report.

Sincerely,

Laura Maschhoff
President

Summary of Data Qualifications

Metals by 6020 & 7471

Sample ID	Analyte	Results	Q flag
all field samples >MDL but <RL	nickel	+B	U at RL
all field samples >MDL but <RL	zinc	+B	U at RL
all field samples >MDL but <RL	lead	+B	U at RL
all field samples	mercury	+/-	R
all field samples	zinc	+/-	J/UJ
59GW02, 59GW02D	zinc	+	R
59GW02	copper	+	J
59GW02D	zinc	+	J
59GW04	thallium	+	J
59GW09	vanadium	+	J
all samples	all analytes	+B	J

Tin by 6020

Sample ID	Analyte	Results	Q flag
No qualifications were required			

Glossary of Qualification Flags and Abbreviations

Qualification Flags (Q-Flags)

U	not detected above the reported sample quantitation limit
J	estimated value
UJ	reported quantitation limit is qualified as estimated
N	analyte has been tentatively identified
JN	analyte has been tentatively identified, estimated value
R	result is rejected; the presence or absence of the analyte cannot be verified

Method/Preparation/Field QC Blank Qualification Flags (Q-Flags)

Organic Methods

NA	The sample result for the blank contaminant is greater than the RL (2X sample RL for common laboratory contaminants) when the blank value is less than the RL. The sample result for the blank contaminant is not qualified with any blank qualifiers.
U*	The sample result for the blank contaminant is less than the RL (2X sample RL for common laboratory contaminants) but greater than the MDL when the blank value is less than the RL. The sample result for the blank contaminant is qualified as non-detect U at the reported concentration.
RL**	The sample result for the blank contaminant is less than the RL (2X sample RL for common laboratory contaminants) but greater than the MDL when the blank value is less than the RL. The sample result for the blank contaminant is changed to the RL and qualified as non-detect U.

* This guideline is used when the laboratory is reporting non-detects to the MDL. ** This guideline is used when the laboratory is reporting non-detects to the RL.

Inorganic Methods

ICB/CCB/PB Action:

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U*/ RL** -	The sample result is greater than or equal to the MDL but less than or equal to the RL, result is reported as non-detect at the reported concentration or at the RL, when the FB result is less or greater than the RL.

Glossary of Qualification Flags and Abbreviations, continued

R -	Sample result is greater than the RL and less than the ICB/CCB/PB value when the ICB/CCB/PB value is greater than the RL.
J -	Sample result is greater than the ICB/CCB/PB value but less than 10X the ICB/CCB/PB value when ICB/CCB/PB value is greater than the RL.
J/UJ -	Sample result is less than 10X RL when blank result is below the negative RL.

Field QC Blank action:

Note – Use field blanks to qualify data only if field blank results are greater than prep blank results.

Do not use rinsate blank associated with soils to qualify water samples and vice versa.

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U* / RL** -	The sample result is greater than or equal to the MDL but less than or equal to the RL, result is reported as non-detect at the reported concentration or at the RL, when the FB result is less or greater than the RL.
R -	Sample result is greater than the RL and less than the FB value when the FB value is greater than the RL.
J -	Sample result is greater than the FB value but less than 10X the FB value when FB value is greater than the RL.

* This guideline is used when the laboratory is reporting non-detects to the MDL. ** This guideline is used when the laboratory is reporting non-detects to the RL.

General Abbreviations

RL	reporting limit
IDL	instrument detection limit
MDL	method detection limit
CRDL	contract required detection limit
CRQL	contract required quantitation limit
+	positive result
-	non-detect result

DataQual

Environmental Services, LLC

Michael Baker, Jr., Inc.
Airside Business Park
100 Airside Drive
Moon Township, PA 15108

September 4, 2010

SDG# 1005188, CompuChem
NAPR SWMU 59; Ceiba, Puerto Rico

Dear Mr. Kimes,

The following Data Validation report is provided as requested for the parameters noted in the table below for SDG # 1005188. The data validation was performed in accordance with the SW-846 methods utilized by the laboratory, the Region II Standard Operating Procedures for the Validation of Organic Data Acquired Using SW-846 Method 8260B-Rev 2, January 2006- SOP #HW-24 and professional judgment. All areas of concern are discussed in the body of the report and a summary of data qualification is provided.

Sample ID	Lab ID	Matrix	VOA App IX
59ER11	1005188-01	water	X
59TB06	1005188-02	water	X

The samples were evaluated based on the following criteria:

- Data Completeness *
- Sample Condition *
- Technical Holding Times *
- GC/MS Tuning *
- Initial/Continuing Calibrations
- Blanks *
- Internal Standards *
- Surrogate Recoveries *
- Laboratory Control Samples *
- Matrix Spike Recoveries NA
- Matrix Duplicate RPDs NA
- Field Duplicates NA
- Identification/Quantitation *
- Reporting Limits *
- Tentatively Identified Compounds NA

* - indicates that qualifications were not required based on this criteria

Overall Evaluation of Data/Potential Usability Issues

A summary of qualifications applied to the sample results are noted below for the fractions validated. Specific details regarding qualification of the data are addressed in the Specific Evaluation section of this narrative. If an issue is not addressed there were no actions required based on unmet quality criteria. When more than one qualifier is associated with a compound/analyte the validator has chosen the qualifier that best indicates possible bias in the results and flagged the data accordingly. However, information regarding all quality control issues is provided in the body of the report and on the qualification summary page.

VOA

The initial and continuing calibrations exhibited some compounds with low RRF values, which resulted in qualifying non-detected values as rejected for these compounds. Due to high %RSDs and %Ds values, in the initial and continuing calibration, some compounds were qualified as estimated.

Specific Evaluation of Data

Data Completeness

The SDG was received complete and intact. Resubmissions were not required.

Technical Holding Times

According to chain of custody records, sampling was performed on 5/22-24/10 and samples were received at the laboratory 5/25/10. All sample preparation and analysis was performed within Region II and/or method holding time requirements.

Initial/Continuing Calibration

VOA

Calibration standards exhibited %Ds and RRF values that were non-compliant. A summary of these non-compliances and affected samples are noted in the following table. Sample results are qualified as indicated.

Standard ID	Compound(s)	RRF, %RSD, %D	Samples	Q Flag
IC 5/24/10	acrolein acrylonitrile 2-butanone propionitrile isobutyl alcohol 1,4-dioxane	0.009 0.016 0.036 0.006 0.002 0.0008	59ER11	J/R
	toluene	15.898		J/UJ
CC 5/26/10	acetone	0.034	59ER11	J/R
	dichlorodifluoromethane bromomethane trichlorofluoromethane iodomethane	31.08 -56.26 27.12 -48.84		J/UJ
IC 5/27/10	2-butanone propionitrile isobutyl alcohol 1,4-dioxane	0.037 0.007 0.002 0.0009	59TB06	J/R
CC 5/27/10	acrolein acetone acrylonitrile	0.013 0.038 0.020	59TB06	J/R
	bromomethane carbon disulfide vinyl acetate	-23.98 21.28 -38.93		J/UJ

A summary of qualifications required is provided on the following page. Please do not hesitate to contact DataQual ES with any questions regarding this validation report.

Sincerely,

Laura Maschhoff
President

Summary of Data Qualifications

VOA

Sample ID	Compound	Results	Q flag
59ER11	acrolein acrylonitrile 2-butanone propionitrile isobutyl alcohol 1,4-dioxane	+/-	J/R
59ER11	toluene	+/-	J/UJ
59ER11	acetone	+/-	J/R
59ER11	dichlorodifluoromethane bromomethane trichlorofluoromethane iodomethane	+/-	J/UJ
59TB06	2-butanone propionitrile isobutyl alcohol 1,4-dioxane	+/-	J/R
59TB06	acrolein acetone acrylonitrile	+/-	J/R
59TB06	bromomethane carbon disulfide vinyl acetate	+/-	J/UJ

Glossary of Qualification Flags and Abbreviations

Qualification Flags (Q-Flags)

U	not detected above the reported sample quantitation limit
J	estimated value
UJ	reported quantitation limit is qualified as estimated
N	analyte has been tentatively identified
JN	analyte has been tentatively identified, estimated value
R	result is rejected; the presence or absence of the analyte cannot be verified

Method/Preparation/Field QC Blank Qualification Flags (Q-Flags)

Organic Methods

NA	The sample result for the blank contaminant is greater than the RL (2X sample RL for common laboratory contaminants) when the blank value is less than the RL. The sample result for the blank contaminant is not qualified with any blank qualifiers.
U*	The sample result for the blank contaminant is less than the RL (2X sample RL for common laboratory contaminants) but greater than the MDL when the blank value is less than the RL. The sample result for the blank contaminant is qualified as non-detect U at the reported concentration.
RL**	The sample result for the blank contaminant is less than the RL (2X sample RL for common laboratory contaminants) but greater than the MDL when the blank value is less than the RL. The sample result for the blank contaminant is changed to the RL and qualified as non-detect U.

* This guideline is used when the laboratory is reporting non-detects to the MDL. ** This guideline is used when the laboratory is reporting non-detects to the RL.

Inorganic Methods

ICB/CCB/PB Action:

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U -	The sample result is greater than or equal to the MDL but less than or equal to the RL, result is reported as non-detect at the reported concentration, when the ICB/CCB/PB result is less or greater than the RL.

Glossary of Qualification Flags and Abbreviations, continued

R -	Sample result is greater than the RL and less than the ICB/CCB/PB value when the ICB/CCB/PB value is greater than the RL.
J -	Sample result is greater than the ICB/CCB/PB value but less than 10X the ICB/CCB/PB value when ICB/CCB/PB value is greater than the RL.
J/UJ -	Sample result is less than 10X RL when blank result is below the negative RL.

Field QC Blank action:

Note – Use field blanks to qualify data only if field blank results are greater than prep blank results.

Do not use rinsate blank associated with soils to qualify soil samples and vice versa.

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U -	The sample result is greater than or equal to the MDL but less than or equal to the RL, result is reported as non-detect at the reported concentration, when the FB result is less or greater than the RL.
R -	Sample result is greater than the RL and less than the FB value when the FB value is greater than the RL.
J -	Sample result is greater than the FB value but less than 10X the FB value when FB value is greater than the RL.

General Abbreviations

RL	reporting limit
IDL	instrument detection limit
MDL	method detection limit
CRDL	contract required detection limit
CRQL	contract required quantitation limit
+	positive result
-	non-detect result

TEST AMERICA SDG 680-82907-1

DataQual

Environmental Services, LLC

Michael Baker, Jr., Inc.
Airside Business Park
100 Airside Drive
Moon Township, PA 15108

January 8, 2013
SDG# 680-82907-1, Test America- Savannah
NAPR SWMU 59, Puerto Rico

Dear Ms. Raub,

The following Data Validation report is provided as requested for the parameters noted in the table below for SDG # 680-82907-1. The data validation was performed in accordance with the SW-846 methods utilized by the laboratory, the Region II Standard Operating Procedures for the Validation of Organic Data Acquired Using SW-846 Methods (8260B-Rev 2, August 2008- SOP #HW-24, 8270D-Rev 4, August 2008-SOP #HW-22) and professional judgment. Region II has not developed a validation checklist SOP for the methods used to assess the organic methods for hydrocarbons and inorganic methods in this SDG (6010C, 6020A and 7471A). Therefore, alternative worksheets were provided. Region II flagging conventions were used. All areas of concern are discussed in the body of the report and a summary of data qualifications are provided.

Sample ID	Lab ID	Matrix	VOA App IX	SVOA App IX	Metals
59SB24-00	680-82907-1	soil	X	X	X
59SB24-00D	680-82907-2	soil	X	X	X
59SB24-01	680-82907-3	soil	X	X	X
59SB24-01D	680-82907-4	soil	X	X	X
59SB32-00	680-82907-5	soil	X	X	X
59SB32-01	680-82907-6	soil	X	X	X
59SB25-00	680-82907-7	soil	X	X	X
59SB25-01	680-82907-8	soil	X	X	X
59SB26-00	680-82907-9	soil	X	X	X
59SB26-01	680-82907-10	soil	X	X	X
59SB27-00	680-82907-11	soil	X	X	X
59SB27-01	680-82907-12	soil	X	X	X
59SB31-00	680-82907-13	soil	X	X	X
59SB31-01	680-82907-14	soil	X	X	X
59SB38-00	680-82907-15	soil	X	X	X
59SB38-01	680-82907-16	soil	X	X	X
59SB29-00	680-82907-17	soil	X	X	X
59SB29-01	680-82907-18	soil	X	X	X
59SB30-00	680-82907-19	soil	X	X	X
59SB30-01	680-82907-20	soil	X	X	X
59SB33-00	680-82907-21	soil	X	X	X
59SB33-01	680-82907-22	soil	X	X	X
59TB07	680-82907-23	water	X		
59FB03	680-82907-24	water	X	X	X
59ER12	680-82907-25	water	X	X	X
59SB24-00 MS	680-82907-1MS	soil	X	X	X
59SB24-00 MSD	680-82907-1MSD	soil	X	X	X

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59SB33-00 MS	680-82907-21MS	soil		X	
59SB33-00 MSD	680-82907-21MSD	soil		X	

The following quality control samples were provided with this SDG: sample 59TB07- trip blank; sample 59ER12- equipment blank; sample 59FB03- field blank; sample 59SB24-00D - field duplicate of sample 59SB24-00; sample 59SB24-01D - field duplicate of sample 59SB24-01.

The samples were evaluated based on the following criteria:

- Data Completeness *
- Sample Condition *
- Technical Holding Times
- GC/MS Tuning *
- ICP-MS Tuning *
- Initial/Continuing Calibrations
- ICSA/ICSAB Standards *
- Blanks *
- GC/MS Internal Standards
- ICP-MS Internal Standards *
- Surrogate Recoveries *
- Laboratory Control Samples
- Matrix Spike Recoveries
- Matrix Duplicate RPDs *
- Serial Dilutions *
- Field Duplicates
- Identification/Quantitation
- Reporting Limits *
- Tentatively Identified Compounds NA

* - indicates that qualifications were not required based on this criteria

Overall Evaluation of Data/Potential Usability Issues

A summary of qualifications applied to the sample results are noted below for the fractions validated. Specific details regarding qualification of the data are addressed in the Specific Evaluation section of this narrative. If an issue is not addressed there were no actions required based on unmet quality criteria. When more than one qualifier is associated with a compound/analyte the validator has chosen the qualifier that best indicates possible bias in the results and flagged the data accordingly. However, information regarding all quality control issues is provided in the body of the report and on the qualification summary page. *If an issue is not addressed in this narrative there were no actions required based on unmet quality control criteria.*

VOA

The initial and continuing calibrations exhibited some compounds with low RRF values, which resulted in qualifying non-detected values as rejected for these compounds. Due to high %D values, some compounds were qualified as estimated.

SVOA

Two samples were re-analyzed due to method blank contamination. The samples were analyzed out of holding time; therefore qualifications were applied to the data.

Due to high %RSD and %D values, some compounds were qualified as estimated.

Qualifications were added to the data for one sample due to low internal standard area recoveries.

Due to low recoveries in the LCS qualifications were added to the associated samples.

Due to low recoveries in the matrix spikes qualifications were added to the associated samples.

Both of the field duplicate pairs did not exhibit comparable results; therefore qualifications were added to the data.

Metals

Blank contamination was noted and qualification was required in the samples in this SDG.

The matrix spike pair submitted in this SDG exhibited non-compliant recoveries in both the MS and the MSD for one analyte for which rejections was required. Other elements exhibited recoveries that were above or below the QC limits due to abundance. No qualifications were required for these elements.

The matrix duplicate submitted in this SDG exhibited two analytes with %RPDs >35% (per Region II). Qualifications were required.

The serial dilution submitted in this SDG exhibited a %D >10% for one analyte that resulted in qualifications in the associated samples.

One of the two field duplicate pairs exhibited non-compliant RPDs or absolute differences. Qualifications were made based on Region II guidance in the field duplicate pair only.

Specific Evaluation of Data

Data Completeness

The SDG was received complete and intact. Resubmissions were not required.

Technical Holding Times

According to chain of custody records, sampling was performed on 9/13/12 and samples were received at the laboratory 9/14/12. All sample preparation and analysis was performed within Region II and/or method holding time requirements with the following exceptions.

SVOA

Due to contamination in the associated method blank, samples 59FB03 and 59ER12 were re-extracted and re-analyzed. The re-extraction exceeded the 14 day extraction holding time by 11 days; therefore qualifications were applied to the data. Samples 59FB03RE and 59ER12RE were qualified as estimated (J/UJ) due to exceeded holding times.

Initial/Continuing Calibration

VOA

Calibration standards exhibited RRF and %D values that were non-compliant. A summary of these non-compliances and affected samples are noted in the following table. Sample results are qualified as indicated.

Standard ID	Compound(s)	RRF, %RSD, %D	Samples	Q Flag
IC 9/14/12 IC 9/09/12 IC 9/10/12	isobutanol	0.0427, 0.0471, 0.0310	all samples	J/R
	1,4-dioxane	0.0111, 0.0103, 0.0129		
CC 9/18/12	iodomethane allyl chloride trans-1,4-dichloro-2-butene pentachloroethane chloromethane bromomethane	33.3 34.3 22.2 48.9 20.4 47.1	59TB07, 59FB03, 59ER12	J/UJ
CC 9/23/12	acetone	29.5	59SB24-00D, 59SB24-01	J/UJ
CC 9/24/12	acrolein iodomethane acetonitrile acrylonitrile propionitrile methacrylonitrile isobutanol	42.5 25.0 31.0 25.4 21.5 30.1 23.8	59SB32-00, 59SB32-01, 59SB25-00, 59SB25-01, 59SB26-00, 59SB26-01, 59SB27-00, 59SB27-01, 59SB31-00, 59SB28-00, 59SB28-01, 59SB29-00, 59SB29-01	J/UJ

CC 9/25/12	acrolein iodomethane acrylonitrile	40.1 21.0 27.2	59SB24-00, 59SB24-01D, 59SB31-01	J/UJ

SVOA

Calibration standards exhibited %RSD and %D values that were non-compliant. A summary of these non-compliances and affected samples are noted in the following table. Sample results are qualified as indicated.

Standard ID	Compound(s)	RRF, %RSD, %D	Samples	Q Flag
IC 10/04/12	1,4-naphthaquinone 4-nitroquinoline-1-oxide methapyrilene hexachlorophene	60.8 37.1 20.7 54.2	59ER12RE, 59FB03RE	J/UJ
IC 9/25/12	a,a-dimethyl phenethylamine 1,4-naphthaquinone	34.5 50.1	all field samples	J/UJ
CC 9/26/12	2,4-dinitrophenol dinoseb indeno(1,2,3-cd)pyrene methyl methasulfonate p-phenylene diamine 1,3,5-trinitrobenzene methapyrilene 3,3'-dimethylbenzidine hexachlorophene	26.9 21.2 30.5 54.9 37.1 43.5 24.0 42.0 47.9	59SB33-00, 59SB33-01, 59SB29-01, 59SB30-01, 59SB27-00, 59SB2800, 59SB29-0059SB30-00	J/UJ
CC 9/25/12	methyl methasulfonate 4-aminobiphenyl methapyrilene	49.8 21.4 35.7	59SB24-00, 59SB24-00D, 59SB24-01, 59SB24-01D, 59SB32-00, 59SB32-01, 59SB25-00, 59SB25-01, 59SB26-00, 59SB26-01, 59SB27-01, 59SB31-00, 59SB31-01, 59SB28-01	J/UJ

Blanks

Metals

Associated blanks exhibited contamination as noted in the following table.

Blank ID	Analyte	Concentration	Action Level	Q Flag
59FB03	barium	7.0 ug/L	35 mg/Kg	J up to action level
	thallium	0.26J ug/L	LOD	U at LOD
59ER12	barium	7.3 ug/L	36.5 mg/Kg	J up to action level
	tin	1.5J ug/L (>LOD)	7.5 mg/Kg	J up to action level

Associated samples and required qualifications are noted in the following table.

Sample ID	Analyte	Q Flag
59SB33-01	barium	J
59SB32-00	thallium	U at LOD
59SB24-00D	tin	J

Internal Standards

SVOA

Sample 59SB30-00 exhibited low internal standard area recoveries for phenanthrene-d10 and perylene-d12; therefore all compounds associated with these standards were qualified as estimated (J/UJ).

Laboratory Control Samples

SVOA

The submitted LCS associated with samples 59ER12RE and 59FB03RE exhibited 6% and 6% recovery for famphur (QC limit 10-130%); therefore all non-detected results for these compounds were qualified as estimated (J/UJ).

Matrix Spike

SVOA

The submitted matrix spike samples exhibited non-compliant recoveries for the compounds listed in the table below; qualifications were applied as stated.

Sample ID	Compound	MS % Rec	MSD % Rec	QC Limit	Qualifier
59SB24-00	p-phenylene diamine	0	0	10-130	J/R
	a,a-dimethyl phenethylamine	0	0	10-130	
	1-naphthylamine	0	10	10-130	
	hexachlorophene	0	0	10-130	
59SB33-00	p-phenylene diamine	0	0	10-130	J/R
	a,a-dimethyl phenethylamine	0	0	10-130	
	1-naphthylamine	0	0	10-130	
	methyl methanesulfonate	9	8	10-130	
	hexachlorophene	0	0	10-130	

Metals

The matrix spike analysis submitted in this SDG exhibited non-compliant %Rs for one analyte that resulted in rejection in the field samples. A summary of this non-compliance and affected samples are noted in the following table. Qualifications were made in the samples if both the MS & the MSD exhibited non-compliant recoveries OR if either the

MS or MSD exhibited a non-compliant recovery and the PDS was non-compliant in the same direction. The PDS recovery is noted in the table only if that recovery was instrumental in determining the qualifications placed on the data. Please note that lead is rejected in the associated samples. Although the PDS recovery was acceptable, the %R in the MS was significantly above the 200% recovery required for rejection based on the Region II guidance and the %R in the MSD was only slightly 200%.

MS/MSD	Analytes	Samples	%R	PDS %R	Q Flag
59SB24-00	lead	all field samples	509/182	95	R

Matrix Duplicates

Metals

The matrix duplicate analysis submitted in this SDG exhibited non-compliant %RPDs >35% (Region II) for two analytes that resulted in qualification in the field samples. A summary of issues and affected samples are noted in the following table.

MD	Analytes	Samples	%D	Q Flag
59SB24-00	cobalt lead	all field samples	71 63	J/UJ

Serial Dilutions

Metals

The serial dilution submitted in this SDG exhibited %D >10% for one analyte. Qualifications were required in the metals samples for the analyte cobalt. A summary of this issue and affected samples are noted in the following table.

SD	Analytes	Samples	%D	Q Flag
59SB24-00	cobalt	all field samples	51	J/UJ

Field Duplicates

SVOA

Sample 59SB24-00 and duplicate 59SB24-00D exhibited non-compliant reproducibility for bis(2-ethylhexyl)phthalate at 69%; therefore results for this compound were qualified as estimated (J/UJ).

Sample 59SB24-01 and duplicate 59SB24-01D exhibited non-compliant reproducibility for bis(2-ethylhexyl)phthalate at 36%; therefore results for this compound were qualified as estimated (J/UJ).

Metals

One of the two field duplicate pairs exhibited non-compliant reproducibility for the following analytes. These field duplicate pairs and analytes were flagged as noted in the table below based on Region II guidelines.

Sample ID	Analyte	RPD or Absolute Difference	Q Flag
59SB24-00	barium	40	J
59SB24-00D	beryllium	40	
	copper	42	
	vanadium	100	
	zinc	40	

Identification/Quantitation

VOA

All sample results for naphthalene were excluded as they were also analyzed by 8270 with lower reporting limits reported.

SVOA

The initial analysis of samples 59ER12 and 59FB03 were rejected in favor of the re-analysis due to method blank contamination associated with the original analyses.

A summary of qualifications required is provided on the following page. Please do not hesitate to contact DataQual ES with any questions regarding this validation report.

Sincerely,

Jacqueline Cleveland

Jacqueline Cleveland
Vice President

Summary of Data Qualifications

VOA

Sample ID	Compound	Results	Q flag
all samples	isobutanol 1,4-dioxane	+/-	J/R
59TB07, 59FB03, 59ER12	iodomethane allyl chloride trans-1,4-dichloro-2-butene pentachloroethane chloromethane bromomethane	+/-	J/UJ
59SB24-00D, 59SB24-01	acetone	+/-	J/UJ
59SB32-00, 59SB32-01, 59SB25-00, 59SB25-01, 59SB26-00, 59SB26-01, 59SB27-00, 59SB27-01, 59SB31-00, 59SB28-00, 59SB28-01, 59SB29-00, 59SB29-01	acrolein iodomethane acetonitrile acrylonitrile propionitrile methacrylonitrile isobutanol	+/-	J/UJ
59SB24-00, 59SB24-01D, 59SB31-01	acrolein iodomethane acrylonitrile	+/-	J/UJ
all samples	naphthalene	+/-	R

SVOA

Sample ID	Compound	Results	Q flag
59FB03RE, 59ER12RE	all results	+/-	J/UJ
59ER12RE, 59FB03RE	1,4-naphthaquinone 4-nitroquinoline-1-oxide methapyrilene hexachlorophene	+/-	J/UJ
all field samples	a,a-dimethyl phenethylamine 1,4-naphthaquinone	+/-	J/UJ
59SB33-00, 59SB33-01, 59SB29-01, 59SB30-01, 59SB27-00, 59SB2800, 59SB29-00, 59SB30-00	2,4-dinitrophenol dinoseb indeno(1,2,3-cd)pyrene methyl methasulfonate p-phenylene diamine 1,3,5-trinitrobenzene methapyrilene 3,3'-dimethylbenzidine hexachlorophene	+/-	J/UJ
59SB24-00, 59SB24-00D, 59SB24-01, 59SB24-01D, 59SB32-00, 59SB32-01, 59SB25-00, 59SB25-01, 59SB26-00, 59SB26-01, 59SB27-01, 59SB31-00, 59SB31-01, 59SB28-01	methyl methasulfonate 4-aminobiphenyl methapyrilene	+/-	J/UJ

Summary of Data Qualifications

SVOA, continued

Sample ID	Compound	Results	Q flag
59SB30-00	all compounds associated with: phenanthrene-d10 perylene-d12	+/-	J/UJ
59ER12RE, 59FB03RE	famphur	+/-	J/UJ
59SB24-00	p-phenylene diamine a,a-dimethyl phenethylamine 1-naphthylamine hexachlorophene	+/-	J/R
59SB33-00	p-phenylene diamine a,a-dimethyl phenethylamine 1-naphthylamine methyl methanesulfonate hexachlorophene	+/-	J/R
59SB24-00, 59SB24-00D, 59SB24-01, 59SB24-01D	bis(2-ethylhexyl)phthalate	+/-	J/UJ
59FB03, 59ER12	all results	+/-	R

Metals

Sample ID	Analyte	Results	Q flag
59SB33-01	barium	+ up to action limit	J
59SB32-00	thallium	+ up to action limit	U at LOD
59SB24-00D	tin	+ up to action limit	J
all field samples	lead	+/-	R
all field samples	cobalt lead	+/-	J/UJ
all field samples	cobalt	+/-	J/UJ
59SB24-00, 59SB24-00D	barium beryllium copper vanadium zinc		J

Glossary of Qualification Flags and Abbreviations

Qualification Flags (Q-Flags)

U	not detected above the reported sample quantitation limit
J	estimated value
UJ	reported quantitation limit is qualified as estimated
N	analyte has been tentatively identified
JN	analyte has been tentatively identified, estimated value
R	result is rejected; the presence or absence of the analyte cannot be verified

Method/Preparation/Field QC Blank Qualification Flags (Q-Flags)

Organic Methods

NA	The sample result for the blank contaminant is greater than the LOD (2X sample LOD for common laboratory contaminants) when the blank value is less than the LOD. The sample result for the blank contaminant is not qualified with any blank qualifiers.
LOD	The sample result for the blank contaminant is less than the LOD (2X sample LOD for common laboratory contaminants) but greater than the MDL when the blank value is less than the LOD. The sample result for the blank contaminant is changed to the LOD and qualified as non-detect U.

Inorganic Methods

ICB/CCB/PB Action:

No Action -	The sample result is greater than the LOD and greater than ten times (10X) the blank value.
U -	The sample result is greater than or equal to the MDL but less than or equal to the LOD, result is reported as non-detect at the LOD, when the ICB/CCB/PB result is less or greater than the LOD.
R -	Sample result is greater than the LOD and less than the ICB/CCB/PB value when the ICB/CCB/PB value is greater than the LOD.
J -	Sample result is greater than the ICB/CCB/PB value but less than 10X the ICB/CCB/PB value when ICB/CCB/PB value is greater than the LOD.
J/UJ -	Sample result is less than 10X LOD when blank result is below the negative LOD.

Glossary of Qualification Flags and Abbreviations, continued

Field QC Blank action:

Note – Use field blanks to qualify data only if field blank results are greater than prep blank results.

Do not use rinsate blank associated with soils to qualify water samples and vice versa.

No Action -	The sample result is greater than the LOD and greater than ten times (10X) the blank value.
U -	The sample result is greater than or equal to the MDL but less than or equal to the LOD, result is reported as non-detect at the LOD when the FB result is less or greater than the LOD.
R -	Sample result is greater than the LOD and less than the FB value when the FB value is greater than the LOD.
J -	Sample result is greater than the FB value but less than 10X the FB value when FB value is greater than the LOD.

General Abbreviations

MDL	method detection limit
IDL	instrument detection limit
LOD/RL	Level of Detection//Reporting Limit
LOQ	Level of Quantitation
+	positive result
-	non-detect result

TEST AMERICA SDG 680-82994-3

DataQual

Environmental Services, LLC

Michael Baker, Jr., Inc.
Airside Business Park
100 Airside Drive
Moon Township, PA 15108

January 8, 2013
SDG# 680-82994-3, Test America- Savannah
NAPR SWMU 59, Puerto Rico

Dear Ms. Raub,

The following Data Validation report is provided as requested for the parameters noted in the table below for SDG # 680-82994-3. The data validation was performed in accordance with the SW-846 methods utilized by the laboratory and professional judgment. Region II has not developed a validation checklist SOP for the methods used to assess the inorganic methods in this SDG (6010C, 6020A and 7470A/7471A). Therefore, alternative worksheets were provided. Region II flagging conventions were used. All areas of concern are discussed in the body of the report and a summary of data qualifications are provided.

Sample ID	Lab ID	Matrix	Metals
59SD12	680-82994-28	soil	X
59SD11	680-82994-29	soil	X
59SD10	680-82994-30	soil	X
59SD09	680-82994-31	soil	X
59SD08	680-82994-32	soil	X
59SD07	680-82994-33	soil	X
59SD06	680-82994-34	soil	X
59SD05	680-82994-35	soil	X
59SD04	680-82994-36	soil	X
59SD04D	680-82994-37	soil	X
59ER14	680-82994-38	water	X
59SD04 MS	680-82994-36MS	soil	X
59SD04 MSD	680-82994-36MSD	soil	X

The following quality control samples were provided with this SDG: sample 59TB07- trip blank; sample 59ER14- equipment blank; and sample 59SD04D - field duplicate of sample 59SD07.

The samples were evaluated based on the following criteria:

- Data Completeness *
- Sample Condition
- Technical Holding Times *
- ICP-MS Tuning *
- Initial/Continuing Calibrations *
- ICSA/ICSAB Standards *

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- Blanks *
- ICP-MS Internal Standards *
- Laboratory Control Samples *
- Matrix Spike Recoveries *
- Matrix Duplicate RPDs *
- Serial Dilutions *
- Field Duplicates
- Identification/Quantitation *
- Reporting Limits *

* - indicates that qualifications were not required based on this criteria

Overall Evaluation of Data/Potential Usability Issues

A summary of qualifications applied to the sample results are noted below for the fractions validated. Specific details regarding qualification of the data are addressed in the Specific Evaluation section of this narrative. If an issue is not addressed there were no actions required based on unmet quality criteria. When more than one qualifier is associated with a compound/analyte the validator has chosen the qualifier that best indicates possible bias in the results and flagged the data accordingly. However, information regarding all quality control issues is provided in the body of the report and on the qualification summary page. *If an issue is not addressed in this narrative there were no actions required based on unmet quality control criteria.*

Metals

All sediment samples required qualification as estimated due to high moisture content (>50%).

The field duplicate pair exhibited non-compliant RPDs or absolute differences. Qualifications were made based on Region II guidance in the field duplicate pair only.

Specific Evaluation of Data

Data Completeness

Resubmissions were required for this SDG. Initially the SDG was received without sediment results. Sediment data was requested and was received in the form of a pdf addendum file. Several items were still missing from this file. The laboratory was contacted regarding an issue with the reported LOD/LOQ/DL quantities. A corrected method blank form was received in response to the fact that the reported LODs and LOQs could not be verified based on the base LOD/LOQ values. Further, an explanation was requested as to the apparent discrepancy (factor of 2) occurring when the validator tried to verify the values. The QA Manager of the lab provided an email explanation indicating that the final volume for the samples in question was 500 ml rather than 1000

ml. Corrected EDD was also required due to these issues. The data package did not contain a case narrative or a chain of custody that covered the sediment samples in this SDG. These two items were requested and received from the laboratory.

Technical Holding Times

According to chain of custody records, sampling was performed on 9/15/12 and samples were received at the laboratory 9/18/12. All sample preparation and analysis was performed within Region II and/or method holding time requirements.

Sample Condition

Metals

The sediment samples in this SDG exhibited moisture content as noted in the following table. Based on Region II guidance, reported results required qualification as estimated J/UJ for moisture content >50%. Therefore the reported results in the samples noted in the following table were qualified as estimated J/UJ.

Sample ID	%Solids
59SD12	8.7
59SD11	12.8
59SD10	5.9
59SD09	7.2
59SD08	12.8
59SD07	7.5
59SD06	20.6
59SD05	24.6
59SD04	54.2
59SD04D	51.1

Field Duplicates

Metals

One of the two field duplicate pairs exhibited non-compliant reproducibility for the following analytes. These field duplicate pairs and analytes were flagged as noted in the table below based on Region II guidelines.

Sample ID	Analyte	RPD or Absolute Difference	Q Flag
59SD04	lead	40	J
59SD04D	zinc	39	

A summary of qualifications required is provided on the following page. Please do not hesitate to contact DataQual ES with any questions regarding this validation report.

Sincerely,

Jacqueline Cleveland

Jacqueline Cleveland
Vice President

Summary of Data Qualifications

Metals

Sample ID	Analyte	Results	Q flag
all sediment samples	all analytes	+/-	J/UJ
59SD04, 59SD04D	lead zinc	+	J

Glossary of Qualification Flags and Abbreviations

Qualification Flags (Q-Flags)

U	not detected above the reported sample quantitation limit
J	estimated value
UJ	reported quantitation limit is qualified as estimated
N	analyte has been tentatively identified
JN	analyte has been tentatively identified, estimated value
R	result is rejected; the presence or absence of the analyte cannot be verified

Method/Preparation/Field QC Blank Qualification Flags (Q-Flags)

Organic Methods

NA	The sample result for the blank contaminant is greater than the LOD (2X sample LOD for common laboratory contaminants) when the blank value is less than the LOD. The sample result for the blank contaminant is not qualified with any blank qualifiers.
LOD	The sample result for the blank contaminant is less than the LOD (2X sample LOD for common laboratory contaminants) but greater than the MDL when the blank value is less than the LOD. The sample result for the blank contaminant is changed to the LOD and qualified as non-detect U.

Inorganic Methods

ICB/CCB/PB Action:

No Action -	The sample result is greater than the LOD and greater than ten times (10X) the blank value.
U -	The sample result is greater than or equal to the MDL but less than or equal to the LOD, result is reported as non-detect at the LOD, when the ICB/CCB/PB result is less or greater than the LOD.
R -	Sample result is greater than the LOD and less than the ICB/CCB/PB value when the ICB/CCB/PB value is greater than the LOD.
J -	Sample result is greater than the ICB/CCB/PB value but less than 10X the ICB/CCB/PB value when ICB/CCB/PB value is greater than the LOD.
J/UJ -	Sample result is less than 10X LOD when blank result is below the negative LOD.

Glossary of Qualification Flags and Abbreviations, continued

Field QC Blank action:

Note – Use field blanks to qualify data only if field blank results are greater than prep blank results.

Do not use rinsate blank associated with soils to qualify water samples and vice versa.

No Action -	The sample result is greater than the LOD and greater than ten times (10X) the blank value.
U -	The sample result is greater than or equal to the MDL but less than or equal to the LOD, result is reported as non-detect at the LOD when the FB result is less or greater than the LOD.
R -	Sample result is greater than the LOD and less than the FB value when the FB value is greater than the LOD.
J -	Sample result is greater than the FB value but less than 10X the FB value when FB value is greater than the LOD.

General Abbreviations

MDL	method detection limit
IDL	instrument detection limit
LOD/RL	Level of Detection//Reporting Limit
LOQ	Level of Quantitation
+	positive result
-	non-detect result

PUERTO RICO CHEMIST CERTIFICATIONS

Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for Metals following Method SW 846, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

R1002745-001
R1002745-002

Lcda. Daliz M. Estades Santaliz

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Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for Wet Chemistry fraction following current EPA methods, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers.

R1002745-001
R1002745-002

Lcda. Daliz M. Estades Santaliz

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Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for Pesticides fraction only following Method SW 846, 3rd Edition, Update 4, Method 8081B, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1004193-01	1004193-05
1004193-02	1004193-06
1004193-03	1004193-07

Lcda. Daliz M. Estades Santaliz

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Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for APPIX metals and mercury following Method SW 846-6010, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1004193-01	1004193-05
1004193-02	1004193-06
1004193-03	1004193-07

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A 1294642

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Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for metals calcium, magnesium, and tin following Method SW 846-6010, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1004193-01	1004193-05
1004193-02	1004193-06
1004193-03	1004193-07

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Dorado, PR 00646-0727

Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for semivolatile and semivolatile Selected Ion Monitoring (SIM) fractions following Method SW 846, 3rd Edition, Update 3, Sonication extraction (Method 3550B), Method 8270C and Selected Ion Monitoring (SIM), from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1004194-01	1004194-07
1004194-02	1004194-08
1004194-03	1004194-09
1004194-04	1004194-10
1004194-05	1004194-11
1004194-06	

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Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for Pesticides fraction only following Method SW 846, 3rd Edition, Update 4, Method 8081B, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1004194-01	1004194-07
1004194-02	1004194-08
1004194-03	1004194-09
1004194-04	1004194-10
1004194-05	1004194-11
1004194-06	

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Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for Volatile Fraction following SW-846, 3rd Edition, Update 3, 8260B, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1004195-01	1004195-11
1004195-02	1004195-12
1004195-03	1004195-13
1004195-04	1004195-14
1004195-05	1004195-15
1004195-06	1004195-16
1004195-07	1004195-17
1004195-08	1004195-18
1004195-09	1004195-19
1004195-10	1004195-20

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Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for APPIX metals and mercury following Method SW 846-6020, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1004195-01	1004195-11
1004195-02	1004195-12
1004195-03	1004195-13
1004195-04	1004195-14
1004195-05	1004195-15
1004195-06	1004195-16
1004195-07	1004195-17
1004195-08	1004195-18
1004195-09	1004195-19
1004195-10	1004195-20

Lcda. Daliz M. Estades Santaliz

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Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for metal tin following Method SW 846, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1004195-01	1004195-11
1004195-02	1004195-12
1004195-03	1004195-13
1004195-04	1004195-14
1004195-05	1004195-15
1004195-06	1004195-16
1004195-07	1004195-17
1004195-08	1004195-18
1004195-09	1004195-19
1004195-10	1004195-20

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Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for Pesticides fraction only following Method SW 846, 3rd Edition, Update 4, Method 8081B, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1004195-01	1004195-11
1004195-02	1004195-12
1004195-03	1004195-13
1004195-04	1004195-14
1004195-05	1004195-15
1004195-06	1004195-16
1004195-07	1004195-17
1004195-08	1004195-18
1004195-09	1004195-19
1004195-10	1004195-20

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Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for semivolatile and semivolatile Selected Ion Monitoring (SIM) fractions following Method SW-846, 3rd Edition, Sonication extraction (Method 3550B), Method 8270C, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1004195-01	1004195-11
1004195-02	1004195-12
1004195-03	1004195-13
1004195-04	1004195-14
1004195-05	1004195-15
1004195-06	1004195-16
1004195-07	1004195-17
1004195-08	1004195-18
1004195-09	1004195-19
1004195-10	1004195-20

Lcda. Daliz M. Estades Santaliz

ASOCIADO DE ESTUDIOS QUIMICOS DE PUERTO RICO
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Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for APPIX metals and mercury following Method SW 846-6020, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1004196-01

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Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for metal tin following Method SW 846, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1004196-01

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Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for APPIX metals and mercury following Method SW 846-6020, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1004208-01

Lcda. Daliz M. Estades Santaliz

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Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for metal tin following Method SW 846 6010, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1004208-01

Lcda. Daliz M. Estades Santaliz

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Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for Pesticides fraction only following Method SW 846, 3rd Edition, Update 4, Method 8081B, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1004208-01

Lcda. Daliz M. Estades Santaliz

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Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:
I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for semivolatile and semivolatile Selected Ion Monitoring (SIM) fractions following Method SW-846, 3rd Edition, Sonication extraction (Method 3550B), Method 8270C, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1004208-01

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Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for Volatile Fraction following SW-846, 3rd Edition, Update 3, 8260B, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1004208-01

Lcda. Daliz M. Estades Santaliz

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Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for Wet Chemistry fraction, following current EPA methods from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers.

1004208-01

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Daliz Estades Santaliz

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To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for semivolatile and semivolatile Selected Ion Monitoring (SIM) fractions following Method SW-846, 3rd Edition, Sonication extraction (Method 3550B), Method 8270C, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1005175-01	1005175-13
1005175-02	1005175-14
1005175-03	1005175-15
1005175-04	1005175-16
1005175-05	1005175-17
1005175-07	1005175-18
1005175-08	1005175-19
1005175-09	1005175-20
1005175-11	1005175-21
1005175-12	1005175-22

Lcda. Daliz M. Estades Santaliz

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Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for Pesticides fraction only following Method SW 846, 3rd Edition, Update 4, Method 8081B, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1005175-01	1005175-13
1005175-02	1005175-14
1005175-03	1005175-15
1005175-04	1005175-16
1005175-05	1005175-17
1005175-07	1005175-18
1005175-08	1005175-19
1005175-09	1005175-20
1005175-11	1005175-21
1005175-12	1005175-22

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To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for Volatile Fraction following SW-846, 3rd Edition, Update 3, 8260B, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1005175-01	1005175-12
1005175-02	1005175-13
1005175-03	1005175-14
1005175-04	1005175-15
1005175-05	1005175-16
1005175-06	1005175-17
1005175-07	1005175-18
1005175-08	1005175-19
1005175-09	1005175-20
1005175-10	1005175-21
1005175-11	1005175-22

Lcda. Daliz M. Estades Santaliz

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Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for APPIX metals and mercury following Method SW 846-6020, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1005175-01	1005175-13
1005175-02	1005175-14
1005175-03	1005175-15
1005175-04	1005175-16
1005175-05	1005175-17
1005175-07	1005175-18
1005175-08	1005175-19
1005175-09	1005175-20
1005175-11	1005175-21
1005175-12	1005175-22

Lcda. Daliz M. Estades Santaliz

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Daliz Estades Santaliz

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To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for metal tin following Method SW 846, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1005175-01	1005175-13
1005175-02	1005175-14
1005175-03	1005175-15
1005175-04	1005175-16
1005175-05	1005175-17
1005175-07	1005175-18
1005175-08	1005175-19
1005175-09	1005175-20
1005175-11	1005175-21
1005175-12	1005175-22

Lcda. Daliz M. Estades Santaliz

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Daliz Estades Santaliz

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To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for Pesticides fraction only following Method SW 846, 3rd Edition, Update 3, Method 8081B, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1005176-01	1005176-11
1005176-02	1005176-12
1005176-03	1005176-13
1005176-04	1005176-14
1005176-05	1005176-15
1005176-06	1005176-16
1005176-07	1005176-17
1005176-08	1005176-18
1005176-09	1005176-19
1005176-10	1005176-20

Lcda. Daliz M. Estades Santaliz

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Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for semivolatile and semivolatile Selected Ion Monitoring (SIM) fractions following Method SW-846, 3rd Edition, Sonication extraction (Method 3550B), Method 8270C, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1005176-01	1005176-11
1005176-02	1005176-12
1005176-03	1005176-13
1005176-04	1005176-14
1005176-05	1005176-15
1005176-06	1005176-16
1005176-07	1005176-17
1005176-08	1005176-18
1005176-09	1005176-19
1005176-10	1005176-20

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Daliz Estades Santaliz

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To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for APPIX metals and mercury following Method SW 846-6020, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1005176-01	1005176-11
1005176-02	1005176-12
1005176-03	1005176-13
1005176-04	1005176-14
1005176-05	1005176-15
1005176-06	1005176-16
1005176-07	1005176-17
1005176-08	1005176-18
1005176-09	1005176-19
1005176-10	1005176-20

Lcda. Daliz M. Estades Santaliz

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Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for Volatile Fraction following SW-846, 3rd Edition, Update 3, 8260B, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1005176-01	1005176-11
1005176-02	1005176-12
1005176-03	1005176-13
1005176-04	1005176-14
1005176-05	1005176-15
1005176-06	1005176-16
1005176-07	1005176-17
1005176-08	1005176-18
1005176-09	1005176-19
1005176-10	1005176-20

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Daliz Estades Santaliz

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To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for metal tin following Method SW 846, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1005176-01	1005176-11
1005176-02	1005176-12
1005176-03	1005176-13
1005176-04	1005176-14
1005176-05	1005176-15
1005176-06	1005176-16
1005176-07	1005176-17
1005176-08	1005176-18
1005176-09	1005176-19
1005176-10	1005176-20

Lcda. Daliz M. Estades Santaliz

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Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for APPIX metals and mercury following Method SW 846-6020, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1005177-01	1005177-11
1005177-02	1005177-12
1005177-03	1005177-13
1005177-04	1005177-14
1005177-05	1005177-15
1005177-06	1005177-16
1005177-07	1005177-17
1005177-08	1005177-18
1005177-09	1005177-19
1005177-10	

Lcda. Daliz M. Estades Santaliz

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Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for Volatile Fraction following SW-846, 3rd Edition, Update 3, 8260B, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1005177-01	1005177-11
1005177-02	1005177-12
1005177-03	1005177-13
1005177-04	1005177-14
1005177-05	1005177-15
1005177-06	1005177-16
1005177-07	1005177-17
1005177-08	1005177-18
1005177-09	1005177-19
1005177-10	

Lcda. Daliz M. Estades Santaliz

ESTADO LIBRE ASOCIADO DE PUERTO RICO
Daliz M. Estades Santaliz
Lic. 4026
QUIMICO LICENCIADO

A 1325696

PO Box 727
Dorado, PR 00646-0727

Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for Pesticides fraction only following Method SW 846, 3rd Edition, Update 4, Method 8081B, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1005177-01	1005177-11
1005177-02	1005177-12
1005177-03	1005177-13
1005177-04	1005177-14
1005177-05	1005177-15
1005177-06	1005177-16
1005177-07	1005177-17
1005177-08	1005177-18
1005177-09	1005177-19
1005177-10	

Lcda. Daliz M. Estades Santaliz

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$1.00
A 1325697

PO Box 727
Dorado, PR 00646-0727

Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for metal tin following Method SW 846, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1005177-01	1005177-11
1005177-02	1005177-12
1005177-03	1005177-13
1005177-04	1005177-14
1005177-05	1005177-15
1005177-06	1005177-16
1005177-07	1005177-17
1005177-08	1005177-18
1005177-09	1005177-19
1005177-10	

Lcda. Daliz M. Estades Santaliz

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A 1325698
LICENCIADO

PO Box 727
Dorado, PR 00646-0727

Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for semivolatile and semivolatile Selected Ion Monitoring (SIM) fractions following Method SW-846, 3rd Edition, Sonication extraction (Method 3550B), Method 8270C, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1005177-01	1005177-11
1005177-02	1005177-12
1005177-03	1005177-13
1005177-04	1005177-14
1005177-05	1005177-15
1005177-06	1005177-16
1005177-07	1005177-17
1005177-08	1005177-18
1005177-09	1005177-19
1005177-10	

Lcda. Daliz M. Estades Santaliz

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QUIMICO LICENCIADO

$1.00 A 1325699

PO Box 727
Dorado, PR 00646-0727

Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for semivolatile and semivolatile Selected Ion Monitoring (SIM) fractions following Method SW-846, 3rd Edition, Sonication extraction (Method 3550B), Method 8270C, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1005178-01
1005178-02
1005178-03
1005178-04
1005178-05

Lcda. Daliz M. Estades Santaliz

ESTADO LIBRE ASOCIADO DE PUERTO RICO
Daliz M. Estades Santaliz
Lic. 4026
QUIMICO LICENCIADO

A 1327185

PO Box 727
Dorado, PR 00646-0727

Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for Wet Chemistry fraction following current EPA methods, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1005178-01
1005178-02
1005178-03
1005178-04
1005178-05

Lcda. Daliz M. Estades Santaliz

Daliz M. Estades Santaliz
Lic. 4026
QUIMICO LICENCIADO
A 1327186

PO Box 727
Dorado, PR 00646-0727

Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for Volatile Fraction following SW-846, 3rd Edition, Update 3, 8260B, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1005178-01
1005178-02
1005178-03
1005178-04
1005178-05

Lcda. Daliz M. Estades Santaliz

ESTADO LIBRE ASOCIADO DE PUERTO RICO
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Lic. 4026
QUIMICO LICENCIADO

A 1327187

PO Box 727
Dorado, PR 00646-0727

Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for Pesticides fraction only following Method SW 846, 3rd Edition, Update 4, Method 8081B, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1005178-01
1005178-02
1005178-03
1005178-04
1005178-05

Lcda. Daliz M. Estades Santaliz

Daliz M. Estades Santaliz
Lic. 4026

A 1327188

PO Box 727
Dorado, PR 00646-0727

Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for APPIX metals and mercury following Method SW 846-6020, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1005178-01
1005178-02
1005178-03
1005178-04
1005178-05

Lcda. Daliz M. Estades Santaliz

Daliz M. Estades Santaliz
Lic. 4026
A 1327189

PO Box 727
Dorado, PR 00646-0727

Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for metal tin following Method SW 846, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1005178-01
1005178-02
1005178-03
1005178-04
1005178-05

Lcda. Daliz M. Estades Santaliz

Daliz M. Estades Santaliz Lic. 4026

A 1327190

PO Box 727
Dorado, PR 00646-0727

Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for APPIX metals and mercury following Method SW 846-6020, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1005179-01	1005179-08
1005179-02	1005179-09
1005179-03	1005179-10
1005179-04	1005179-11
1005179-05	1005179-12
1005179-06	1005179-13
1005179-07	

Lcda. Daliz M. Estades Santaliz

PO Box 727
Dorado, PR 00646-0727

Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for metal tin following Method SW 846, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1005179-01	1005179-08
1005179-02	1005179-09
1005179-03	1005179-10
1005179-04	1005179-11
1005179-05	1005179-12
1005179-06	1005179-13
1005179-07	

Lcda. Daliz M. Estades Santaliz

ESTADO LIBRE ASOCIADO DE PUERTO RICO
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QUIMICO LICENCIADO
$1.00
A 1327210

PO Box 727
Dorado, PR 00646-0727

Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for Volatile Fraction following SW-846, 3rd Edition, Update 3, 8260B, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1005188-01
1005188-02

Lcda. Daliz M. Estades Santaliz

Daliz M. Estades Santaliz
Lic. 4026
QUIMICO LICENCIADO
PUERTO RICO

A 1327211

PO Box 727
Dorado, PR 00646-0727

Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for Wet Chemistry fraction following current EPA methods, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers.

1005191-02

Lcda. Daliz M. Estades Santaliz

Lic. 4026

A 1325687

PO Box 727
Dorado, PR 00646-0727

Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for Volatile Fraction following TCLP (Method 1311), SW846, 3rd Edition, Update 3, 8260B, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1005191-01

Lcda. Daliz M. Estades Santaliz

Daliz M. Estades Santaliz Lic. 4028 ESTADO LIBRE ASOCIADO DE PUERTO RICO QUIMICO LICENCIADO

A 1325688

PO Box 727
Dorado, PR 00646-0727

Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for Semivolatile Fraction following TCLP (Method 1311) and 8270C, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1005191-01

Lcda. Daliz M. Estades Santaliz

Daliz M. Estades Santaliz Lic. 4026

QUIMICO LICENCIADO

A 1325689

PO Box 727
Dorado, PR 00646-0727

Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for TCLP metals and mercury following Method SW846, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1005191-01

Lcda. Daliz M. Estades Santaliz

Daliz M. Estades Santaliz
Lic. 4023
QUIMICO LICENCIADO
A 1325690

PO Box 727
Dorado, PR 00646-0727

Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for Wet Chemistry fraction following current EPA methods, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers.

1005192-02

Lcda. Daliz M. Estades Santaliz

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QUIMICO LICENCIADO

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PO Box 727
Dorado, PR 00646-0727

Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for Semivolatile Fraction following TCLP (Method 1311) and 8270C, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1005192-01

Lcda. Daliz M. Estades Santaliz

Daliz M. Estades Santaliz Lic. 4026

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Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for Volatile Fraction following TCLP (Method 1311), SW846, 3rd Edition, Update 3, 8260B, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1005192-01

Lcda. Daliz M. Estades Santaliz

Daliz M. Estades Santaliz
Lic. 4026
ESTADO LIBRE ASOCIADO DE PUERTO RICO
QUIMICO LICENCIADO

A 1325693

PO Box 727
Dorado, PR 00646-0727

Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results of samples analyzed for TCLP metals and mercury following Method SW846, from Project Name NAPR SWMU59/DO, and Laboratory ID Numbers:

1005192-01

Lcda. Daliz M. Estades Santaliz

Daliz M. Estades Santaliz Lic. 4028

A 1325694

PO Box 727
Dorado, PR 00646-0727

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

PUERTO RICO CERTIFICATION

I Herby certify that I have reviewed the Quality Assurance Data for Project Number **680-82907-1,** and to the best of my knowledge, the results are correct and reliable.

Abraham Ortiz

$1.00 $1.00

A 1426469

ESTADO LIBRE ASOCIADO DE PUERTO RICO

Lic. Abraham Ortiz Charriez

Lic. 2413

QUIMICO LICENCIADO

Daliz Estades Santaliz

Licensed Chemist

To Whom It May Concern:

I, Daliz M. Estades Santaliz, in my capacity as Puerto Rico Certified Chemist, hereby certify the attached Analytical Results from Project NAPR SWMU 59 and Laboratory ID Numbers:

680-82994-1	680-82994-11
680-82994-2	680-82994-12
680-82994-3	680-82994-13
680-82994-4	680-82994-14
680-82994-5	680-82994-15
680-82994-6	680-82994-16
680-82994-7	680-82994-17
680-82994-8	680-82994-18
680-82994-9	680-82994-27
680-82994-10	

ESTADO LIBRE ASOCIADO DE PUERTO RICO
Daliz M. Estades Santaliz
Lic. 4026
QUIMICO LICENCIADO

Lcda. Daliz M. Estades Santaliz

A 1443872

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Dorado, PR 00646-0727

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

PUERTO RICO CERTIFICATION

I Herby certify that I have reviewed the Quality Assurance Data for Project Number **680-82994-2,** and to the best of my knowledge, the results are correct and reliable.

Abraham Ortiz

$1.00 $1.00

A 1408516

Lic. Abraham Ortiz Charriez Lic. 2314

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

PUERTO RICO CERTIFICATION

I Herby certify that I have reviewed the Quality Assurance Data for Project Number **680-82994-3,** and to the best of my knowledge, the results are correct and reliable.

Abraham Ortiz

$1.00 $1.00

A 1408515

ESTADO QUIMICO LICENCIADO

Ortiz Charriez

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

PUERTO RICO CERTIFICATION

I Herby certify that I have reviewed the Quality Assurance Data for Project Number **680-84737-1,** and to the best of my knowledge, the results are correct and reliable.

Abraham Ortiz

$1.00 $1.00

A 1455407

Lic Abraham Ortiz Cherrez Lic 2314

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APPENDIX D
DATA USED IN THE ECOLOGICAL RISK ASSESSMENT

APPENDIX D

SURFACE SOIL ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB06	59SB07	59SB08	59SB09	59SB11	59SB12
Sample ID	59SB01-00	59SB02-00	59SB03-00	59SB04-00	59SB06-00	59SB07-00	59SB08-00	59SB09-00	59SB11-00	59SB12-00
Sample Date	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	5/19/2010	5/18/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Volatile Organics (µg/kg)										
1,1,1,2-Tetrachloroethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
1,1,1-Trichloroethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
1,1,2,2-Tetrachloroethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
1,1,2-Trichloroethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
1,1-Dichloroethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
1,1-Dichloroethene	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
1,2,3-Trichloropropane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
1,2-Dibromo-3-chloropropane (DBCP)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
1,2-Dibromoethane (EDB)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
1,2-Dichloroethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
1,2-Dichloroethene (trans)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
1,2-Dichloropropane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
1,3-Dichloropropene (cis)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
1,3-Dichloropropene (trans)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
1,4-Dichloro-2-butene (trans)	22 U	21 U	16 U	15 U	18 U	17 U	15 U	19 U	17 U	18 U
1,4-Dioxane (p-)	280 R	260 R	210 R	190 R	220 R	210 R	190 R	240 R	210 R	220 R
2-Butanone (MEK)	14 UJ	13 UJ	10 UJ	9.4 UJ	11 UJ	11 UJ	9.6 UJ	12 UJ	14 U	16 U
2-Chloro-1,3-butadiene (Chloroprene)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
2-Hexanone (MBK)	14 UJ	13 UJ	10 UJ	9.4 UJ	11 UJ	11 UJ	9.6 UJ	12 UJ	11 U	4.8 J
3-Chloropropene (Allyl Chloride)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
4-Methyl-2-pentanone (MIBK)	14 UJ	13 UJ	10 UJ	9.4 UJ	11 UJ	11 UJ	9.6 UJ	12 UJ	11 U	11 U
Acetone	14 UJ	15 UJ	24 J	25 J	17 UJ	91 J	9.6 UJ	37 J	64	110 J
Acetonitrile	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Acrolein	56 R	53 R	41 R	38 R	45 R	43 R	38 R	47 R	43 R	45 R
Acrylonitrile	56 U	53 U	41 U	38 U	45 U	43 U	38 U	47 U	43 U	3.4 J
Benzene	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	0.44 J	0.37 J
Bromodichloromethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Bromoform	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Bromomethane	5.6 UJ	5.3 UJ	4.1 UJ	3.8 UJ	4.5 UJ	4.3 UJ	3.8 UJ	4.7 UJ	6.3	2.4 J
Carbon Disulfide	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	0.52 J
Carbon Tetrachloride	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Chlorobenzene	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Chloroethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 UJ	4.5 UJ
Chloroform	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Chloromethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	0.99 J	0.39 J
Dibromochloromethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U

APPENDIX D

SURFACE SOIL ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB06	59SB07	59SB08	59SB09	59SB11	59SB12
Sample ID	59SB01-00	59SB02-00	59SB03-00	59SB04-00	59SB06-00	59SB07-00	59SB08-00	59SB09-00	59SB11-00	59SB12-00
Sample Date	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	5/19/2010	5/18/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Volatile Organics (µg/kg) (cont.)										
Dibromomethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Ethyl Methacrylate	56 U	53 U	41 U	38 U	45 U	43 U	38 U	47 U	43 U	45 U
Ethylbenzene	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Freon 11 (Trichlorofluoromethane)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Freon-12 (Dichlorodifluoromethane)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Isobutyl Alcohol	280 R	260 R	210 R	190 R	220 R	210 R	190 R	240 R	210 R	220 R
Methyl Acrylonitrile	56 U	53 U	41 U	38 U	45 U	43 U	38 U	47 U	43 U	3.3 J
Methyl Iodide	5.6 U	0.97 J	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	12	1.9 J
Methyl Methacrylate	56 R	53 R	41 R	38 R	45 R	43 R	38 R	47 R	43 R	45 R
Methylene Chloride	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Pentachloroethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Propionitrile (Ethyl Cyanide)	280 R	260 R	210 R	190 R	220 R	210 R	8.1 J	240 R	210 R	220 R
Styrene (Ethenylbenzene)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Tetrachloroethene (PCE)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Toluene	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Trichloroethene (TCE)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Vinyl Acetate	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Vinyl Chloride	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Xylene, m/p-	11 U	0.32 J	8.2 U	0.15 J	9 U	8.5 U	0.14 J	9.5 U	8.5 U	8.9 U
Xylene, o-	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Xylenes, total	5.6 U	0.32 J	4.1 U	0.15 J	4.5 U	4.3 U	0.14 J	4.7 U	4.3 U	4.5 U
Semivolatile Organics (µg/kg)										
1,2,4,5-Tetrachlorobenzene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
1,2,4-Trichlorobenzene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
1,2-Dichlorobenzene (o-)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
1,3,5-Trinitrobenzene (TNB)	240 UJ	220 UJ	190 UJ	200 UJ	190 UJ	200 UJ	200 UJ	200 UJ	200 UJ	190 UJ
1,3-Dichlorobenzene (m-)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
1,3-Dinitrobenzene (m-)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
1,4-Dichlorobenzene (p-)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
1,4-Naphthoquinone	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
1,4-Phenylenediamine	2400 R	2200 R	1900 R	2000 R	1900 R	2000 R	2000 R	2000 R	2000 R	1900 R
1-Naphthylamine	240 U	220 R	190 U	200 UJ	190 UJ	200 UJ	200 UJ	200 UJ	200 UJ	190 UJ
2,2'-Oxybis[1-chloropropane]	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
2,3,4,6-Tetrachlorophenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ
2,4,5-Trichlorophenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB06	59SB07	59SB08	59SB09	59SB11	59SB12
Sample ID	59SB01-00	59SB02-00	59SB03-00	59SB04-00	59SB06-00	59SB07-00	59SB08-00	59SB09-00	59SB11-00	59SB12-00
Sample Date	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	5/19/2010	5/18/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Semivolatile Organics (µg/kg) (cont.)										
2,4,6-Trichlorophenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ
2,4-Dichlorophenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ
2,4-Dimethylphenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ
2,4-Dinitrophenol	460 UJ	430 UJ	360 UJ	390 UJ	370 UJ	390 UJ	390 UJ	380 UJ	380 UJ	370 UJ
2,4-Dinitrotoluene (DNT)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
2,6-Dichlorophenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ
2,6-Dinitrotoluene (DNT)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
2-Acetylaminofluorene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
2-Chloronaphthalene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
2-Chlorophenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ
2-Methyl-5-nitroaniline	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
2-Methylphenol (o-Cresol)	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ
2-Naphthylamine	240 U	220 R	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
2-Nitroaniline	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
2-Nitrophenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ
2-Picoline	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
3,3'-Dichlorobenzidine	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
3,3'-Dimethylbenzidine	240 U	220 R	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
3-Methylcholanthrene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
3-Methylphenol (m-Cresol)	350 U	320 U	270 U	290 U	280 U	290 U	290 U	290 U	290 UJ	280 UJ
3-Nitroaniline	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
4,6-Dinitro-2-methylphenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ
4-Aminobiphenyl	240 U	220 R	190 UJ	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
4-Bromophenyl-phenylether	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
4-Chloro-3-methylphenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ
4-Chloroaniline	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
4-Chlorophenyl-phenylether	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
4-Dimethylaminoazobenzene (p-)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
4-Methylphenol (p-Cresol)	350 U	320 U	270 U	290 U	280 U	290 U	290 U	290 U	290 UJ	280 UJ
4-Nitroaniline	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
4-Nitrophenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ
4-Nitroquinoline-1-oxide	240 UJ	220 U	190 UJ	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
7,12-Dimethylbenz(a)anthracene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
a,a-Dimethylphenethylamine	460 UJ	430 UJ	360 UJ	390 UJ	370 UJ	390 UJ	390 UJ	380 UJ	540 UJ	520 UJ
Acetophenone	120 U	110 U	93 U	100 U	94 U	100 U	100 U	98 U	98 UJ	94 UJ
Aniline	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB06	59SB07	59SB08	59SB09	59SB11	59SB12
Sample ID	59SB01-00	59SB02-00	59SB03-00	59SB04-00	59SB06-00	59SB07-00	59SB08-00	59SB09-00	59SB11-00	59SB12-00
Sample Date	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	5/19/2010	5/18/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Semivolatile Organics (µg/kg) (cont.)										
Aramite	240 UJ	220 U	190 UJ	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Benzyl Alcohol	240 UJ	220 UJ	190 UJ	200 UJ	190 UJ	200 UJ	200 UJ	200 UJ	200 UJ	190 UJ
Bis(2-chloroethoxy)methane	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Bis(2-chloroethyl)ether	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Bis(2-ethylhexyl) Phthalate (BEHP)	630 J	240	190 U	200 U	190 U	48 J	200	200 U	200 UJ	190 UJ
Butyl Benzyl Phthalate	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Diallate (cis)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Diallate (trans)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Dibenzofuran	240 U	220 U	190 U	750	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Diethyl Phthalate (DEP)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Dimethyl Phthalate	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Di-n-butyl Phthalate (DBP)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Di-n-octyl Phthalate	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Dinoseb	NA	NA	NA	NA	NA	NA	NA	NA	200 UJ	190 UJ
Ethyl Methane Sulfonate (EMS)	240 UJ	220 UJ	190 UJ	200 UJ	190 UJ	200 UJ	200 UJ	200 UJ	200 UJ	190 UJ
Hexachloro-1,3-butadiene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Hexachlorobenzene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Hexachlorocyclopentadiene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Hexachloroethane	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Hexachloropropene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Isophorone	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Isosafrole	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Methapyrilene	240 UJ	220 R	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Methyl Methane Sulfonate	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Nitrobenzene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
n-Nitrosodiethylamine	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
n-Nitrosodimethylamine (NDMA)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
n-Nitroso-di-n-butylamine	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
n-Nitrosodi-n-propylamine	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
n-Nitrosodiphenylamine	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
n-Nitrosomethylethylamine	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
n-Nitrosomorpholine	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
n-Nitrosopiperidine	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
n-Nitrosopyrrolidine	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
o-Toluidine	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Pentachlorobenzene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB06	59SB07	59SB08	59SB09	59SB11	59SB12
Sample ID	59SB01-00	59SB02-00	59SB03-00	59SB04-00	59SB06-00	59SB07-00	59SB08-00	59SB09-00	59SB11-00	59SB12-00
Sample Date	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	5/19/2010	5/18/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Semivolatile Organics (µg/kg) (cont.)										
Pentachloronitrobenzene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Pentachlorophenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ
Phenacetin	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Phenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ
Pronamide	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Pyridine	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Safrole	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
LLPAHs (µg/kg)										
2-Methylnaphthalene	1.2 J	11 UJ	9.1 UJ	31 J	9.2 UJ	9.8 UJ	9.8 U	9.5 UJ	9.5 UJ	9.2 UJ
Acenaphthene	12 U	0.82 J	9.1 U	360 R	9.2 U	9.8 U	9.8 U	1.5 J	9.5 UJ	9.2 UJ
Acenaphthylene	12 U	11 U	9.1 U	27	9.2 U	9.8 U	9.8 U	16	9.5 UJ	9.2 UJ
Anthracene	1.9 J	2.3 J	9.1 U	580 R	0.57 J	0.82 J	0.64 J	12	0.6 J	2.2 J
Fluoranthene	6.9 J	11	9.1 U	3300 R	1.8 J	9.8 U	3.1 J	68	2.3 J	16 J
Fluorene	0.82 J	0.73 J	9.1 U	430 R	9.2 U	9.8 U	9.8 U	1.1 J	9.5 UJ	0.63 J
Naphthalene	12 U	11 U	9.1 U	9.8 U	9.2 U	9.8 U	9.8 U	9.5 U	9.5 UJ	0.92 J
Phenanthrene	8.1 J	8.2 J	9.1 U	4500 R	1.5 J	9.8 U	3.4 J	28	9.5 UJ	9.2 UJ
Benzo(a)anthracene	3.9 J	5.8 J	0.91 J	940 R	1.8 J	0.72 J	1.4 J	46	1.1 J	9.6 J
Benzo(a)pyrene (BaP)	2.5 J	4.1 J	0.89 J	360 R	9.2 U	0.8 J	0.84 J	57	9.5 UJ	11 J
Benzo(b)fluoranthene	2.5 J	3.7 J	0.99 J	560 R	9.2 U	1.2 J	0.86 J	51	1.3 J	9.9 J
Benzo(g,h,i)perylene	2 J	2.5 J	9.1 UJ	200 R	1.3 J	1.5 J	9.8 UJ	53 J	0.53 J	9.2 UJ
Benzo(k)fluoranthene	2.6 J	5 J	1.2 J	750 R	9.2 UJ	0.78 J	0.91 J	62 J	0.75 J	9.8 J
Chrysene	3.7 J	3.9 J	0.77 J	760 R	1.4 J	0.78 J	1.4 J	39	1.4 J	9.9 J
Dibenz(a,h)anthracene	0.92 J	11 U	9.1 U	92	9.2 U	9.8 U	9.8 UJ	9.5 U	9.5 UJ	9.2 UJ
Indeno(1,2,3-cd)pyrene	3 J	3.6 J	9.1 UJ	300 R	1.8 J	9.8 UJ	9.8 UJ	65 J	9.5 UJ	9.2 UJ
Pyrene	6.5 J	8.3 J	1 J	2100 R	1.6 J	1.2 J	2.9 J	66	9.5 UJ	18 J
LLPAH Totals (µg/kg)										
Low molecular weight PAHs	54.92	56.05	72.8	67.8	49.87	69.42	56.14	145.6	59.9	56.55
High molecular weight PAHs	27.62	47.9	33.06	92	44.7	26.58	37.71	448.5	43.08	95.8

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB06	59SB07	59SB08	59SB09	59SB11	59SB12
Sample ID	59SB01-00	59SB02-00	59SB03-00	59SB04-00	59SB06-00	59SB07-00	59SB08-00	59SB09-00	59SB11-00	59SB12-00
Sample Date	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	5/19/2010	5/18/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Pesticides (µg/kg)										
4,4'-DDD	4.6 UJ	0.6 J	0.79 J	3.9 UJ	3.7 U	3.9 U	3.9 UJ	2.4 J	19 UJ	3.7 U
4,4'-DDE	4.6 UJ	0.48 J	4.5	3.9 UJ	0.46 J	0.67 J	3.9 UJ	53	19 UJ	3.7 U
4,4'-DDT	4.6 UJ	4.3 U	3.2 J	3.9 UJ	3.7 U	0.66 J	3.9 UJ	15	19 UJ	0.85 J
Aldrin	2.4 UJ	2.2 U	1.8 U	2 UJ	1.9 U	2 U	2 UJ	1.9 U	9.7 UJ	1.9 U
BHC, alpha-	2.4 UJ	2.2 U	1.8 U	2 UJ	1.9 U	2 U	2 UJ	1.9 U	9.7 UJ	1.9 U
BHC, beta-	2.4 UJ	2.2 U	0.47 J	2.4 R	1.9 U	0.57 J	2 UJ	1.9 U	4.8 UJ	0.95 U
BHC, delta-	2.4 UJ	2.2 U	1.8 U	2 UJ	1.9 U	2 U	2 UJ	1.9 U	9.7 UJ	1.9 U
BHC, gamma- (Lindane)	2.4 UJ	2.2 U	1.8 U	2 UJ	1.9 U	2 U	2 UJ	1.9 U	9.7 UJ	1.9 U
Chlordane, alpha-	2.4 UJ	2.2 U	1.2 J	1.1 J	1.9 U	1.2 J	2 UJ	1.9 U	1.3 NJ	0.25 J
Chlordane, gamma-	2.4 UJ	2.2 U	1.8 U	2 UJ	0.57 J	2 U	2 UJ	1.9 U	9.7 UJ	1.9 U
Chlorobenzilate	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Dieldrin	4.6 UJ	4.3 U	3.6 U	3.9 UJ	3.7 U	3.9 U	3.9 UJ	3.8 U	19 UJ	3.7 U
Endosulfan I	2.4 UJ	2.2 U	1.8 U	2 UJ	1.9 U	2 U	2 UJ	1.9 U	9.7 UJ	1.9 U
Endosulfan II	4.6 UJ	4.3 U	3.6 U	3.9 UJ	3.7 U	3.9 U	3.9 UJ	3.8 U	19 UJ	3.7 U
Endosulfan Sulfate	4.6 UJ	4.3 U	3.6 U	0.72 J	3.7 U	3.9 U	3.9 UJ	0.61 J	19 UJ	0.52 J
Endrin	4.6 UJ	4.3 U	3.6 U	3.9 UJ	3.7 U	3.9 U	3.9 UJ	3.8 U	19 UJ	3.7 U
Endrin Aldehyde	4.6 R	4.3 R	3.6 R	3.9 R	3.7 R	3.9 R	3.9 R	1.8 J	19 UJ	3.7 U
Heptachlor	2.4 UJ	2.2 U	1.8 U	2 UJ	1.9 U	2 U	2 UJ	1.9 U	9.7 UJ	1.9 U
Heptachlor Epoxide	2.4 UJ	2.2 U	1.8 U	2 UJ	1.9 U	2 U	2 UJ	1.9 U	9.7 UJ	1.9 U
Isodrin	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Kepone (Chlordecone)	240 UJ	220 UJ	190 UJ	200 UJ	190 UJ	200 UJ	200 UJ	200 UJ	200 R	190 R
Methoxychlor	24 UJ	22 U	18 U	20 UJ	19 U	20 U	20 UJ	19 U	26 NJ	19 U
Toxaphene	120 UJ	110 U	90 U	98 UJ	92 U	98 U	98 UJ	94 U	470 UJ	92 U

APPENDIX D

SURFACE SOIL ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB06	59SB07	59SB08	59SB09	59SB11	59SB12
Sample ID	59SB01-00	59SB02-00	59SB03-00	59SB04-00	59SB06-00	59SB07-00	59SB08-00	59SB09-00	59SB11-00	59SB12-00
Sample Date	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	5/19/2010	5/18/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Metals (mg/kg)										
Antimony	6.5 UJ	1.3 UJ	1.1 UJ	1.1 UJ	1.1 UJ	1.1 UJ	1.2 UJ	1.2 J	5.7 UJ	0.77 J
Arsenic	1.2	0.81	0.78	0.57 U	0.53 U	1.4	0.58 U	0.89	2.8 U	0.69
Barium	184 J	40.2 J	90.2 J	155 J	87.3 J	42.9 J	267 J	154 J	36.6	81.5
Beryllium	0.34 J	0.41 J	0.14 J	0.26 J	0.21 J	0.21 J	0.36 J	0.2 J	2.8 U	0.23 J
Cadmium	0.071 J	0.93	0.5 J	0.087 J	0.35 J	0.31 J	1.3	2	0.25 J	0.8
Chromium	31 J	41.9 J	24.3 J	5.3 J	41.6 J	40.7 J	19 J	45.6 J	25.9 J	15.7 J
Cobalt	10.4 J	27.1 J	25.9 J	18.4 J	20.2 J	26.4 J	19.2 J	26.9 J	25.5	14.1
Copper	96.8 J	84.7 J	106 J	24.8 J	91.7 J	126 J	41.5 J	237 J	107	81.3
Lead	17 J	31 J	51.3 J	3.4 J	10.5 J	27.3 J	2.6 J	654 J	8.7 J	47.4
Mercury	0.05	0.017 J	0.02 J	0.014 J	0.015 J	0.009 J	0.014 J	0.081	0.017 J	0.095
Nickel	6.1	13.5	22.3	7.9	14.1	26.8	11	27.5	11.7	12
Selenium	1 J	1.1 J	0.21 J	0.22 J	0.36 J	0.46 J	0.57 J	0.47 J	14.2 U	0.5 J
Silver	3.3 U	0.65 U	0.53 U	0.57 U	0.53 U	0.57 U	0.58 U	2.6	2.8 U	0.55 U
Thallium	3.3 U	0.65 U	0.53 U	0.57 U	0.53 U	0.57 U	0.58 U	0.56 U	2.8 U	0.032 J
Tin	3 J	5.7 J	6.3	3.8 J	3.8 J	5.6 J	3.3 J	36.5	5.7 U	8.5
Vanadium	260 J	226 J	118 J	91.7 J	132 J	157 J	72.8 J	191 J	169	84.3
Zinc	34.1 J	57 J	101 J	62.3 J	77.9 J	82.4 J	80.5 J	468 J	64.5	232

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Site ID	59SB13	59SB14	59SB15	59SB17	59SB18	59SB20	59SB21	59SB22	59SB23
Sample ID	59SB13-00	59SB14-00	59SB15-00	59SB17-00	59SB18-00	59SB20-00	59SB21-00	59SB22-00	59SB23-00
Sample Date	5/18/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Volatile Organics (µg/kg)									
1,1,1,2-Tetrachloroethane	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
1,1,1-Trichloroethane	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
1,1,2,2-Tetrachloroethane	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
1,1,2-Trichloroethane	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
1,1-Dichloroethane	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
1,1-Dichloroethene	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
1,2,3-Trichloropropane	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
1,2-Dibromo-3-chloropropane (DBCP)	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
1,2-Dibromoethane (EDB)	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
1,2-Dichloroethane	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
1,2-Dichloroethene (trans)	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
1,2-Dichloropropane	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
1,3-Dichloropropene (cis)	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
1,3-Dichloropropene (trans)	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
1,4-Dichloro-2-butene (trans)	19 U	18 U	18 U	18 U	17 U	16 U	18 U	16 U	18 U
1,4-Dioxane (p-)	240 R	230 R	230 R	220 R	210 R	200 R	220 R	200 R	220 R
2-Butanone (MEK)	12 U	11 U	11 U	11 U	11 U	10 U	11 U	10 U	11 U
2-Chloro-1,3-butadiene (Chloroprene)	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
2-Hexanone (MBK)	12 U	11 U	11 U	11 U	11 U	10 U	11 U	10 U	11 U
3-Chloropropene (Allyl Chloride)	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
4-Methyl-2-pentanone (MIBK)	12 U	11 U	11 U	11 U	11 U	10 U	11 U	10 U	11 U
Acetone	16 U	14 U	59 J	72	34	31	190	97	38
Acetonitrile	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Acrolein	47 R	45 R	46 R	45 R	42 R	41 R	45 R	40 R	44 R
Acrylonitrile	47 U	45 U	46 U	45 U	42 U	41 U	45 U	40 U	44 U
Benzene	4.7 U	4.5 U	0.73 J	4.5 U	0.53 J	4.1 U	4.5 U	4 U	4.4 U
Bromodichloromethane	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Bromoform	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Bromomethane	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	3.4 J
Carbon Disulfide	4.7 U	4.5 U	4.6 U	1 J	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Carbon Tetrachloride	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Chlorobenzene	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Chloroethane	4.7 U	4.5 UJ	4.6 UJ	4.5 UJ	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Chloroform	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Chloromethane	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	0.35 J	0.52 J	0.47 J
Dibromochloromethane	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB13	59SB14	59SB15	59SB17	59SB18	59SB20	59SB21	59SB22	59SB23
Sample ID	59SB13-00	59SB14-00	59SB15-00	59SB17-00	59SB18-00	59SB20-00	59SB21-00	59SB22-00	59SB23-00
Sample Date	5/18/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Volatile Organics (µg/kg) (cont.)									
Dibromomethane	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Ethyl Methacrylate	47 U	45 U	46 U	45 U	42 U	41 U	45 U	40 U	44 U
Ethylbenzene	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Freon 11 (Trichlorofluoromethane)	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Freon-12 (Dichlorodifluoromethane)	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Isobutyl Alcohol	240 R	230 R	230 R	220 R	210 R	200 R	220 R	200 R	220 R
Methyl Acrylonitrile	47 U	45 U	46 U	45 U	42 U	41 U	45 U	40 U	44 U
Methyl Iodide	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	2.6 J
Methyl Methacrylate	47 R	45 R	46 R	45 R	42 R	41 R	45 R	40 R	44 R
Methylene Chloride	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Pentachloroethane	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Propionitrile (Ethyl Cyanide)	240 R	230 R	230 R	220 R	210 R	200 R	220 R	200 R	220 R
Styrene (Ethenylbenzene)	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Tetrachloroethene (PCE)	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Toluene	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Trichloroethene (TCE)	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Vinyl Acetate	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 UJ	4.5 UJ	4 UJ	4.4 UJ
Vinyl Chloride	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Xylene, m/p-	9.5 U	9.1 U	9.2 U	8.9 U	8.4 U	8.1 U	8.9 U	8 U	8.8 U
Xylene, o-	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Xylenes, total	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U
Semivolatile Organics (µg/kg)									
1,2,4,5-Tetrachlorobenzene	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
1,2,4-Trichlorobenzene	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
1,2-Dichlorobenzene (o-)	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
1,3,5-Trinitrobenzene (TNB)	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
1,3-Dichlorobenzene (m-)	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
1,3-Dinitrobenzene (m-)	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
1,4-Dichlorobenzene (p-)	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
1,4-Naphthoquinone	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
1,4-Phenylenediamine	2100 R	2100 R	1900 R	2000 R	2000 R	1800 R	2000 R	2000 R	2100 R
1-Naphthylamine	210 UJ	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
2,2'-Oxybis[1-chloropropane]	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
2,3,4,6-Tetrachlorophenol	410 U	410 UJ	370 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U
2,4,5-Trichlorophenol	410 U	410 UJ	370 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB13	59SB14	59SB15	59SB17	59SB18	59SB20	59SB21	59SB22	59SB23
Sample ID	59SB13-00	59SB14-00	59SB15-00	59SB17-00	59SB18-00	59SB20-00	59SB21-00	59SB22-00	59SB23-00
Sample Date	5/18/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Semivolatile Organics (µg/kg) (cont.)									
2,4,6-Trichlorophenol	410 U	410 UJ	370 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U
2,4-Dichlorophenol	410 U	410 UJ	370 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U
2,4-Dimethylphenol	410 U	410 UJ	370 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U
2,4-Dinitrophenol	410 U	410 UJ	370 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U
2,4-Dinitrotoluene (DNT)	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
2,6-Dichlorophenol	410 U	410 UJ	370 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U
2,6-Dinitrotoluene (DNT)	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
2-Acetylaminofluorene	210 U	210 UJ	190 UJ	200 UJ	200 UJ	180 UJ	200 U	200 UJ	210 U
2-Chloronaphthalene	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
2-Chlorophenol	410 U	410 UJ	370 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U
2-Methyl-5-nitroaniline	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
2-Methylphenol (o-Cresol)	410 U	410 UJ	370 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U
2-Naphthylamine	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
2-Nitroaniline	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
2-Nitrophenol	410 U	410 UJ	370 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U
2-Picoline	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
3,3'-Dichlorobenzidine	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
3,3'-Dimethylbenzidine	210 U	210 UJ	190 UJ	200 UJ	200 UJ	180 UJ	200 U	200 UJ	210 U
3-Methylcholanthrene	210 U	210 UJ	190 UJ	200 UJ	200 UJ	180 UJ	200 U	200 UJ	210 U
3-Methylphenol (m-Cresol)	310 U	310 UJ	280 UJ	300 UJ	290 U	270 U	290 U	290 U	310 U
3-Nitroaniline	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
4,6-Dinitro-2-methylphenol	410 U	410 UJ	370 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U
4-Aminobiphenyl	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
4-Bromophenyl-phenylether	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
4-Chloro-3-methylphenol	410 U	410 UJ	370 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U
4-Chloroaniline	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
4-Chlorophenyl-phenylether	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
4-Dimethylaminoazobenzene (p-)	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
4-Methylphenol (p-Cresol)	310 U	310 UJ	280 UJ	300 UJ	290 U	270 U	290 U	290 U	310 U
4-Nitroaniline	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
4-Nitrophenol	410 U	410 UJ	370 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U
4-Nitroquinoline-1-oxide	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
7,12-Dimethylbenz(a)anthracene	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
a,a-Dimethylphenethylamine	590 U	580 UJ	520 UJ	560 UJ	540 UJ	510 UJ	540 U	550 UJ	590 U
Acetophenone	110 U	100 UJ	94 UJ	100 UJ	98 U	92 U	98 U	100 U	110 U
Aniline	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U

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Sample ID	59SB13-00	59SB14-00	59SB15-00	59SB17-00	59SB18-00	59SB20-00	59SB21-00	59SB22-00	59SB23-00
Sample Date	5/18/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Semivolatile Organics (µg/kg) (cont.)									
Aramite	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Benzyl Alcohol	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Bis(2-chloroethoxy)methane	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Bis(2-chloroethyl)ether	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Bis(2-ethylhexyl) Phthalate (BEHP)	210 U	210 UJ	470 J	200 UJ	200 U	180 U	200 U	200 U	53 J
Butyl Benzyl Phthalate	210 U	210 UJ	170 J	200 UJ	200 U	180 U	200 U	200 U	210 U
Diallate (cis)	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Diallate (trans)	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Dibenzofuran	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Diethyl Phthalate (DEP)	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Dimethyl Phthalate	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Di-n-butyl Phthalate (DBP)	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Di-n-octyl Phthalate	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Dinoseb	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Ethyl Methane Sulfonate (EMS)	210 UJ	210 UJ	190 UJ	200 UJ	200 UJ	180 UJ	200 UJ	200 UJ	210 UJ
Hexachloro-1,3-butadiene	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Hexachlorobenzene	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Hexachlorocyclopentadiene	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Hexachloroethane	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Hexachloropropene	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Isophorone	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Isosafrole	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Methapyrilene	210 R	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Methyl Methane Sulfonate	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Nitrobenzene	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
n-Nitrosodiethylamine	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
n-Nitrosodimethylamine (NDMA)	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
n-Nitroso-di-n-butylamine	210 UJ	210 UJ	190 UJ	200 UJ	200 UJ	180 UJ	200 UJ	200 UJ	210 UJ
n-Nitrosodi-n-propylamine	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
n-Nitrosodiphenylamine	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
n-Nitrosomethylethylamine	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
n-Nitrosomorpholine	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
n-Nitrosopiperidine	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
n-Nitrosopyrrolidine	210 U	210 UJ	190 UJ	200 UJ	200 UJ	180 UJ	200 U	200 UJ	210 U
o-Toluidine	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Pentachlorobenzene	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB13	59SB14	59SB15	59SB17	59SB18	59SB20	59SB21	59SB22	59SB23
Sample ID	59SB13-00	59SB14-00	59SB15-00	59SB17-00	59SB18-00	59SB20-00	59SB21-00	59SB22-00	59SB23-00
Sample Date	5/18/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Semivolatile Organics (µg/kg) (cont.)									
Pentachloronitrobenzene	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Pentachlorophenol	410 U	410 UJ	370 UJ	380 UJ	380 U	360 U	380 U	390 U	410 U
Phenacetin	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Phenol	410 U	410 UJ	370 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U
Pronamide	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Pyridine	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Safrole	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
LLPAHs (µg/kg)									
2-Methylnaphthalene	10 U	10 UJ	1.2 J	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Acenaphthene	10 U	10 UJ	9.2 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Acenaphthylene	10 U	10 UJ	1.7 J	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Anthracene	10 U	10 UJ	3.8 J	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Fluoranthene	10 U	10 UJ	15 J	9.9 UJ	1.8 J	9 U	9.5 U	9.8 U	4.6 J
Fluorene	10 U	10 UJ	9.2 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Naphthalene	10 U	1.4 J	2.2 J	1.2 J	9.5 U	9 U	9.5 U	9.8 U	10 U
Phenanthrene	10 U	10 UJ	9.2 UJ	9.9 UJ	9.5 U	9 U	1.7 J	9.8 U	10 U
Benzo(a)anthracene	10 U	10 UJ	22 J	0.87 J	9.5 U	9 U	9.5 U	9.8 U	10 U
Benzo(a)pyrene (BaP)	10 U	10 UJ	9.2 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Benzo(b)fluoranthene	10 U	10 UJ	9.2 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Benzo(g,h,i)perylene	10 U	10 UJ	9.2 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Benzo(k)fluoranthene	10 U	10 UJ	9.2 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Chrysene	10 U	10 UJ	32 J	1.2 J	1.5 J	9 U	9.5 U	9.8 U	2.3 J
Dibenz(a,h)anthracene	10 U	10 UJ	9.2 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Indeno(1,2,3-cd)pyrene	10 U	10 UJ	9.2 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U
Pyrene	10 U	10 UJ	81 J	9.9 UJ	2.1 J	3.2 J	9.5 U	9.8 U	3.5 J
LLPAH Totals (µg/kg)									
Low molecular weight PAHs	80	71.4	51.5	70.5	68.3	72	68.2	78.4	74.6
High molecular weight PAHs	90	90	190.2	71.37	70.1	75.2	85.5	88.2	75.8

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB13	59SB14	59SB15	59SB17	59SB18	59SB20	59SB21	59SB22	59SB23
Sample ID	59SB13-00	59SB14-00	59SB15-00	59SB17-00	59SB18-00	59SB20-00	59SB21-00	59SB22-00	59SB23-00
Sample Date	5/18/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Pesticides (µg/kg)									
4,4'-DDD	4.1 UJ	4.1 U	8.1 J	3.9 U	3.8 U	3.6 U	3.8 U	3.9 U	4.1 U
4,4'-DDE	4.1 UJ	4.1 U	160	1.2 J	12	3.6 U	3.8 U	3.4 J	1.6 J
4,4'-DDT	4.1 UJ	4.1 U	160	1.7 J	2.7 J	3.6 U	3.8 U	1.2 J	2.3 J
Aldrin	2.1 UJ	2.1 U	19 U	2 U	2 U	1.8 U	2 U	2 U	2.1 U
BHC, alpha-	2.1 UJ	2.1 U	19 U	2 U	2 U	1.8 U	2 U	2 U	2.1 U
BHC, beta-	0.63 NJ	1.1 U	8.6 NJ	9.2 NJ	2 U	1.8 U	2 U	2 U	2.1 U
BHC, delta-	2.1 UJ	2.1 U	19 U	2 U	2 U	1.8 U	2 U	2 U	2.1 U
BHC, gamma- (Lindane)	2.1 UJ	2.1 U	19 U	2 U	2 U	1.8 U	2 U	2 U	2.1 U
Chlordane, alpha-	2.1 UJ	2.1 U	19 U	2 U	2 U	1.8 U	2 U	1.9 J	1.1 J
Chlordane, gamma-	2.1 UJ	2.1 U	3.5 J	2 U	2 U	1.8 U	2 U	2 U	2.1 U
Chlorobenzilate	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Dieldrin	4.1 UJ	4.1 U	37 U	3.9 U	3.8 U	3.6 U	3.8 U	3.9 U	4.1 U
Endosulfan I	2.1 UJ	2.1 U	19 U	2 U	2 U	1.8 U	2 U	2 U	2.1 U
Endosulfan II	4.1 UJ	4.1 U	37 U	3.9 U	3.8 U	3.6 U	3.8 U	3.9 U	4.1 U
Endosulfan Sulfate	4.1 UJ	4.1 U	37 U	3.9 U	3.8 U	3.6 U	3.8 U	3.9 U	4.1 U
Endrin	4.1 UJ	4.1 U	37 U	3.9 U	3.8 U	3.6 U	3.8 U	3.9 U	4.1 U
Endrin Aldehyde	4.1 UJ	4.1 U	37 U	3.9 U	3.8 U	3.6 U	3.8 U	3.9 U	4.1 U
Heptachlor	2.1 UJ	2.1 U	19 U	2 U	2 U	1.8 U	2 U	2 U	2.1 U
Heptachlor Epoxide	2.1 UJ	2.1 U	19 U	2 U	2 U	1.8 U	2 U	2 U	2.1 U
Isodrin	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U
Kepone (Chlordecone)	210 U	210 R	1900 R	200 R	200 UJ	180 UJ	200 UJ	200 UJ	210 U
Methoxychlor	21 UJ	21 U	190 U	20 U	20 U	18 U	20 U	20 U	21 U
Toxaphene	100 UJ	100 U	920 U	99 U	95 U	90 U	95 U	98 U	100 U

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB13	59SB14	59SB15	59SB17	59SB18	59SB20	59SB21	59SB22	59SB23
Sample ID	59SB13-00	59SB14-00	59SB15-00	59SB17-00	59SB18-00	59SB20-00	59SB21-00	59SB22-00	59SB23-00
Sample Date	5/18/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Metals (mg/kg)									
Antimony	0.29 J	5.9 UJ	8.5 J	5.7 UJ	0.17 J	0.88 J	5.6 UJ	5.7 UJ	0.17 J
Arsenic	0.63 U	2.9 U	5.5	2.9 U	0.29 J	2.5 U	2.8 U	2.9 U	0.71
Barium	33.4	122	145	86.7	48	104	102	107	81.6
Beryllium	0.23 J	2.9 U	0.31 J	0.29 J	0.15 J	0.62 J	0.27 J	2.9 U	0.19 J
Cadmium	0.15 J	0.34 J	2.6	0.33 J	0.26 J	0.64 J	0.26 J	0.42 J	0.35 J
Chromium	7.4	45.7 J	32.5 J	30 J	19.6	54.4	29.4	29.5	51.2
Cobalt	20.2 J	45.2	15.6	23.3	15.2 J	30.2 J	18.3 J	21.2 J	29 J
Copper	94.9 J	291	120	76.3	59.5 J	94.2 J	102 J	76.6 J	73.9 J
Lead	5.2	3.5	638	22.4	7.1	3.6	15.1	16.7	11.8
Mercury	0.041 U	0.041 U	0.053	0.026 J	0.038 U	0.01 J	0.009 J	0.011 J	0.041 U
Nickel	6.6	20.7	13.1	12.5	10.3	22.2	13.9	16.1	22.2
Selenium	0.27 J	14.7 U	0.61 J	0.86 J	0.34 J	2.4 J	13.9 U	14.3 U	0.46 J
Silver	0.093 J	2.9 U	0.55 U	2.9 U	0.1 J	0.48 J	2.8 U	2.9 U	0.14 J
Thallium	0.05 J	2.9 U	0.065 J	2.9 U	0.032 J	0.37 J	2.8 U	2.9 U	0.027 J
Tin	6.3 UJ	5.9 U	10.5	6	5.6 UJ	5.1 UJ	5.6 UJ	5.7 UJ	6.2 UJ
Vanadium	129 J	249	94.9	184	102 J	109 J	107 J	126 J	115 J
Zinc	58.6	123	747	132	59.9	81.5	87.7	77.4	52

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SURFACE SOIL ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Notes:

J - Estimated: The analyte was positively identified; the quantitation is an estimation.
U - Non detected at the Reporting Limit
UJ - Reported quantitation limit is qualified as estimated.
NJ - Analyte has been tentatively identified.; the quantitation is an estimation.
R - Rejected data; data is not usable
ft bgs - feet below ground surface
LLPAHs - Low Level Polynuclear Aromatic Hydrocarbons
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram

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SURFACE SOIL ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT, 2012 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB24-00	59SB25-00	59SB26-00	59SB27-00	59SB28-00	59SB29-00	59SB30-00	59SB31-00	59SB32-00	59SB33-00
Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Depth Range (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Volatile Organics (µg/kg)										
1,1,1,2-Tetrachloroethane	2.5 U	2.3 U	2.3 U	2.4 U	2.1 U	1.7 U	1.9 U	2.2 U	2.6 U	2.4 U
1,1,1-Trichloroethane	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
1,1,2,2-Tetrachloroethane	1.6 U	1.6 U	1.5 U	1.6 U	1.4 U	1.1 U	1.3 U	1.4 U	1.7 U	1.6 U
1,1,2-Trichloroethane	1.3 U	1.3 U	1.2 U	1.3 U	1.1 U	0.93 U	1 U	1.2 U	1.4 U	1.3 U
1,1-Dichloroethane	1.1 U	1.1 U	1 U	1.1 U	0.97 U	0.79 U	0.88 U	0.99 U	1.2 U	1.1 U
1,1-Dichloroethene	1.5 U	1.5 U	1.4 U	1.5 U	1.3 U	1.1 U	1.2 U	1.3 U	1.6 U	1.5 U
1,2,3-Trichloropropane	2.5 U	2.3 U	2.3 U	2.4 U	2.1 U	1.7 U	1.9 U	2.2 U	2.6 U	2.4 U
1,2,4-Trichlorobenzene	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
1,2-Dibromo-3-Chloropropane	4.5 U	4.3 U	4.2 U	4.4 U	3.9 U	3.1 U	3.5 U	4 U	4.7 U	4.4 U
1,2-Dibromoethane	1.5 U	1.5 U	1.4 U	1.5 U	1.3 U	1.1 U	1.2 U	1.3 U	1.6 U	1.5 U
1,2-Dichlorobenzene	1.3 U	1.3 U	1.2 U	1.3 U	1.1 U	0.93 U	1 U	1.2 U	1.4 U	1.3 U
1,2-Dichloroethane	1.1 U	1.1 U	1 U	1.1 U	0.97 U	0.79 U	0.88 U	0.99 U	1.2 U	1.1 U
1,2-Dichloropropane	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
1,3-Dichlorobenzene	1.6 U	1.6 U	1.5 U	1.6 U	1.4 U	1.1 U	1.3 U	1.4 U	1.7 U	1.6 U
1,4-Dichlorobenzene	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
1,4-Dioxane	51 R	48 R	48 R	49 R	44 R	36 R	40 R	45 R	53 R	50 R
2-Butanone	2.5 U	2.3 U	2.3 U	2.4 U	2.1 U	1.7 U	1.9 U	2.2 U	2.6 U	2.4 U
2-Hexanone	3.4 U	3.2 U	3.1 U	3.3 U	2.9 U	2.4 U	2.7 U	3 U	3.5 U	3.3 U
4-Methyl-2-pentanone	4.3 U	4.1 U	4 U	4.2 U	3.7 U	3 U	3.4 U	3.8 U	4.5 U	4.2 U
Acetone	11 UJ	27 J	10 U	11 U	9.7 U	7.9 U	15 J	30 J	45 J	11 U
Acetonitrile	42 U	40 UJ	39 UJ	41 UJ	36 UJ	29 UJ	33 U	37 UJ	44 UJ	41 U
Acrolein	25 U	23 UJ	23 UJ	24 UJ	21 UJ	17 UJ	19 U	22 UJ	26 UJ	24 U
Acrylonitrile	35 U	33 UJ	32 UJ	34 UJ	30 UJ	24 UJ	27 U	31 UJ	36 UJ	34 U
Allyl chloride	2.3 U	2.1 U	2.1 U	2.2 U	1.9 U	1.6 U	1.8 U	2 U	2.4 U	2.2 U
Benzene	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
Bromodichloromethane	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
Bromoform	1.5 U	1.5 U	1.4 U	1.5 U	1.3 U	1.1 U	1.2 U	1.3 U	1.6 U	1.5 U
Bromomethane	1.5 U	1.5 U	1.4 U	1.5 U	1.3 U	1.1 U	1.2 U	1.3 U	1.6 U	1.5 U
Carbon disulfide	1.1 U	1.1 U	1 U	1.1 U	0.97 U	0.79 U	0.88 U	0.99 U	1.2 U	1.1 U
Carbon tetrachloride	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
Chlorobenzene	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
Chloroethane	2.8 U	2.6 U	2.6 U	2.7 U	2.4 U	1.9 U	2.2 U	2.4 U	2.9 U	2.7 U
Chloroform	1.1 U	1.1 U	1 U	1.1 U	0.97 U	0.79 U	0.88 U	0.99 U	1.2 U	1.1 U
Chloromethane	2.1 U	1.9 U	1.9 U	2 U	1.8 U	1.4 U	1.6 U	1.8 U	2.1 U	2 U
Chloroprene	2.2 U	2 U	2 U	2.1 U	1.8 U	1.5 U	1.7 U	1.9 U	2.2 U	2.1 U
cis-1,3-Dichloropropene	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U

APPENDIX D

SURFACE SOIL ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT, 2012 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB24-00	59SB25-00	59SB26-00	59SB27-00	59SB28-00	59SB29-00	59SB30-00	59SB31-00	59SB32-00	59SB33-00
Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Depth Range (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Volatile Organics (µg/kg) (cont.)										
Dibromochloromethane	1.8 U	1.6 U	1.6 U	1.7 U	1.5 U	1.2 U	1.4 U	1.5 U	1.8 U	1.7 U
Dibromomethane	1.8 U	1.6 U	1.6 U	1.7 U	1.5 U	1.2 U	1.4 U	1.5 U	1.8 U	1.7 U
Dichlorodifluoromethane	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
Ethyl methacrylate	3.5 U	3.3 U	3.2 U	3.4 U	3 U	2.4 U	2.7 U	3.1 U	3.6 U	3.4 U
Ethylbenzene	1.3 U	1.3 U	1.2 U	1.3 U	1.1 U	0.93 U	1 U	1.2 U	1.4 U	1.3 U
Hexachlorobutadiene	3.2 U	3 U	3 U	3.1 U	2.7 U	2.2 U	2.5 U	2.8 U	3.3 U	3.1 U
Iodomethane	1.9 U	1.7 UJ	1.7 UJ	1.8 UJ	1.6 UJ	1.3 UJ	1.4 U	1.6 UJ	1.9 UJ	1.8 U
Isobutanol	54 R	50 R	50 R	51 R	46 R	37 R	42 R	47 R	56 R	52 R
Methacrylonitrile	24 U	22 UJ	22 UJ	23 UJ	20 UJ	16 UJ	18 U	21 UJ	25 UJ	23 U
Methyl methacrylate	4.6 U	4.4 U	4.3 U	4.5 U	4 U	3.2 U	3.6 U	4 U	4.8 U	4.5 U
Methylene Chloride	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
Naphthalene	1.9 R	1.2 R	1.1 R	1.2 R	1.1 R	0.86 R	0.96 R	1.1 R	1.3 R	1.2 R
Pentachloroethane	6.5 U	6.1 U	6 U	6.2 U	5.5 U	4.5 U	5.1 U	5.7 U	6.7 U	6.3 U
Propionitrile	27 U	25 UJ	25 UJ	26 UJ	23 UJ	19 UJ	21 U	23 UJ	28 UJ	26 U
Styrene	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
Tetrachloroethene	2 U	1.8 U	1.8 U	1.9 U	1.7 U	1.4 U	1.5 U	1.7 U	2 U	1.9 U
Toluene	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
trans-1,2-Dichloroethene	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
trans-1,3-Dichloropropene	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
trans-1,4-Dichloro-2-butene	3 U	2.8 U	2.8 U	2.9 U	2.5 U	2.1 U	2.3 U	2.6 U	3.1 U	2.9 U
Trichloroethene	1.3 U	1.3 U	1.2 U	1.3 U	1.1 U	0.93 U	1 U	1.2 U	1.4 U	1.3 U
Trichlorofluoromethane	1.2 U	1.2 U	1.1 U	1.2 U	1.1 U	0.86 U	0.96 U	1.1 U	1.3 U	1.2 U
Vinyl acetate	2.6 U	2.4 U	2.4 U	2.5 U	2.2 U	1.8 U	2 U	2.2 U	2.7 U	2.5 U
Vinyl chloride	1.5 U	1.5 U	1.4 U	1.5 U	1.3 U	1.1 U	1.2 U	1.3 U	1.6 U	1.5 U
Xylenes, Total	1.1 U	1.1 U	1 U	1.1 U	0.97 U	0.79 U	0.88 U	0.99 U	1.2 U	1.1 U
Semivolatile Organics (µg/kg)										
1,2,4,5-Tetrachlorobenzene	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
1,2,4-Trichlorobenzene	6.1 U	6.1 U	5.7 U	64 U	26 U	27 U	27 U	5.9 U	6.4 U	6.2 U
1,2-Dichlorobenzene	8.7 U	8.7 U	8.2 U	92 U	37 U	39 U	39 U	8.5 U	9.1 U	8.8 U
1,3,5-Trinitrobenzene	22 U	22 U	21 U	240 UJ	96 UJ	100 UJ	100 UJ	22 U	24 U	23 UJ
1,3-Dichlorobenzene	7.4 U	7.4 U	7 U	78 U	32 U	33 U	33 U	7.2 U	7.8 U	7.5 U
1,3-Dinitrobenzene	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
1,4-Dichlorobenzene	6.8 U	6.9 U	6.5 U	73 U	29 U	31 U	31 U	6.7 U	7.2 U	7 U
1,4-Dioxane	8.8 U	8.8 U	8.3 U	93 U	38 U	40 U	39 U	8.6 U	9.3 U	9 U
1,4-Naphthoquinone	4.3 UJ	4.4 UJ	4.1 UJ	46 UJ	19 UJ	20 UJ	19 UJ	4.3 UJ	4.6 UJ	4.4 UJ

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SURFACE SOIL ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT, 2012 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB24-00	59SB25-00	59SB26-00	59SB27-00	59SB28-00	59SB29-00	59SB30-00	59SB31-00	59SB32-00	59SB33-00
Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Depth Range (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Semivolatile Organics (µg/kg) (cont.)										
1-Naphthylamine	22 UJ	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 UJ
2,2'-oxybis[1-chloropropane]	9.5 U	9.5 U	9 U	100 U	41 U	43 U	42 U	9.3 U	10 U	9.6 U
2,3,4,6-Tetrachlorophenol	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
2,4,5-Trichlorophenol	10 U	10 U	9.5 U	110 U	43 U	45 U	45 U	9.8 U	11 U	10 U
2,4,6-Trichlorophenol	10 U	10 U	9.8 U	110 U	44 U	47 U	47 U	10 U	11 U	11 U
2,4-Dichlorophenol	9.5 U	9.5 U	9 U	100 U	41 U	43 U	42 U	9.3 U	10 U	9.6 U
2,4-Dimethylphenol	10 U	10 U	9.5 U	110 U	43 U	45 U	45 U	9.8 U	11 U	10 U
2,4-Dinitrophenol	55 U	55 U	52 U	590 UJ	240 UJ	250 UJ	250 UJ	54 U	58 U	56 UJ
2,4-Dinitrotoluene	9.9 U	9.9 U	9.3 U	100 U	42 U	44 U	44 U	9.7 U	10 U	10 U
2,6-Dichlorophenol	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
2,6-Dinitrotoluene	10 U	10 U	9.8 U	110 U	44 U	47 U	47 U	10 U	11 U	11 U
2-Acetylaminofluorene	43 U	44 U	41 U	460 U	190 U	200 U	190 U	43 U	46 U	44 U
2-Chloronaphthalene	7.9 U	7.9 U	7.5 U	84 U	34 U	36 U	35 U	7.7 U	8.3 U	8 U
2-Chlorophenol	7 U	7 U	6.6 U	74 U	30 U	31 U	31 U	6.8 U	7.3 U	7.1 U
2-Methylphenol	8.3 U	8.3 U	7.8 U	88 U	35 U	37 U	37 U	8.1 U	8.7 U	8.4 U
2-Naphthylamine	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
2-Nitroaniline	9.2 U	9.2 U	8.7 U	98 U	39 U	41 U	41 U	9 U	9.7 U	9.4 U
2-Nitrophenol	7.6 U	7.7 U	7.2 U	81 U	33 U	34 U	34 U	7.5 U	8 U	7.8 U
2-Picoline	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
2-Toluidine	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
3 & 4 Methylphenol	9.6 U	9.6 U	9.1 U	100 U	41 U	43 U	43 U	9.4 U	10 U	9.8 U
3,3'-Dichlorobenzidine	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
3,3'-Dimethylbenzidine	87 U	87 U	82 U	920 UJ	370 UJ	390 UJ	390 UJ	85 U	91 U	88 UJ
3-Methylcholanthrene	43 U	44 U	41 U	460 U	190 U	200 U	190 U	43 U	46 U	44 U
3-Nitroaniline	8.8 U	8.8 U	8.3 U	93 U	38 U	40 U	39 U	8.6 U	9.3 U	9 U
4,6-Dinitro-2-methylphenol	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
4-Aminobiphenyl	22 UJ	22 UJ	21 UJ	240 U	96 U	100 U	100 U	22 UJ	24 UJ	23 U
4-Bromophenyl phenyl ether	9.1 U	9.1 U	8.6 U	96 U	39 U	41 U	41 U	8.9 U	9.6 U	9.2 U
4-Chloro-3-methylphenol	9.2 U	9.2 U	8.7 U	98 U	39 U	41 U	41 U	9 U	9.7 U	9.4 U
4-Chloroaniline	6.8 U	6.9 U	6.5 U	73 U	29 U	31 U	31 U	6.7 U	7.2 U	7 U
4-Chlorophenyl phenyl ether	8.4 U	8.5 U	8 U	89 U	36 U	38 U	38 U	8.3 U	8.9 U	8.6 U
4-Nitroaniline	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
4-Nitrophenol	96 U	96 U	91 U	1000 U	410 U	430 U	430 U	94 U	100 U	98 U
4-Nitroquinoline-1-oxide	55 U	55 U	52 U	590 U	240 U	250 U	250 U	54 U	58 U	56 U
7,12-Dimethylbenz(a)anthracene	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
Acetophenone	9 U	9 U	8.5 U	95 U	38 U	40 U	40 U	8.8 U	9.4 U	9.1 U

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB24-00	59SB25-00	59SB26-00	59SB27-00	59SB28-00	59SB29-00	59SB30-00	59SB31-00	59SB32-00	59SB33-00
Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Depth Range (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Semivolatile Organics (µg/kg) (cont.)										
alpha,alpha-Dimethyl phenethylamine	430 UJ	440 UJ	410 UJ	4600 UJ	1900 UJ	2000 UJ	1900 UJ	430 UJ	460 UJ	440 UJ
Aniline	11 U	11 U	10 U	110 U	46 U	49 U	48 U	11 U	11 U	11 U
Aramite, Total	6.3 U	6.3 U	6 U	67 U	27 U	28 U	28 U	6.2 U	6.6 U	6.4 U
Benzyl alcohol	8 U	8.1 U	7.6 U	85 U	34 U	36 U	36 U	7.9 U	8.4 U	8.2 U
Bis(2-chloroethoxy)methane	8.6 U	8.6 U	8.1 U	91 U	37 U	38 U	38 U	8.4 U	9 U	8.7 U
Bis(2-chloroethyl)ether	8.6 U	8.6 U	8.1 U	91 U	37 U	38 U	38 U	8.4 U	9 U	8.7 U
Bis(2-ethylhexyl) phthalate	43 J	78 J	7.5 U	84 U	34 U	36 U	35 J	11 J	8.3 U	19 J
Butyl benzyl phthalate	8.8 U	8.8 U	8.3 U	93 U	38 U	40 U	39 U	8.6 U	9.3 U	9 U
Diallate	7.4 U	7.4 U	7 U	78 U	32 U	33 U	33 U	7.2 U	7.8 U	7.5 U
Dibenzofuran	8.8 U	8.8 U	8.3 U	93 U	38 U	40 U	39 U	8.6 U	9.3 U	9 U
Diethyl phthalate	9.7 U	9.8 U	9.2 U	100 U	42 U	44 U	44 U	9.5 U	10 U	9.9 U
Dimethyl phthalate	9.9 U	9.9 U	9.3 U	100 U	42 U	44 U	44 U	9.7 U	10 U	10 U
Di-n-butyl phthalate	22 U	22 U	21 U	240 U	96 U	100 U	100 UJ	22 U	24 U	23 U
Di-n-octyl phthalate	8.8 U	8.8 U	8.3 U	93 U	38 U	40 U	39 U	8.6 U	9.3 U	9 U
Dinoseb	8.8 U	8.8 U	8.3 U	93 UJ	38 UJ	40 UJ	39 UJ	8.6 U	9.3 U	9 UJ
Ethyl methanesulfonate	10 U	10 U	9.7 U	110 U	44 U	46 U	46 U	10 U	11 U	10 U
Hexachlorobenzene	10 U	10 U	9.5 U	110 U	43 U	45 U	45 U	9.8 U	11 U	10 U
Hexachlorobutadiene	9 U	9 U	8.5 U	95 U	38 U	40 U	40 U	8.8 U	9.4 U	9.1 U
Hexachlorocyclopentadiene	4.9 U	4.9 U	4.6 U	52 U	21 U	22 U	22 U	4.8 U	5.1 U	5 U
Hexachloroethane	7.6 U	7.7 U	7.2 U	81 U	33 U	34 U	34 U	7.5 U	8 U	7.8 U
Hexachlorophene	3200 UJ	3200 U	3000 U	33000 UJ	14000 UJ	14000 UJ	14000 UJ	3100 U	3300 U	3200 UJ
Hexachloropropene	7 U	7 U	6.6 U	74 U	30 U	31 U	31 U	6.8 U	7.3 U	7.1 U
Isophorone	9.2 U	9.2 U	8.7 U	98 U	39 U	41 U	41 U	9 U	9.7 U	9.4 U
Isosafrole	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
Methapyrilene	88 UJ	88 UJ	83 UJ	930 UJ	380 UJ	400 UJ	390 UJ	86 UJ	93 UJ	90 UJ
Methyl methanesulfonate	5 UJ	5 UJ	4.7 UJ	53 UJ	21 UJ	22 UJ	22 UJ	4.9 UJ	5.3 UJ	5.1 UJ
Nitrobenzene	8.7 U	8.7 U	8.2 U	92 U	37 U	39 U	39 U	8.5 U	9.1 U	8.8 U
N-Nitro-o-toluidine	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
N-Nitrosodiethylamine	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
N-Nitrosodimethylamine	25 U	25 U	24 U	270 U	110 U	110 U	110 U	25 U	26 U	25 U
N-Nitrosodi-n-butylamine	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
N-Nitrosodi-n-propylamine	9.9 U	9.9 U	9.3 U	100 U	42 U	44 U	44 U	9.7 U	10 U	10 U
N-Nitrosodiphenylamine	8 U	8.1 U	7.6 U	85 U	34 U	36 U	36 U	7.9 U	8.4 U	8.2 U
N-Nitrosomethylethylamine	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
N-Nitrosomorpholine	5.9 U	5.9 U	5.6 U	63 U	25 U	27 U	27 U	5.8 U	6.2 U	6 U
N-Nitrosopiperidine	4.5 U	4.5 U	4.2 U	47 U	19 U	20 U	20 U	4.4 U	4.7 U	4.6 U

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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB24-00	59SB25-00	59SB26-00	59SB27-00	59SB28-00	59SB29-00	59SB30-00	59SB31-00	59SB32-00	59SB33-00
Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Depth Range (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Semivolatile Organics (µg/kg) (cont.)										
N-Nitrosopyrrolidine	4.7 U	4.8 U	4.5 U	50 U	20 U	21 U	21 U	4.6 U	5 U	4.8 U
p-Dimethylamino azobenzene	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
Pentachlorobenzene	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
Pentachloronitrobenzene	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
Pentachlorophenol	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
Phenacetin	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
Phenol	8.6 U	8.6 U	8.1 U	91 U	37 U	38 U	38 U	8.4 U	9 U	8.7 U
p-Phenylene diamine	1100 UJ	1100 U	1000 U	12000 UJ	4700 UJ	4900 UJ	4900 UJ	1100 U	1100 U	1100 UJ
Pronamide	5.5 U	5.5 U	5.2 U	59 U	24 U	25 U	25 U	5.4 U	5.8 U	5.6 U
Pyridine	26 U	26 U	25 U	280 U	110 U	120 U	120 U	26 U	28 U	27 U
Safrole, Total	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
LLPAHs (µg/kg)										
2-Methylnaphthalene	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	6.4 J	4.6 U	4.4 U
Acenaphthene	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
Acenaphthylene	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
Anthracene	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 UJ	4.3 U	4.6 U	4.4 U
Benzo[a]anthracene	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
Benzo[a]pyrene	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 UJ	4.3 U	4.6 U	4.4 U
Benzo[b]fluoranthene	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 UJ	4.3 U	4.6 U	4.4 U
Benzo[g,h,i]perylene	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 UJ	4.3 U	4.6 U	4.4 U
Benzo[k]fluoranthene	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 UJ	4.3 U	4.6 U	4.4 U
Chrysene	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
Dibenz(a,h)anthracene	8.8 U	8.8 U	8.3 U	93 U	38 U	40 U	39 UJ	8.6 U	9.3 U	9 U
Fluoranthene	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 UJ	4.3 U	4.6 U	4.4 U
Fluorene	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
Indeno[1,2,3-cd]pyrene	4.3 U	4.4 U	4.1 U	46 UJ	19 UJ	20 UJ	19 UJ	4.3 U	4.6 U	4.4 UJ
Naphthalene	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
Phenanthrene	8.8 U	8.8 U	8.3 U	93 U	38 U	40 U	39 UJ	6 J	9.3 U	9 U
Pyrene	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
LLPAH Totals (µg/kg)										
Low Molecular Weight PAHs	38.9	39.6	37	415	171	180	172	38.2	41.5	39.8
High Molecular Weight PAHs	43.2	44	41.1	461	190	200	191	43	46.1	44.2

APPENDIX D

SURFACE SOIL ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT, 2012 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB24-00	59SB25-00	59SB26-00	59SB27-00	59SB28-00	59SB29-00	59SB30-00	59SB31-00	59SB32-00	59SB33-00
Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Depth Range (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Metals (mg/kg)										
Antimony	0.65 U	0.64 U	0.62 U	0.69 U	0.57 U	0.6 U	0.59 U	0.64 U	0.69 U	0.66 U
Arsenic	1.8	1.3	0.69	0.84	0.46	0.9	1	0.82	1.7	1.4
Barium	210 J	160	110	100	24	160	130	99	91	130
Beryllium	0.63 J	0.28	0.38	0.097	0.11	0.22	0.26	0.37	0.33	0.18
Cadmium	0.16	0.47	0.075	0.1	0.062	0.11	0.071	0.11	0.047 J	0.12
Chromium	91	61	47	71	33	36	32	51	73	150
Cobalt	27 J	25 J	36 J	22 J	14 J	15 J	17 J	19 J	6 J	20 J
Copper	260 J	71	100	50	66	130	83	99	120	110
Lead	12 R	12 R	3 R	1.4 R	1.8 R	2.7 R	4.4 R	3.2 R	6.9 R	4.7 R
Mercury	0.011 U	0.069	0.0098 U	0.011 U	0.0093 U	0.014 J	0.017 J	0.01 U	0.038	0.012 U
Nickel	33 J	30	30	33	17	17	16	23	15	47
Selenium	0.32 U	0.74	0.31 U	0.35 U	0.29 U	0.3 U	0.47 J	0.32 U	1.2	0.33 U
Silver	0.088 J	0.15	0.062 U	0.069 U	0.057 U	0.06 U	0.059 U	0.064 U	0.35	0.066 U
Thallium	0.039 J	0.043 J	0.031 U	0.035 U	0.029 U	0.03 U	0.073 J	0.032 U	0.035 U	0.033 U
Tin	8.3 J	3.3 U	3.1 U	3.5 U	2.9 U	3 U	3 U	3.3 U	3.5 U	3.4 U
Vanadium	280 J	180	140	230	110	140	170	240	240	330
Zinc	100 J	73	76	42	44	68	50	78	46	57

Notes:

J - Estimated: The analyte was positively identified; the quantitation is an estimation.
U - Non detected at the Limit of Detection.
UJ - Reported quantitation limit is qualified as estimated.
R - Rejected data; data is not usable
ft bgs - feet below ground surface
LLPAHs - Low Level Polynuclear Aromatic Hydrocarbons
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram

APPENDIX D

SUBSURFACE SOIL ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB05	59SB06	59SB07	59SB08	59SB09	59SB10	59SB11
Sample ID	59SB01-01	59SB02-01	59SB03-01	59SB04-01	59SB05-01	59SB06-01	59SB07-01	59SB08-01	59SB09-01	59SB10-01	59SB11-01
Sample Date	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	4/21/2010	5/19/2010
Sample Depth (ft bgs)	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0
Volatile Organics (µg/kg)											
1,1,1,2-Tetrachloroethane	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
1,1,1-Trichloroethane	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
1,1,2,2-Tetrachloroethane	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
1,1,2-Trichloroethane	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
1,1-Dichloroethane	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
1,1-Dichloroethene	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
1,2,3-Trichloropropane	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
1,2-Dibromo-3-chloropropane (DBCP)	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
1,2-Dibromoethane (EDB)	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
1,2-Dichloroethane	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
1,2-Dichloroethene (trans)	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
1,2-Dichloropropane	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
1,3-Dichloropropene (cis)	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
1,3-Dichloropropene (trans)	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
1,4-Dichloro-2-butene (trans)	21 U	21 UJ	20 U	22 U	15 UJ	18 UJ	18 UJ	15 UJ	16 UJ	19 UJ	16 U
1,4-Dioxane (p-)	270 R	260 R	250 R	280 R	190 R	220 R	230 R	190 R	200 R	240 R	200 R
2-Butanone (MEK)	13 U	13 U	12 U	14 UJ	9.6 U	11 U	11 U	9.4 U	10 U	12 U	10 U
2-Chloro-1,3-butadiene (Chloroprene)	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
2-Hexanone (MBK)	13 U	13 UJ	12 U	14 UJ	9.6 UJ	11 UJ	11 UJ	9.4 UJ	10 UJ	12 UJ	10 U
3-Chloropropene (Allyl Chloride)	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
4-Methyl-2-pentanone (MIBK)	13 U	13 U	12 U	14 UJ	9.6 U	11 U	11 U	9.4 U	10 U	12 U	10 U
Acetone	13 U	150	12 U	25 UJ	9.6 U	11 U	11 U	9.4 U	26	12 U	11 U
Acetonitrile	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
Acrolein	54 R	52 R	50 R	55 R	38 R	44 R	46 R	38 R	41 R	47 R	40 R
Acrylonitrile	54 U	52 U	50 U	55 U	38 U	44 U	46 U	38 U	41 U	47 U	40 U
Benzene	5.4 U	0.4 J	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
Bromodichloromethane	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
Bromoform	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
Bromomethane	5.4 U	1.4 J	5 U	5.5 UJ	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	1.2 J
Carbon Disulfide	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
Carbon Tetrachloride	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
Chlorobenzene	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
Chloroethane	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 UJ
Chloroform	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
Chloromethane	5.4 U	1.1 J	5 U	5.5 U	3.8 UJ	4.4 UJ	4.6 UJ	3.8 UJ	4.1 UJ	4.7 UJ	4 U
Dibromochloromethane	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U

APPENDIX D

SUBSURFACE SOIL ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB05	59SB06	59SB07	59SB08	59SB09	59SB10	59SB11
Sample ID	59SB01-01	59SB02-01	59SB03-01	59SB04-01	59SB05-01	59SB06-01	59SB07-01	59SB08-01	59SB09-01	59SB10-01	59SB11-01
Sample Date	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	4/21/2010	5/19/2010
Sample Depth (ft bgs)	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0
Volatile Organics (µg/kg) (cont.)											
Dibromomethane	5.4 U	5.2 UJ	5 U	5.5 U	3.8 UJ	4.4 UJ	4.6 UJ	3.8 UJ	4.1 UJ	4.7 UJ	4 U
Ethyl Methacrylate	54 U	52 U	50 U	55 U	38 U	44 U	46 U	38 U	41 U	47 U	40 U
Ethylbenzene	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
Freon 11 (Trichlorofluoromethane)	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
Freon-12 (Dichlorodifluoromethane)	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
Isobutyl Alcohol	270 R	260 R	250 R	280 R	190 R	220 R	230 R	190 R	200 R	240 R	200 R
Methyl Acrylonitrile	54 U	52 U	50 U	55 U	38 U	44 U	46 U	38 U	41 U	47 U	40 U
Methyl Iodide	5.4 U	30 J	5 U	5.5 U	3.8 UJ	1.9 J	4.6 UJ	3.8 UJ	1.3 J	4.7 UJ	4 U
Methyl Methacrylate	54 R	52 R	50 R	55 R	38 R	44 R	46 R	38 R	41 R	47 R	40 R
Methylene Chloride	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
Pentachloroethane	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
Propionitrile (Ethyl Cyanide)	270 R	260 R	250 R	280 R	190 R	220 R	230 R	190 R	200 R	240 R	200 R
Styrene (Ethenylbenzene)	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
Tetrachloroethene (PCE)	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
Toluene	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
Trichloroethene (TCE)	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
Vinyl Acetate	5.4 U	5.2 UJ	5 U	5.5 U	3.8 UJ	4.4 UJ	4.6 UJ	3.8 UJ	4.1 UJ	4.7 UJ	4 U
Vinyl Chloride	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
Xylene, m/p-	0.19 J	0.19 J	9.9 U	11 U	0.15 J	0.16 J	0.19 J	0.12 J	0.15 J	0.14 J	8 U
Xylene, o-	5.4 U	5.2 U	5 U	5.5 U	3.8 U	4.4 U	4.6 U	3.8 U	4.1 U	4.7 U	4 U
Xylenes, total	0.19 J	0.19 J	5 U	5.5 U	0.15 J	0.16 J	0.18 J	0.12 J	0.15 J	0.14 J	4 U
Semivolatile Organics (µg/kg)											
1,2,4,5-Tetrachlorobenzene	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
1,2,4-Trichlorobenzene	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
1,2-Dichlorobenzene (o-)	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
1,3,5-Trinitrobenzene (TNB)	250 UJ	220 UJ	200 UJ	230 UJ	190 UJ	200 UJ	210 UJ	190 UJ	190 UJ	220 UJ	200 UJ
1,3-Dichlorobenzene (m-)	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
1,3-Dinitrobenzene (m-)	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
1,4-Dichlorobenzene (p-)	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
1,4-Naphthoquinone	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
1,4-Phenylenediamine	2500 R	2200 R	2000 R	2300 R	1900 R	2000 R	2100 R	1900 R	1900 R	2200 R	2000 R
1-Naphthylamine	250 U	220 U	200 U	230 UJ	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
2,2'-Oxybis[1-chloropropane]	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
2,3,4,6-Tetrachlorophenol	480 U	430 U	400 U	440 U	370 U	380 U	410 U	370 U	360 U	430 U	390 UJ
2,4,5-Trichlorophenol	480 U	430 U	400 U	440 U	370 U	380 U	410 U	370 U	360 U	430 U	390 UJ

APPENDIX D

SUBSURFACE SOIL ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB05	59SB06	59SB07	59SB08	59SB09	59SB10	59SB11
Sample ID	59SB01-01	59SB02-01	59SB03-01	59SB04-01	59SB05-01	59SB06-01	59SB07-01	59SB08-01	59SB09-01	59SB10-01	59SB11-01
Sample Date	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	4/21/2010	5/19/2010
Sample Depth (ft bgs)	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0
Semivolatile Organics (µg/kg) (cont.)											
2,4,6-Trichlorophenol	480 U	430 U	400 U	440 U	370 U	380 U	410 U	370 U	360 U	430 U	390 UJ
2,4-Dichlorophenol	480 U	430 U	400 U	440 U	370 U	380 U	410 U	370 U	360 U	430 U	390 UJ
2,4-Dimethylphenol	480 U	430 U	400 U	440 U	370 U	380 U	410 U	370 U	360 U	430 U	390 UJ
2,4-Dinitrophenol	480 UJ	430 UJ	400 UJ	440 UJ	370 UJ	380 UJ	410 UJ	370 UJ	360 UJ	430 UJ	390 UJ
2,4-Dinitrotoluene (DNT)	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
2,6-Dichlorophenol	480 U	430 U	400 U	440 U	370 U	380 U	410 U	370 U	360 U	430 U	390 UJ
2,6-Dinitrotoluene (DNT)	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
2-Acetylaminofluorene	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
2-Chloronaphthalene	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
2-Chlorophenol	480 U	430 U	400 U	440 U	370 U	380 U	410 U	370 U	360 U	430 U	390 UJ
2-Methyl-5-nitroaniline	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
2-Methylphenol (o-Cresol)	480 U	430 U	400 U	440 U	370 U	380 U	410 U	370 U	360 U	430 U	390 UJ
2-Naphthylamine	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
2-Nitroaniline	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
2-Nitrophenol	480 U	430 U	400 U	440 U	370 U	380 U	410 U	370 U	360 U	430 U	390 UJ
2-Picoline	250 U	220 U	200 U	230 U	190 UJ	200 U	210 U	190 UJ	190 UJ	220 UJ	200 UJ
3,3'-Dichlorobenzidine	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
3,3'-Dimethylbenzidine	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
3-Methylcholanthrene	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
3-Methylphenol (m-Cresol)	370 U	320 U	300 U	330 U	280 U	290 U	310 U	280 U	270 U	330 U	290 UJ
3-Nitroaniline	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
4,6-Dinitro-2-methylphenol	480 U	430 U	400 U	440 U	370 U	380 U	410 U	370 U	360 U	430 U	390 UJ
4-Aminobiphenyl	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
4-Bromophenyl-phenylether	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
4-Chloro-3-methylphenol	480 U	430 U	400 U	440 U	370 U	380 U	410 U	370 U	360 U	430 U	390 UJ
4-Chloroaniline	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
4-Chlorophenyl-phenylether	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
4-Dimethylaminoazobenzene (p-)	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
4-Methylphenol (p-Cresol)	370 U	320 U	300 U	330 U	280 U	290 U	310 U	280 U	270 U	330 U	290 UJ
4-Nitroaniline	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
4-Nitrophenol	480 U	430 U	400 U	440 U	370 U	380 U	410 U	370 U	360 U	430 U	390 UJ
4-Nitroquinoline-1-oxide	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
7,12-Dimethylbenz(a)anthracene	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
a,a-Dimethylphenethylamine	480 UJ	430 UJ	400 UJ	440 UJ	370 UJ	380 UJ	410 UJ	370 UJ	360 UJ	430 UJ	550 UJ
Acetophenone	120 U	110 U	100 U	110 U	94 U	99 U	100 U	96 U	93 U	110 U	100 UJ
Aniline	250 U	220 U	200 U	230 U	190 UJ	200 U	210 U	190 UJ	190 UJ	220 UJ	200 UJ

APPENDIX D

SUBSURFACE SOIL ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB05	59SB06	59SB07	59SB08	59SB09	59SB10	59SB11
Sample ID	59SB01-01	59SB02-01	59SB03-01	59SB04-01	59SB05-01	59SB06-01	59SB07-01	59SB08-01	59SB09-01	59SB10-01	59SB11-01
Sample Date	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	4/21/2010	5/19/2010
Sample Depth (ft bgs)	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0
Semivolatile Organics (µg/kg) (cont.)											
Aramite	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
Benzyl Alcohol	250 UJ	220 UJ	200 UJ	230 UJ	190 UJ	200 UJ	210 UJ	190 UJ	190 UJ	220 UJ	200 UJ
Bis(2-chloroethoxy)methane	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
Bis(2-chloroethyl)ether	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
Bis(2-ethylhexyl) Phthalate (BEHP)	250 U	220 U	200 U	230 U	190 U	200 U	58 J	83 J	190 U	220 U	200 UJ
Butyl Benzyl Phthalate	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
Diallate (cis)	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
Diallate (trans)	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
Dibenzofuran	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
Diethyl Phthalate (DEP)	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
Dimethyl Phthalate	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
Di-n-butyl Phthalate (DBP)	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
Di-n-octyl Phthalate	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
Dinoseb	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	200 UJ
Ethyl Methane Sulfonate (EMS)	250 U	220 U	200 U	230 UJ	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
Hexachloro-1,3-butadiene	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
Hexachlorobenzene	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
Hexachlorocyclopentadiene	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
Hexachloroethane	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
Hexachloropropene	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
Isophorone	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
Isosafrole	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
Methapyrilene	250 U	220 U	200 U	230 U	190 UJ	200 U	210 U	190 UJ	190 UJ	220 UJ	200 R
Methyl Methane Sulfonate	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
Nitrobenzene	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
n-Nitrosodiethylamine	250 U	220 U	200 U	230 U	190 UJ	200 U	210 U	190 UJ	190 UJ	220 UJ	200 UJ
n-Nitrosodimethylamine (NDMA)	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
n-Nitroso-di-n-butylamine	250 UJ	220 UJ	200 UJ	230 U	190 UJ	200 UJ	210 UJ	190 UJ	190 UJ	220 UJ	200 UJ
n-Nitrosodi-n-propylamine	250 U	220 U	200 U	230 U	190 UJ	200 U	210 U	190 UJ	190 UJ	220 UJ	200 UJ
n-Nitrosodiphenylamine	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
n-Nitrosomethylethylamine	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
n-Nitrosomorpholine	250 U	220 U	200 U	230 U	190 UJ	200 U	210 U	190 UJ	190 UJ	220 UJ	200 UJ
n-Nitrosopiperidine	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
n-Nitrosopyrrolidine	250 U	220 U	200 U	230 U	190 UJ	200 U	210 U	190 UJ	190 UJ	220 UJ	200 UJ
o-Toluidine	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
Pentachlorobenzene	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB05	59SB06	59SB07	59SB08	59SB09	59SB10	59SB11
Sample ID	59SB01-01	59SB02-01	59SB03-01	59SB04-01	59SB05-01	59SB06-01	59SB07-01	59SB08-01	59SB09-01	59SB10-01	59SB11-01
Sample Date	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	4/21/2010	5/19/2010
Sample Depth (ft bgs)	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0
Semivolatile Organics (µg/kg) (cont.)											
Pentachloronitrobenzene	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
Pentachlorophenol	480 U	430 U	400 U	440 U	370 U	380 U	410 U	370 U	360 U	430 U	390 UJ
Phenacetin	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
Phenol	480 U	430 U	400 U	440 U	370 U	380 U	410 U	370 U	360 U	430 U	390 UJ
Pronamide	480 U	430 U	400 U	230 U	370 U	380 U	410 U	370 U	360 U	430 U	200 UJ
Pyridine	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
Safrole	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
LLPAHs (µg/kg)											
2-Methylnaphthalene	12 UJ	7.9 J	10 UJ	11 U	0.96 J	9.7 UJ	10 UJ	9.3 UJ	9.1 UJ	11 UJ	9.8 UJ
Acenaphthene	12 U	7.7 J	10 U	11 U	9.2 U	9.7 U	10 U	9.3 U	9.1 U	11 U	9.8 UJ
Acenaphthylene	12 U	11 U	10 U	11 U	9.2 U	9.7 U	10 U	0.65 J	9.1 U	11 U	9.8 UJ
Anthracene	12 U	3.1 J	10 U	11 U	9.2 U	9.7 U	10 U	9.3 U	9.1 U	11 U	9.8 UJ
Fluoranthene	12 U	8.6 J	10 U	11 U	9.2 U	9.7 U	10 U	7.3 J	9.1 U	11 U	9.8 UJ
Fluorene	12 UJ	6 J	10 UJ	11 U	9.2 UJ	9.7 UJ	10 UJ	9.3 UJ	9.1 UJ	11 U	9.8 UJ
Naphthalene	12 U	11 U	10 U	11 U	9.2 U	9.7 U	10 U	9.3 U	9.1 U	11 U	9.8 UJ
Phenanthrene	12 U	20 J	10 U	11 U	1.8 J	9.7 U	10 U	5.6 J	9.1 U	11 U	9.8 UJ
Benzo(a)anthracene	12 U	2.3 J	10 U	11 U	0.8 J	9.7 U	10 U	1.2 J	0.63 J	11 U	9.8 UJ
Benzo(a)pyrene (BaP)	12 U	1 J	10 U	11 U	0.94 J	9.7 U	10 U	3 J	0.85 J	11 U	9.8 UJ
Benzo(b)fluoranthene	12 U	1 J	10 UJ	11 U	1.2 J	9.7 UJ	10 UJ	2.8 J	0.64 J	11 U	9.8 UJ
Benzo(g,h,i)perylene	12 U	1.2 J	10 UJ	11 UJ	9.2 UJ	9.7 UJ	10 UJ	1.9 J	0.58 J	11 UJ	9.8 UJ
Benzo(k)fluoranthene	12 UJ	1.5 J	10 U	11 UJ	0.49 J	9.7 U	10 U	4.1 J	0.92 J	11 U	9.8 UJ
Chrysene	12 UJ	2 J	10 UJ	11 U	2 J	9.7 UJ	10 UJ	3 J	9.1 UJ	11 UJ	9.8 UJ
Dibenz(a,h)anthracene	12 U	11 U	10 U	11 UJ	9.2 U	9.7 U	10 U	0.39 J	9.1 U	11 U	9.8 UJ
LLPAHs (µg/kg) (cont.)											
Indeno(1,2,3-cd)pyrene	12 UJ	0.77 J	10 UJ	11 UJ	9.2 UJ	9.7 UJ	10 UJ	2.8 J	0.84 J	11 UJ	9.8 UJ
Pyrene	12 U	5.7 J	10 U	11 U	1.1 J	9.7 U	10 U	6.1 J	9.1 U	11 U	9.8 UJ
LLPAH Totals (µg/kg)											
Low molecular weight PAHs	96	75.3	80	88	57.96	77.6	80	60.05	72.8	88	78.4
High molecular weight PAHs	108	26.47	90	99	34.13	87.3	90	25.29	31.76	99	88.2

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB05	59SB06	59SB07	59SB08	59SB09	59SB10	59SB11
Sample ID	59SB01-01	59SB02-01	59SB03-01	59SB04-01	59SB05-01	59SB06-01	59SB07-01	59SB08-01	59SB09-01	59SB10-01	59SB11-01
Sample Date	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	4/21/2010	5/19/2010
Sample Depth (ft bgs)	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0
Pesticides (µg/kg)											
4,4'-DDD	4.9 U	4.3 U	4 U	4.4 U	3.7 U	3.8 U	4.1 U	3.7 U	3.6 U	4.3 U	3.9 U
4,4'-DDE	4.9 U	4.3 U	4 U	4.4 U	3.5 J	3.8 U	4.1 U	3.7 U	3.6 U	4.3 U	3.9 U
4,4'-DDT	4.9 U	4.3 U	4 U	4.4 U	0.77 J	3.8 U	4.1 U	3.7 U	3.6 U	4.3 U	3.9 U
Aldrin	2.5 U	2.2 U	2 U	2.3 U	1.9 U	2 U	2.1 U	1.9 U	1.9 U	2.2 U	2 U
BHC, alpha-	2.5 U	2.2 U	2 U	2.3 U	1.9 U	2 U	2.1 U	1.9 U	1.9 U	2.2 U	2 U
BHC, beta-	2.5 U	0.87 J	2 U	2.3 U	0.84 J	0.88 J	2.1 U	1.9 U	1.9 U	2.2 U	1 U
BHC, delta-	2.5 U	2.2 U	2 U	2.3 U	1.9 U	2 U	2.1 U	1.9 U	1.9 U	2.2 U	2 U
BHC, gamma- (Lindane)	2.5 U	2.2 U	2 U	2.3 U	1.9 U	2 U	2.1 U	1.9 U	1.9 U	2.2 U	2 U
Chlordane, alpha-	2.5 U	2.2 U	2 U	2.3 U	1.9 U	2 U	2.1 U	1.9 U	1.9 U	2.2 U	2 U
Chlordane, gamma-	2.5 U	2.2 U	2 U	2.3 U	1.9 U	2 U	2.1 U	1.9 U	1.9 U	2.2 U	2 U
Chlorobenzilate	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
Dieldrin	4.9 U	4.3 U	4 U	4.4 U	3.7 U	3.8 U	4.1 U	3.7 U	3.6 U	4.3 U	3.9 U
Endosulfan I	2.5 U	2.2 U	2 U	2.3 U	1.9 U	2 U	2.1 U	1.9 U	1.9 U	2.2 U	2 U
Endosulfan II	4.9 U	4.3 U	4 U	4.4 U	3.7 U	3.8 U	4.1 U	3.7 U	3.6 U	4.3 U	3.9 U
Endosulfan Sulfate	4.9 U	4.3 U	4 U	4.4 U	3.7 U	3.8 U	4.1 U	3.7 U	3.6 U	4.3 U	3.9 U
Endrin	4.9 U	4.3 U	4 U	0.56 J	3.7 U	3.8 U	4.1 U	3.7 U	3.6 U	4.3 U	3.9 U
Endrin Aldehyde	4.9 U	4.3 U	4 U	4.4 R	0.46 J	3.8 U	4.1 U	3.7 U	3.6 U	0.54 J	3.9 U
Heptachlor	2.5 U	2.2 U	2 U	2.3 U	1.9 U	2 U	2.1 U	1.9 U	1.9 U	2.2 U	2 U
Heptachlor Epoxide	2.5 U	2.2 U	2 U	2.3 U	1.9 U	2 U	2.1 U	1.9 U	1.9 U	2.2 U	2 U
Isodrin	250 U	220 U	200 U	230 U	190 U	200 U	210 U	190 U	190 U	220 U	200 UJ
Kepone (Chlordecone)	250 R	220 R	200 R	230 UJ	190 R	200 R	210 R	190 R	190 R	220 R	200 R
Methoxychlor	25 U	22 U	20 U	23 U	19 U	20 U	21 U	19 U	19 U	22 U	20 U
Toxaphene	120 U	110 U	100 U	110 U	92 U	97 U	100 U	93 U	91 U	110 U	98 U

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SUBSURFACE SOIL ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB05	59SB06	59SB07	59SB08	59SB09	59SB10	59SB11
Sample ID	59SB01-01	59SB02-01	59SB03-01	59SB04-01	59SB05-01	59SB06-01	59SB07-01	59SB08-01	59SB09-01	59SB10-01	59SB11-01
Sample Date	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	4/21/2010	5/19/2010
Sample Depth (ft bgs)	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0
Metals (mg/kg)											
Antimony	7.1 UJ	6.5 UJ	1.2 UJ	6.5 UJ	1.1 UJ	5.8 UJ	6 UJ	1.1 UJ	5.3 UJ	1.3 UJ	5.9 UJ
Arsenic	3.5 UJ	1.3 J	0.6 UJ	3.2 U	1.2 J	2.9 UJ	3 UJ	0.19 J	2.7 UJ	0.65 UJ	2.9 U
Barium	33.3 R	186 R	62.1 R	229 J	69.9 R	151 R	173 R	149 R	127 R	163 R	86.8
Beryllium	3.5 U	0.47 J	0.24 J	3.2 U	0.3 J	2.9 U	0.27 J	0.38 J	2.7 U	0.44 J	2.9 U
Cadmium	3.5 U	0.76 J	0.22 J	0.75 J	0.34 J	0.22 J	0.35 J	0.62	0.31 J	0.28 J	0.2 J
Chromium	13 J	50.9 J	50.3 J	63.5 J	17.2 J	46.4 J	57.3 J	16.2 J	59.5 J	22.5 J	25.3 J
Cobalt	9.6 J	72.1 J	32.6 J	53.4 J	15.9 J	17.5 J	26.7 J	13 J	32.6 J	28 J	26.9
Copper	126 J	91.9 J	71.1 J	217 J	82.6 J	77.7 J	74.3 J	5.1 J	77.6 J	49.3 J	89.6
Lead	3.5 UJ	33 J	1 J	3.2 UJ	14.1 J	5.3 J	4.7 J	1.8 J	3 J	1.3 J	2.9 U
Mercury	0.048 U	0.1	0.04 U	0.009 J	0.014 J	0.038 U	0.04 U	0.037 U	0.016 J	0.009 J	0.039 U
Nickel	9.1 J	17.8 J	18.5 J	20.7	10.8 J	16.3 J	27.9 J	8.7 J	27.9 J	29.6 J	14.9
Selenium	17.7 UJ	2.6 J	0.41 J	16.2 U	0.48 J	14.5 UJ	0.48 J	0.56 J	13.3 UJ	0.64 J	14.7 U
Silver	3.5 U	0.41 J	0.6 U	3.2 U	0.56 U	2.9 U	3 U	0.55 U	2.7 U	0.65 U	2.9 U
Thallium	3.5 U	0.041 J	0.6 U	3.2 U	0.036 J	2.9 U	3 U	0.029 J	2.7 U	0.65 U	0.1 J
Tin	2.8 J	2 J	2.5 J	2.7 J	2.8 J	2.3 J	2.6 J	1.9 J	2.7 J	2.3 J	5.9 U
Vanadium	73.1 J	282 J	161 J	138 J	85.1 J	146 J	151 J	73.6 J	190 J	46.9 J	145
Zinc	66.8 J	77.3 J	63.2 J	242 J	49.5 J	61.9 J	78.6 J	90.6 J	75.4 J	68.7 J	71

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB12	59SB13	59SB14	59SB15	59SB16	59SB17	59SB18	59SB19	59SB20	59SB21	59SB22	59SB23
Sample ID	59SB12-01	59SB13-01	59SB14-01	59SB15-01	59SB16-01	59SB17-01	59SB18-01	59SB19-01	59SB20-01	59SB21-01	59SB22-01	59SB23-01
Sample Date	5/18/2010	5/18/2010	5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010
Sample Depth (ft bgs)	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0
Volatile Organics (µg/kg)												
1,1,1,2-Tetrachloroethane	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
1,1,1-Trichloroethane	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
1,1,2,2-Tetrachloroethane	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
1,1,2-Trichloroethane	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
1,1-Dichloroethane	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
1,1-Dichloroethene	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
1,2,3-Trichloropropane	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
1,2-Dibromo-3-chloropropane (DBCP)	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
1,2-Dibromoethane (EDB)	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
1,2-Dichloroethane	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
1,2-Dichloroethene (trans)	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
1,2-Dichloropropane	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
1,3-Dichloropropene (cis)	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
1,3-Dichloropropene (trans)	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
1,4-Dichloro-2-butene (trans)	22 U	19 U	18 U	20 U	18 U	17 U	17 U	21 U	16 U	17 U	16 U	17 U
1,4-Dioxane (p-)	270 R	240 R	230 R	250 R	220 R	210 R	220 R	260 R	200 R	210 R	190 R	210 R
2-Butanone (MEK)	14 U	12 U	11 U	12 U	11 U	11 U	11 U	13 U	10 U	10 U	9.7 U	10 U
2-Chloro-1,3-butadiene (Chloroprene)	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
2-Hexanone (MBK)	14 U	12 U	11 U	12 U	11 U	11 U	11 U	13 U	10 U	10 U	9.7 U	10 U
3-Chloropropene (Allyl Chloride)	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
4-Methyl-2-pentanone (MIBK)	14 U	12 U	11 U	12 U	11 U	11 U	11 U	13 U	10 U	10 U	9.7 U	10 U
Acetone	27 U	19 U	19 U	13 U	13 U	37	18 U	13 U	10 U	10 U	40	10 U
Acetonitrile	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
Acrolein	54 R	48 R	46 R	50 R	45 R	43 R	43 R	52 R	41 R	42 R	39 R	42 R
Acrylonitrile	54 U	48 U	46 U	50 U	45 U	43 U	43 U	52 U	41 U	42 U	39 U	42 U
Benzene	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	0.71 J	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
Bromodichloromethane	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
Bromoform	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
Bromomethane	5.4 U	4.8 U	4.6 U	5 U	4.5 U	1.6 J	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
Carbon Disulfide	5.4 U	0.76 J	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	0.54 J	4.2 U
Carbon Tetrachloride	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
Chlorobenzene	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
Chloroethane	5.4 UJ	4.8 U	4.6 UJ	5 UJ	4.5 UJ	4.3 UJ	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
Chloroform	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
Chloromethane	0.37 J	4.8 U	4.6 U	5 U	4.5 U	0.74 J	4.3 U	5.2 U	4.1 U	4.2 U	0.43 J	4.2 U
Dibromochloromethane	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U

APPENDIX D

SUBSURFACE SOIL ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB12	59SB13	59SB14	59SB15	59SB16	59SB17	59SB18	59SB19	59SB20	59SB21	59SB22	59SB23
Sample ID	59SB12-01	59SB13-01	59SB14-01	59SB15-01	59SB16-01	59SB17-01	59SB18-01	59SB19-01	59SB20-01	59SB21-01	59SB22-01	59SB23-01
Sample Date	5/18/2010	5/18/2010	5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010
Sample Depth (ft bgs)	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0
Volatile Organics (µg/kg) (cont.)												
Dibromomethane	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
Ethyl Methacrylate	54 U	48 U	46 U	50 U	45 U	43 U	43 U	52 U	41 U	42 U	39 U	42 U
Ethylbenzene	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
Freon 11 (Trichlorofluoromethane)	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
Freon-12 (Dichlorodifluoromethane)	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
Isobutyl Alcohol	270 R	240 R	230 R	250 R	220 R	210 R	220 R	260 R	200 R	210 R	190 R	210 R
Methyl Acrylonitrile	54 U	48 U	46 U	50 U	45 U	43 U	43 U	52 U	41 U	42 U	39 U	42 U
Methyl Iodide	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
Methyl Methacrylate	54 R	48 R	46 R	50 R	45 R	43 R	43 R	52 R	41 R	42 R	39 R	42 R
Methylene Chloride	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
Pentachloroethane	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
Propionitrile (Ethyl Cyanide)	270 R	240 R	230 R	250 R	220 R	210 R	220 R	260 R	200 R	210 R	190 R	210 R
Styrene (Ethenylbenzene)	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
Tetrachloroethene (PCE)	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
Toluene	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
Trichloroethene (TCE)	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
Vinyl Acetate	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 UJ	5.2 UJ	4.1 UJ	4.2 UJ	3.9 UJ	4.2 UJ
Vinyl Chloride	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
Xylene, m/p-	11 U	9.7 U	9.2 U	9.9 U	8.9 U	8.6 U	8.6 U	10 U	8.1 U	8.3 U	7.8 U	8.4 U
Xylene, o-	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
Xylenes, total	5.4 U	4.8 U	4.6 U	5 U	4.5 U	4.3 U	4.3 U	5.2 U	4.1 U	4.2 U	3.9 U	4.2 U
Semivolatile Organics (µg/kg)												
1,2,4,5-Tetrachlorobenzene	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
1,2,4-Trichlorobenzene	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
1,2-Dichlorobenzene (o-)	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
1,3,5-Trinitrobenzene (TNB)	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
1,3-Dichlorobenzene (m-)	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
1,3-Dinitrobenzene (m-)	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
1,4-Dichlorobenzene (p-)	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
1,4-Naphthoquinone	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
1,4-Phenylenediamine	2100 R	2200 R	2200 R	1900 R	2100 R	2000 R	1800 R	2200 R	1800 R	1800 R	2000 R	1900 R
1-Naphthylamine	210 UJ	220 UJ	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
2,2'-Oxybis[1-chloropropane]	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
2,3,4,6-Tetrachlorophenol	400 UJ	420 U	420 UJ	370 UJ	410 UJ	390 UJ	350 U	430 U	360 U	360 U	380 UJ	380 U
2,4,5-Trichlorophenol	400 UJ	420 U	420 UJ	370 UJ	410 UJ	390 UJ	350 U	430 U	360 U	360 U	380 UJ	380 U

APPENDIX D

SUBSURFACE SOIL ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB12	59SB13	59SB14	59SB15	59SB16	59SB17	59SB18	59SB19	59SB20	59SB21	59SB22	59SB23
Sample ID	59SB12-01	59SB13-01	59SB14-01	59SB15-01	59SB16-01	59SB17-01	59SB18-01	59SB19-01	59SB20-01	59SB21-01	59SB22-01	59SB23-01
Sample Date	5/18/2010	5/18/2010	5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010
Sample Depth (ft bgs)	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0
Semivolatile Organics (µg/kg) (cont.)												
2,4,6-Trichlorophenol	400 UJ	420 U	420 UJ	370 UJ	410 UJ	390 UJ	350 U	430 U	360 U	360 U	380 UJ	380 U
2,4-Dichlorophenol	400 UJ	420 U	420 UJ	370 UJ	410 UJ	390 UJ	350 U	430 U	360 U	360 U	380 UJ	380 U
2,4-Dimethylphenol	400 UJ	420 U	420 UJ	370 UJ	410 UJ	390 UJ	350 U	430 U	360 U	360 U	380 UJ	380 U
2,4-Dinitrophenol	400 UJ	420 U	420 UJ	370 UJ	410 UJ	390 UJ	350 U	430 U	360 U	360 U	380 UJ	380 U
2,4-Dinitrotoluene (DNT)	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
2,6-Dichlorophenol	400 UJ	420 U	420 UJ	370 UJ	410 UJ	390 UJ	350 U	430 U	360 U	360 U	380 UJ	380 U
2,6-Dinitrotoluene (DNT)	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
2-Acetylaminofluorene	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 UJ	190 U
2-Chloronaphthalene	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
2-Chlorophenol	400 UJ	420 U	420 UJ	370 UJ	410 UJ	390 UJ	350 U	430 U	360 U	360 U	380 UJ	380 U
2-Methyl-5-nitroaniline	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
2-Methylphenol (o-Cresol)	400 UJ	420 UJ	420 UJ	370 UJ	410 UJ	390 UJ	350 U	430 U	360 U	360 U	380 UJ	380 U
2-Naphthylamine	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
2-Nitroaniline	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
2-Nitrophenol	400 UJ	420 U	420 UJ	370 UJ	410 UJ	390 UJ	350 U	430 U	360 U	360 U	380 UJ	380 U
2-Picoline	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
3,3'-Dichlorobenzidine	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
3,3'-Dimethylbenzidine	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 UJ	190 U
3-Methylcholanthrene	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 UJ	190 U
3-Methylphenol (m-Cresol)	300 UJ	320 U	320 UJ	280 UJ	310 UJ	300 UJ	260 U	320 U	270 U	270 U	290 UJ	280 U
3-Nitroaniline	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
4,6-Dinitro-2-methylphenol	400 UJ	420 U	420 UJ	370 UJ	410 UJ	390 UJ	350 U	430 U	360 U	360 U	380 UJ	380 U
4-Aminobiphenyl	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
4-Bromophenyl-phenylether	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
4-Chloro-3-methylphenol	400 UJ	420 U	420 UJ	370 UJ	410 UJ	390 UJ	350 U	430 U	360 U	360 U	380 UJ	380 U
4-Chloroaniline	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
4-Chlorophenyl-phenylether	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
4-Dimethylaminoazobenzene (p-)	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
4-Methylphenol (p-Cresol)	300 UJ	320 U	320 UJ	280 UJ	310 UJ	300 UJ	260 U	320 U	270 U	270 U	290 UJ	280 U
4-Nitroaniline	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
4-Nitrophenol	400 UJ	420 U	420 UJ	370 UJ	410 UJ	390 UJ	350 U	430 U	360 U	360 U	380 UJ	380 U
4-Nitroquinoline-1-oxide	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
7,12-Dimethylbenz(a)anthracene	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
a,a-Dimethylphenethylamine	570 UJ	590 UJ	600 UJ	530 UJ	590 UJ	560 UJ	500 U	610 U	510 U	510 UJ	540 UJ	530 U
Acetophenone	100 UJ	110 U	110 UJ	96 UJ	110 UJ	100 UJ	90 U	110 U	92 U	92 U	98 U	96 U
Aniline	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U

APPENDIX D

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB12	59SB13	59SB14	59SB15	59SB16	59SB17	59SB18	59SB19	59SB20	59SB21	59SB22	59SB23
Sample ID	59SB12-01	59SB13-01	59SB14-01	59SB15-01	59SB16-01	59SB17-01	59SB18-01	59SB19-01	59SB20-01	59SB21-01	59SB22-01	59SB23-01
Sample Date	5/18/2010	5/18/2010	5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010
Sample Depth (ft bgs)	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0
Semivolatile Organics (µg/kg) (cont.)												
Aramite	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
Benzyl Alcohol	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 UJ	200 UJ	190 U
Bis(2-chloroethoxy)methane	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
Bis(2-chloroethyl)ether	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
Bis(2-ethylhexyl) Phthalate (BEHP)	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
Butyl Benzyl Phthalate	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
Diallate (cis)	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
Diallate (trans)	210 UJ	220 UJ	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
Dibenzofuran	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
Diethyl Phthalate (DEP)	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
Dimethyl Phthalate	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
Di-n-butyl Phthalate (DBP)	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
Di-n-octyl Phthalate	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	55 J	190 U
Dinoseb	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
Ethyl Methane Sulfonate (EMS)	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 UJ	220 UJ	180 UJ	180 UJ	200 UJ	190 UJ
Hexachloro-1,3-butadiene	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
Hexachlorobenzene	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
Hexachlorocyclopentadiene	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
Hexachloroethane	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
Hexachloropropene	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
Isophorone	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
Isosafrole	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
Methapyrilene	210 UJ	220 R	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
Methyl Methane Sulfonate	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
Nitrobenzene	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
n-Nitrosodiethylamine	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
n-Nitrosodimethylamine (NDMA)	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
n-Nitroso-di-n-butylamine	210 UJ	220 UJ	220 UJ	190 UJ	210 UJ	200 UJ	180 UJ	220 UJ	180 UJ	180 UJ	200 UJ	190 UJ
n-Nitrosodi-n-propylamine	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
n-Nitrosodiphenylamine	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
n-Nitrosomethylethylamine	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
n-Nitrosomorpholine	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
n-Nitrosopiperidine	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
n-Nitrosopyrrolidine	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 UJ	190 U
o-Toluidine	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
Pentachlorobenzene	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U

APPENDIX D

SUBSURFACE SOIL ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB12	59SB13	59SB14	59SB15	59SB16	59SB17	59SB18	59SB19	59SB20	59SB21	59SB22	59SB23
Sample ID	59SB12-01	59SB13-01	59SB14-01	59SB15-01	59SB16-01	59SB17-01	59SB18-01	59SB19-01	59SB20-01	59SB21-01	59SB22-01	59SB23-01
Sample Date	5/18/2010	5/18/2010	5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010
Sample Depth (ft bgs)	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0
Semivolatile Organics (µg/kg) (cont.)												
Pentachloronitrobenzene	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
Pentachlorophenol	400 UJ	420 U	420 UJ	370 UJ	410 UJ	390 UJ	350 U	430 U	360 U	360 U	380 UJ	380 U
Phenacetin	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
Phenol	400 UJ	420 U	420 UJ	370 UJ	410 UJ	390 UJ	350 U	430 U	360 U	360 U	380 UJ	380 U
Pronamide	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
Pyridine	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
Safrole	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
LLPAHs (µg/kg)												
2-Methylnaphthalene	10 UJ	11 U	11 UJ	9.3 UJ	10 UJ	9.9 UJ	8.8 U	11 U	9 U	9 U	9.5 U	9.4 U
Acenaphthene	10 UJ	11 U	11 UJ	9.3 UJ	10 UJ	9.9 UJ	2 J	11 U	9 U	9 U	9.5 U	9.4 U
Acenaphthylene	10 UJ	11 U	11 UJ	9.3 UJ	10 UJ	9.9 UJ	0.61 J	11 U	9 U	9 U	9.5 U	9.4 U
Anthracene	10 UJ	11 UJ	11 UJ	9.3 UJ	10 UJ	9.9 UJ	8.8 U	11 U	9 U	9 U	9.5 U	9.4 U
Fluoranthene	10 UJ	11 U	11 UJ	9.3 UJ	10 UJ	9.9 UJ	21	11 U	9 U	9 U	9.5 U	9.4 U
Fluorene	10 UJ	11 U	11 UJ	9.3 UJ	10 UJ	9.9 UJ	8.8 U	11 U	9 U	9 U	9.5 U	9.4 U
Naphthalene	10 UJ	11 U	11 UJ	9.3 UJ	1.1 J	9.9 UJ	8.8 U	11 U	9 U	9 U	9.5 U	9.4 U
Phenanthrene	10 UJ	11 U	11 UJ	9.3 UJ	10 UJ	9.9 UJ	6.5 J	11 U	9 U	9 U	9.5 U	9.4 U
Benzo(a)anthracene	10 UJ	11 U	11 UJ	9.3 UJ	10 UJ	0.7 J	12	11 U	9 U	9 U	9.5 U	9.4 U
Benzo(a)pyrene (BaP)	10 UJ	11 U	11 UJ	9.3 UJ	10 UJ	0.88 J	8.8 U	11 U	9 U	9 U	9.5 U	9.4 U
Benzo(b)fluoranthene	10 UJ	11 U	11 UJ	9.3 UJ	10 UJ	1.4 J	8.8 U	11 U	9 U	9 U	9.5 U	9.4 U
Benzo(g,h,i)perylene	10 UJ	11 U	11 UJ	9.3 UJ	10 UJ	9.9 UJ	8.8 U	11 U	9 U	9 U	9.5 U	9.4 U
Benzo(k)fluoranthene	10 UJ	11 U	11 UJ	9.3 UJ	10 UJ	0.99 J	8.8 U	11 U	9 U	9 U	9.5 U	9.4 U
Chrysene	10 UJ	11 U	11 UJ	9.3 UJ	10 UJ	0.85 J	15	11 U	9 U	9 U	0.88 J	9.4 U
Dibenz(a,h)anthracene	10 UJ	11 U	11 UJ	9.3 UJ	10 UJ	9.9 UJ	8.8 U	11 U	9 U	9 U	9.5 U	9.4 U
LLPAHs (µg/kg) (cont.)												
Indeno(1,2,3-cd)pyrene	10 UJ	11 U	11 UJ	9.3 UJ	10 UJ	9.9 UJ	8.8 U	11 U	9 U	9 U	9.5 U	9.4 U
Pyrene	10 UJ	11 U	11 UJ	9.3 UJ	10 UJ	9.9 UJ	24	11 U	9 U	9 U	1.5 J	9.4 U
LLPAH Totals (µg/kg)												
Low molecular weight PAHs	80	88	88	74.4	71.1	79.2	65.31	88	72	72	76	75.2
High molecular weight PAHs	90	99	99	83.7	90	44.42	103.8	99	81	81	68.88	84.6

APPENDIX D

SUBSURFACE SOIL ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB12	59SB13	59SB14	59SB15	59SB16	59SB17	59SB18	59SB19	59SB20	59SB21	59SB22	59SB23
Sample ID	59SB12-01	59SB13-01	59SB14-01	59SB15-01	59SB16-01	59SB17-01	59SB18-01	59SB19-01	59SB20-01	59SB21-01	59SB22-01	59SB23-01
Sample Date	5/18/2010	5/18/2010	5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010
Sample Depth (ft bgs)	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0
Pesticides (µg/kg)												
4,4'-DDD	4 U	4.2 U	4.2 U	3.7 U	4.1 U	3.9 U	0.39 J	4.3 U	3.6 U	3.6 U	3.8 U	3.8 U
4,4'-DDE	4 U	4.2 U	4.2 U	0.66 J	4.1 U	3.9 U	1.2 J	4.3 U	3.6 U	3.6 U	3.8 U	2.9 J
4,4'-DDT	4 U	4.2 U	4.2 U	3.7 U	4.1 U	3.9 U	1.3 J	4.3 U	3.6 U	3.6 U	3.8 U	0.63 J
Aldrin	2.1 U	2.2 U	2.2 U	1.9 U	2.1 U	2 U	1.8 U	2.2 U	1.8 U	1.8 U	2 U	1.9 U
BHC, alpha-	2.1 U	2.2 U	2.2 U	1.9 U	2.1 U	2 U	1.8 U	2.2 U	1.8 U	1.8 U	2 U	1.9 U
BHC, beta-	1 U	1.1 U	1.1 U	8.9 NJ	1.1 U	1 U	1.8 U	2.2 U	1.8 U	1.8 U	2 U	1.9 U
BHC, delta-	2.1 U	2.2 U	2.2 U	1.9 U	2.1 U	2 U	1.8 U	2.2 U	1.8 U	1.8 U	2 U	1.9 U
BHC, gamma- (Lindane)	2.1 U	2.2 U	2.2 U	1.9 U	2.1 U	2 U	1.8 U	2.2 U	1.8 U	1.8 U	2 U	1.9 U
Chlordane, alpha-	2.1 U	2.2 U	2.2 U	1.9 U	2.1 U	2 U	1.8 U	2.2 U	1.8 U	1.8 U	2 U	1.9 U
Chlordane, gamma-	2.1 U	2.2 U	2.2 U	1.9 U	2.1 U	2 U	1.8 U	2.2 U	1.8 U	1.8 U	2 U	1.9 U
Chlorobenzilate	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
Dieldrin	4 U	4.2 U	4.2 U	3.7 U	4.1 U	3.9 U	3.5 U	4.3 U	3.6 U	3.6 U	3.8 U	3.8 U
Endosulfan I	2.1 U	2.2 U	2.2 U	1.9 U	2.1 U	2 U	1.8 U	2.2 U	1.8 U	1.8 U	2 U	1.9 U
Endosulfan II	4 U	4.2 U	4.2 U	3.7 U	4.1 U	3.9 U	3.5 U	4.3 U	3.6 U	3.6 U	3.8 U	3.8 U
Endosulfan Sulfate	4 U	4.2 U	4.2 U	3.7 U	4.1 U	3.9 U	3.5 U	4.3 U	3.6 U	3.6 U	3.8 U	3.8 U
Endrin	4 U	4.2 U	4.2 U	3.7 U	4.1 U	3.9 U	3.5 U	4.3 U	3.6 U	3.6 U	3.8 U	3.8 U
Endrin Aldehyde	4 U	4.2 U	4.2 U	3.7 U	4.1 U	3.9 U	0.53 J	4.3 U	3.6 U	3.6 U	3.8 U	3.8 U
Heptachlor	2.1 U	0.22 J	2.2 U	1.9 U	2.1 U	2 U	1.8 U	2.2 U	1.8 U	1.8 U	2 U	1.9 U
Heptachlor Epoxide	2.1 U	2.2 U	2.2 U	1.9 U	2.1 U	2 U	1.8 U	2.2 U	1.8 U	1.8 U	2 U	1.9 U
Isodrin	210 UJ	220 U	220 UJ	190 UJ	210 UJ	200 UJ	180 U	220 U	180 U	180 U	200 U	190 U
Kepone (Chlordecone)	210 R	220 UJ	220 R	190 R	210 R	200 R	180 U	220 U	180 UJ	180 UJ	200 UJ	190 U
Methoxychlor	21 U	22 U	22 U	19 U	21 U	20 U	18 U	22 U	18 U	18 U	20 U	19 U
Toxaphene	100 U	110 U	110 U	92 U	100 U	99 U	88 U	110 U	90 U	90 U	95 U	94 U

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SUBSURFACE SOIL ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB12	59SB13	59SB14	59SB15	59SB16	59SB17	59SB18	59SB19	59SB20	59SB21	59SB22	59SB23
Sample ID	59SB12-01	59SB13-01	59SB14-01	59SB15-01	59SB16-01	59SB17-01	59SB18-01	59SB19-01	59SB20-01	59SB21-01	59SB22-01	59SB23-01
Sample Date	5/18/2010	5/18/2010	5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010
Sample Depth (ft bgs)	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0
Metals (mg/kg)												
Antimony	6.1 UJ	0.39 J	6.4 UJ	1 J	6.2 UJ	5.7 UJ	1.1 J	1.2 J	0.15 J	5.3 UJ	5.3 UJ	5.6 UJ
Arsenic	3.1 U	0.54 J	3.2 U	0.63	3.1 U	1 J	1.8	0.51 J	0.54 U	2.6 U	2.6 U	2.8 U
Barium	82.8	267 J	76	58	76.8	89.1	51.2	161	29.5	111	118	88.3
Beryllium	0.3 J	0.96	3.2 U	0.18 J	0.34 J	0.37 J	0.4 J	0.71	0.091 J	2.6 U	2.6 U	0.34 J
Cadmium	3.1 U	0.28 J	0.36 J	0.23 J	3.1 U	0.43 J	0.68	0.77	0.12 J	0.44 J	0.52 J	0.37 J
Chromium	79.3 J	8	39.8 J	32.1 J	29.5 J	57.2 J	14.3	23.1	24.4	16.3	32.7	34.5
Cobalt	28.8	67.6 J	41.6	27.7	31.6	28.6	14.4 J	20.2 J	9.8 J	21 J	22.1 J	22.6 J
Copper	76.2	83.1 J	270	56.2	115	109	51.1 J	64.6 J	34.9 J	54 J	74.8 J	79.4 J
Lead	3.1 U	28.4 R	4.1	3.2	3.1 U	24.6	31.3	1.9	2	3	15.7	18.7
Mercury	0.04 U	0.04 U	0.01 J	0.037 U	0.041 U	0.032 J	0.01 J	0.043 U	0.036 U	0.01 J	0.04 U	0.022 J
Nickel	22.6	6.3	21.6	13.3	14.1	47.3	8.4	14.2	9.8	7.9	16.9	14.4
Selenium	15.3 U	0.48 J	16 U	0.21 J	15.5 U	0.95 J	2 J	2.4 J	0.2 J	13.2 U	13.2 U	0.97 J
Silver	3.1 U	0.1 J	3.2 U	0.56 U	3.1 U	2.8 U	0.43 J	0.57 J	0.12 J	2.6 U	2.6 U	2.8 U
Thallium	3.1 U	0.06 J	3.2 U	0.072 J	3.1 U	2.8 U	0.4 J	0.5 J	0.54 U	2.6 U	2.6 U	2.8 U
Tin	6.1 U	6.3 U	6.4 U	5.6 U	6.2 U	26	5.1 UJ	6.5 UJ	5.4 UJ	5.3 UJ	5.3 UJ	5.6 UJ
Vanadium	136	107 J	236	125	214	188	65.3 J	87.2 J	43.5 J	93.1 J	126 J	171 J
Zinc	75.3	160	92.8	78.4	40.2	148	50.7	67.3	39.3	132	71.8 J	119

APPENDIX D

SUBSURFACE SOIL ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT, 2010 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Notes:

J - Estimated: The analyte was positively identified; the quantitation is an estimation.
U - Non detected at the Reporting Limit
UJ - Reported quantitation limit is qualified as estimated.
NJ - Analyte has been tentatively identified.; the quantitation is an estimation.
R - Rejected data; data is not usable
ft bgs - feet below ground surface
LLPAHs - Low Level Polynuclear Aromatic Hydrocarbons
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram

APPENDIX D

SUBSURFACE SOIL ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT, 2012 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB24-01	59SB25-01	59SB26-01	59SB27-01	59SB28-01	59SB29-01	59SB30-01	59SB31-01	59SB32-01	59SB33-01
Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Depth Range	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0
Volatile Organics (µg/kg)										
1,1,1,2-Tetrachloroethane	2.4 U	2.3 U	2.3 U	2.7 U	2 U	2.3 U	2.3 U	3.4 U	2.1 U	2.5 U
1,1,1-Trichloroethane	0.99 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
1,1,2,2-Tetrachloroethane	1.6 U	1.5 U	1.6 U	1.8 U	1.3 U	1.5 U	1.5 U	2.3 U	1.4 U	1.7 U
1,1,2-Trichloroethane	1.3 U	1.2 U	1.3 U	1.5 U	1.1 U	1.2 U	1.3 U	1.8 U	1.1 U	1.4 U
1,1-Dichloroethane	1.1 U	1 U	1.1 U	1.2 U	0.91 U	1 U	1.1 U	1.5 U	0.95 U	1.2 U
1,1-Dichloroethene	1.5 U	1.4 U	1.5 U	1.7 U	1.2 U	1.4 U	1.4 U	2.1 U	1.3 U	1.6 U
1,2,3-Trichloropropane	2.4 U	2.3 U	2.3 U	2.7 U	2 U	2.3 U	2.3 U	3.4 U	2.1 U	2.5 U
1,2,4-Trichlorobenzene	0.99 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
1,2-Dibromo-3-Chloropropane	4.4 U	4.2 U	4.3 U	4.9 U	3.6 U	4.2 U	4.2 U	6.2 U	3.8 U	4.7 U
1,2-Dibromoethane	1.5 U	1.4 U	1.5 U	1.7 U	1.2 U	1.4 U	1.4 U	2.1 U	1.3 U	1.6 U
1,2-Dichlorobenzene	1.3 U	1.2 U	1.3 U	1.5 U	1.1 U	1.2 U	1.3 U	1.8 U	1.1 U	1.4 U
1,2-Dichloroethane	1.1 U	1 U	1.1 U	1.2 U	0.91 U	1 U	1.1 U	1.5 U	0.95 U	1.2 U
1,2-Dichloropropane	0.99 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
1,3-Dichlorobenzene	1.6 U	1.5 U	1.6 U	1.8 U	1.3 U	1.5 U	1.5 U	2.3 U	1.4 U	1.7 U
1,4-Dichlorobenzene	0.99 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
1,4-Dioxane	49 R	47 R	49 R	56 R	41 R	48 R	48 R	70 R	43 R	53 R
2-Butanone	2.4 U	2.3 U	2.3 U	2.7 U	2 U	2.3 U	2.3 U	3.4 U	2.1 U	2.5 U
2-Hexanone	3.3 U	3.1 U	3.2 U	3.7 U	2.7 U	3.1 U	3.2 U	4.6 U	2.8 U	3.5 U
4-Methyl-2-pentanone	4.2 U	4 U	4.1 U	4.7 U	3.5 U	4 U	4 U	5.9 U	3.6 U	4.5 U
Acetone	11 UJ	16 J	11 U	12 U	9.1 U	40 J	14 J	15 U	9.5 U	12 U
Acetonitrile	41 U	39 U	40 UJ	46 UJ	34 UJ	39 UJ	40 U	58 U	35 UJ	44 U
Acrolein	24 U	23 U	23 UJ	27 UJ	20 UJ	23 UJ	23 U	34 UJ	21 UJ	25 U
Acrylonitrile	34 U	32 U	33 UJ	38 UJ	28 UJ	32 UJ	33 U	48 UJ	29 UJ	36 U
Allyl chloride	2.2 U	2.1 U	2.1 U	2.5 U	1.8 U	2.1 U	2.1 U	3.1 U	1.9 U	2.3 U
Benzene	0.99 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
Bromodichloromethane	0.99 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
Bromoform	1.5 U	1.4 U	1.5 U	1.7 U	1.2 U	1.4 U	1.4 U	2.1 U	1.3 U	1.6 U
Bromomethane	1.5 U	1.4 U	1.5 U	1.7 U	1.2 U	1.4 U	1.4 U	2.1 U	1.3 U	1.6 U
Carbon disulfide	1.1 U	1 U	1.1 U	1.2 U	0.91 U	1 U	1.1 U	1.5 U	0.95 U	1.2 U
Carbon tetrachloride	0.99 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
Chlorobenzene	0.99 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
Chloroethane	2.7 U	2.5 U	2.6 U	3 U	2.2 U	2.6 U	2.6 U	3.8 U	2.3 U	2.9 U
Chloroform	1.1 U	1 U	1.1 U	1.2 U	0.91 U	1 U	1.1 U	1.5 U	0.95 U	1.2 U
Chloromethane	2 U	1.9 U	1.9 U	2.2 U	1.7 U	1.9 U	1.9 U	2.8 U	1.7 U	2.1 U
Chloroprene	2.1 U	2 U	2 U	2.4 U	1.7 U	2 U	2 U	3 U	1.8 U	2.2 U
cis-1,3-Dichloropropene	0.99 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U

APPENDIX D

SUBSURFACE SOIL ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT, 2012 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB24-01	59SB25-01	59SB26-01	59SB27-01	59SB28-01	59SB29-01	59SB30-01	59SB31-01	59SB32-01	59SB33-01
Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Depth Range	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0
Volatile Organics (µg/kg) (cont.)										
Dibromochloromethane	1.7 U	1.6 U	1.7 U	1.9 U	1.4 U	1.6 U	1.6 U	2.4 U	1.5 U	1.8 U
Dibromomethane	1.7 U	1.6 U	1.7 U	1.9 U	1.4 U	1.6 U	1.6 U	2.4 U	1.5 U	1.8 U
Dichlorodifluoromethane	0.99 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
Ethyl methacrylate	3.4 U	3.2 U	3.3 U	3.8 U	2.8 U	3.2 U	3.3 U	4.8 U	2.9 U	3.6 U
Ethylbenzene	1.3 U	1.2 U	1.3 U	1.5 U	1.1 U	1.2 U	1.3 U	1.8 U	1.1 U	1.4 U
Hexachlorobutadiene	3.1 U	2.9 U	3 U	3.5 U	2.6 U	2.9 U	3 U	4.4 U	2.7 U	3.3 U
Iodomethane	1.8 U	1.7 U	1.8 UJ	2 UJ	1.5 UJ	1.7 UJ	1.7 U	2.5 UJ	1.5 UJ	1.9 U
Isobutanol	51 R	49 R	51 R	58 R	43 R	49 R	50 R	73 R	45 R	55 R
Methacrylonitrile	23 U	22 U	22 UJ	26 UJ	19 UJ	22 UJ	22 U	32 U	20 UJ	24 U
Methyl methacrylate	4.5 U	4.2 U	4.4 U	5.1 U	3.7 U	4.3 U	4.3 U	6.3 U	3.9 U	4.8 U
Methylene Chloride	0.99 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	7.2	0.86 U	1.1 U
Naphthalene	1.2 R	1.1 R	1.2 R	1.3 R	0.99 R	1.1 R	1.2 R	1.7 R	1 R	1.3 R
Pentachloroethane	6.2 U	5.9 U	6.1 U	7.1 U	5.2 U	6 U	6.1 U	8.9 U	5.4 U	6.7 U
Propionitrile	26 U	25 U	25 UJ	29 UJ	22 UJ	25 UJ	25 U	37 U	22 UJ	28 U
Styrene	0.99 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
Tetrachloroethene	1.9 U	1.8 U	1.8 U	2.1 U	1.6 U	1.8 U	1.8 U	2.7 U	1.6 U	2 U
Toluene	0.99 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
trans-1,2-Dichloroethene	0.99 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
trans-1,3-Dichloropropene	0.99 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
trans-1,4-Dichloro-2-butene	2.9 U	2.7 U	2.8 U	3.3 U	2.4 U	2.8 U	2.8 U	4.1 U	2.5 U	3.1 U
Trichloroethene	1.3 U	1.2 U	1.3 U	1.5 U	1.1 U	1.2 U	1.3 U	1.8 U	1.1 U	1.4 U
Trichlorofluoromethane	1.2 U	1.1 U	1.2 U	1.3 U	0.99 U	1.1 U	1.2 U	1.7 U	1 U	1.3 U
Vinyl acetate	2.5 U	2.4 U	2.4 U	2.8 U	2.1 U	2.4 U	2.4 U	3.5 U	2.2 U	2.7 U
Vinyl chloride	1.5 U	1.4 U	1.5 U	1.7 U	1.2 U	1.4 U	1.4 U	2.1 U	1.3 U	1.6 U
Xylenes, Total	1.1 U	1 U	1.1 U	1.2 U	0.91 U	1 U	1.1 U	1.5 U	0.95 U	1.2 U
Semivolatile Organics (µg/kg)										
1,2,4,5-Tetrachlorobenzene	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
1,2,4-Trichlorobenzene	5.9 U	6 U	6.3 U	6.5 U	5.2 U	6.1 U	6.2 U	6.5 U	5.8 U	6.3 U
1,2-Dichlorobenzene	8.5 U	8.7 U	9.1 U	9.4 U	7.4 U	8.7 U	9 U	9.4 U	8.3 U	9.1 U
1,3,5-Trinitrobenzene	22 U	22 U	23 U	24 U	19 U	22 UJ	23 UJ	24 U	21 U	23 UJ
1,3-Dichlorobenzene	7.2 U	7.4 U	7.7 U	7.9 U	6.3 U	7.4 U	7.6 U	8 U	7.1 U	7.7 U
1,3-Dinitrobenzene	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
1,4-Dichlorobenzene	6.7 U	6.8 U	7.2 U	7.4 U	5.9 U	6.9 U	7.1 U	7.4 U	6.6 U	7.2 U
1,4-Naphthoquinone	4.2 UJ	4.3 UJ	4.5 UJ	4.7 UJ	3.7 UJ	4.4 UJ	4.5 UJ	4.7 UJ	4.2 UJ	4.5 UJ
1-Naphthylamine	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U

APPENDIX D

SUBSURFACE SOIL ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT, 2012 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB24-01	59SB25-01	59SB26-01	59SB27-01	59SB28-01	59SB29-01	59SB30-01	59SB31-01	59SB32-01	59SB33-01
Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Depth Range	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0
Semivolatile Organics (µg/kg) (cont.)										
2,2'-oxybis[1-chloropropane]	9.2 U	9.5 U	9.9 U	10 U	8.1 U	9.5 U	9.8 U	10 U	9.1 U	9.9 U
2,3,4,6-Tetrachlorophenol	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
2,4,5-Trichlorophenol	9.7 U	10 U	10 U	11 U	8.6 U	10 U	10 U	11 U	9.6 U	10 U
2,4,6-Trichlorophenol	10 U	10 U	11 U	11 U	8.9 U	10 U	11 U	11 U	10 U	11 U
2,4-Dichlorophenol	9.2 U	9.5 U	9.9 U	10 U	8.1 U	9.5 U	9.8 U	10 U	9.1 U	9.9 U
2,4-Dimethylphenol	9.7 U	17 J	10 U	11 U	8.6 U	10 U	10 U	11 U	9.6 U	10 U
2,4-Dinitrophenol	54 U	55 U	58 U	60 U	47 U	55 UJ	57 UJ	60 U	53 U	58 UJ
2,4-Dinitrotoluene	9.6 U	9.9 U	10 U	11 U	8.5 U	9.9 U	10 U	11 U	9.5 U	10 U
2,6-Dichlorophenol	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
2,6-Dinitrotoluene	10 U	10 U	11 U	11 U	8.9 U	10 U	11 U	11 U	10 U	11 U
2-Acetylaminofluorene	42 U	43 U	45 U	47 U	37 U	44 U	45 U	47 U	42 U	45 U
2-Chloronaphthalene	7.7 U	7.9 U	8.3 U	8.5 U	6.8 U	7.9 U	8.1 U	8.5 U	7.6 U	8.3 U
2-Chlorophenol	6.8 U	7 U	7.3 U	7.5 U	6 U	7 U	7.2 U	7.5 U	6.7 U	7.3 U
2-Methylphenol	8.1 U	8.3 U	8.7 U	8.9 U	7.1 U	8.3 U	8.6 U	9 U	7.9 U	8.7 U
2-Naphthylamine	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
2-Nitroaniline	9 U	9.2 U	9.6 U	9.9 U	7.9 U	9.2 U	9.5 U	10 U	8.8 U	9.6 U
2-Nitrophenol	7.4 U	7.6 U	8 U	8.2 U	6.5 U	7.7 U	7.9 U	8.3 U	7.3 U	8 U
2-Picoline	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
2-Toluidine	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
3 & 4 Methylphenol	9.4 U	9.6 U	10 U	10 U	8.2 U	9.6 U	9.9 U	10 U	9.2 U	10 U
3,3'-Dichlorobenzidine	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
3,3'-Dimethylbenzidine	85 U	87 U	91 U	94 U	74 U	87 UJ	90 UJ	94 U	83 U	91 UJ
3-Methylcholanthrene	42 U	43 U	45 U	47 U	37 U	44 U	45 U	47 U	42 U	45 U
3-Nitroaniline	8.6 U	8.8 U	9.2 U	9.5 U	7.6 U	8.8 U	9.1 U	9.5 U	8.4 U	9.2 U
4,6-Dinitro-2-methylphenol	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
4-Aminobiphenyl	22 UJ	22 UJ	23 UJ	24 UJ	19 UJ	22 U	23 U	24 UJ	21 UJ	23 U
4-Bromophenyl phenyl ether	8.8 U	9.1 U	9.5 U	9.8 U	7.8 U	9.1 U	9.4 U	9.8 U	8.7 U	9.5 U
4-Chloro-3-methylphenol	9 U	9.2 U	9.6 U	9.9 U	7.9 U	9.2 U	9.5 U	10 U	8.8 U	9.6 U
4-Chloroaniline	6.7 U	6.8 U	7.2 U	7.4 U	5.9 U	6.9 U	7.1 U	7.4 U	6.6 U	7.2 U
4-Chlorophenyl phenyl ether	8.2 U	8.4 U	8.8 U	9.1 U	7.2 U	8.4 U	8.7 U	9.1 U	8.1 U	8.8 U
4-Nitroaniline	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
4-Nitrophenol	94 U	96 U	100 U	100 U	82 U	96 U	99 U	100 U	92 U	100 U
4-Nitroquinoline-1-oxide	54 U	55 U	58 U	60 U	47 U	55 U	57 U	60 U	53 U	58 U
7,12-Dimethylbenz(a)anthracene	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
Acetophenone	8.7 U	8.9 U	9.4 U	9.6 U	7.7 U	9 U	9.2 U	9.7 U	8.6 U	9.4 U
alpha,alpha-Dimethyl phenethylamine	420 UJ	430 UJ	450 UJ	470 UJ	370 UJ	440 UJ	450 UJ	470 UJ	420 UJ	450 UJ

APPENDIX D

SUBSURFACE SOIL ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT, 2012 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB24-01	59SB25-01	59SB26-01	59SB27-01	59SB28-01	59SB29-01	59SB30-01	59SB31-01	59SB32-01	59SB33-01
Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Depth Range	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0
Semivolatile Organics (µg/kg) (cont.)										
Aniline	11 U	11 U	11 U	12 U	9.3 U	11 U	11 U	12 U	10 U	11 U
Aramite, Total	6.2 U	6.3 U	6.6 U	6.8 U	5.4 U	6.3 U	6.5 U	6.8 U	6.1 U	6.6 U
Benzyl alcohol	7.8 U	8 U	8.4 U	8.7 U	6.9 U	8 U	8.3 U	8.7 U	7.7 U	8.4 U
Bis(2-chloroethoxy)methane	8.3 U	8.5 U	8.9 U	9.2 U	7.3 U	8.6 U	8.8 U	9.3 U	8.2 U	9 U
Bis(2-chloroethyl)ether	8.3 U	8.5 U	8.9 U	9.2 U	7.3 U	8.6 U	8.8 U	9.3 U	8.2 U	9 U
Bis(2-ethylhexyl) phthalate	12 J	59 J	43 J	14 J	15 J	7.9 U	18 J	8.6 J	8.5 J	8.3 U
Butyl benzyl phthalate	8.6 U	8.8 U	9.2 U	9.5 U	7.6 U	8.8 U	9.1 U	9.5 U	8.4 U	9.2 U
Diallate	7.2 U	7.4 U	7.7 U	7.9 U	6.3 U	7.4 U	7.6 U	8 U	7.1 U	7.7 U
Dibenzofuran	8.6 U	8.8 U	9.2 U	9.5 U	7.6 U	8.8 U	9.1 U	9.5 U	8.4 U	9.2 U
Diethyl phthalate	9.5 U	9.7 U	10 U	10 U	8.4 U	9.8 U	10 U	11 U	9.3 U	10 U
Dimethyl phthalate	9.6 U	9.9 U	10 U	11 U	8.5 U	9.9 U	10 U	11 U	9.5 U	10 U
Di-n-butyl phthalate	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
Di-n-octyl phthalate	8.6 U	8.8 U	9.2 U	9.5 U	7.6 U	8.8 U	9.1 U	9.5 U	8.4 U	9.2 U
Dinoseb	8.6 U	8.8 U	9.2 U	9.5 U	7.6 U	8.8 UJ	9.1 UJ	9.5 U	8.4 U	9.2 UJ
Ethyl methanesulfonate	10 U	10 U	11 U	11 U	8.8 U	10 U	11 U	11 U	9.8 U	11 U
Hexachlorobenzene	9.7 U	10 U	10 U	11 U	8.6 U	10 U	10 U	11 U	9.6 U	10 U
Hexachlorobutadiene	8.7 U	8.9 U	9.4 U	9.6 U	7.7 U	9 U	9.2 U	9.7 U	8.6 U	9.4 U
Hexachlorocyclopentadiene	4.7 U	4.9 U	5.1 U	5.2 U	4.2 U	4.9 U	5 U	5.3 U	4.7 U	5.1 U
Hexachloroethane	7.4 U	7.6 U	8 U	8.2 U	6.5 U	7.7 U	7.9 U	8.3 U	7.3 U	8 U
Hexachlorophene	3100 U	3200 U	3300 U	3400 U	2700 U	3200 UJ	3300 UJ	3400 U	3000 U	3300 UJ
Hexachloropropene	6.8 U	7 U	7.3 U	7.5 U	6 U	7 U	7.2 U	7.5 U	6.7 U	7.3 U
Isophorone	9 U	9.2 U	9.6 U	9.9 U	7.9 U	9.2 U	9.5 U	10 U	8.8 U	9.6 U
Isosafrole	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Methapyrilene	86 UJ	88 UJ	92 UJ	95 UJ	76 UJ	88 UJ	91 UJ	95 UJ	84 UJ	92 UJ
Methyl methanesulfonate	4.9 UJ	5 UJ	5.2 UJ	5.4 UJ	4.3 UJ	5 UJ	5.2 UJ	5.4 UJ	4.8 UJ	5.2 UJ
Nitrobenzene	8.5 U	8.7 U	9.1 U	9.4 U	7.4 U	8.7 U	9 U	9.4 U	8.3 U	9.1 U
N-Nitro-o-toluidine	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
N-Nitrosodiethylamine	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
N-Nitrosodimethylamine	24 U	25 U	26 U	27 U	21 U	25 U	26 U	27 U	24 U	26 U
N-Nitrosodi-n-butylamine	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
N-Nitrosodi-n-propylamine	9.6 U	9.9 U	10 U	11 U	8.5 U	9.9 U	10 U	11 U	9.5 U	10 U
N-Nitrosodiphenylamine	7.8 U	8 U	8.4 U	8.7 U	6.9 U	8 U	8.3 U	8.7 U	7.7 U	8.4 U
N-Nitrosomethylethylamine	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
N-Nitrosomorpholine	5.8 U	5.9 U	6.2 U	6.4 U	5.1 U	5.9 U	6.1 U	6.4 U	5.7 U	6.2 U
N-Nitrosopiperidine	4.4 U	4.5 U	4.7 U	4.8 U	3.8 U	4.5 U	4.6 U	4.8 U	4.3 U	4.7 U
N-Nitrosopyrrolidine	4.6 U	4.7 U	5 U	5.1 U	4.1 U	4.7 U	4.9 U	5.1 U	4.5 U	5 U

APPENDIX D

SUBSURFACE SOIL ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT, 2012 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB24-01	59SB25-01	59SB26-01	59SB27-01	59SB28-01	59SB29-01	59SB30-01	59SB31-01	59SB32-01	59SB33-01
Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Depth Range	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0
Semivolatile Organics (µg/kg) (cont.)										
p-Dimethylamino azobenzene	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
Pentachlorobenzene	5.6 J	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Pentachloronitrobenzene	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
Pentachlorophenol	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
Phenacetin	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
Phenol	8.3 U	8.5 U	8.9 U	9.2 U	7.3 U	8.6 U	8.8 U	9.3 U	8.2 U	9 U
p-Phenylene diamine	1100 U	1100 U	1100 U	1200 U	940 U	1100 UJ	1100 UJ	1200 U	1000 U	1100 UJ
Pronamide	5.4 U	5.5 U	5.8 U	6 U	4.7 U	5.5 U	5.7 U	6 U	5.3 U	5.8 U
Pyridine	26 U	26 U	28 U	28 U	23 U	26 U	27 U	28 U	25 U	28 U
Safrole, Total	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
LLPAHs (µg/kg)										
2-Methylnaphthalene	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Acenaphthene	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Acenaphthylene	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Anthracene	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Benzo[a]anthracene	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Benzo[a]pyrene	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Benzo[b]fluoranthene	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Benzo[g,h,i]perylene	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Benzo[k]fluoranthene	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Chrysene	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Dibenz(a,h)anthracene	8.6 U	8.8 U	9.2 U	9.5 U	7.6 U	8.8 U	9.1 U	9.5 U	8.4 U	9.2 U
Fluoranthene	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Fluorene	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Indeno[1,2,3-cd]pyrene	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 UJ	4.5 UJ	4.7 U	4.2 U	4.5 UJ
Naphthalene	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Phenanthrene	8.6 U	8.8 U	9.2 U	9.5 U	7.6 U	4.6 J	9.1 U	9.5 U	8.4 U	9.2 U
Pyrene	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
LLPAH Totals (µg/kg)										
Low Molecular Weight PAHs	38	38.9	40.7	42.4	33.5	35.4	40.6	42.4	37.8	40.7
High Molecular Weight PAHs	42.2	43.2	45.2	47.1	37.2	44	45.1	47.1	42	45.2

APPENDIX D

SUBSURFACE SOIL ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT, 2012 CMS INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB24-01	59SB25-01	59SB26-01	59SB27-01	59SB28-01	59SB29-01	59SB30-01	59SB31-01	59SB32-01	59SB33-01
Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Depth Range	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0
Metals (mg/kg)										
Antimony	0.63 U	0.64 U	0.68 U	0.7 U	0.55 U	0.65 U	0.67 U	0.7 U	0.64 U	0.7 U
Arsenic	1.2	1.1	1	0.7	1.1	0.95	1	0.74	1.1	0.86
Barium	120	120	77	120	30	110	120	81	51	43 J
Beryllium	0.5	0.24	0.42	0.12	0.13	0.27	0.22	0.24	0.31	0.14
Cadmium	0.048 J	0.45	0.22	0.11	0.043 J	0.049 J	0.034 U	0.041 J	0.016 J	0.066 J
Chromium	45	63	60	25	23	64	70	110	16	120
Cobalt	18 J	24 J	15 J	16 J	15 J	15 J	4.7 J	14 J	3.5 J	15 J
Copper	210	60	110	73	150	89	110	48	67	110
Lead	6.3 R	12 R	2.8 R	1.2 R	0.64 R	3.5 R	3.8 R	0.85 R	4.6 R	2.1 R
Mercury	0.011 U	0.067	0.011 U	0.013 J	0.0091 U	0.083	0.011 U	0.011 U	0.011 U	0.011 J
Nickel	18	29	43	26	14	25	17	32	5.7	44
Selenium	0.32 U	0.69	0.34 U	0.35 U	0.28 U	0.56 J	0.49 J	0.35 U	0.57 J	0.35 U
Silver	0.063 U	0.064 U	0.068 U	0.07 U	0.055 U	0.065 U	0.067 U	0.07 U	0.064 U	0.26
Thallium	0.032 U	0.032 U	0.034 U	0.035 U	0.028 U	0.033 U	0.034 U	0.035 U	0.037 J	0.035 U
Tin	3.2 U	3.3 U	3.5 U	3.6 U	2.8 U	3.3 U	3.4 U	3.6 U	3.3 U	3.5 U
Vanadium	180	170	180	170	110	280	280	320	140	400
Zinc	62	61	77	41	47	56	35	39	68	47

Notes:

J - Estimated: The analyte was positively identified; the quantitation is an estimation.
U - Non detected at the Limit of Detection.
UJ - Reported quantitation limit is qualified as estimated.
R - Rejected data; data is not usable
ft bgs - feet below ground surface
LLPAHs - Low Level Polynuclear Aromatic Hydrocarbons
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram

APPENDIX D

GROUNDWATER ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB05	59SB06	59SB07	59SB08	59SB09	59SB10
Sample ID	59GW01	59GW02	59GW03	59GW04	59GW05	59GW06	59GW07	59GW08	59GW09	59GW10
Sample Date	5/22/2010	5/23/2010	5/22/2010	5/23/2010	5/22/2010	5/21/2010	5/21/2010	5/22/2010	5/21/2010	5/22/2010
Volatile Organics (µg/L)										
1,1,1,2-Tetrachloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,1-Trichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2,2-Tetrachloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2-Trichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-Dichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-Dichloroethene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,3-Trichloropropane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dibromo-3-chloropropane (DBCP)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dibromoethane (EDB)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloroethene (trans)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloropropane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,3-Dichloropropene (cis)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,3-Dichloropropene (trans)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,4-Dichloro-2-butene (trans)	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
1,4-Dioxane (p-)	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R
2-Butanone (MEK)	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R
2-Chloro-1,3-butadiene (Chloroprene)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
2-Hexanone (MBK)	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
3-Chloropropene (Allyl Chloride)	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ
4-Methyl-2-pentanone (MIBK)	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Acetone	3.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R
Acetonitrile	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Acrolein	5 R	5 R	5 R	5 R	5 R	5 R	5 R	5 R	5 R	5 R
Acrylonitrile	5 R	5 R	5 R	5 R	5 R	5 R	5 R	5 R	5 R	5 R
Benzene	0.5 U	0.5 U	0.5 U	0.06 J	0.5 U	0.5 U	0.04 J	0.07 J	0.1 J	0.5 U
Bromodichloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromoform	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromomethane	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ
Carbon Disulfide	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.06 J	0.05 J	0.5 U	0.15 J	0.5 U
Carbon Tetrachloride	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloroform	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U

APPENDIX D

GROUNDWATER ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB05	59SB06	59SB07	59SB08	59SB09	59SB10
Sample ID	59GW01	59GW02	59GW03	59GW04	59GW05	59GW06	59GW07	59GW08	59GW09	59GW10
Sample Date	5/22/2010	5/23/2010	5/22/2010	5/23/2010	5/22/2010	5/21/2010	5/21/2010	5/22/2010	5/21/2010	5/22/2010
Volatile Organics (µg/L) (cont.)										
Dibromochloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Dibromomethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Ethyl Methacrylate	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Ethylbenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Freon 11 (Trichlorofluoromethane)	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ
Freon-12 (Dichlorodifluoromethane)	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ
Isobutyl Alcohol	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R
Methyl Acrylonitrile	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Methyl Iodide	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ
Methyl Methacrylate	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Methylene Chloride	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Pentachloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Propionitrile (Ethyl Cyanide)	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R
Styrene (Ethenylbenzene)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Tetrachloroethene (PCE)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Toluene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Trichloroethene (TCE)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Vinyl Acetate	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Vinyl Chloride	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Xylene, m/p-	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Xylene, o-	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Xylenes, total	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Semivolatile Organics (µg/L)										
1,2,4,5-Tetrachlorobenzene	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
1,2,4-Trichlorobenzene	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
1,2-Dichlorobenzene (o-)	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
1,3,5-Trinitrobenzene (TNB)	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
1,3-Dichlorobenzene (m-)	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
1,3-Dinitrobenzene (m-)	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
1,4-Dichlorobenzene (p-)	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
1,4-Naphthoquinone	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
1,4-Phenylenediamine	51 R	54 R	51 R	51 R	51 R	51 R	51 R	51 R	52 R	51 R
1-Naphthylamine	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
2,2'-Oxybis[1-chloropropane]	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ

APPENDIX D

GROUNDWATER ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB05	59SB06	59SB07	59SB08	59SB09	59SB10
Sample ID	59GW01	59GW02	59GW03	59GW04	59GW05	59GW06	59GW07	59GW08	59GW09	59GW10
Sample Date	5/22/2010	5/23/2010	5/22/2010	5/23/2010	5/22/2010	5/21/2010	5/21/2010	5/22/2010	5/21/2010	5/22/2010
Semivolatile Organics (µg/L) (cont.)										
2,3,4,6-Tetrachlorophenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
2,4,5-Trichlorophenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
2,4,6-Trichlorophenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
2,4-Dichlorophenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
2,4-Dimethylphenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
2,4-Dinitrophenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
2,4-Dinitrotoluene (DNT)	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
2,6-Dichlorophenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
2,6-Dinitrotoluene (DNT)	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
2-Acetylaminofluorene	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
2-Chloronaphthalene	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
2-Chlorophenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
2-Methyl-5-nitroaniline	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
2-Methylphenol (o-Cresol)	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
2-Naphthylamine	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
2-Nitroaniline	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
2-Nitrophenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
2-Picoline	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
3,3'-Dichlorobenzidine	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
3,3'-Dimethylbenzidine	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
3-Methylcholanthrene	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
3-Methylphenol (m-Cresol)	8 UJ	8.4 UJ	8 UJ	8 UJ	8 UJ	8 UJ	8 UJ	8 UJ	8.2 UJ	8 UJ
3-Nitroaniline	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
4,6-Dinitro-2-methylphenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
4-Aminobiphenyl	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
4-Bromophenyl-phenylether	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
4-Chloro-3-methylphenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
4-Chloroaniline	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
4-Chlorophenyl-phenylether	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
4-Dimethylaminoazobenzene (p-)	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
4-Methylphenol (p-Cresol)	8 UJ	8.4 UJ	8 UJ	8 UJ	8 UJ	8 UJ	8 UJ	8 UJ	8.2 UJ	8 UJ
4-Nitroaniline	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
4-Nitrophenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
4-Nitroquinoline-1-oxide	5 R	5.3 R	5 R	5 R	5 UJ	5 R	5 R	5 R	5.1 R	5 R
7,12-Dimethylbenz(a)anthracene	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ

APPENDIX D

GROUNDWATER ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB05	59SB06	59SB07	59SB08	59SB09	59SB10
Sample ID	59GW01	59GW02	59GW03	59GW04	59GW05	59GW06	59GW07	59GW08	59GW09	59GW10
Sample Date	5/22/2010	5/23/2010	5/22/2010	5/23/2010	5/22/2010	5/21/2010	5/21/2010	5/22/2010	5/21/2010	5/22/2010
Semivolatile Organics (µg/L) (cont.)										
a,a-Dimethylphenethylamine	50 UJ	53 UJ	50 UJ	50 UJ	50 UJ	50 UJ	50 UJ	50 UJ	51 UJ	50 UJ
Acetophenone	2.5 UJ	2.6 UJ	2.5 UJ	2.5 UJ	2.5 UJ	2.5 UJ	2.5 UJ	2.5 UJ	2.6 UJ	2.5 UJ
Aniline	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Aramite	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Benzyl Alcohol	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Bis(2-chloroethoxy)methane	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Bis(2-chloroethyl)ether	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Bis(2-ethylhexyl) Phthalate (BEHP)	5 UJ	5.3 UJ	5 UJ	5 UJ	2.4 J	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Butyl Benzyl Phthalate	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Diallate (cis)	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Diallate (trans)	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Dibenzofuran	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Diethyl Phthalate (DEP)	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Dimethyl Phthalate	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Di-n-butyl Phthalate (DBP)	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Di-n-octyl Phthalate	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Dinoseb	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Ethyl Methane Sulfonate (EMS)	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Hexachloro-1,3-butadiene	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Hexachlorobenzene	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Hexachlorocyclopentadiene	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Hexachloroethane	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Hexachloropropene	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Isophorone	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Isosafrole	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Methapyrilene	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Methyl Methane Sulfonate	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Nitrobenzene	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
n-Nitrosodiethylamine	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
n-Nitrosodimethylamine (NDMA)	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
n-Nitroso-di-n-butylamine	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
n-Nitrosodi-n-propylamine	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
n-Nitrosodiphenylamine	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
n-Nitrosomethylethylamine	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
n-Nitrosomorpholine	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ

APPENDIX D

GROUNDWATER ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB05	59SB06	59SB07	59SB08	59SB09	59SB10
Sample ID	59GW01	59GW02	59GW03	59GW04	59GW05	59GW06	59GW07	59GW08	59GW09	59GW10
Sample Date	5/22/2010	5/23/2010	5/22/2010	5/23/2010	5/22/2010	5/21/2010	5/21/2010	5/22/2010	5/21/2010	5/22/2010
Semivolatile Organics (µg/L) (cont.)										
n-Nitrosopiperidine	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
n-Nitrosopyrrolidine	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
o-Toluidine	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Pentachlorobenzene	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Pentachloronitrobenzene	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Pentachlorophenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
Phenacetin	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Phenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
Pronamide	5 UJ	5.3 R	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Pyridine	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Safrole	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
LLPAHs (µg/L)										
2-Methylnaphthalene	0.2 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Acenaphthene	0.2 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Acenaphthylene	0.2 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Anthracene	0.2 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Benzo(a)anthracene	0.2 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Benzo(a)pyrene (BaP)	0.2 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Benzo(b)fluoranthene	0.2 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Benzo(g,h,i)perylene	0.2 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Benzo(k)fluoranthene	0.2 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Chrysene	0.2 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Dibenz(a,h)anthracene	0.2 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Fluoranthene	0.2 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Fluorene	0.2 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Indeno(1,2,3-cd)pyrene	0.2 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Naphthalene	0.2 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	1.3 J	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Phenanthrene	0.2 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.05 J
Pyrene	0.01 J	0.01 J	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Pesticides (µg/L)										
4,4'-DDD	0.11 U	0.11 U	0.11 U	0.1 U	0.1 U	0.1 U	0.1 U	0.11 U	0.1 U	0.11 U
4,4'-DDE	0.11 U	0.11 U	0.11 U	0.1 U	0.1 U	0.1 U	0.1 U	0.11 U	0.1 U	0.11 U
4,4'-DDT	0.11 U	0.11 U	0.11 U	0.1 U	0.1 U	0.1 U	0.1 U	0.11 U	0.1 U	0.11 U

APPENDIX D

GROUNDWATER ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB05	59SB06	59SB07	59SB08	59SB09	59SB10
Sample ID	59GW01	59GW02	59GW03	59GW04	59GW05	59GW06	59GW07	59GW08	59GW09	59GW10
Sample Date	5/22/2010	5/23/2010	5/22/2010	5/23/2010	5/22/2010	5/21/2010	5/21/2010	5/22/2010	5/21/2010	5/22/2010
Pesticides (µg/L)										
Aldrin	0.06 U	0.06 U	0.06 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
BHC, alpha-	0.06 U	0.06 U	0.06 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
BHC, beta-	0.06 U	0.06 U	0.06 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
BHC, delta-	0.06 U	0.06 U	0.06 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
BHC, gamma- (Lindane)	0.06 U	0.06 U	0.06 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Chlordane, alpha-	0.06 U	0.06 U	0.06 U	0.02 NJ	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Chlordane, gamma-	0.06 U	0.06 U	0.06 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Chlorobenzilate	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Dieldrin	0.11 U	0.11 U	0.11 U	0.1 U	0.1 U	0.1 U	0.1 U	0.11 U	0.1 U	0.11 U
Endosulfan I	0.06 U	0.06 U	0.06 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Endosulfan II	0.11 U	0.11 U	0.11 U	0.1 U	0.1 U	0.1 U	0.1 U	0.11 U	0.1 U	0.11 U
Endosulfan Sulfate	0.11 U	0.11 U	0.11 U	0.1 U	0.1 U	0.1 U	0.1 U	0.11 U	0.1 U	0.11 U
Endrin	0.11 U	0.11 U	0.11 U	0.1 U	0.1 U	0.1 U	0.1 U	0.11 U	0.1 U	0.11 U
Endrin Aldehyde	0.11 U	0.11 UJ	0.11 U	0.1 U	0.1 U	0.1 U	0.1 U	0.11 U	0.1 U	0.11 U
Heptachlor	0.06 U	0.06 U	0.06 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Heptachlor Epoxide	0.06 U	0.06 U	0.06 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Isodrin	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Kepone (Chlordecone)	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Methoxychlor	0.56 U	0.56 U	0.56 U	0.5 U	0.5 U	0.51 U	0.5 U	0.54 U	0.51 U	0.54 U
Toxaphene	2.8 U	2.8 U	2.8 U	2.5 U	2.5 U	2.6 U	2.5 U	2.7 U	2.6 U	2.7 U
Total Metals (µg/L)										
Antimony	0.5 J	2 U	0.52 J	0.36 J	0.26 J	2 U	0.26 J	2 U	0.54 J	2 U
Arsenic	6.2	4.5	1.1	2.9	3.1	4.1	4.3	0.94 J	2.9	2.1
Barium	22.2	46.5	20.4	16.2	6.5 J	49.1	15.1	27.9	7.5 J	34.4
Beryllium	1 U	1 U	0.06 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Cadmium	0.71 J	1 U	0.19 J	0.26 J	0.09 J	0.67 J	1 U	0.11 J	0.07 J	1 U
Chromium	1.4 J	0.48 J	5.5	0.6 J	1.3 J	2.2	0.67 J	0.46 J	0.58 J	0.6 J
Cobalt	2.6	2.1	5.8	1.9	1.5	5.5	0.81 J	0.77 J	0.3 J	1.8
Copper	21.3	4.7 J	20.1	8.7	8	10.9	8.2	3.9	5	4.3
Lead	1 U	1 U	5	1 U	1 U	1.7	1 U	1 U	1 U	1 U
Mercury	0.2 R	0.2 R	0.2 R	0.2 R	0.2 R	0.2 R	0.2 R	0.2 R	0.1 R	0.2 R
Nickel	8	1.2	4.6	2.8	2.1	3.9	2.4	1 U	1.6	1.8
Selenium	24.2	13.9	0.48 J	11.7	15.3	18.1	10.1	4.1 J	2.1 J	2.5 J
Silver	0.65 J	1 UJ	0.06 J	0.19 J	0.05 J	0.41 J	0.08 J	1 UJ	1 UJ	1 UJ

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CORRECTIVE MEASURES STUDY REPORT
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Site ID	59SB01	59SB02	59SB03	59SB04	59SB05	59SB06	59SB07	59SB08	59SB09	59SB10
Sample ID	59GW01	59GW02	59GW03	59GW04	59GW05	59GW06	59GW07	59GW08	59GW09	59GW10
Sample Date	5/22/2010	5/23/2010	5/22/2010	5/23/2010	5/22/2010	5/21/2010	5/21/2010	5/22/2010	5/21/2010	5/22/2010
Total Metals (µg/L) (cont.)										
Thallium	0.43 J	1 U	1 U	0.2 J	0.1 J	1 U	0.2 J	1 U	0.1 J	1 U
Tin	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Vanadium	24.9	9.2	66.2	20.2	107	22.2	97	30.1	85.1 J	171
Zinc	15 R	24.4 R	32.9 R	8.9 R	3.8 R	11.3 R	3.4 R	3 R	11.3 R	3.2 R
Dissolved Metals (µg/L)										
Antimony	0.45 J	0.23 J	0.3 J	0.47 J	0.23 J	2 U	0.25 J	2 U	0.44 J	2 U
Arsenic	5.3	4.4	0.92 J	2.7	3	3.7	4.2	1	2.4	2.3
Barium	21.3	44.7	4.6 J	13.7	6.1 J	45.7	15.7	27.3	6.6 J	31.5
Beryllium	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Cadmium	0.55 J	1 U	1 U	0.19 J	0.1 J	0.55 J	1 U	1 U	1 U	1 U
Chromium	1.4 J	0.54 J	2 U	0.6 J	1.2 J	1.3 J	0.69 J	0.27 J	0.47 J	0.33 J
Cobalt	2.6	2	0.4 J	1.3	1.3	3.5	0.84 J	0.69 J	0.19 J	1.5
Copper	19	5.8 J	2.3	9.7	8.2	8.3	8.4	3.4	4.3	3.9
Lead	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Mercury	0.2 R	0.2 R	0.2 R	0.2 R	0.2 R	0.2 R	0.2 R	0.2 R	0.2 R	0.2 R
Nickel	8.3	1.1	1 U	2.7	2.3	3.3	2.6	1 U	1.4	1.7
Selenium	23.8	14.1	0.6 J	12	16	19.3	10.4	4.7 J	2.2 J	2.8 J
Silver	0.05 J	1 U	1 U	0.06 J	1 U	1 U	1 U	1 U	1 U	1 U
Thallium	0.39 J	1 U	1 U	0.29 J	0.08 J	1 U	0.19 J	1 U	0.1 J	1 U
Tin	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Vanadium	22.8	9.5	57.6	19.8	106	16.8	102	29.6	113 J	179
Zinc	13.4 J	12.1 R	2.6 J	8.2 J	3.8 J	4.8 J	2.8 J	2 UJ	4.4 J	2 UJ

Notes:

J - Estimated: The analyte was positively identified; the quantitation is an estimation.
U - Non detected at the Reporting Limit.
UJ - Reported quantitation limit is qualified as estimated.
R - Rejected data; data is not usable.
LLPAHs - Low Level Polynuclear Aromatic Hydrocarbons
µg/L - microgram per liter

APPENDIX D

SURFACE WATER ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SW01	59SW02	59SW03
Sample ID	59SW01	59SW02	59SW03
Sample Date	4/20/2010	5/20/2010	5/20/2010
Volatile Organics (µg/L)			
1,1,1,2-Tetrachloroethane	0.5 U	0.5 U	0.5 U
1,1,1-Trichloroethane	0.5 U	0.5 U	0.5 U
1,1,2,2-Tetrachloroethane	0.5 UJ	0.5 U	0.5 U
1,1,2-Trichloroethane	0.5 UJ	0.5 U	0.5 U
1,1-Dichloroethane	0.5 U	0.5 U	0.5 U
1,1-Dichloroethene	0.5 U	0.5 U	0.5 U
1,2,3-Trichloropropane	0.5 UJ	0.5 U	0.5 U
1,2-Dibromo-3-chloropropane (DBCP)	0.5 UJ	0.5 U	0.5 U
1,2-Dibromoethane (EDB)	0.5 UJ	0.5 U	0.5 U
1,2-Dichloroethane	0.5 U	0.5 U	0.5 U
1,2-Dichloroethene (trans)	0.5 U	0.5 U	0.5 U
1,2-Dichloropropane	0.5 U	0.5 U	0.5 U
1,3-Dichloropropene (cis)	0.5 U	0.5 U	0.5 U
1,3-Dichloropropene (trans)	0.5 U	0.5 U	0.5 U
1,4-Dichloro-2-butene (trans)	2 UJ	2 U	2 U
1,4-Dioxane (p-)	25 R	25 R	25 R
2-Butanone (MEK)	2.5 R	2.5 R	2.5 R
2-Chloro-1,3-butadiene (Chloroprene)	0.5 U	0.5 U	0.5 U
2-Hexanone (MBK)	2.5 UJ	2.5 U	2.5 U
3-Chloropropene (Allyl Chloride)	0.5 U	0.5 U	0.5 U
4-Methyl-2-pentanone (MIBK)	2.5 UJ	2.5 U	2.5 U
Acetone	2.5 R	2.5 R	2.8 R
Acetonitrile	0.5 UJ	0.5 U	0.5 U
Acrolein	5 R	5 R	5 R
Acrylonitrile	5 R	5 R	5 R
Benzene	0.5 U	0.5 U	0.5 U
Bromodichloromethane	0.34 J	0.5 U	0.5 U
Bromoform	0.5 U	0.5 U	0.5 U
Bromomethane	0.5 U	0.5 U	0.5 U
Carbon Disulfide	0.5 U	0.5 U	0.021 J
Carbon Tetrachloride	0.5 U	0.5 U	0.5 U
Chlorobenzene	0.5 U	0.5 U	0.5 U
Chloroethane	0.5 U	0.5 U	0.5 U
Chloroform	1.2	0.5 U	0.5 U
Chloromethane	0.5 U	0.5 U	0.5 U
Dibromochloromethane	0.16 J	0.5 U	0.5 U
Dibromomethane	0.5 U	0.5 U	0.5 U
Ethyl Methacrylate	5 UJ	5 U	5 U
Ethylbenzene	0.5 U	0.5 U	0.5 U
Freon 11 (Trichlorofluoromethane)	0.5 U	0.5 UJ	0.5 UJ
Freon-12 (Dichlorodifluoromethane)	0.5 U	0.5 U	0.5 U
Isobutyl Alcohol	25 R	25 R	25 R
Methyl Acrylonitrile	5 UJ	5 U	5 U
Methyl Iodide	0.5 U	0.5 U	0.5 U
Methyl Methacrylate	5 U	5 U	5 U
Methylene Chloride	0.5 U	0.5 U	0.5 U
Pentachloroethane	0.5 U	0.5 U	0.5 U
Propionitrile (Ethyl Cyanide)	25 R	25 R	25 R
Styrene (Ethenylbenzene)	0.5 U	0.5 U	0.5 U
Tetrachloroethene (PCE)	0.5 U	0.5 U	0.5 U
Toluene	0.5 U	0.5 U	0.5 U

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SW01	59SW02	59SW03
Sample ID	59SW01	59SW02	59SW03
Sample Date	4/20/2010	5/20/2010	5/20/2010
Volatile Organics (µg/L) (cont.)			
Trichloroethene (TCE)	0.5 UJ	0.5 U	0.5 U
Vinyl Acetate	1 UJ	1 U	1 U
Vinyl Chloride	0.5 U	0.5 U	0.5 U
Xylene, m/p-	1 U	1 U	1 U
Xylene, o-	0.5 U	0.5 U	0.5 U
Xylenes, total	0.5 U	0.5 U	0.5 U
Semivolatile Organics (µg/L)			
1,2,4,5-Tetrachlorobenzene	5 U	5.1 UJ	5 UJ
1,2,4-Trichlorobenzene	5 U	5.1 UJ	5 UJ
1,2-Dichlorobenzene (o-)	5 U	5.1 UJ	5 UJ
1,3,5-Trinitrobenzene (TNB)	5 UJ	5.1 UJ	5 UJ
1,3-Dichlorobenzene (m-)	5 U	5.1 UJ	5 UJ
1,3-Dinitrobenzene (m-)	5 U	5.1 UJ	5 UJ
1,4-Dichlorobenzene (p-)	5 U	5.1 UJ	5 UJ
1,4-Naphthoquinone	5 U	5.1 UJ	5 UJ
1,4-Phenylenediamine	51 R	52 R	51 R
1-Naphthylamine	5 U	5.1 UJ	5 UJ
2,2'-Oxybis[1-chloropropane]	5 U	5.1 UJ	5 UJ
2,3,4,6-Tetrachlorophenol	10 U	10 UJ	10 UJ
2,4,5-Trichlorophenol	10 U	10 UJ	10 UJ
2,4,6-Trichlorophenol	10 U	10 UJ	10 UJ
2,4-Dichlorophenol	10 U	10 UJ	10 UJ
2,4-Dimethylphenol	10 U	10 UJ	10 UJ
2,4-Dinitrophenol	10 UJ	10 UJ	10 UJ
2,4-Dinitrotoluene (DNT)	5 U	5.1 UJ	5 UJ
2,6-Dichlorophenol	10 U	10 UJ	10 UJ
2,6-Dinitrotoluene (DNT)	5 U	5.1 UJ	5 UJ
2-Acetylaminofluorene	5 U	5.1 UJ	5 UJ
2-Chloronaphthalene	5 U	5.1 UJ	5 UJ
2-Chlorophenol	10 U	10 UJ	10 UJ
2-Methyl-5-nitroaniline	5 U	5.1 UJ	5 UJ
2-Methylphenol (o-Cresol)	10 U	10 UJ	10 UJ
2-Naphthylamine	5 U	5.1 UJ	5 UJ
2-Nitroaniline	5 U	5.1 UJ	5 UJ
2-Nitrophenol	10 U	10 UJ	10 UJ
2-Picoline	5 U	5.1 UJ	5 UJ
3,3'-Dichlorobenzidine	5 U	5.1 UJ	5 UJ
3,3'-Dimethylbenzidine	5 U	5.1 UJ	5 UJ
3-Methylcholanthrene	5 U	5.1 UJ	5 UJ
3-Methylphenol (m-Cresol)	8 U	8.2 UJ	8 UJ
3-Nitroaniline	5 U	5.1 UJ	5 UJ
4,6-Dinitro-2-methylphenol	10 U	10 UJ	10 UJ
4-Aminobiphenyl	5 U	5.1 UJ	5 UJ
4-Bromophenyl-phenylether	5 U	5.1 UJ	5 UJ
4-Chloro-3-methylphenol	10 U	10 UJ	10 UJ
4-Chloroaniline	5 U	5.1 UJ	5 UJ
4-Chlorophenyl-phenylether	5 U	5.1 UJ	5 UJ
4-Dimethylaminoazobenzene (p-)	5 U	5.1 UJ	5 UJ
4-Methylphenol (p-Cresol)	8 U	8.2 UJ	8 UJ
4-Nitroaniline	5 U	5.1 UJ	5 UJ

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CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SW01	59SW02	59SW03
Sample ID	59SW01	59SW02	59SW03
Sample Date	4/20/2010	5/20/2010	5/20/2010
Semivolatile Organics (µg/L) (cont.)			
4-Nitrophenol	10 U	10 UJ	10 UJ
4-Nitroquinoline-1-oxide	5 U	5.1 R	5 R
7,12-Dimethylbenz(a)anthracene	5 U	5.1 UJ	5 UJ
a,a-Dimethylphenethylamine	50 UJ	51 UJ	50 UJ
Acetophenone	2.5 U	2.6 UJ	2.5 UJ
Aniline	5 U	5.1 UJ	5 UJ
Aramite	5 U	5.1 UJ	5 UJ
Benzyl Alcohol	5 UJ	5.1 UJ	5 UJ
Bis(2-chloroethoxy)methane	5 U	5.1 UJ	5 UJ
Bis(2-chloroethyl)ether	5 U	5.1 UJ	5 UJ
Bis(2-ethylhexyl) Phthalate (BEHP)	5 U	5.1 UJ	5 UJ
Butyl Benzyl Phthalate	5 U	5.1 UJ	5 UJ
Diallate (cis)	5 U	5.1 UJ	5 UJ
Diallate (trans)	5 U	5.1 UJ	5 UJ
Dibenzofuran	5 U	5.1 UJ	5 UJ
Diethyl Phthalate (DEP)	5 U	5.1 UJ	5 UJ
Dimethyl Phthalate	5 U	5.1 UJ	5 UJ
Di-n-butyl Phthalate (DBP)	5 U	5.1 UJ	5 UJ
Di-n-octyl Phthalate	5 U	5.1 UJ	5 UJ
Dinoseb	NA	5.1 UJ	5 UJ
Ethyl Methane Sulfonate (EMS)	5 U	5.1 UJ	5 UJ
Hexachloro-1,3-butadiene	5 U	5.1 UJ	5 UJ
Hexachlorobenzene	5 U	5.1 UJ	5 UJ
Hexachlorocyclopentadiene	5 U	5.1 UJ	5 UJ
Hexachloroethane	5 U	5.1 UJ	5 UJ
Hexachloropropene	5 U	5.1 UJ	5 UJ
Isophorone	5 U	5.1 UJ	5 UJ
Isosafrole	5 U	5.1 UJ	5 UJ
Methapyrilene	5 U	5.1 UJ	5 UJ
Methyl Methane Sulfonate	5 U	5.1 UJ	5 UJ
Nitrobenzene	5 U	5.1 UJ	5 UJ
n-Nitrosodiethylamine	5 U	5.1 UJ	5 UJ
n-Nitrosodimethylamine (NDMA)	5 U	5.1 UJ	5 UJ
n-Nitroso-di-n-butylamine	5 U	5.1 UJ	5 UJ
n-Nitrosodi-n-propylamine	5 U	5.1 UJ	5 UJ
n-Nitrosodiphenylamine	5 U	5.1 UJ	5 UJ
n-Nitrosomethylethylamine	5 U	5.1 UJ	5 UJ
n-Nitrosomorpholine	5 U	5.1 UJ	5 UJ
n-Nitrosopiperidine	5 U	5.1 UJ	5 UJ
n-Nitrosopyrrolidine	5 U	5.1 UJ	5 UJ
o-Toluidine	5 U	5.1 UJ	5 UJ
Pentachlorobenzene	5 U	5.1 UJ	5 UJ
Pentachloronitrobenzene	5 U	5.1 UJ	5 UJ
Pentachlorophenol	10 U	10 UJ	10 UJ
Phenacetin	5 U	5.1 UJ	5 UJ
Phenol	10 U	10 UJ	10 UJ
Pronamide	10 U	5.1 UJ	5 UJ
Pyridine	5 U	5.1 UJ	5 UJ
Safrole	5 U	5.1 UJ	5 UJ

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CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SW01	59SW02	59SW03
Sample ID	59SW01	59SW02	59SW03
Sample Date	4/20/2010	5/20/2010	5/20/2010
LLPAHs (µg/L)			
2-Methylnaphthalene	0.2 UJ	0.21 UJ	0.2 UJ
Acenaphthene	0.2 U	0.21 UJ	0.2 UJ
Acenaphthylene	0.2 U	0.21 UJ	0.2 UJ
Anthracene	0.2 U	0.21 UJ	0.2 UJ
Benzo(a)anthracene	0.2 U	0.21 UJ	0.2 UJ
Benzo(a)pyrene (BaP)	0.2 U	0.21 UJ	0.2 UJ
Benzo(b)fluoranthene	0.2 U	0.21 UJ	0.2 UJ
Benzo(g,h,i)perylene	0.2 U	0.21 UJ	0.2 UJ
Benzo(k)fluoranthene	0.2 UJ	0.21 UJ	0.2 UJ
Chrysene	0.2 U	0.21 UJ	0.2 UJ
Dibenz(a,h)anthracene	0.2 U	0.21 UJ	0.2 UJ
Fluoranthene	0.2 U	0.019 J	0.017 J
Fluorene	0.2 U	0.21 UJ	0.2 UJ
Indeno(1,2,3-cd)pyrene	0.2 U	0.21 UJ	0.2 UJ
Naphthalene	0.2 U	0.21 UJ	0.2 UJ
Phenanthrene	0.2 U	0.21 UJ	0.2 UJ
Pyrene	0.2 U	0.02 J	0.018 J
Pesticides (µg/L)			
4,4'-DDD	0.1 U	0.1 U	0.1 U
4,4'-DDE	0.006 J	0.1 U	0.1 U
4,4'-DDT	0.007 J	0.1 U	0.1 U
Aldrin	0.05 U	0.05 U	0.051 U
BHC, alpha-	0.05 U	0.05 U	0.051 U
BHC, beta-	0.05 U	0.05 U	0.051 U
BHC, delta-	0.05 U	0.05 U	0.051 U
BHC, gamma- (Lindane)	0.05 U	0.05 U	0.051 U
Chlordane, alpha-	0.05 U	0.05 U	0.051 U
Chlordane, gamma-	0.05 U	0.05 U	0.051 U
Chlorobenzilate	5 U	5.1 UJ	5 UJ
Dieldrin	0.1 U	0.1 U	0.1 U
Endosulfan I	0.05 U	0.05 U	0.051 U
Endosulfan II	0.1 U	0.1 U	0.1 U
Endosulfan Sulfate	0.1 U	0.1 U	0.1 U
Endrin	0.1 U	0.1 U	0.1 U
Endrin Aldehyde	0.1 R	0.1 U	0.1 U
Heptachlor	0.05 U	0.05 U	0.051 U
Heptachlor Epoxide	0.05 U	0.05 U	0.051 U
Isodrin	5 U	5.1 UJ	5 UJ
Kepone (Chlordecone)	5 U	5.1 UJ	5 UJ
Methoxychlor	0.5 U	0.5 U	0.51 U
Toxaphene	2.5 U	2.5 U	2.6 U
Total Metals (µg/L)			
Antimony	2 U	0.26 J	0.23 J
Arsenic	0.49 J	0.44 J	0.42 J
Barium	21.4	19.9	19.4
Beryllium	1 U	1 U	1 U
Cadmium	1 U	1 U	1 U
Calcium	18900	NA	NA
Chromium	0.68 J	0.76 J	0.75 J

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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SW01	59SW02	59SW03
Sample ID	59SW01	59SW02	59SW03
Sample Date	4/20/2010	5/20/2010	5/20/2010
Total Metals (µg/L) (cont.)			
Cobalt	0.32 J	0.34 J	0.34 J
Copper	3.8	4	4
Lead	1 U	1 U	1 U
Magnesium	5000 U	NA	NA
Mercury	0.2 U	0.2 R	0.2 R
Nickel	1 U	1 U	1 U
Selenium	0.75 J	0.52 J	0.47 J
Silver	1 U	1 UJ	1 UJ
Thallium	1 U	1 U	1 U
Tin	20 U	20 U	20 U
Vanadium	7	7.6	7.3
Zinc	7.9 J	7 R	7.1 R
Dissolved Metals (µg/L)			
Antimony	2 U	0.23 J	0.23 J
Arsenic	0.52 J	0.41 J	0.4 J
Barium	20.5	17.8	17.7
Beryllium	1 U	1 U	1 U
Cadmium	1 U	1 U	1 U
Chromium	0.39 J	0.4 J	0.39 J
Cobalt	0.084 J	0.062 J	0.061 J
Copper	3.1	3	2.9
Lead	1 U	1 U	1 U
Mercury	0.2 U	0.2 R	0.2 R
Nickel	1 U	1 U	1 U
Selenium	0.82 J	0.51 J	0.48 J
Silver	1 U	1 U	1 U
Thallium	1 U	1 U	1 U
Tin	20 U	20 U	20 U
Vanadium	6.3	6.1	6.1
Zinc	5.5 J	2.2 J	2.4 J

Notes:

J - Estimated: The analyte was positively identified; the quantitation is an estimation.
U - Non detected at the Reporting Limit.
UJ - Reported quantitation limit is qualified as estimated.
R - Rejected data; data is not usable.
µg/L - microgram per liter
LLPAHs - Low Level Polynuclear Aromatic Hydrocarbons

APPENDIX D

SEDIMENT ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SD01	59SD02	59SD03	59SD04	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Sample ID	59SD01	59SD02	59SD03	59SD04	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Sample Date	4/22/2010	5/20/2010	5/20/2010	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012
	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5
Volatile Organics (µg/kg)												
1,1,1,2-Tetrachloroethane	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethene	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,3-Trichloropropane	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dibromo-3-chloropropane (DBCP)	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dibromoethane (EDB)	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloroethane	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloroethene (trans)	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Dichloropropene (cis)	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Dichloropropene (trans)	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dichloro-2-butene (trans)	42 UJ	47 UJ	27 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dioxane (p-)	530 R	590 R	340 R	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Butanone (MEK)	26 UJ	29 UJ	17 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Chloro-1,3-butadiene (Chloroprene)	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Hexanone (MBK)	26 UJ	29 UJ	17 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
3-Chloropropene (Allyl Chloride)	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Methyl-2-pentanone (MIBK)	26 UJ	29 UJ	17 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acetone	28 R	150 J	78	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acetonitrile	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acrolein	110 R	120 R	67 R	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acrylonitrile	110 R	120 UJ	67 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bromodichloromethane	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bromoform	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bromomethane	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbon Disulfide	2.3 J	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbon Tetrachloride	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzene	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroethane	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloromethane	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibromochloromethane	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA

APPENDIX D

SEDIMENT ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SD01	59SD02	59SD03	59SD04	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Sample ID	59SD01	59SD02	59SD03	59SD04	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Sample Date	4/22/2010	5/20/2010	5/20/2010	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012
	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5
Volatile Organics (µg/kg) (cont.)												
Dibromomethane	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethyl Methacrylate	110 UJ	120 UJ	67 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Freon 11 (Trichlorofluoromethane)	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Freon-12 (Dichlorodifluoromethane)	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Isobutyl Alcohol	530 R	590 R	340 R	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Acrylonitrile	110 UJ	120 UJ	67 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Iodide	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Methacrylate	110 UJ	120 R	67 R	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methylene Chloride	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachloroethane	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Propionitrile (Ethyl Cyanide)	530 R	590 R	340 R	NA	NA	NA	NA	NA	NA	NA	NA	NA
Styrene (Ethenylbenzene)	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene (PCE)	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Toluene	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethene (TCE)	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Acetate	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Chloride	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Xylene, m/p-	0.79 J	24 UJ	13 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Xylene, o-	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Xylenes, total	0.79 J	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organics (µg/kg)												
1,2,4,5-Tetrachlorobenzene	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene (o-)	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3,5-Trinitrobenzene (TNB)	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Dichlorobenzene (m-)	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Dinitrobenzene (m-)	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene (p-)	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Naphthoquinone	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Phenylenediamine	3500 R	3600 R	3100 R	NA	NA	NA	NA	NA	NA	NA	NA	NA
1-Naphthylamine	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,2'-Oxybis[1-chloropropane]	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,3,4,6-Tetrachlorophenol	690 UJ	700 UJ	600 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4,5-Trichlorophenol	690 UJ	700 UJ	600 U	NA	NA	NA	NA	NA	NA	NA	NA	NA

APPENDIX D

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SD01	59SD02	59SD03	59SD04	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Sample ID	59SD01	59SD02	59SD03	59SD04	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Sample Date	4/22/2010	5/20/2010	5/20/2010	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012
	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5
Semivolatile Organics (µg/kg) (cont.)												
2,4,6-Trichlorophenol	690 UJ	700 UJ	600 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dichlorophenol	690 UJ	700 UJ	600 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dimethylphenol	690 UJ	700 UJ	600 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrophenol	690 UJ	700 UJ	600 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrotoluene (DNT)	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,6-Dichlorophenol	690 UJ	700 UJ	600 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,6-Dinitrotoluene (DNT)	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Acetylaminofluorene	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Chloronaphthalene	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Chlorophenol	690 UJ	700 UJ	600 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Methyl-5-nitroaniline	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylphenol (o-Cresol)	690 UJ	700 UJ	600 UJ	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Naphthylamine	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Nitroaniline	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Nitrophenol	690 UJ	700 UJ	600 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Picoline	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
3,3'-Dichlorobenzidine	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
3,3'-Dimethylbenzidine	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
3-Methylcholanthrene	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
3-Methylphenol (m-Cresol)	520 UJ	530 UJ	450 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
3-Nitroaniline	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,6-Dinitro-2-methylphenol	690 UJ	700 UJ	600 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Aminobiphenyl	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Bromophenyl-phenylether	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chloro-3-methylphenol	690 UJ	700 UJ	600 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chloroaniline	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chlorophenyl-phenylether	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Dimethylaminoazobenzene (p-)	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Methylphenol (p-Cresol)	520 UJ	530 UJ	450 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Nitroaniline	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Nitrophenol	690 UJ	700 UJ	600 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Nitroquinoline-1-oxide	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
7,12-Dimethylbenz(a)anthracene	350 UJ	360 UJ	310 UJ	NA	NA	NA	NA	NA	NA	NA	NA	NA
a,a-Dimethylphenethylamine	690 UJ	1000 UJ	850 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acetophenone	180 UJ	180 UJ	150 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aniline	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SD01	59SD02	59SD03	59SD04	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Sample ID	59SD01	59SD02	59SD03	59SD04	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Sample Date	4/22/2010	5/20/2010	5/20/2010	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012
	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5
Semivolatile Organics (µg/kg) (cont.)												
Aramite	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzyl Alcohol	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bis(2-chloroethoxy)methane	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bis(2-chloroethyl)ether	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bis(2-ethylhexyl) Phthalate (BEHP)	140 J	110 J	730	NA	NA	NA	NA	NA	NA	NA	NA	NA
Butyl Benzyl Phthalate	63 J	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Diallate (cis)	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Diallate (trans)	350 UJ	360 UJ	310 UJ	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzofuran	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Diethyl Phthalate (DEP)	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dimethyl Phthalate	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-butyl Phthalate (DBP)	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-octyl Phthalate	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dinoseb	NA	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethyl Methane Sulfonate (EMS)	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloro-1,3-butadiene	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorocyclopentadiene	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloroethane	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloropropene	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Isophorone	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Isosafrole	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methapyrilene	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Methane Sulfonate	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrobenzene	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Nitrosodiethylamine	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Nitrosodimethylamine (NDMA)	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Nitroso-di-n-butylamine	350 UJ	360 UJ	310 UJ	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Nitrosodi-n-propylamine	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Nitrosodiphenylamine	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Nitrosomethylethylamine	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Nitrosomorpholine	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Nitrosopiperidine	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Nitrosopyrrolidine	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
o-Toluidine	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorobenzene	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SD01	59SD02	59SD03	59SD04	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Sample ID	59SD01	59SD02	59SD03	59SD04	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Sample Date	4/22/2010	5/20/2010	5/20/2010	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012
	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5
Semivolatile Organics (µg/kg) (cont.)												
Pentachloronitrobenzene	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	690 UJ	700 UJ	600 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenacetin	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenol	690 UJ	700 UJ	600 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pronamide	690 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyridine	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Safrole	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
LLPAHs (µg/kg)												
2-Methylnaphthalene	4.4 J	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthene	17 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthylene	1.6 J	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Anthracene	4.6 J	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	5 J	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene (BaP)	17 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	17 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	17 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	17 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	6.9 J	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenz(a,h)anthracene	17 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	7.2 J	360 UJ	36 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluorene	2.3 J	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	8.3 J	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	17 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	6.3 J	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	8.8 J	360 UJ	41 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides (µg/kg)												
4,4'-DDD	1.6 J	2.6 J	5.9 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE	35 J	32 J	160	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT	1.3 J	7 UJ	6 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aldrin	3.5 UJ	3.6 UJ	0.66 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
BHC, alpha-	3.5 UJ	3.6 UJ	3.1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
BHC, beta-	1.8 UJ	1.8 UJ	1.5 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
BHC, delta-	3.5 UJ	3.6 UJ	3.1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
BHC, gamma- (Lindane)	3.5 UJ	3.6 UJ	3.1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SD01	59SD02	59SD03	59SD04	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Sample ID	59SD01	59SD02	59SD03	59SD04	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Sample Date	4/22/2010	5/20/2010	5/20/2010	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012
	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5
Pesticides (µg/kg) (cont.)												
Chlordane, alpha-	2.1 NJ	25 NJ	3.1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chlordane, gamma-	18 J	31 J	3.1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzilate	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dieldrin	0.9 J	7 UJ	6 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan I	3.5 UJ	3.6 UJ	3.1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan II	6.9 UJ	7 UJ	6 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan Sulfate	6.9 UJ	7 UJ	6 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endrin	6.9 UJ	7 UJ	6 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endrin Aldehyde	1.1 J	0.87 J	6 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor	3.5 UJ	1.2 J	3.1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor Epoxide	3.5 UJ	3.6 UJ	3.1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Isodrin	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kepone (Chlordecone)	350 UJ	360 U	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methoxychlor	35 UJ	36 UJ	31 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Toxaphene	170 UJ	180 UJ	150 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Metals (mg/kg)												
Antimony	2.1 UJ	0.8 J	0.58 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	0.98 J	0.65 J	1.5	NA	NA	NA	NA	NA	NA	NA	NA	NA
Barium	81.6 J	164 J	109 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	0.38 J	0.45 J	0.35 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	0.9 J	0.69 J	0.99 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	39.1 J	42.1 J	37.3	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt	20.9 J	31.9 J	22.4 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Copper	125 J	144 J	90.7 J	107	187 J	160 J	87.6 J	134 J	36.2 J	78.3 J	161 J	52.4 J
Lead	71.2 J	37.6 R	36.9 R	45.3 J	55 J	70 J	20.4 J	23.1 J	4.92 J	10.9 J	22.6 J	4.93 J
Mercury	0.087	0.033 J	0.19	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	18.7 J	22.6 J	28.1	NA	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	0.8 J	1 J	0.69 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Silver	0.17 J	0.23 J	0.17 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	1 UJ	0.14 J	0.053 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tin	10.4 UJ	10.5 UJ	8.1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	156 J	232 J	144 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	122 J	139 J	176	193 J	357 J	319 J	191 J	154 J	71.7 J	108 J	232 J	262 J

APPENDIX D

SEDIMENT ANALYTICAL DATA USED IN THE ECOLOGICAL RISK ASSESSMENT
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SD01	59SD02	59SD03	59SD04	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Sample ID	59SD01	59SD02	59SD03	59SD04	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Sample Date	4/22/2010	5/20/2010	5/20/2010	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012
	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5
TOC (mg/kg)												
Total Organic Carbon	21290	21000	68100	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEM Metals (umole/g)												
Cadmium	NA	0.00305	0.00269	NA	NA	NA	NA	NA	NA	NA	NA	NA
Copper	NA	0.588	0.339	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead	NA	0.071 J	0.0485 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	NA	0.075	0.066	NA	NA	NA	NA	NA	NA	NA	NA	NA
Silver	NA	0.0018 U	0.0014 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	NA	0.92	1.12	NA	NA	NA	NA	NA	NA	NA	NA	NA
AVS (umole/g)												
Sulfide	NA	0.17 U	0.15	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEM total (umole/g)	NA	1.65795	1.57689	NA	NA	NA	NA	NA	NA	NA	NA	NA
SEM-to-AVS ratio	NA	9.75265	10.5126	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

J - Estimated: The analyte was positively identified; the quantitation is an estimation.
U - Non detected at the Reporting Limit/Limit of Detection.
UJ - Reported quantitation limit is qualified as estimated.
NJ - Analyte has been tentatively identified.; the quantitation is an estimation.
R - Rejected data; data is not usable.
AVS - Acid Volatile Sulfide
LLPAHs - Low Level Polynuclear Aromatic Hydrocarbons
µg/kg - microgram per kilogram
µmole/g - micromole per gram
mg/kg - milligram per kilogram
NA - Not Analyzed
SEM - Simultaneously Extracted Metals
TOC - Total Organic Carbon

APPENDIX E
EQUILIBRIUM PARTITIONING APPROACH

APPENDIX E

EQUILIBRIUM PARTITIONING APPROACH

The United States Environmental Protection Agency (USEPA, 1993) has chosen the equilibrium partitioning (EqP) approach for developing sediment quality criteria for nonionic organic chemicals. This approach was used in the screening level ecological risk assessment (SERA) for SWMU 59 to derive freshwater sediment screening values for organic chemicals lacking literature-based, bulk sediment screening values.

There are three underlying assumptions to the derivation of sediment quality criteria using EqP. First, it is assumed that sediment toxicity correlates with the concentration of the chemical in the sediment pore water and not the bulk sediment concentration (i.e., the pore water concentration represents the bioavailable fraction). Second, partitioning between sediment pore water and bulk sediment is assumed to be dependent on the organic content of the sediment with little dependence upon other chemical or physical properties. Third, the EqP approach assumes that equilibrium has been attained between the sediment pore water concentration and the bulk sediment concentration.

The relationship between the concentration of a nonionic organic chemical in sediment pore water and bulk sediment is described by the partitioning coefficient, K_p (USEPA, 1993):

$$K_p = (C_s)/(C_{pw}) \quad \text{(Equation E-1)}$$

Where C_s is the concentration in bulk sediment and C_{pw} is the concentration in sediment pore water. For a given organic chemical, the partition coefficient can be derived by multiplying the fraction of organic carbon (f_{oc}) present in the sediment by the chemical's organic carbon partition coefficient (K_{oc}) (USEPA, 1993):

$$K_p = (f_{oc})(K_{oc}) \quad \text{(Equation E-2)}$$

Combining Equations E-1 and E-2 yields the following:

$$C_s = (K_{oc})(f_{oc})(C_{PW}) \quad \text{(Equation E-3)}$$

If the organic carbon content of the sediment is known, a site-specific sediment screening value (SSV) can be calculated for a given organic chemical by setting C_{pw} equivalent to a conservative surface water screening value for that chemical (SWSV):

$$SSV = (K_{oc})(f_{oc})(SWSV) \quad \text{(Equation E-4)}$$

In this equation, SSV represents the concentration of the chemical in bulk sediment that, at equilibrium, will result in a sediment pore water concentration equal to the surface water screening value. Sediment concentrations less than SSV would be protective of sediment-associated biota. The use of surface water screening values (i.e., criteria and toxicological benchmarks) in Equation E-4 assumes that the sensitivities of sediment-associated biota and the species typically tested to derive surface water screening values such as USEPA NAWQC (predominantly water column species) are similar. Furthermore, it assumes that levels of protection afforded by the surface water screening values are appropriate for sediment-associated biota. It is noted that the EqP approach can only be used if the total organic carbon (TOC) content in sediment is greater than 0.2 percent (i.e., 2,000 mg/kg). At TOC concentrations less

than 0.2 percent, other factors (e.g., particle size, sorption to nonorganic mineral fractions) become relatively more important (USEPA, 1993).

Although the EqP approach was developed by the USEPA for nonionic organic chemicals (e.g. semi-volatile organic chemicals [SVOCs]), this method was used to derive sediment screening values for all organic chemicals lacking literature-based, bulk sediment screening values, including ionic organic chemicals (e.g., volatile organic chemicals [VOCs]). Application of the EqP approach to ionic organic chemicals likely overestimates their pore water concentrations since adsorption mechanisms other than hydrophobicity may significantly increase the fraction of the chemical sorbed to sediment particles (Jones et al., 1997). The overly conservative nature of sediment quality benchmarks derived using EqP is documented in the literature (Fuschman, 2003). Regardless, application of the EqP approach to the development of sediment screening values for ionic chemicals is documented in the literature (USEPA, 1996 and Jones et al., 1997).

Sediment screening values derived using EqP (see Table 7-8) are based on a f_{oc} of 0.021. This value represents the minimum f_{oc} measured in drainage ditch sediment collected at SWMU 59 during the 2010 CMS field investigation. K_{oc} values used in the derivation of EqP-based sediment screening values are those listed in Table 7-3. The K_{oc} values listed in Table 7-3 were estimated from the following equation (USEPA, 1993 and 1996):

$$Log\ K_{oc} = 0.00028 + (0.983)(Log\ K_{ow}) \quad \text{(Equation E-5)}$$

In this equation, log K_{ow} represented the log octanol-water partition coefficient. The surface water screening values used to derive EqP-based sediment screening values for organic chemicals lacking bulk sediment screening values are listed within Table 7-7. They were identified from the literature using the sources and procedures presented in Section 7.4.1.3. It is noted that EqP-based sediment screening values could not be calculated for those organic chemicals lacking a surface water screening value.

Appendix E References

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APPENDIX F
IDENTIFICATION OF BIOACCUMULATIVE CHEMICALS

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IDENTIFICATION OF BIOACCUMULATIVE CHEMICALS

Only those organic chemicals with a log octanol-water partition coefficient (K_{ow}) value greater than or equal to 3.0 will be considered a bioaccumulative chemical. Justification for defining bioaccumulative organic chemicals as those with log K_{ow} values greater than or equal to 3.0 is provided below.

- The potential for organic chemicals to accumulate in organisms has been shown to correlate well with the K_{ow}. USEPA (1985), as sited in USEPA/ACOE (1998), recommends that only chemicals for which the log K_{ow} is greater than 3.5 be considered for evaluation of bioaccumulation potential since chemicals with log K_{ow} values less than 3.5 are not likely to bioaccumulate to a significant degree.

- Although organic chemicals with log K_{ow} values in the 2 to 7 range have at least some potential to bioconcentrate (Connell, 1990), significant bioconcentration does not generally occur for chemicals with log K_{ow} values less than 3.0 (Maki and Duthie, 1978) to 5.0 (Gobas and Mackay, 1990). Most work with bioconcentration (uptake from the surrounding medium, such as water) and bioaccumulation (uptake from all exposure routes, including via food) of organic chemicals has concerned chemicals with log K_{ow} values of 3.0 or more (USEPA, 1995a), since organic chemicals with lower log K_{ow} values generally have little potential for significant bioaccumulation.

- The USEPA has developed a number of scoring algorithms to evaluate the relative hazard of chemicals to human or ecological receptors. All of these algorithms have a component that addresses bioaccumulation potential. The evaluation of bioaccumulation potential is generally based on measured or estimated (using log K_{ow} values) BCFs or BAFs, or less commonly using log K_{ow} itself. For example, USEPA (1980) developed a bioaccumulation potential scoring system that considered organics with BCF values of less than 100 (equivalent to a log K_{ow} of approximately 3.0) to have negligible potential to bioaccumulate in aquatic food webs, while organic chemicals with BCFs in the 100 to 1,000 range (equivalent to log K_{ow} values of about 3.0 to 4.3) are considered to have low bioaccumulation potential. The more recent Scoring and Ranking Assessment Model (SCRAM), developed by EPA Region 5 for the Great Lakes, has similar bioaccumulation scoring cut-offs (USEPA, 2000).

- The proposed categorization of persistent, bioaccumulative, and toxic (PBT) chemicals under the Toxic Substances Control Act (TSCA) defines chemicals with a tendency to accumulate in organisms as those with a BCF or BAF of greater than 1,000 (Federal Register 63(192):53417; 10/5/98). Using the equation listed below (USEPA, 1995b), a BCF/BAF of 1,000 equates to a log K_{ow} value of approximately 4.3.

$$Log\ BCF = [(0.79)(\log K_{ow}) - 0.40] \qquad \text{(Equation F-1)}$$

- The Beta Test Version 1.0 of the EPA Waste Minimization Prioritization Tool (WMPT), used to develop a list of PBTs for the Resource Conservation and Recovery Act (RCRA) program, defined organic chemicals with a low potential to bioaccumulate as those with log K_{ow} values of less than 3.5 and those with a high potential to bioaccumulate as those with log K_{ow} values greater than 5.0 (USEPA, 1998). The 1998 version of the EPA WMPT defines bioaccumulation potential based on BCF or BAF values (rather than on log K_{ow} values directly), with a scoring "fenceline" for organic chemicals with a low

bioaccumulation potential defined as a BCF or BAF of less than 250. Although the tool no longer uses log K_{ow} directly, log K_{ow} values can be used to estimate a BCF or BAF value. Using Equation F-1, a BCF/BAF of 250 equates to a log K_{ow} value of approximately 3.5.

- Garten and Trabalka (1983) have reviewed terrestrial food web data and concluded that only organic chemicals with log K_{ow} values greater than 3.5 have the potential to significantly bioaccumulate from food to birds to mammals.

The information listed above indicates that a log K_{ow} of 3.0 to 3.5 is a reasonable, non-arbitrary parameter value to use in defining an organic chemical with the potential to bioaccumulate. For conservatism, the low end (3.0) of this log K_{ow} range will be used to define a bioaccumulative organic chemical. Table 7-3 lists log K_{ow} values (range and recommended value) for the volatiles, semi-volatiles, and pesticides that were analyzed for in media collected at SWMU 59. Log K_{ow} values were primarily obtained from the USEPA (1995c and 2011). The recommended value from these sources generally represents a "high-end" or best estimate from empirical data. The organic chemicals that will be evaluated in the dietary intake models are those with a log K_{ow} value of greater than or equal to 3.0. For conservatism, the maximum value in the log K_{ow} range is used for this determination, not the recommended value.

Inorganic chemicals were not quantitatively screened for bioaccumulation potential since log K_{ow} values are not available for these chemicals. Although all Appendix IX metals are retained for evaluation in the upper trophic level food chain models, only mercury and selenium are known to biomagnify in food chains (in organic forms [Suter II, 1993]) and only cadmium, copper, and zinc generally have the potential to bioaccumulate significantly. The other metals are retained by default.

Appendix F References

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APPENDIX G
SERA DIETARY DOSE TABLES

TABLE G-1
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR MOURNING DOVE DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical	Surface Water Concentration [1] (mg/L)	Surface Soil Concentration [2] (mg/kg)	Soil-to-Plant BAF/Uptake Equation (unitless)	Plant Tissue Concentration [3] (mg/kg)	Dietary Intake [4] (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates [6]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [5] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Volatile Organics:											
1,1,1,2-Tetrachloroethane	0.0005	0.0056	5.17618	0.0290	0.00423	NA	NA	NA	---	---	---
Carbon tetrachloride	0.0005	0.0056	4.71454	0.0264	0.00386	NA	NA	NA	---	---	---
Chlorobenzene	0.0005	0.0056	4.17540	0.0234	0.00343	NA	NA	NA	---	---	---
Chloroform	0.0012	0.0056	10.04745	0.0563	0.00820	NA	NA	NA	---	---	---
Ethylbenzene	0.0005	0.0056	3.21442	0.0180	0.00267	NA	NA	NA	---	---	---
Pentachloroethane	0.0005	0.0056	2.98295	0.0167	0.00248	NA	NA	NA	---	---	---
Styrene	0.0005	0.0056	3.87473	0.0217	0.00319	NA	NA	NA	---	---	---
Toluene	0.0005	0.0056	4.62727	0.0259	0.00379	NA	NA	NA	---	---	---
Trichloroethene	0.0005	0.0056	4.80345	0.0269	0.00393	NA	NA	NA	---	---	---
o-Xylene	0.0005	0.0056	3.24458	0.0182	0.00269	40.50000	203.00000	90.67249	<0.01	<0.01	<0.01
m,p-Xylene	0.0010	0.0003	3.12558	0.0010	0.00027	40.50000	203.00000	90.67249	<0.01	<0.01	<0.01
Xylenes (total)	0.0005	0.0003	3.24458	0.0010	0.00021	40.50000	203.00000	90.67249	<0.01	<0.01	<0.01
Semivolatile Organics:											
1,2,4,5-Tetrachlorobenzene	0.0051	0.2400	0.79168	0.1900	0.02949	NA	NA	NA	---	---	---
1,2,4-Trichlorobenzene	0.0051	0.2400	1.42608	0.3423	0.05117	NA	NA	NA	---	---	---
1,2-Dichlorobenzene	0.0051	0.2400	2.45160	0.5884	0.08621	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
1,3-Dichlorobenzene	0.0051	0.2400	2.23295	0.5359	0.07874	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
1,4-Dichlorobenzene	0.0051	0.2400	2.47461	0.5939	0.08700	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
2,3,4,6-Tetrachlorophenol	0.0100	0.4600	0.94544	0.4349	0.06663	NA	NA	NA	---	---	---
2,4,5-Trichlorophenol	0.0100	0.4600	1.86980	0.8601	0.12716	NA	NA	NA	---	---	---
2,4,6-Trichlorophenol	0.0100	0.4600	1.90507	0.8763	0.12947	NA	NA	NA	---	---	---
2,4-Dichlorophenol	0.0100	0.4600	3.39973	1.5639	0.22736	NA	NA	NA	---	---	---
2-Acetylaminofluorene	0.0051	0.2400	3.27504	0.7860	0.11435	NA	NA	NA	---	---	---
2-Chloronaphthalene	0.0051	0.2400	1.58041	0.3793	0.05644	NA	NA	NA	---	---	---
3,3'-Dichlorobenzidine	0.0051	0.2400	2.27506	0.5460	0.08018	NA	NA	NA	---	---	---
3,3'-Dimethylbenzidine	0.0051	0.2400	4.93997	1.1856	0.17124	NA	NA	NA	---	---	---
3-Methylcholanthrene	0.0051	0.2400	0.15011	0.0360	0.00757	NA	NA	NA	---	---	---
4-Bromophenyl phenyl ether	0.0051	0.2400	0.56559	0.1357	0.02177	NA	NA	NA	---	---	---
4-Chloro-3-methylphenol	0.0100	0.4600	3.33680	1.5349	0.22324	NA	NA	NA	---	---	---
4-Chlorophenyl phenyl ether	0.0051	0.2400	0.59263	0.1422	0.02269	NA	NA	NA	---	---	---
7,12-Dimethylbenz(a)anthracene	0.0051	0.2400	0.12453	0.0299	0.00670	2.00000	20.00000	6.32456	<0.01	<0.01	<0.01
Aramite, total	0.0051	0.2400	0.66915	0.1606	0.02531	NA	NA	NA	---	---	---
Bis(2-ethylhexyl)phthalate	0.0051	0.6300	0.06598	0.0416	0.01128	1.11000	5.55000	2.48204	0.01	<0.01	<0.01
Butyl benzyl phthalate	0.0051	0.1700	0.65677	0.1117	0.01781	NA	NA	NA	---	---	---
Diallate, cis-	0.0051	0.2400	0.91077	0.2186	0.03356	NA	NA	NA	---	---	---
Diallate, trans-	0.0051	0.2400	0.91077	0.2186	0.03356	NA	NA	NA	---	---	---
Dibenzofuran	0.0051	0.7500	1.28681	0.9651	0.14367	NA	NA	NA	---	---	---
Diethyl phthalate	0.0051	0.2400	5.84454	1.4027	0.20215	NA	NA	NA	---	---	---
Di-n-butyl phthalate	0.0051	0.2400	0.81418	0.1954	0.03026	0.22200	1.11000	0.49641	0.14	0.03	0.06
Di-n-octyl phthalate	0.0051	0.2400	0.03244	0.0078	0.00355	50.00000	250.00000	111.80340	<0.01	<0.01	<0.01
Dinoseb	0.0051	0.2100	2.17124	0.4560	0.06713	0.26400	1.32000	0.59032	0.23	0.05	0.11
Hexachlorobenzene	0.0051	0.2400	0.24628	0.0591	0.01086	0.11000	0.57000	0.25040	0.10	0.02	0.04
Hexachlorobutadiene	0.0051	0.2400	0.67543	0.1621	0.02552	3.39000	17.00000	7.59144	<0.01	<0.01	<0.01
Hexachlorocyclopentadiene	0.0051	0.2400	0.39290	0.0943	0.01587	NA	NA	NA	---	---	---
Hexachloroethane	0.0051	0.2400	1.43946	0.3455	0.05163	NA	NA	NA	---	---	---
Hexachloropropene	0.0051	0.2400	1.00933	0.2422	0.03693	NA	NA	NA	---	---	---
Isosafrole	0.0051	0.2400	2.59293	0.6223	0.09104	NA	NA	NA	---	---	---
n-Nitrosodiphenylamine	0.0051	0.2400	3.15492	0.7572	0.11024	NA	NA	NA	---	---	---
p-Dimethylamino azobenzene	0.0051	0.2400	0.83732	0.2010	0.03105	NA	NA	NA	---	---	---
Pentachlorobenzene	0.0051	0.2400	0.44363	0.1065	0.01760	NA	NA	NA	---	---	---
Pentachloronitrobenzene	0.0051	0.2400	0.79168	0.1900	0.02949	7.07000	70.70000	22.35730	<0.01	<0.01	<0.01
Pentachlorophenol	0.0100	0.4600	46.02000	21.1692	3.01866	6.73000	67.30000	21.28213	0.45	0.04	0.14
Pronamide	0.0100	0.2400	2.27506	0.5460	0.08080	NA	NA	NA	---	---	---
LLPAHs:											
2-Methylnaphthalene	0.0002	0.0310	1.64058	0.0509	0.00750	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Acenaphthene	0.0002	0.4800	$\ln(Cp) = -0.8556[\ln[Cs]) - 5.562$	0.0072	0.00465	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Acenaphthylene	0.0002	0.0270	1.52245	0.0411	0.00608	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Anthracene	0.0002	0.6900	$\ln(C_p) = 0.7784[\ln(C_s)] - 0.9887$	0.2787	0.04488	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01

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FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR MOURNING DOVE DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical	Surface Water Concentration (1) (mg/L)	Surface Soil Concentration (2) (mg/kg)	Soil-to-Plant BAF/Uptake Equation (unitless)	Plant Tissue Concentration (3) (mg/kg)	Dietary Intake (4) (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates (6)		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC (5) (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
LLPAHs (cont.):											
Benzo(a)anthracene	0.0002	0.0840	$\ln(C_p) = 0.5944[\ln(C_s)] - 2.7078$	0.0153	0.00283	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(a)pyrene	0.0002	0.3900	$\ln(C_p) = 0.975[\ln(C_s)] - 2.0615$	0.0508	0.01018	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(b)fluoranthene	0.0002	0.7500	0.48000	0.3600	0.05690	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(g,h,i)perylene	0.0002	0.2200	$\ln(C_p) = 1.1829[\ln(C_s)] - 0.9313$	0.0657	0.01103	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(k)fluoranthene	0.0002	0.7300	$\ln(C_p) = 0.8595[\ln(C_s)] - 2.1579$	0.0882	0.01805	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Chrysene	0.0002	1.2000	$\ln(C_p) = 0.5944[\ln(C_s)] - 2.7078$	0.0743	0.01960	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Dibenzo(a,h)anthracene	0.0002	0.0920	0.23000	0.0212	0.00373	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Fluoranthene	0.0000	4.6000	6.00000	27.6000	3.96400	39.50000	198.00000	88.43642	0.10	0.02	0.04
Fluorene	0.0002	0.5800	$\ln(C_p) = -0.8556[\ln[C_s]) - 5.562$	0.0061	0.00524	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	0.0002	0.2400	0.15000	0.0360	0.00695	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Naphthalene	0.0002	0.0022	48.00000	0.1056	0.01508	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Phenanthrene	0.0002	7.0000	$\ln(C_p) = 0.6203[\ln(C_s)] - 0.1665$	2.8308	0.45551	39.50000	198.00000	88.43642	0.01	<0.01	<0.01
Pyrene	0.0000	3.0000	3.70000	11.1000	1.60284	39.50000	198.00000	88.43642	0.04	<0.01	0.02
Organochlorine Pesticides:											
4,4'-DDD	0.0001	0.0081	0.20241	0.0016	0.00031	0.22700	2.27000	0.71784	<0.01	<0.01	<0.01
4,4'-DDE	0.0000	0.1600	0.14000	0.0224	0.00439	0.22700	2.27000	0.71784	0.02	<0.01	<0.01
4,4'-DDT	0.0000	0.1600	0.07900	0.0126	0.00300	0.22700	2.27000	0.71784	0.01	<0.01	<0.01
Aldrin	0.0001	0.0190	0.13930	0.0026	0.00053	0.07000	0.35000	0.15652	<0.01	<0.01	<0.01
alpha-BHC	0.0001	0.0190	1.73516	0.0330	0.00484	0.56300	2.25000	1.12550	<0.01	<0.01	<0.01
alpha-Chlordane	0.0001	0.0019	0.16481	0.0003	0.00007	2.14000	10.70000	4.78519	<0.01	<0.01	<0.01
beta-BHC	0.0001	0.0092	1.71903	0.0158	0.00233	0.56300	2.25000	1.12550	<0.01	<0.01	<0.01
Chlorobenzilate	0.0051	0.2400	0.72108	0.1731	0.02708	9.73000	19.73000	13.85543	<0.01	<0.01	<0.01
delta-BHC	0.0001	0.0190	1.26300	0.0240	0.00357	0.56300	2.25000	1.12550	<0.01	<0.01	<0.01
Dieldrin	0.0001	0.0370	2.22200	0.0822	0.01200	0.70900	3.78000	1.63708	0.02	<0.01	<0.01
Endosulfan I	0.0001	0.0190	1.68721	0.0321	0.00471	10.00000	50.00000	22.36068	<0.01	<0.01	<0.01
Endosulfan II	0.0001	0.0370	1.68721	0.0624	0.00918	10.00000	50.00000	22.36068	<0.01	<0.01	<0.01
Endosulfan sulfate	0.0001	0.0007	1.97760	0.0014	0.00022	10.00000	50.00000	22.36068	<0.01	<0.01	<0.01
Endrin	0.0001	0.0370	0.53476	0.0198	0.00311	0.02100	0.10400	0.04673	0.15	0.03	0.07
Endrin aldehyde	0.0001	0.0018	1.43946	0.0026	0.00039	0.02100	0.10400	0.04673	0.02	<0.01	<0.01
gamma-BHC (lindane)	0.0001	0.0190	1.85242	0.0352	0.00516	4.00000	20.00000	8.94427	<0.01	<0.01	<0.01
gamma-Chlordane	0.0001	0.0035	0.16481	0.0006	0.00011	2.14000	10.70000	4.78519	<0.01	<0.01	<0.01
Heptachlor	0.0001	0.0190	0.17431	0.0033	0.00062	0.49000	2.17000	1.03116	<0.01	<0.01	<0.01
Heptachlor epoxide	0.0001	0.0190	0.56559	0.0107	0.00168	0.49000	2.17000	1.03116	<0.01	<0.01	<0.01
Isodrin	0.0051	0.2400	0.13930	0.0334	0.00720	NA	NA	NA	---	---	---
Kepone	0.0051	0.2400	0.42736	0.1026	0.01704	1.67000	8.35000	3.73423	0.01	<0.01	<0.01
Methoxychlor	0.0005	0.0260	0.52486	0.0136	0.00220	355.00000	1775.00000	793.80413	<0.01	<0.01	<0.01
Toxaphene	0.0026	0.9200	0.35453	0.3262	0.05366	1.00000	5.00000	2.23607	0.05	0.01	0.02
Metals:											
Antimony	0.0003	8.5000	$\ln(C_p) = 0.938[\ln(C_s)] - 3.233$	0.2936	0.10552	4740.00000	47400.00000	14989.19611	<0.01	<0.01	<0.01
Arsenic	0.0005	5.5000	$\ln(C_p) = 0.564[\ln[C_s]) - 1.992$	0.3568	0.09208	2.24000	4.51000	3.17843	0.04	0.02	0.03
Barium	0.0214	267.0000	0.44700	119.3490	18.99565	20.80000	41.70000	29.45098	0.91	0.46	0.64
Beryllium	0.0010	0.6200	$\ln(C_p) = 0.7345[\ln[C_s]) - 0.5361$	0.4118	0.06340	NA	NA	NA	---	---	---
Cadmium	0.0010	2.6000	$\ln(C_p) = 0.546[\ln(C_s)] - 0.475$	1.0478	0.16879	1.47000	6.36000	3.05765	0.11	0.03	0.06
Chromium, total	0.0008	54.4000	0.08390	4.5642	1.05755	2.66000	15.60000	6.44174	0.40	0.07	0.16
Cobalt	0.0003	45.2000	0.02480	1.1210	0.49834	7.61000	18.30000	11.80097	0.07	0.03	0.04
Copper	0.0040	291.0000	$\ln(C_p) = 0.394[\ln(C_s)] + 0.668$	18.2340	4.77713	4.05000	12.10000	7.00036	1.18	0.39	0.68
Lead	0.0010	654.0000	$\ln(C_p) = 0.561[\ln(C_s)] - 1.328$	10.0646	6.33374	1.63000	3.26000	2.30517	3.89	1.94	2.75
Mercury	0.0002	0.0950	$\ln(C_p) = 0.544[\ln[C_s]) - 0.996$	0.1026	0.01535	0.02600	0.07800	0.04503	0.59	0.20	0.34
Nickel	0.0010	27.5000	$\ln(C_p) = 0.748[\ln(C_s)] - 2.224$	1.2905	0.38992	6.71000	18.60000	11.17166	0.06	0.02	0.03
Selenium	0.0008	2.4000	$\ln(C_p) = 1.104[\ln(C_s)] - 0.678$	1.3344	0.20807	0.29000	0.57900	0.40977	0.72	0.36	0.51
Silver	0.0010	2.6000	0.03670	0.0954	0.03319	2.02000	20.20000	6.38780	0.02	<0.01	<0.01
Thallium	0.0010	0.3700	0.00400	0.0015	0.00311	0.35000	1.75000	0.78262	<0.01	<0.01	<0.01
Tin	0.0200	36.5000	0.03000	1.0950	0.43193	6.80000	16.90000	10.72007	0.06	0.03	0.04
Vanadium	0.0076	260.0000	0.00970	2.5220	2.30830	0.34400	0.68800	0.48649	6.71	3.36	4.74
Zinc	0.0079	747.0000	$\ln(C_p) = 0.554[\ln(C_s)] + 1.575$	188.7267	32.46838	66.10000	171.00000	106.31604	0.49	0.19	0.31

TABLE G-1
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR MOURNING DOVE DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Notes:

BAF = Bioaccumulation Factor
PAH = Polynuclear Aromatic Hydrocarbon
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
HQ = Hazard Quotient
mg/kg-BW/day = milligram per kilogram-body weight per day
ln = natural logarithm
C_p = Concentration in plant tissue (mg/kg - dry weight)
C_s = Maximum concentration in surface soil (mg/kg - dry weight)
NA = Not Available
--- = Step 2 screening level risk estimate could not be calculated due to the lack of a toxicity reference value.
mg/kg = milligram per kilogram
mg/L = milligram per liter

(1) Maximum detected surface water concentrations or, in the case of non-detected chemicals, maximum Reporting Limits.
(2) Maximum detected surface soil concentrations or, in the case of non-detected chemicals, maximum Reporting Limits.
(3) As discussed in Section 7.5.2.2.1, plant tissue concentrations were derived by (a) multiplying maximum surface soil concentrations by soil-to-plant bioaccumulation factors, or (b) soil-to-plant uptake equations.
(4) The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FIR_{dove})(FC_{plant})(PDF_{plant})] + [(FIR_{dove})(SC_x)(PDS)]+(WIR_{dove}(WC_x)]\}/BW_{dove}$$

Where:

DI_x = Dietary intake of chemical x by the mourning dove (mg/kg-body weight/day)
FIR_{dove} = Maximum food ingestion rate for the mourning dove (0.01723 kg/day - dry weight; see Table 7-16)
FC_{plant} = Maximum concentration of chemical x in plant tissue (chemical-specific - dry weight; see Table G-1 above)
PDF_{plant} = Proportion of diet composed of plants (0.95 - dry weight basis [unitless]; see Table 7-17)
SC_x = Concentration in surface soil (chemical specific - dry weight; see Table G-1 above)
PDS = Proportion of diet composed of surface soil (0.05, dry weight basis [unitless]; see Table 7-17)
WIR_{dove} = Maximum water ingestiong rate for the mourning dove (0.01449 L/day; see Table 7-16)
WC_x = Maximum concentration in surface water (chemical-specific; see Table G-1 above)
BW_{dove} = Minimum body weight for the mourning dove (0.115 kg; see Table 7-16)

(5) MATC values were derived by calculating the geometric mean of the NOAEL and LOAEL values.
(6) NOAEL-, LOAEL, and MATC-based screening level risk estimates (i.e., HQs) were derived by dividing dietary intakes by NOAEL, LOAEL-, and MATC-based toxicity reference values, respectively

TABLE G-2
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR AMERICAN ROBIN DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical	Surface Water Concentration [1] (mg/L)	Surface Soil Concentration [2] (mg/kg)	Soil-to-Invertebrate BAF/Uptake Equation (unitless)	Invertebrate Tissue Concentration [3] (mg/kg)	Dietary Intake [4] (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates [6]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [5] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Volatile Organics:											
1,1,1,2-Tetrachloroethane	0.0005	0.0056	3.15072	0.0176	0.00452	NA	NA	NA	---	---	---
Carbon tetrachloride	0.0005	0.0056	3.06980	0.0172	0.00441	NA	NA	NA	---	---	---
Chlorobenzene	0.0005	0.0056	2.96770	0.0166	0.00427	NA	NA	NA	---	---	---
Chloroform	0.0012	0.0056	3.79001	0.0212	0.00555	NA	NA	NA	---	---	---
Ethylbenzene	0.0005	0.0056	2.75918	0.0155	0.00399	NA	NA	NA	---	---	---
Pentachloroethane	0.0005	0.0056	2.81777	0.0158	0.00407	NA	NA	NA	---	---	---
Styrene	0.0005	0.0056	2.90656	0.0163	0.00419	NA	NA	NA	---	---	---
Toluene	0.0005	0.0056	3.05387	0.0171	0.00439	NA	NA	NA	---	---	---
Trichloroethene	0.0005	0.0056	3.08582	0.0173	0.00443	NA	NA	NA	---	---	---
o-Xylene	0.0005	0.0056	2.76637	0.0155	0.00400	40.50000	203.00000	90.67249	<0.01	<0.01	<0.01
m,p-Xylene	0.0010	0.0003	2.76637	0.0009	0.00046	40.50000	203.00000	90.67249	<0.01	<0.01	<0.01
Xylenes (total)	0.0005	0.0003	2.76637	0.0009	0.00034	40.50000	203.00000	90.67249	<0.01	<0.01	<0.01
Semivolatile Organics:											
1,2,4,5-Tetrachlorobenzene	0.0051	0.2400	1.86758	0.4482	0.11571	NA	NA	NA	---	---	---
1,2,4-Trichlorobenzene	0.0051	0.2400	2.20024	0.5281	0.13489	NA	NA	NA	---	---	---
1,2-Dichlorobenzene	0.0051	0.2400	2.55864	0.6141	0.15556	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
1,3-Dichlorobenzene	0.0051	0.2400	2.49293	0.5983	0.15177	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
1,4,-Dichlorobenzene	0.0051	0.2400	2.56531	0.6157	0.15594	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
2,3,4,6-Tetrachlorophenol	0.0100	0.4600	1.96223	0.9026	0.23229	NA	NA	NA	---	---	---
2,4,5-Trichlorophenol	0.0100	0.4600	2.37268	1.0914	0.27765	NA	NA	NA	---	---	---
2,4,6-Trichlorophenol	0.0100	0.4600	2.38506	1.0971	0.27902	NA	NA	NA	---	---	---
2,4-Dichlorophenol	0.0100	0.4600	2.80259	1.2892	0.32517	NA	NA	NA	---	---	---
2-Acetylaminofluorene	0.0051	0.2400	2.77358	0.6657	0.16795	NA	NA	NA	---	---	---
2-Chloronaphthalene	0.0051	0.2400	2.26412	0.5434	0.13857	NA	NA	NA	---	---	---
3,3'-Dichlorobenzidine	0.0051	0.2400	2.50594	0.6014	0.15252	NA	NA	NA	---	---	---
3,3'-Dimethylbenzidine	0.0051	0.2400	3.11000	0.7464	0.18735	NA	NA	NA	---	---	---
3-Methylcholanthrene	0.0051	0.2400	1.17528	0.2821	0.07578	NA	NA	NA	---	---	---
4-Bromophenyl phenyl ether	0.0051	0.2400	1.70059	0.4081	0.10608	NA	NA	NA	---	---	---
4-Chloro-3-methylphenol	0.0100	0.4600	2.78805	1.2825	0.32356	NA	NA	NA	---	---	---
4-Chlorophenyl phenyl ether	0.0051	0.2400	1.72286	0.4135	0.10736	NA	NA	NA	---	---	---
7,12-Dimethylbenz(a)anthracene	0.0051	0.2400	1.11568	0.2678	0.07234	2.00000	20.00000	6.32456	0.04	<0.01	0.01
Aramite, total	0.0051	0.2400	1.78213	0.4277	0.11078	NA	NA	NA	---	---	---
Bis(2-ethylhexyl)phthalate	0.0051	0.6300	0.93476	0.5889	0.16050	1.11000	5.55000	2.48204	0.14	0.03	0.06
Butyl benzyl phthalate	0.0051	0.1700	1.77288	0.3014	0.07845	NA	NA	NA	---	---	---
Diallate, cis-	0.0051	0.2400	1.94191	0.4661	0.11999	NA	NA	NA	---	---	---
Diallate, trans-	0.0051	0.2400	1.94191	0.4661	0.11999	NA	NA	NA	---	---	---
Dibenzofuran	0.0051	0.7500	2.13816	1.6036	0.40771	NA	NA	NA	---	---	---
Diethyl phthalate	0.0051	0.2400	3.25912	0.7822	0.19595	NA	NA	NA	---	---	---
Di-n-butyl phthalate	0.0051	0.2400	1.88222	0.4517	0.11655	0.22200	1.11000	0.49641	0.52	0.10	0.23
Di-n-octyl phthalate	0.0051	0.2400	0.76704	0.1841	0.05224	50.00000	250.00000	111.80340	<0.01	<0.01	<0.01
Dinoseb	0.0051	0.2100	2.47355	0.5194	0.13197	0.26400	1.32000	0.59032	0.48	0.10	0.22
Hexachlorobenzene	0.0051	0.2400	1.34906	0.3238	0.08580	0.11000	0.57000	0.25040	0.78	0.15	0.34
Hexachlorobutadiene	0.0051	0.2400	1.78678	0.4288	0.11105	3.39000	17.00000	7.59144	0.03	<0.01	0.01
Hexachlorocyclopentadiene	0.0051	0.2400	1.53649	0.3688	0.09661	NA	NA	NA	---	---	---
Hexachloroethane	0.0051	0.2400	2.20597	0.5294	0.13522	NA	NA	NA	---	---	---
Hexachloropropene	0.0051	0.2400	1.99830	0.4796	0.12324	NA	NA	NA	---	---	---
Isosafrole	0.0051	0.2400	2.59890	0.6237	0.15788	NA	NA	NA	---	---	---
n-Nitrosodiphenylamine	0.0051	0.2400	2.74486	0.6588	0.16630	NA	NA	NA	---	---	---
p-Dimethylamino azobenzene	0.0051	0.2400	1.89697	0.4553	0.11740	NA	NA	NA	---	---	---
Pentachlorobenzene	0.0051	0.2400	1.58935	0.3814	0.09966	NA	NA	NA	---	---	---
Pentachloronitrobenzene	0.0051	0.2400	1.86758	0.4482	0.11571	7.07000	70.70000	22.35730	0.02	<0.01	<0.01
Pentachlorophenol	0.0100	0.4600	88.12000	40.5352	9.75542	6.73000	67.30000	21.28213	1.45	0.14	0.46
Pronamide	0.0100	0.2400	2.50594	0.6014	0.15371	NA	NA	NA	---	---	---
LLPAHs:											
2-Methylnaphthalene	0.0002	0.0310	2.28781	0.0709	0.01797	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Acenaphthene	0.0002	0.4800	2.25237	1.0811	0.27336	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Acenaphthylene	0.0002	0.0270	2.24068	0.0605	0.01535	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Anthracene	0.0002	0.6900	1.91183	1.3192	0.33648	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01

TABLE G-2
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR AMERICAN ROBIN DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical	Surface Water Concentration [1] (mg/L)	Surface Soil Concentration [2] (mg/kg)	Soil-to-Invertebrate BAF/Uptake Equation (unitless)	Invertebrate Tissue Concentration [3] (mg/kg)	Dietary Intake [4] (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates [6]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [5] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
LLPAHs (cont.):											
Benzo(a)anthracene	0.0002	0.0840	1.41742	0.1191	0.03103	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(a)pyrene	0.0002	0.3900	1.27400	0.4969	0.13043	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(b)fluoranthene	0.0002	0.7500	1.24451	0.9334	0.24547	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(g,h,i)perylene	0.0002	0.2200	1.09270	0.2404	0.06402	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(k)fluoranthene	0.0002	0.7300	1.24451	0.9085	0.23893	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Chrysene	0.0002	1.2000	1.41742	1.7009	0.44258	39.50000	198.00000	88.43642	0.01	<0.01	<0.01
Dibenzo(a,h)anthracene	0.0002	0.0920	1.09554	0.1008	0.02686	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Fluoranthene	0.0000	4.6000	1.64831	7.5822	1.95158	39.50000	198.00000	88.43642	0.05	<0.01	0.02
Fluorene	0.0002	0.5800	2.08867	1.2114	0.30749	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	0.0002	0.2400	1.10701	0.2657	0.07066	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Naphthalene	0.0002	0.0022	2.60567	0.0057	0.00149	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Phenanthrene	0.0002	7.0000	1.91183	13.3828	3.41308	39.50000	198.00000	88.43642	0.09	0.02	0.04
Pyrene	0.0000	3.0000	1.65261	4.9578	1.27587	39.50000	198.00000	88.43642	0.03	<0.01	0.01
Organochlorine Pesticides:											
4,4'-DDD	0.0001	0.0081	$\ln(C_e) = 0.6975[\ln(C_s)] + 1.1613$	0.1110	0.02694	0.22700	2.27000	0.71784	0.12	0.01	0.04
4,4'-DDE	0.0000	0.1600	$\ln(C_e) = 0.8804[\ln(C_s)] + 2.4771$	2.3719	0.57445	0.22700	2.27000	0.71784	2.53	0.25	0.80
4,4'-DDT	0.0000	0.1600	$\ln(C_e) = 0.8689[\ln(C_s)] + 2.1247$	1.7030	0.41371	0.22700	2.27000	0.71784	1.82	0.18	0.58
Aldrin	0.0001	0.0190	3.30000	0.0627	0.01561	0.07000	0.35000	0.15652	0.22	0.04	0.10
alpha-BHC	0.0001	0.0190	2.32381	0.0442	0.01116	0.56300	2.25000	1.12550	0.02	<0.01	<0.01
alpha-Chlordane	0.0001	0.0019	4.00000	0.0076	0.00189	2.14000	10.70000	4.78519	<0.01	<0.01	<0.01
beta-BHC	0.0001	0.0092	2.31777	0.0213	0.00540	0.56300	2.25000	1.12550	<0.01	<0.01	<0.01
Chlorobenzilate	0.0051	0.2400	1.81963	0.4367	0.11294	9.73000	19.73000	13.85543	0.01	<0.01	<0.01
delta-BHC	0.0001	0.0190	2.12706	0.0404	0.01026	0.56300	2.25000	1.12550	0.02	<0.01	<0.01
Dieldrin	0.0001	0.0370	49.67000	1.8378	0.44266	0.70900	3.78000	1.63708	0.62	0.12	0.27
Endosulfan I	0.0001	0.0190	2.14931	0.0408	0.01036	10.00000	50.00000	22.36068	<0.01	<0.01	<0.01
Endosulfan II	0.0001	0.0370	2.14931	0.0795	0.02018	10.00000	50.00000	22.36068	<0.01	<0.01	<0.01
Endosulfan sulfate	0.0001	0.0007	2.41002	0.0017	0.00046	10.00000	50.00000	22.36068	<0.01	<0.01	<0.01
Endrin	0.0001	0.0370	3.60000	0.1332	0.03307	0.02100	0.10400	0.04673	1.57	0.32	0.71
Endrin aldehyde	0.0001	0.0018	2.20597	0.0040	0.00103	0.02100	0.10400	0.04673	0.05	<0.01	0.02
gamma-BHC (lindane)	0.0001	0.0190	26.60000	0.5054	0.12199	4.00000	20.00000	8.94427	0.03	<0.01	0.01
gamma-Chlordane	0.0001	0.0035	4.00000	0.0140	0.00348	2.14000	10.70000	4.78519	<0.01	<0.01	<0.01
Heptachlor	0.0001	0.0190	3.00000	0.0570	0.01424	0.49000	2.17000	1.03116	0.03	<0.01	0.01
Heptachlor epoxide	0.0001	0.0190	10.00000	0.1900	0.04620	0.49000	2.17000	1.03116	0.09	0.02	0.04
Isodrin	0.0051	0.2400	1.15107	0.2763	0.07439	NA	NA	NA	---	---	---
Kepone	0.0051	0.2400	1.57290	0.3775	0.09871	1.67000	8.35000	3.73423	0.06	0.01	0.03
Methoxychlor	0.0005	0.0260	1.66556	0.0433	0.01126	355.00000	1775.00000	793.80413	<0.01	<0.01	<0.01
Toxaphene	0.0026	0.9200	1.49314	1.3737	0.35664	1.00000	5.00000	2.23607	0.36	0.07	0.16
Metals:											
Antimony	0.0003	8.5000	1.00000	8.5000	2.28210	4740.00000	47400.00000	14989.19611	<0.01	<0.01	<0.01
Arsenic	0.0005	5.5000	$\ln(C_e) = 0.706[\ln(C_s)] - 1.421$	0.8046	0.34849	2.24000	4.51000	3.17843	0.16	0.08	0.11
Barium	0.0214	267.0000	0.16000	42.7200	17.79690	20.80000	41.70000	29.45098	0.86	0.43	0.60
Beryllium	0.0010	0.6200	1.18200	0.7328	0.19381	NA	NA	NA	---	---	---
Cadmium	0.0010	2.6000	$\ln(C_e) = 0.795[\ln(C_s)] + 2.114$	17.7012	4.32687	1.47000	6.36000	3.05765	2.94	0.68	1.42
Chromium, total	0.0008	54.4000	3.16200	172.0128	42.86589	2.66000	15.60000	6.44174	16.11	2.75	6.65
Cobalt	0.0003	45.2000	0.29100	13.1532	4.43479	7.61000	18.30000	11.80097	0.58	0.24	0.38
Copper	0.0040	291.0000	$\ln(C_e) = 0.264[\ln(C_s)] + 1.675$	23.8732	13.94062	4.05000	12.10000	7.00036	3.44	1.15	1.99
Lead	0.0010	654.0000	$\ln(C_e) = 0.807[\ln(C_s)] - 2.18$	21.1548	23.51964	1.63000	3.26000	2.30517	14.43	7.21	10.20
Mercury	0.0002	0.0950	20.63000	1.9599	0.47365	0.02600	0.07800	0.04503	18.22	6.07	10.52
Nickel	0.0010	27.5000	4.73000	130.0750	32.03060	6.71000	18.60000	11.17166	4.77	1.72	2.87
Selenium	0.0008	2.4000	$\ln(C_e) = 0.733[\ln(C_s)] - 0.075$	1.7625	0.49133	0.29000	0.57900	0.40977	1.69	0.85	1.20
Silver	0.0010	2.6000	15.33800	39.8788	9.65583	2.02000	20.20000	6.38780	4.78	0.48	1.51
Thallium	0.0010	0.3700	1.00000	0.3700	0.09958	0.35000	1.75000	0.78262	0.28	0.06	0.13
Tin	0.0200	36.5000	1.00000	36.5000	9.80421	6.80000	16.90000	10.72007	1.44	0.58	0.91
Vanadium	0.0076	260.0000	0.08800	22.8800	12.82896	0.34400	0.68800	0.48649	37.29	18.65	26.37
Zinc	0.0079	747.0000	$\ln(C_e) = 0.328[\ln(C_s)] + 4.449$	749.2475	201.09306	66.10000	171.00000	106.31604	3.04	1.18	1.89

TABLE G-2
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR AMERICAN ROBIN DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Notes:

BAF = Bioacumulation Factor
PAH = Polynuclear Aromatic Hydrocarbon
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
HQ = Hazard Quotient
mg/kg-BW/day = milligram per kilogram-body weight per day
ln = natural logarithm
C_e = Concentration in earthworm tissue (mg/kg - dry weight)
C_s = Maximum concentration in surface soil (mg/kg - dry weight)
NA = Not Available
--- = Step 2 screening level risk estimate could not be calculated due to the lack of a toxicity reference value.
mg/kg = milligram per kilogram
mg/L = milligram per liter

(1) Maximum detected surface water concentrations or, in the case of non-detected chemicals, maximum Reporting Limits.
(2) Maximum detected surface soil concentrations or, in the case of non-detected chemicals, maximum Reporting Limits.
(3) As discussed in Section 7.5.2.2.1, soil invertebrate tissue concentrations were derived by (a) multiplying maximum surface soil concentrations by soil-to-invertebrate bioaccumulation factors or, (b) soil-to-invertebrate uptake equations.
(4) The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FIR_{robin})(FC_{invert})(PDF_{invert})] + [(FIR_{robin})(SC_x)(PDS)]+[(WIR_{robin})(WC_x)]\}/BW_{robin}$$

Where:

DI_x = Dietary intake of chemical x by the American robin (mg/kg-body weight/day)
FIR_{robin} = Maximum food ingestion rate for the American robin (0.01503 kg/day - dry weight; see Table 7-16)
FC_{invert} = Concentration of chemical x in soil invertebrate tissue (chemical-specific - dry weight; see Table G-2 above)
PDF_{invert} = Proportion of diet composed of soil invertebrates (0.895 - dry weight basis [unitless]; see Table 7-17)
SC_x = Maximum concentration in surface soil (chemical specific - dry weight; see Table G-2 above)
PDS = Proportion of diet composed of surface soil (0.105 - dry weight basis [unitless]; see Table 7-17)
WIR_{robin} = Maximum water ingestion rate for the robin (0.01361 L/day; see Table 7-16)
WC_x = Maximum concentration of surface water (chemical-specific; see Table G-2 above)
BW_{robin} = Minimum body weight for the American robin (0.056 kg; see Table 7-16)

(5) MATC values were derived by calculating the geometric mean of the NOAEL and LOAEL values.
(6) NOAEL-, LOAEL, and MATC-based screening level risk estimates (i.e., HQs) were derived by dividing dietary intakes by NOAEL, LOAEL-, and MATC-based toxicity reference values, respectively

TABLE G-3
FOOD ITEM CONCENTRATIONS, DIETARY DOSES, AND HAZARD QUOTIENT VALUES FOR RED TAILED HAWK DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical	Surface Water Concentration [1] (mg/L)	Surface Soil Concentration [2] (mg/kg)	Soil-to-Small Mammal BAF/Uptake Equation (unitless)	Small Mammal Concentration [3] (mg/kg)	Dietary Intake [4] (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates [6]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [5] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Volatile Organics:											
1,1,1,2-Tetrachloroethane	0.0005	0.0056	$C_m = [(BAF_d)(DI)]/0.32$	0.0115	0.00124	NA	NA	NA	---	---	---
Carbon tetrachloride	0.0005	0.0056	$C_m = [(BAF_d)(DI)]/0.32$	0.0112	0.00121	NA	NA	NA	---	---	---
Chlorobenzene	0.0005	0.0056	$C_m = [(BAF_d)(DI)]/0.32$	0.0109	0.00118	NA	NA	NA	---	---	---
Chloroform	0.0012	0.0056	$C_m = [(BAF_d)(DI)]/0.32$	0.0143	0.00159	NA	NA	NA	---	---	---
Ethylbenzene	0.0005	0.0056	$C_m = [(BAF_d)(DI)]/0.32$	0.0101	0.00110	NA	NA	NA	---	---	---
Pentachloroethane	0.0005	0.0056	$C_m = [(BAF_d)(DI)]/0.32$	0.0103	0.00112	NA	NA	NA	---	---	---
Styrene	0.0005	0.0056	$C_m = [(BAF_d)(DI)]/0.32$	0.0106	0.00115	NA	NA	NA	---	---	---
Toluene	0.0005	0.0056	$C_m = [(BAF_d)(DI)]/0.32$	0.0112	0.00121	NA	NA	NA	---	---	---
Trichloroethene	0.0005	0.0056	$C_m = [(BAF_d)(DI)]/0.32$	0.0113	0.00122	NA	NA	NA	---	---	---
o-Xylene	0.0005	0.0056	$C_m = [(BAF_d)(DI)]/0.32$	0.0102	0.00110	40.50000	203.00000	90.67249	<0.01	<0.01	<0.01
m,p-Xylene	0.0010	0.0003	$C_m = [(BAF_d)(DI)]/0.32$	0.0014	0.00022	40.50000	203.00000	90.67249	<0.01	<0.01	<0.01
Xylenes (total)	0.0005	0.0003	$C_m = [(BAF_d)(DI)]/0.32$	0.0010	0.00014	40.50000	203.00000	90.67249	<0.01	<0.01	<0.01
Semivolatile Organics:											
1,2,4,5-Tetrachlorobenzene	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.2870	0.03047	NA	NA	NA	---	---	---
1,2,4-Trichlorobenzene	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.3368	0.03570	NA	NA	NA	---	---	---
1,2-Dichlorobenzene	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.3905	0.04133	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
1,3-Dichlorobenzene	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.3806	0.04030	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
1,4,-Dichlorobenzene	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.3915	0.04143	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
2,3,4,6-Tetrachlorophenol	0.0100	0.4600	$C_m = [(BAF_d)(DI)]/0.32$	0.5774	0.06130	NA	NA	NA	---	---	---
2,4,5-Trichlorophenol	0.0100	0.4600	$C_m = [(BAF_d)(DI)]/0.32$	0.6952	0.07365	NA	NA	NA	---	---	---
2,4,6-Trichlorophenol	0.0100	0.4600	$C_m = [(BAF_d)(DI)]/0.32$	0.6988	0.07402	NA	NA	NA	---	---	---
2,4-Dichlorophenol	0.0100	0.4600	$C_m = [(BAF_d)(DI)]/0.32$	0.8186	0.08659	NA	NA	NA	---	---	---
2-Acetylaminofluorene	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.4227	0.04470	NA	NA	NA	---	---	---
2-Chloronaphthalene	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.3464	0.03670	NA	NA	NA	---	---	---
3,3'-Dichlorobenzidine	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.3826	0.04050	NA	NA	NA	---	---	---
3,3'-Dimethylbenzidine	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.4730	0.04999	NA	NA	NA	---	---	---
3-Methylcholanthrene	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.1833	0.01960	NA	NA	NA	---	---	---
4-Bromophenyl phenyl ether	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.2620	0.02785	NA	NA	NA	---	---	---
4-Chloro-3-methylphenol	0.0100	0.4600	$C_m = [(BAF_d)(DI)]/0.32$	0.8144	0.08615	NA	NA	NA	---	---	---
4-Chlorophenyl phenyl ether	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.2653	0.02820	NA	NA	NA	---	---	---
7,12-Dimethylbenz(a)anthracene	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.1744	0.01867	2.00000	20.00000	6.32456	<0.01	<0.01	<0.01
Aramite, total	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.2742	0.02913	NA	NA	NA	---	---	---
Bis(2-ethylhexyl)phthalate	0.0051	0.6300	$C_m = [(BAF_d)(DI)]/0.32$	0.3797	0.04020	1.11000	5.55000	2.48204	0.04	<0.01	0.02
Butyl benzyl phthalate	0.0051	0.1700	$C_m = [(BAF_d)(DI)]/0.32$	0.1945	0.02077	NA	NA	NA	---	---	---
Diallate, cis-	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.2981	0.03164	NA	NA	NA	---	---	---
Diallate, trans-	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.2981	0.03164	NA	NA	NA	---	---	---
Dibenzofuran	0.0051	0.7500	$C_m = [(BAF_d)(DI)]/0.32$	1.0144	0.10676	NA	NA	NA	---	---	---
Diethyl phthalate	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.4954	0.05233	NA	NA	NA	---	---	---
Di-n-butyl phthalate	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.2892	0.03070	0.22200	1.11000	0.49641	0.14	0.03	0.06
Di-n-octyl phthalate	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.1222	0.01319	50.00000	250.00000	111.80340	<0.01	<0.01	<0.01
Dinoseb	0.0051	0.2100	$C_m = [(BAF_d)(DI)]/0.32$	0.3310	0.03510	0.26400	1.32000	0.59032	0.13	0.03	0.06
Hexachlorobenzene	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.2093	0.02233	0.11000	0.57000	0.25040	0.20	0.04	0.09
Hexachlorobutadiene	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.2749	0.02921	3.39000	17.00000	7.59144	<0.01	<0.01	<0.01
Hexachlorocyclopentadiene	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.2374	0.02528	NA	NA	NA	---	---	---
Hexachloroethane	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.3377	0.03579	NA	NA	NA	---	---	---
Hexachloropropene	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.3066	0.03253	NA	NA	NA	---	---	---
Isosafrole	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.3965	0.04196	NA	NA	NA	---	---	---
n-Nitrosodiphenylamine	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.4184	0.04425	NA	NA	NA	---	---	---
p-Dimethylamino azobenzene	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.2914	0.03094	NA	NA	NA	---	---	---
Pentachlorobenzene	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.2453	0.02611	NA	NA	NA	---	---	---
Pentachloronitrobenzene	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.2870	0.03047	7.07000	70.70000	22.35730	<0.01	<0.01	<0.01

TABLE G-3
FOOD ITEM CONCENTRATIONS, DIETARY DOSES, AND HAZARD QUOTIENT VALUES FOR RED TAILED HAWK DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical	Surface Water Concentration [1] (mg/L)	Surface Soil Concentration [2] (mg/kg)	Soil-to-Small Mammal BAF/Uptake Equation (unitless)	Small Mammal Concentration [3] (mg/kg)	Dietary Intake [4] (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates [6]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [5] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Semivolatile Organics (cont.):											
Pentachlorophenol	0.0100	0.4600	$C_m = [(BAF_d)(DI)]/0.32$	25.3083	2.65463	6.73000	67.30000	21.28213	0.39	0.04	0.12
Pronamide	0.0100	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.3866	0.04129	NA	NA	NA	---	---	---
LLPAHs:											
2-Methylnaphthalene	0.0002	0.0310	0.00000	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Acenaphthene	0.0002	0.4800	0.00000	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Acenaphthylene	0.0002	0.0270	0.00000	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Anthracene	0.0002	0.6900	0.00000	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(a)anthracene	0.0002	0.0840	0.00000	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(a)pyrene	0.0002	0.3900	0.00000	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(b)fluoranthene	0.0002	0.7500	0.00000	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(g,h,i)perylene	0.0002	0.2200	0.00000	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(k)fluoranthene	0.0002	0.7300	0.00000	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Chrysene	0.0002	1.2000	0.00000	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Dibenzo(a,h)anthracene	0.0002	0.0920	0.00000	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Fluoranthene	0.0000	4.6000	0.00000	0.0000	0.00000	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Fluorene	0.0002	0.5800	0.00000	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	0.0002	0.2400	0.00000	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Naphthalene	0.0002	0.0022	0.00000	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Phenanthrene	0.0002	7.0000	0.00000	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Pyrene	0.0000	3.0000	0.00000	0.0000	0.00000	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Organochlorine Pesticides:											
4,4'-DDD	0.0001	0.0081	$C_m = [(BAF_d)(DI)]/0.32$	0.0695	0.00729	0.22700	2.27000	0.71784	0.03	<0.01	0.01
4,4'-DDE	0.0000	0.1600	$C_m = [(BAF_d)(DI)]/0.32$	1.4821	0.15542	0.22700	2.27000	0.71784	0.68	0.07	0.22
4,4'-DDT	0.0000	0.1600	$C_m = [(BAF_d)(DI)]/0.32$	1.0647	0.11165	0.22700	2.27000	0.71784	0.49	0.05	0.16
Aldrin	0.0001	0.0190	$C_m = [(BAF_d)(DI)]/0.32$	0.0394	0.00414	0.07000	0.35000	0.15652	0.06	0.01	0.03
alpha-BHC	0.0001	0.0190	$C_m = [(BAF_d)(DI)]/0.32$	0.0278	0.00292	0.56300	2.25000	1.12550	<0.01	<0.01	<0.01
alpha-Chlordane	0.0001	0.0019	$C_m = [(BAF_d)(DI)]/0.32$	0.0048	0.00051	2.14000	10.70000	4.78519	<0.01	<0.01	<0.01
beta-BHC	0.0001	0.0092	$C_m = [(BAF_d)(DI)]/0.32$	0.0135	0.00142	0.56300	2.25000	1.12550	<0.01	<0.01	<0.01
Chlorobenzilate	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.2798	0.02972	9.73000	19.73000	13.85543	<0.01	<0.01	<0.01
delta-BHC	0.0001	0.0190	$C_m = [(BAF_d)(DI)]/0.32$	0.0255	0.00268	0.56300	2.25000	1.12550	<0.01	<0.01	<0.01
Dieldrin	0.0001	0.0370	$C_m = [(BAF_d)(DI)]/0.32$	1.1473	0.12032	0.70900	3.78000	1.63708	0.17	0.03	0.07
Endosulfan I	0.0001	0.0190	$C_m = [(BAF_d)(DI)]/0.32$	0.0258	0.00271	10.00000	50.00000	22.36068	<0.01	<0.01	<0.01
Endosulfan II	0.0001	0.0370	$C_m = [(BAF_d)(DI)]/0.32$	0.0502	0.00527	10.00000	50.00000	22.36068	<0.01	<0.01	<0.01
Endosulfan sulfate	0.0001	0.0007	$C_m = [(BAF_d)(DI)]/0.32$	0.0012	0.00013	10.00000	50.00000	22.36068	<0.01	<0.01	<0.01
Endrin	0.0001	0.0370	$C_m = [(BAF_d)(DI)]/0.32$	0.0837	0.00878	0.02100	0.10400	0.04673	0.42	0.08	0.19
Endrin aldehyde	0.0001	0.0018	$C_m = [(BAF_d)(DI)]/0.32$	0.0026	0.00028	0.02100	0.10400	0.04673	0.01	<0.01	<0.01
gamma-BHC (lindane)	0.0001	0.0190	$C_m = [(BAF_d)(DI)]/0.32$	0.3157	0.03310	4.00000	20.00000	8.94427	<0.01	<0.01	<0.01
gamma-Chlordane	0.0001	0.0035	$C_m = [(BAF_d)(DI)]/0.32$	0.0088	0.00093	2.14000	10.70000	4.78519	<0.01	<0.01	<0.01
Heptachlor	0.0001	0.0190	$C_m = [(BAF_d)(DI)]/0.32$	0.0359	0.00376	0.49000	2.17000	1.03116	<0.01	<0.01	<0.01
Heptachlor epoxide	0.0001	0.0190	$C_m = [(BAF_d)(DI)]/0.32$	0.1188	0.01247	0.49000	2.17000	1.03116	0.03	<0.01	0.01
Isodrin	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.1797	0.01922	NA	NA	NA	---	---	---
Kepone	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.2428	0.02585	1.67000	8.35000	3.73423	0.02	<0.01	<0.01
Methoxychlor	0.0005	0.0260	$C_m = [(BAF_d)(DI)]/0.32$	0.0278	0.00295	355.00000	1775.00000	793.80413	<0.01	<0.01	<0.01
Toxaphene	0.0026	0.9200	$C_m = [(BAF_d)(DI)]/0.32$	0.8711	0.09154	1.00000	5.00000	2.23607	0.09	0.02	0.04
Metals:											
Antimony	0.0003	8.5000	$C_m = [(BAF_d)(DI)]/0.32$	0.4250	0.04459	4740.00000	47400.00000	14989.19611	<0.01	<0.01	<0.01
Arsenic	0.0005	5.5000	$\ln(C_m) = 0.8188[\ln(C_s)] - 4.8471$	0.0317	0.00336	2.24000	4.51000	3.17843	<0.01	<0.01	<0.01
Barium	0.0214	267.0000	0.11210	0.3540	0.03873	20.80000	41.70000	29.45098	<0.01	<0.01	<0.01
Beryllium	0.0010	0.6200	$C_m = [(BAF_d)(DI)]/0.32$	0.0365	0.00391	NA	NA	NA	---	---	---
Cadmium	0.0010	2.6000	$\ln(C_m) = 0.4865[\ln(C_s)] - 0.4306$	1.0348	0.10859	1.47000	6.36000	3.05765	0.07	0.02	0.04
Chromium, total	0.0008	54.4000	$\ln(C_m) = 0.7338[\ln(C_s)] - 1.4599$	4.3607	0.45733	2.66000	15.60000	6.44174	0.17	0.03	0.07
Cobalt	0.0003	45.2000	$\ln(C_m) = 1.3070[\ln(C_s)] - 4.4669$	1.6723	0.17539	7.61000	18.30000	11.80097	0.02	<0.01	0.01
Copper	0.0040	291.0000	$\ln(C_m) = 0.1444[\ln(C_s)] + 0.2042$	17.4830	1.83361	4.05000	12.10000	7.00036	0.45	0.15	0.26
Lead	0.0010	654.0000	$\ln(C_m) = 0.4422[\ln(C_s)] + 0.0761$	18.9714	1.98946	1.63000	3.26000	2.30517	1.22	0.61	0.86

TABLE G-3
FOOD ITEM CONCENTRATIONS, DIETARY DOSES, AND HAZARD QUOTIENT VALUES FOR RED TAILED HAWK DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Surface Water Concentration [1] (mg/L)	Surface Soil Concentration [2] (mg/kg)	Soil-to-Small Mammal BAF/Uptake Equation (unitless)	Small Mammal Concentration [3] (mg/kg)	Dietary Intake [4] (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates [6]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [5] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Metals (cont.):											
Mercury	0.0002	0.0950	0.19200	0.0182	0.00193	0.02600	0.07800	0.04503	0.07	0.02	0.04
Nickel	0.0010	27.5000	$\ln(C_m) = 0.4658[\ln(C_s)] - 0.2462$	3.6603	0.38390	6.71000	18.60000	11.17166	0.06	0.02	0.03
Selenium	0.0008	2.4000	$\ln(C_m) = 0.3764[\ln(C_s)] - 0.4158$	0.9173	0.09625	0.29000	0.57900	0.40977	0.33	0.17	0.23
Silver	0.0010	2.6000	0.50130	1.3034	0.13675	2.02000	20.20000	6.38780	0.07	<0.01	0.02
Thallium	0.0010	0.3700	$C_m = [(BAF_d)(DI)]/0.32$	0.2364	0.02487	0.35000	1.75000	0.78262	0.07	0.01	0.03
Tin	0.0200	36.5000	$C_m = [(BAF_d)(DI)]/0.32$	23.2575	2.44034	6.80000	16.90000	10.72007	0.36	0.14	0.23
Vanadium	0.0076	260.0000	0.01790	4.6540	0.48860	0.34400	0.68800	0.48649	1.42	0.71	1.00
Zinc	0.0079	747.0000	$\ln(C_m) = 0.0738[\ln(C_s)] + 4.4713$	142.5319	14.94682	66.10000	171.00000	106.31604	0.23	0.09	0.14

Notes:

BAF = Bioaccumulation Factor
PAH = Polynuclear Aromatic Hydrocarbon
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
HQ = Hazard Quotient
mg/kg-BW/day = milligram per kilogram-body weight per day
ln = natural logarithm
C_m = Concentration in small mammal tissue (mg/kg - dry weight)
C_s = Maximum concentration in surface soil (mg/kg - dry weight)
BAF_d = small mammal diet-to-whole body bioaccumulation factor (wet weight)
DI_m = Small mammal dietary intake (mg/kg-BW/day)
NA = Not Available
--- = Step 2 screening level risk estimate could not be calculated due to the lack of a toxicity reference value.
mg/kg = milligram per kilogram
mg/L = milligram per liter

[1] Maximum detected surface water concentrations or, in the case of non-detected chemicals, maximum Reporting Limits.
[2] Maximum detected surface soil concentrations or, in the case of non-detected chemicals, maximum Reporting Limits.
[3] As discussed in Section 7.5.2.2.1, small mammal (i.e., Norway rat) tissue concentrations were derived by (a) multiplying maximum surface soil concentrations by soil-to-small mammal bioaccumulation factors, (b) soil-to-small mammal uptake equations, or (c) multiplying small mammal dietary intakes (see Table G-4 for small mammal dietary intake values) by small mammal diet-to-whole body BAF values (BAF_d assumed to be 1.0 for all chemicals [wet weight basis]) and dividing the products by 0.32 (solids content of small mammals).
[4] The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FIR_{hawk})(FC_{sm})(PDF_{sm})] + [(FIR_{hawk})(SC_x)(PDS)]+[(WIR_{hawk})(WC_x)]\}/BW_{hawk}$$

Where:

DI_x = Dietary intake of chemical x by the red-tailed hawk (mg/kg-body weight/day)
FIR_{hawk} = Maximum food ingestion rate for the red-tailed hawk (0.09679 kg/day - dry weight; see Table 7-16)
FC_{sm}= Concentration of chemical x in small mammal tissue (chemical-specific - dry weight; see Table G-3 above)
PDF_{sm} = Proportion of diet composed of small mammals (1.0 - dry weight basis [unitless]; see Table 7-17)
SC_x = Maximum concentration in surface soil (chemical specific - dry weight; see Table G-3 above)
PDS = Proportion of diet composed of surface soil (0.0 - dry weight basis [unitless]; see Table 7-17)
WIR_{hawk} = Maximum water ingestion rate for the red tailed hawk (0.06910 L/day; see Table 7-16)
WC_x = Maximum concentration in surface water (chemical-specific; see Table G-3 above)
BW_{hawk} = Minimum body weight for the red-tailed hawk (0.923 kg; see Table 7-16)

[5] MATC values were derived by calculating the geometric mean of the NOAEL and LOAEL values.
[6] NOAEL-, LOAEL, and MATC-based screening level risk estimates (i.e., HQs) were derived by dividing dietary intakes by NOAEL, LOAEL-, and MATC-based toxicity reference values, respectively

TABLE G-4
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR BROWN FLOWER BAT DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Surface Water Concentration [1] (mg/L)	Surface Soil Concentration [2] (mg/kg)	Soil-to-Plant BAF/Uptake Equation (unitless)	Plant Tissue Concentration [3] (mg/kg)	Dietary Intake [4] (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates [6]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [5] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Volatile Organics:											
1,1,1,2-Tetrachloroethane	0.0005	0.0056	5.17618	0.0290	0.00511	NA	NA	NA	---	---	---
Carbon tetrachloride	0.0005	0.0056	4.71454	0.0264	0.00466	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
Chlorobenzene	0.0005	0.0056	4.17540	0.0234	0.00414	27.25000	54.50000	38.53732	<0.01	<0.01	<0.01
Chloroform	0.0012	0.0056	10.04745	0.0563	0.00997	15.00000	75.00000	33.54102	<0.01	<0.01	<0.01
Ethylbenzene	0.0005	0.0056	3.21442	0.0180	0.00321	136.00000	408.00000	235.55891	<0.01	<0.01	<0.01
Pentachloroethane	0.0005	0.0056	2.98295	0.0167	0.00299	NA	NA	NA	---	---	---
Styrene	0.0005	0.0056	3.87473	0.0217	0.00385	35.00000	175.00000	78.26238	<0.01	<0.01	<0.01
Toluene	0.0005	0.0056	4.62727	0.0259	0.00458	52.00000	260.00000	116.27553	<0.01	<0.01	<0.01
Trichloroethene	0.0005	0.0056	4.80345	0.0269	0.00475	5.00000	2.50000	3.53553	<0.01	<0.01	<0.01
o-Xylene	0.0005	0.0056	3.12558	0.0010	0.00036	2.06000	2.58000	2.30539	<0.01	<0.01	<0.01
m,p-Xylene	0.0010	0.0003	3.24458	0.0010	0.00027	2.06000	2.58000	2.30539	<0.01	<0.01	<0.01
Xylenes (total)	0.0005	0.0003	3.24458	0.0010	0.00027	2.06000	2.58000	2.30539	<0.01	<0.01	<0.01
Semivolatile Organics:											
1,2,4,5-Tetrachlorobenzene	0.0051	0.2400	0.79168	0.1900	0.03385	NA	NA	NA	---	---	---
1,2,4-Trichlorobenzene	0.0051	0.2400	1.42608	0.3423	0.06021	53.00000	106.00000	74.95332	<0.01	<0.01	<0.01
1,2-Dichlorobenzene	0.0051	0.2400	2.45160	0.5884	0.10282	171.00000	857.00000	382.81458	<0.01	<0.01	<0.01
1,3-Dichlorobenzene	0.0051	0.2400	2.23295	0.5359	0.09373	171.00000	857.00000	382.81458	<0.01	<0.01	<0.01
1,4,-Dichlorobenzene	0.0051	0.2400	2.47461	0.5939	0.10377	250.00000	500.00000	353.55339	<0.01	<0.01	<0.01
2,3,4,6-Tetrachlorophenol	0.0100	0.4600	0.94544	0.4349	0.07716	NA	NA	NA	---	---	---
2,4,5-Trichlorophenol	0.0100	0.4600	1.86980	0.8601	0.15078	160.00000	800.00000	357.77088	<0.01	<0.01	<0.01
2,4,6-Trichlorophenol	0.0100	0.4600	1.90507	0.8763	0.15359	160.00000	800.00000	357.77088	<0.01	<0.01	<0.01
2,4-Dichlorophenol	0.0100	0.4600	3.39973	1.5639	0.27262	88.00000	440.00000	196.77398	<0.01	<0.01	<0.01
2-Acetylaminofluorene	0.0051	0.2400	3.27504	0.7860	0.13703	NA	NA	NA	---	---	---
2-Chloronaphthalene	0.0051	0.2400	1.58041	0.3793	0.06662	NA	NA	NA	---	---	---
3,3'-Dichlorobenzidine	0.0051	0.2400	2.27506	0.5460	0.09548	NA	NA	NA	---	---	---
3,3'-Dimethylbenzidine	0.0051	0.2400	4.93997	1.1856	0.20621	NA	NA	NA	---	---	---
3-Methylcholanthrene	0.0051	0.2400	0.15011	0.0360	0.00719	NA	NA	NA	---	---	---
4-Bromophenyl phenyl ether	0.0051	0.2400	0.56559	0.1357	0.02445	NA	NA	NA	---	---	---
4-Chloro-3-methylphenol	0.0100	0.4600	3.33680	1.5349	0.26761	NA	NA	NA	---	---	---
4-Chlorophenyl phenyl ether	0.0051	0.2400	0.59263	0.1422	0.02558	NA	NA	NA	---	---	---
7,12-Dimethylbenz(a)anthracene	0.0051	0.2400	0.12453	0.0299	0.00613	NA	NA	NA	---	---	---
Aramite, total	0.0051	0.2400	0.66915	0.1606	0.02876	NA	NA	NA	---	---	---
Bis(2-ethylhexyl)phthalate	0.0051	0.6300	0.06598	0.0416	0.00815	18.30000	183.30000	57.91710	<0.01	<0.01	<0.01
Butyl benzyl phthalate	0.0051	0.1700	0.65677	0.1117	0.02028	480.00000	2400.00000	1073.31263	<0.01	<0.01	<0.01
Diallate, cis-	0.0051	0.2400	0.91077	0.2186	0.03880	NA	NA	NA	---	---	---
Diallate, trans-	0.0051	0.2400	0.91077	0.2186	0.03880	NA	NA	NA	---	---	---
Dibenzofuran	0.0051	0.7500	1.28681	0.9651	0.16804	NA	NA	NA	---	---	---
Diethyl phthalate	0.0051	0.2400	5.84454	1.4027	0.24379	4583.00000	22915.00000	10247.89954	<0.01	<0.01	<0.01
Di-n-butyl phthalate	0.0051	0.2400	0.81418	0.1954	0.03478	550.00000	1833.00000	1004.06673	<0.01	<0.01	<0.01
Di-n-octyl phthalate	0.0051	0.2400	0.03244	0.0078	0.00230	55.00000	550.00000	173.92527	<0.01	<0.01	<0.01
Dinoseb	0.0051	0.2100	2.17124	0.4560	0.07989	NA	NA	NA	---	---	---
Hexachlorobenzene	0.0051	0.2400	0.24628	0.0591	0.01119	8.00000	16.00000	11.31371	<0.01	<0.01	<0.01
Hexachlorobutadiene	0.0051	0.2400	0.67543	0.1621	0.02902	4.00000	20.00000	8.94427	<0.01	<0.01	<0.01
Hexachlorocyclopentadiene	0.0051	0.2400	0.39290	0.0943	0.01728	10.00000	30.00000	17.32051	<0.01	<0.01	<0.01
Hexachloroethane	0.0051	0.2400	1.43946	0.3455	0.06076	NA	NA	NA	---	---	---
Hexachloropropene	0.0051	0.2400	1.00933	0.2422	0.04289	NA	NA	NA	---	---	---
Isosafrole	0.0051	0.2400	2.59293	0.6223	0.10869	NA	NA	NA	---	---	---
n-Nitrosodiphenylamine	0.0051	0.2400	3.15492	0.7572	0.13204	300.00000	1500.00000	670.82039	<0.01	<0.01	<0.01
p-Dimethylamino azobenzene	0.0051	0.2400	0.83732	0.2010	0.03575	NA	NA	NA	---	---	---
Pentachlorobenzene	0.0051	0.2400	0.44363	0.1065	0.01939	7.25000	36.25000	16.21149	<0.01	<0.01	<0.01
Pentachloronitrobenzene	0.0051	0.2400	0.79168	0.1900	0.03385	NA	NA	NA	---	---	---
Pentachlorophenol	0.0100	0.4600	46.02000	21.1692	3.66679	8.42000	22.65000	13.80989	0.44	0.16	0.27
Pronamide	0.0100	0.2400	2.27506	0.5460	0.09640	NA	NA	NA	---	---	---
LLPAHs:											
2-Methylnaphthalene	0.0002	0.0310	1.64058	0.0509	0.00884	65.60000	328.00000	146.68606	<0.01	<0.01	<0.01
Acenaphthene	0.0002	0.4800	$\ln(C_p) = -0.8556[\ln[C_s]) - 5.562$	0.0072	0.00129	65.60000	328.00000	146.68606	<0.01	<0.01	<0.01
Acenaphthylene	0.0002	0.0270	1.52245	0.0411	0.00716	65.60000	328.00000	146.68606	<0.01	<0.01	<0.01
Anthracene	0.0002	0.6900	$\ln(C_p) = 0.7784[\ln(C_s)] - 0.9887$	0.2787	0.04829	65.60000	328.00000	146.68606	<0.01	<0.01	<0.01

TABLE G-4
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR BROWN FLOWER BAT DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical	Surface Water Concentration [1] (mg/L)	Surface Soil Concentration [2] (mg/kg)	Soil-to-Plant BAF/Uptake Equation (unitless)	Plant Tissue Concentration [3] (mg/kg)	Dietary Intake [4] (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates [6]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [5] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
LLPAHs (cont.):											
Benzo(a)anthracene	0.0002	0.0840	$\ln(C_p) = 0.5944[\ln(C_s)] - 2.7078$	0.0153	0.00269	0.61500	3.01000	1.36057	<0.01	<0.01	<0.01
Benzo(a)pyrene	0.0002	0.3900	$\ln(C_p) = 0.975[\ln(C_s)] - 2.0615$	0.0508	0.00884	0.61500	3.01000	1.36057	0.01	<0.01	<0.01
Benzo(b)fluoranthene	0.0002	0.7500	0.48000	0.3600	0.06236	0.61500	3.01000	1.36057	0.10	0.02	0.05
Benzo(g,h,i)perylene	0.0002	0.2200	$\ln(C_p) = 1.1829[\ln(C_s)] - 0.9313$	0.0657	0.01142	0.61500	3.01000	1.36057	0.02	<0.01	<0.01
Benzo(k)fluoranthene	0.0002	0.7300	$\ln(C_p) = 0.8595[\ln(C_s)] - 2.1579$	0.0882	0.01531	0.61500	3.01000	1.36057	0.02	<0.01	0.01
Chrysene	0.0002	1.2000	$\ln(C_p) = 0.5944[\ln(C_s)] - 2.7078$	0.0743	0.01291	0.61500	3.01000	1.36057	0.02	<0.01	<0.01
Dibenzo(a,h)anthracene	0.0002	0.0920	0.23000	0.0212	0.00370	0.61500	3.01000	1.36057	<0.01	<0.01	<0.01
Fluoranthene	0.0000	4.6000	6.00000	27.6000	4.77825	65.60000	328.00000	146.68606	0.07	0.01	0.03
Fluorene	0.0002	0.5800	$\ln(C_p) = -0.8556[\ln[C_s]) - 5.562$	0.0061	0.00110	65.60000	328.00000	146.68606	<0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	0.0002	0.2400	0.15000	0.0360	0.00627	0.61500	3.01000	1.36057	0.01	<0.01	<0.01
Naphthalene	0.0002	0.0022	48.00000	0.1056	0.01832	65.60000	328.00000	146.68606	<0.01	<0.01	<0.01
Phenanthrene	0.0002	7.0000	$\ln(C_p) = 0.6203[\ln(C_s)] - 0.1665$	2.8308	0.49012	65.60000	328.00000	146.68606	<0.01	<0.01	<0.01
Pyrene	0.0000	3.0000	3.70000	11.1000	1.92169	0.61500	3.01000	1.36057	3.12	0.64	1.41
Organochlorine Pesticides:											
4,4'-DDD	0.0001	0.0081	0.20241	0.0016	0.00030	0.14700	0.73500	0.32870	<0.01	<0.01	<0.01
4,4'-DDE	0.0000	0.1600	0.14000	0.0224	0.00388	0.14700	0.73500	0.32870	0.03	<0.01	0.01
4,4'-DDT	0.0000	0.1600	0.07900	0.0126	0.00219	0.14700	0.73500	0.32870	0.01	<0.01	<0.01
Aldrin	0.0001	0.0190	0.13930	0.0026	0.00047	0.20000	1.00000	0.44721	<0.01	<0.01	<0.01
alpha-BHC	0.0001	0.0190	1.73516	0.0330	0.00572	0.01370	0.13700	0.04332	0.42	0.04	0.13
alpha-Chlordane	0.0001	0.0019	0.16481	0.0003	0.00006	0.15000	0.75000	0.33541	<0.01	<0.01	<0.01
beta-BHC	0.0001	0.0092	1.71903	0.0158	0.00275	0.40000	2.00000	0.89443	<0.01	<0.01	<0.01
Chlorobenzilate	0.0051	0.2400	0.72108	0.1731	0.03092	5.00000	20.00000	10.00000	<0.01	<0.01	<0.01
delta-BHC	0.0001	0.0190	1.26300	0.0240	0.00416	0.01370	0.13700	0.04332	0.30	0.03	0.10
Dieldrin	0.0001	0.0370	2.22200	0.0822	0.01425	0.01500	0.03000	0.02121	0.95	0.48	0.67
Endosulfan I	0.0001	0.0190	1.68721	0.0321	0.00556	0.15000	0.75000	0.33541	0.04	<0.01	0.01
Endosulfan II	0.0001	0.0370	1.68721	0.0624	0.01083	0.15000	0.75000	0.33541	0.07	0.01	0.03
Endosulfan sulfate	0.0001	0.0007	1.97760	0.0014	0.00027	0.15000	0.75000	0.33541	<0.01	<0.01	<0.01
Endrin	0.0001	0.0370	0.53476	0.0198	0.00344	0.09200	0.92000	0.29093	0.04	<0.01	0.02
Endrin aldehyde	0.0001	0.0018	1.43946	0.0026	0.00047	0.09200	0.92000	0.29093	<0.01	<0.01	<0.01
gamma-BHC (lindane)	0.0001	0.0190	1.85242	0.0352	0.00610	0.01370	0.13700	0.04332	0.45	0.04	0.14
gamma-Chlordane	0.0001	0.0035	0.16481	0.0006	0.00011	0.15000	0.75000	0.33541	<0.01	<0.01	<0.01
Heptachlor	0.0001	0.0190	0.17431	0.0033	0.00058	0.15000	0.25000	0.19365	<0.01	<0.01	<0.01
Heptachlor epoxide	0.0001	0.0190	0.56559	0.0107	0.00187	0.15000	0.25000	0.19365	0.01	<0.01	<0.01
Isodrin	0.0051	0.2400	0.13930	0.0334	0.00674	NA	NA	NA	---	---	---
Kepone	0.0051	0.2400	0.42736	0.1026	0.01871	0.08000	0.40000	0.17889	0.23	0.05	0.10
Methoxychlor	0.0005	0.0260	0.52486	0.0136	0.00246	5.01000	35.50000	13.33623	<0.01	<0.01	<0.01
Toxaphene	0.0026	0.9200	0.35453	0.3262	0.05695	8.00000	40.00000	17.88854	<0.01	<0.01	<0.01
Metals:											
Antimony	0.0003	8.5000	$\ln(C_p) = 0.938[\ln(C_s)] - 3.233$	0.2936	0.05087	0.05900	0.59000	0.18657	0.86	0.09	0.27
Arsenic	0.0005	5.5000	$\ln(C_p) = 0.564[\ln[C_s]) - 1.992$	0.3568	0.06187	1.04000	1.66000	1.31393	0.06	0.04	0.05
Barium	0.0214	267.0000	0.44700	119.3490	20.66630	51.80000	82.70000	65.45120	0.40	0.25	0.32
Beryllium	0.0010	0.6200	$\ln(C_p) = 0.7345[\ln[C_s]) - 0.5361$	0.4118	0.07148	0.53200	0.56700	0.54922	0.13	0.13	0.13
Cadmium	0.0010	2.6000	$\ln(C_p) = 0.546[\ln(C_s)] - 0.475$	1.0478	0.18159	0.77000	7.70000	2.43495	0.24	0.02	0.07
Chromium, total	0.0008	54.4000	0.08390	4.5642	0.79031	2.40000	58.53000	11.85209	0.33	0.01	0.07
Cobalt	0.0003	45.2000	0.02480	1.1210	0.19413	7.33000	18.90000	11.77017	0.03	0.01	0.02
Copper	0.0040	291.0000	$\ln(C_p) = 0.394[\ln(C_s)] + 0.668$	18.2340	3.15751	5.60000	9.34000	7.23215	0.56	0.34	0.44
Lead	0.0010	654.0000	$\ln(C_p) = 0.561[\ln(C_s)] - 1.328$	10.0646	1.74262	4.70000	8.90000	6.46761	0.37	0.20	0.27
Mercury	0.0002	0.0950	$\ln(C_p) = 0.544[\ln[C_s]) - 0.996$	0.1026	0.01781	0.03200	0.16000	0.07155	0.56	0.11	0.25
Nickel	0.0010	27.5000	$\ln(C_p) = 0.748[\ln(C_s)] - 2.224$	1.2905	0.22360	1.70000	3.40000	2.40416	0.13	0.07	0.09
Selenium	0.0008	2.4000	$\ln(C_p) = 1.104[\ln(C_s)] - 0.678$	1.3344	0.23117	0.14300	0.21500	0.17534	1.62	1.08	1.32
Silver	0.0010	2.6000	0.03670	0.0954	0.01671	6.02000	60.20000	19.03691	<0.01	<0.01	<0.01
Thallium	0.0010	0.3700	0.00400	0.0015	0.00044	0.00740	0.07400	0.02340	0.06	<0.01	0.02
Tin	0.0200	36.5000	0.03000	1.0950	0.19331	23.40000	35.00000	28.61818	<0.01	<0.01	<0.01
Vanadium	0.0076	260.0000	0.00970	2.5220	0.43804	4.16000	8.31000	5.87959	0.11	0.05	0.07
Zinc	0.0079	747.0000	$\ln(C_p) = 0.554[\ln(C_s)] + 1.575$	188.7267	32.67479	75.40000	82.30000	78.77449	0.43	0.40	0.41

TABLE G-4
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR BROWN FLOWER BAT DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Notes:

BAF = Bioaccumulation Factor
PAH = Polynuclear Aromatic Hydrocarbon
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
HQ = Hazard Quotient
mg/kg-BW/day = milligram per kilogram-body weight per day
ln = natural logarithm
C_p = Concentration in plant tissue (mg/kg - dry weight)
C_s = Maximum concentration in surface soil (mg/kg - dry weight)
NA = Not Available
--- = Step 2 screening level risk estimate could not be calculated due to the lack of a toxicity reference value.
mg/kg = milligram per kilogram
mg/L = milligram per liter

(1) Maximum detected surface water concentrations or, in the case of non-detected chemicals, maximum Reporting Limits.
(2) Maximum detected surface soil concentrations or, in the case of non-detected chemicals, maximum Reporting Limits.
(3) As discussed in Section 7.5.2.2.1, plant tissue concentrations were derived by (a) multiplying maximum surface soil concentrations by soil-to-plant bioaccumulation factors, or (b) soil-to-plant uptake equations.
(4) The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FI_{bat})(FC_{plant})(PDF_{plant})] + [(FIR_{bat})(SC_x)(PDS)]+[(WIR_{bat})(WC_x)]\}/BW_{bat}$$

Where:

DI_x = Dietary intake of chemical x by the brown flower bat (mg/kg-body weight/day)
FIR_{bat} = Maximum food ingestion rate for the brown flower bat (0.00277 kg/day - dry weight; see Table 7-16)
FC_{plant} = Concentration of chemical x in soil invertebrate tissue (chemical-specific - dry weight; see Table G-4 above)
PDF_{plant} = Proportion of diet composed of plants (1.0 - dry weight basis [unitless]; see Table 7-17)
SC_x = Maximum concentration in surface soil (chemical specific - dry weight; see Table G-4 above)
PDS = Proportion of diet composed of surface soil (0.0 - dry weight basis [unitless]; see Table 7-17)
WIR_{bat} = Maximum water ingestion rate for the brown flower bat (0.00299 L/day; see Table 7-16)
WC_x = Maximum concentration in surface water (chemical-specific; see Table G-4 above)
BW_{bat} = Minimum body weight for the brown flower bat (0.016 kg; see Table 7-16)

(5) MATC values were derived by calculating the geometric mean of the NOAEL and LOAEL values.
(6) NOAEL-, LOAEL, and MATC-based screening level risk estimates (i.e., HQs) were derived by dividing dietary intakes by NOAEL, LOAEL-, and MATC-based toxicity reference values, respectively

TABLE G-5
FOOD ITEM CONCENTRATIONS AND DIETARY INTAKES FOR NORWAY RAT DIETARY EXPOSURES
TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical [1]	Surface Water Concentration [2] (mg/L)	Surface Soil Concentration [3] (mg/kg)	Soil-to-Invertebrate BAF (unitless)	Invertebrate Tissue Concentration [4] (mg/kg)	Dietary Intake [5] (mg/kg-BW/day)
Volatile Organics:					
1,1,1,2-Tetrachloroethane	0.0005	0.0056	3.15072	0.0176	0.00368
Carbon tetrachloride	0.0005	0.0056	3.06980	0.0172	0.00359
Chlorobenzene	0.0005	0.0056	2.96770	0.0166	0.00347
Chloroform	0.0012	0.0056	3.79001	0.0212	0.00458
Ethylbenzene	0.0005	0.0056	2.75918	0.0155	0.00324
Pentachloroethane	0.0005	0.0056	2.81777	0.0158	0.00331
Styrene	0.0005	0.0056	2.90656	0.0163	0.00341
Toluene	0.0005	0.0056	3.05387	0.0171	0.00357
Trichloroethene	0.0005	0.0056	3.08582	0.0173	0.00361
o-Xylene	0.0005	0.0056	2.76637	0.0155	0.00325
m,p-Xylene	0.0010	0.0003	2.76637	0.0009	0.00044
Xylenes (total)	0.0005	0.0003	2.76637	0.0009	0.00031
Semivolatile Organics:					
1,2,4,5-Tetrachlorobenzene	0.0051	0.2400	1.86758	0.4482	0.09183
1,2,4-Trichlorobenzene	0.0051	0.2400	2.20024	0.5281	0.10777
1,2-Dichlorobenzene	0.0051	0.2400	2.55864	0.6141	0.12495
1,3-Dichlorobenzene	0.0051	0.2400	2.49293	0.5983	0.12180
1,4,-Dichlorobenzene	0.0051	0.2400	2.56531	0.6157	0.12527
2,3,4,6-Tetrachlorophenol	0.0100	0.4600	1.96223	0.9026	0.18476
2,4,5-Trichlorophenol	0.0100	0.4600	2.37268	1.0914	0.22247
2,4,6-Trichlorophenol	0.0100	0.4600	2.38506	1.0971	0.22360
2,4-Dichlorophenol	0.0100	0.4600	2.80259	1.2892	0.26195
2-Acetylaminofluorene	0.0051	0.2400	2.77358	0.6657	0.13525
2-Chloronaphthalene	0.0051	0.2400	2.26412	0.5434	0.11084
3,3'-Dichlorobenzidine	0.0051	0.2400	2.50594	0.6014	0.12242
3,3'-Dimethylbenzidine	0.0051	0.2400	3.11000	0.7464	0.15137
3-Methylcholanthrene	0.0051	0.2400	1.17528	0.2821	0.05865
4-Bromophenyl phenyl ether	0.0051	0.2400	1.70059	0.4081	0.08383
4-Chloro-3-methylphenol	0.0100	0.4600	2.78805	1.2825	0.26062
4-Chlorophenyl phenyl ether	0.0051	0.2400	1.72286	0.4135	0.08490
7,12-Dimethylbenz(a)anthracene	0.0051	0.2400	1.11568	0.2678	0.05580
Aramite, total	0.0051	0.2400	1.78213	0.4277	0.08774
Bis(2-ethylhexyl)phthalate	0.0051	0.6300	0.93476	0.5889	0.12151
Butyl benzyl phthalate	0.0051	0.1700	1.77288	0.3014	0.06223
Diallate, cis-	0.0051	0.2400	1.94191	0.4661	0.09539
Diallate, trans-	0.0051	0.2400	1.94191	0.4661	0.09539
Dibenzofuran	0.0051	0.7500	2.13816	1.6036	0.32462
Diethyl phthalate	0.0051	0.2400	3.25912	0.7822	0.15852
Di-n-butyl phthalate	0.0051	0.2400	1.88222	0.4517	0.09253
Di-n-octyl phthalate	0.0051	0.2400	0.76704	0.1841	0.03909

TABLE G-5
FOOD ITEM CONCENTRATIONS AND DIETARY INTAKES FOR NORWAY RAT DIETARY EXPOSURES
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Chemical [1]	Surface Water Concentration [2] (mg/L)	Surface Soil Concentration [3] (mg/kg)	Soil-to-Invertebrate BAF (unitless)	Invertebrate Tissue Concentration [4] (mg/kg)	Dietary Intake [5] (mg/kg-BW/day)
Semivolatile Organics (cont.):					
Dinoseb	0.0051	0.2100	2.47355	0.5194	0.10593
Hexachlorobenzene	0.0051	0.2400	1.34906	0.3238	0.06698
Hexachlorobutadiene	0.0051	0.2400	1.78678	0.4288	0.08796
Hexachlorocyclopentadiene	0.0051	0.2400	1.53649	0.3688	0.07596
Hexachloroethane	0.0051	0.2400	2.20597	0.5294	0.10805
Hexachloropropene	0.0051	0.2400	1.99830	0.4796	0.09810
Isosafrole	0.0051	0.2400	2.59890	0.6237	0.12688
n-Nitrosodiphenylamine	0.0051	0.2400	2.74486	0.6588	0.13387
p-Dimethylamino azobenzene	0.0051	0.2400	1.89697	0.4553	0.09324
Pentachlorobenzene	0.0051	0.2400	1.58935	0.3814	0.07850
Pentachloronitrobenzene	0.0051	0.2400	1.86758	0.4482	0.09183
Pentachlorophenol	0.0100	0.4600	88.12000	40.5352	8.09864
Pronamide	0.0100	0.2400	2.50594	0.6014	0.12372
Organochlorine Pesticides:					
4,4'-DDD	0.0001	0.0081	$In(C_e) = 0.6975[In(C_s)] + 1.1613$	0.1110	0.02223
4,4'-DDE	0.0000	0.1600	$In(C_e) = 0.8804[In(C_s)] + 2.4771$	2.3719	0.47428
4,4'-DDT	0.0000	0.1600	$In(C_e) = 0.8689[In(C_s)] + 2.1247$	1.7030	0.34070
Aldrin	0.0001	0.0190	3.30000	0.0627	0.01261
alpha-BHC	0.0001	0.0190	2.32381	0.0442	0.00891
alpha-Chlordane	0.0001	0.0019	4.00000	0.0076	0.00154
beta-BHC	0.0001	0.0092	2.31777	0.0213	0.00431
Chlorobenzilate	0.0051	0.2400	1.81963	0.4367	0.08953
delta-BHC	0.0001	0.0190	2.12706	0.0404	0.00816
Dieldrin	0.0001	0.0370	49.67000	1.8378	0.36715
Endosulfan I	0.0001	0.0190	2.14931	0.0408	0.00825
Endosulfan II	0.0001	0.0370	2.14931	0.0795	0.01606
Endosulfan sulfate	0.0001	0.0007	2.41002	0.0017	0.00038
Endrin	0.0001	0.0370	3.60000	0.1332	0.02677
Endrin aldehyde	0.0001	0.0018	2.20597	0.0040	0.00083
gamma-BHC (lindane)	0.0001	0.0190	26.60000	0.5054	0.10101
gamma-Chlordane	0.0001	0.0035	4.00000	0.0140	0.00282
Heptachlor	0.0001	0.0190	3.00000	0.0570	0.01147
Heptachlor epoxide	0.0001	0.0190	10.00000	0.1900	0.03803
Isodrin	0.0051	0.2400	1.15107	0.2763	0.05749
Kepone	0.0051	0.2400	1.57290	0.3775	0.07771
Methoxychlor	0.0005	0.0260	1.66556	0.0433	0.00889
Toxaphene	0.0026	0.9200	1.49314	1.3737	0.27874
Metals:					
Antimony	0.0003	8.5000	1.00000	8.5000	1.73200
Beryllium	0.0010	0.6200	1.18200	0.7328	0.14913

TABLE G-5
FOOD ITEM CONCENTRATIONS AND DIETARY INTAKES FOR NORWAY RAT DIETARY EXPOSURES
TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical [1]	Surface Water Concentration [2] (mg/L)	Surface Soil Concentration [3] (mg/kg)	Soil-to-Invertebrate BAF (unitless)	Invertebrate Tissue Concentration [4] (mg/kg)	Dietary Intake [5] (mg/kg-BW/day)
Metals (cont.):					
Thallium	0.0010	0.3700	1.00000	0.3700	0.07566
Tin	0.0200	36.5000	1.00000	36.5000	7.44241

Notes:

BAF = Bioaccumulation Factor
mg/kg = milligram per kilogram
mg/kg-BW/day = milligram per kilogram-body weight per day (dry weight basis)
mg/L = milligram per liter

(1) Only those chemicals with Norway rat tissue concentrations estimated using dietary intakes and diet-to-whole body BAF values are listed (see Table G-3).
(2) Maximum detected surface water concentrations or, in the case of non-detected chemicals, maximum Reporting Limits.
(3) Maximum detected surface soil concentrations or, in the case of non-detected chemicals, maximum Reporting Limits.
(4) Soil invertebrate tissue concentrations were derived by multiplying maximum surface soil concentrations by soil-to-invertebrate bioaccumulation factors.
(5) The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FIR_{rat})(FC_{invert})(PDF_{invert})] + [(FIR_{rat})(SC_x)(PDS)]+[(WIR_{rat})(WC_x)]\}/BW_{rat}$$

Where:

DI_x = Dietary intake of chemical x by the Norway rat (mg/kg-body weight/day)
FIR_{rat} = Maximum food ingestion rate for the Norway rat (0.04075 kg/day - dry weight basis; see Table 7-16)
FC_{invert} = Concentration of chemical x in soil invertebrate tissue (chemical-specific - dry weight basis; see Table G-5 above)
PDF_{invert} = Proportion of diet composed of soil invertebrates (0.98 - dry weight basis [unitless]; see Table 7-17)
SC_x = Maximum concentration in surface soil (chemical specific - dry weight basis; see Table G-5 above)
PDS = Proportion of diet composed of surface soil (0.02 - dry weight basis [unitless]; see Table 7-17)
WIR_{rat} = Maximum water ingestion rate for the rat (0.5305 L/day; see Table 7-16)
WC_x = Maximum concentration in surface water (chemical-specific; see Table G-5 above)
BW_{rat} = Minimum body weight for the Norway rat (0.200 kg; see Table 7-16)

TABLE G-6
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR MOURNING DOVE DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical	Surface Water Concentration (1) (mg/L)	Surface Soil Concentration (2) (mg/kg)	Soil-to-Plant BAF/Uptake Equation (unitless)	Plant Tissue Concentration (3) (mg/kg)	Dietary Intake (4) (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates (6)		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC (5) (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Volatile Organics:											
1,1,1,2-Tetrachloroethane	0.0005	0.0026	5.17618	0.0135	0.00200	NA	NA	NA	---	---	---
Carbon tetrachloride	0.0005	0.0011	4.71454	0.0052	0.00081	NA	NA	NA	---	---	---
Chlorobenzene	0.0005	0.0011	4.17540	0.0046	0.00073	NA	NA	NA	---	---	---
Chloroform	0.0012	0.0012	10.04745	0.0121	0.00188	NA	NA	NA	---	---	---
Ethylbenzene	0.0005	0.0014	3.21442	0.0045	0.00071	NA	NA	NA	---	---	---
Pentachloroethane	0.0005	0.0067	2.98295	0.0200	0.00296	NA	NA	NA	---	---	---
Styrene	0.0005	0.0011	3.87473	0.0043	0.00068	NA	NA	NA	---	---	---
Toluene	0.0005	0.0011	4.62727	0.0051	0.00080	NA	NA	NA	---	---	---
Trichloroethene	0.0005	0.0014	4.80345	0.0067	0.00103	NA	NA	NA	---	---	---
Xylenes (total)	0.0005	0.0012	3.24458	0.0039	0.00063	40.50000	203.00000	90.67249	<0.01	<0.01	<0.01
Semivolatile Organics:											
1,2,4,5-Tetrachlorobenzene	0.0000	0.0460	0.79168	0.0364	0.00553	NA	NA	NA	---	---	---
1,2,4-Trichlorobenzene	0.0051	0.0011	1.42608	0.0016	0.00087	NA	NA	NA	---	---	---
1,2-Dichlorobenzene	0.0051	0.0014	2.45160	0.0034	0.00114	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
1,3-Dichlorobenzene	0.0051	0.0017	2.23295	0.0038	0.00120	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
1,4-Dichlorobenzene	0.0051	0.0011	2.47461	0.0027	0.00104	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
2,3,4,6-Tetrachlorophenol	0.0100	0.0460	0.94544	0.0435	0.00780	NA	NA	NA	---	---	---
2,4,5-Trichlorophenol	0.0100	0.1100	1.86980	0.2057	0.03137	NA	NA	NA	---	---	---
2,4,6-Trichlorophenol	0.0100	0.1100	1.90507	0.2096	0.03192	NA	NA	NA	---	---	---
2,4-Dichlorophenol	0.0100	0.1000	3.39973	0.3400	0.05041	NA	NA	NA	---	---	---
2-Acetylaminofluorene	0.0051	0.4600	3.27504	1.5065	0.21858	NA	NA	NA	---	---	---
2-Chloronaphthalene	0.0051	0.0840	1.58041	0.1328	0.02017	NA	NA	NA	---	---	---
3,3'-Dichlorobenzidine	0.0051	0.2400	2.27506	0.5460	0.08018	NA	NA	NA	---	---	---
3,3'-Dimethylbenzidine	0.0051	0.9200	4.93997	4.5448	0.65459	NA	NA	NA	---	---	---
3-Methylcholanthrene	0.0051	0.4600	0.15011	0.0691	0.01392	NA	NA	NA	---	---	---
4-Bromophenyl phenyl ether	0.0051	0.0960	0.56559	0.0543	0.00909	NA	NA	NA	---	---	---
4-Chloro-3-methylphenol	0.0100	0.0980	3.33680	0.3270	0.04855	NA	NA	NA	---	---	---
4-Chlorophenyl phenyl ether	0.0051	0.0890	0.59263	0.0527	0.00882	NA	NA	NA	---	---	---
7,12-Dimethylbenz(a)anthracene	0.0051	0.2400	0.12453	0.0299	0.00670	2.00000	20.00000	6.32456	<0.01	<0.01	<0.01
Aramite, total	0.0051	0.0670	0.66915	0.0448	0.00753	NA	NA	NA	---	---	---
Bis(2-ethylhexyl)phthalate	0.0051	0.0780	0.06598	0.0051	0.00196	1.11000	5.55000	2.48204	<0.01	<0.01	<0.01
Butyl benzyl phthalate	0.0051	0.0930	0.65677	0.0611	0.01004	NA	NA	NA	---	---	---
Diallate	0.0051	0.0780	0.91077	0.0710	0.01134	NA	NA	NA	---	---	---
Dibenzofuran	0.0051	0.0930	1.28681	0.1197	0.01838	NA	NA	NA	---	---	---
Diethyl phthalate	0.0051	0.1000	5.84454	0.5845	0.08460	NA	NA	NA	---	---	---
Di-n-butyl phthalate	0.0051	0.2400	0.81418	0.1954	0.03026	0.22200	1.11000	0.49641	0.14	0.03	0.06
Di-n-octyl phthalate	0.0051	0.0930	0.03244	0.0030	0.00177	50.00000	250.00000	111.80340	<0.01	<0.01	<0.01
Dinoseb	0.0051	0.0930	2.17124	0.2019	0.03009	0.26400	1.32000	0.59032	0.11	0.02	0.05
Hexachlorobenzene	0.0051	0.1100	0.24628	0.0271	0.00532	0.11000	0.57000	0.25040	0.05	<0.01	0.02
Hexachlorobutadiene	0.0051	0.0033	0.67543	0.0022	0.00098	3.39000	17.00000	7.59144	<0.01	<0.01	<0.01
Hexachlorocyclopentadiene	0.0051	0.0520	0.39290	0.0204	0.00394	NA	NA	NA	---	---	---
Hexachloroethane	0.0051	0.0810	1.43946	0.1166	0.01785	NA	NA	NA	---	---	---
Hexachloropropene	0.0051	0.0740	1.00933	0.0747	0.01183	NA	NA	NA	---	---	---
Isosafrole	0.0051	0.0460	2.59293	0.1193	0.01797	NA	NA	NA	---	---	---
n-Nitrosodiphenylamine	0.0051	0.0850	3.15492	0.2682	0.03946	NA	NA	NA	---	---	---
p-Dimethylamino azobenzene	0.0051	0.2400	0.83732	0.2010	0.03105	NA	NA	NA	---	---	---
Pentachlorobenzene	0.0051	0.0460	0.44363	0.0204	0.00389	NA	NA	NA	---	---	---
Pentachloronitrobenzene	0.0051	0.2400	0.79168	0.1900	0.02949	7.07000	70.70000	22.35730	<0.01	<0.01	<0.01
Pentachlorophenol	0.0100	0.2400	46.02000	11.0448	1.57555	6.73000	67.30000	21.28213	0.23	0.02	0.07
Pronamide	0.0100	0.0590	2.27506	0.1342	0.02081	NA	NA	NA	---	---	---
LLPAHs:											
2-Methylnaphthalene	0.0002	0.0064	1.64058	0.0105	0.00157	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Acenaphthene	0.0002	0.0460	$\ln(C_p) = -0.8556[\ln[C_s]) - 5.562$	0.0535	0.00799	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Acenaphthylene	0.0002	0.0460	1.52245	0.0700	0.01034	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Anthracene	0.0002	0.0460	$\ln(C_p) = 0.7784[\ln(C_s)] - 0.9887$	0.0339	0.00519	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(a)anthracene	0.0002	0.0460	$\ln(C_p) = 0.5944[\ln(C_s)] - 2.7078$	0.0107	0.00189	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(a)pyrene	0.0002	0.0460	$\ln(C_p) = 0.975[\ln(C_s)] - 2.0615$	0.0063	0.00127	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01

TABLE G-6
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR MOURNING DOVE DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical	Surface Water Concentration [1] (mg/L)	Surface Soil Concentration [2] (mg/kg)	Soil-to-Plant BAF/Uptake Equation (unitless)	Plant Tissue Concentration [3] (mg/kg)	Dietary Intake [4] (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates [6]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [5] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
LLPAHs (cont.):											
Benzo(b)fluoranthene	0.0002	0.0460	0.48000	0.0221	0.00351	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(g,h,i)perylene	0.0002	0.0460	$\ln(C_p) = 1.1829[\ln(C_s)] - 0.9313$	0.0103	0.00184	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(k)fluoranthene	0.0002	0.0460	$\ln(C_p) = 0.8595[\ln(C_s)] - 2.1579$	0.0082	0.00154	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Chrysene	0.0002	0.0460	$\ln(C_p) = 0.5944[\ln(C_s)] - 2.7078$	0.0107	0.00189	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Dibenzo(a,h)anthracene	0.0002	0.0930	0.23000	0.0214	0.00377	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Fluoranthene	0.0000	0.0460	6.00000	0.2760	0.03964	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Fluorene	0.0002	0.0460	$\ln(C_p) = -0.8556[\ln[C_s]) - 5.562$	0.0535	0.00799	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	0.0002	0.0460	0.15000	0.0069	0.00135	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Naphthalene	0.0002	0.0460	48.00000	2.2080	0.31473	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Phenanthrene	0.0002	0.0060	$\ln(C_p) = 0.6203[\ln(C_s)] - 0.1665$	0.0354	0.00512	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Pyrene	0.0000	0.0460	3.70000	0.1702	0.02458	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Metals:											
Antimony	0.0003	0.6900	$\ln(C_p) = 0.938[\ln(C_s)] - 3.233$	0.0278	0.00917	4740.00000	47400.00000	14989.19611	<0.01	<0.01	<0.01
Arsenic	0.0005	1.8000	$\ln(C_p) = 0.564[\ln(C_s)] - 1.992$	0.1900	0.04061	2.24000	4.51000	3.17843	0.02	<0.01	0.01
Barium	0.0214	210.0000	0.44700	93.8700	14.94098	20.80000	41.70000	29.45098	0.72	0.36	0.51
Beryllium	0.0000	0.6300	$\ln(C_p) = 0.7345[\ln(C_s)] - 0.5361$	0.4167	0.06404	NA	NA	NA	---	---	---
Cadmium	0.0010	0.4700	$\ln(C_p) = 0.546[\ln(C_s)] - 0.475$	0.4118	0.06228	1.47000	6.36000	3.05765	0.04	<0.01	0.02
Chromium, total	0.0008	150.0000	0.08390	12.5850	2.91588	2.66000	15.60000	6.44174	1.10	0.19	0.45
Cobalt	0.0003	36.0000	0.02480	0.8928	0.39692	7.61000	18.30000	11.80097	0.05	0.02	0.03
Copper	0.0040	260.0000	$\ln(C_p) = 0.394[\ln(C_s)] + 0.668$	17.4425	4.43214	4.05000	12.10000	7.00036	1.09	0.37	0.63
Mercury	0.0002	0.0690	$\ln(C_p) = 0.544[\ln(C_s)] - 0.996$	0.0863	0.01282	0.02600	0.07800	0.04503	0.49	0.16	0.28
Nickel	0.0010	47.0000	$\ln(C_p) = 0.748[\ln(C_s)] - 2.224$	1.9269	0.62666	6.71000	18.60000	11.17166	0.09	0.03	0.06
Selenium	0.0008	1.2000	$\ln(C_p) = 1.104[\ln(C_s)] - 0.678$	0.6208	0.09748	0.29000	0.57900	0.40977	0.34	0.17	0.24
Silver	0.0010	0.3500	0.03670	0.0128	0.00458	2.02000	20.20000	6.38780	<0.01	<0.01	<0.01
Thallium	0.0010	0.0730	0.00400	0.0003	0.00071	0.35000	1.75000	0.78262	<0.01	<0.01	<0.01
Tin	20.0000	8.3000	0.03000	0.2490	2.61776	6.80000	16.90000	10.72007	0.38	0.15	0.24
Vanadium	0.0076	330.0000	0.00970	3.2010	2.92951	0.34400	0.68800	0.48649	8.52	4.26	6.02
Zinc	0.0079	100.0000	$\ln(C_p) = 0.554[\ln(C_s)] + 1.575$	61.9461	9.56986	66.10000	171.00000	106.31604	0.14	0.06	0.09

Notes:

BAF = Bioaccumulation Factor
PAH = Polynuclear Aromatic Hydrocarbon
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration

HQ = Hazard Quotient
mg/kg-BW/day = milligram per kilogram-body weight per day
ln = natural logarithm
C_p = Concentration in plant tissue (mg/kg - dry weight)

C_s = Maximum concentration in surface soil (mg/kg - dry weight)
NA = Not Available
--- = Step 2 screening level risk estimate could not be calculated due to the lack of a toxicity reference value.
mg/kg = milligram per kilogram
mg/L = milligram per liter

[1] Maximum detected surface water concentrations or, in the case of non-detected chemicals, maximum Reporting Limits.
[2] Maximum detected surface soil concentrations or, in the case of non-detected chemicals, maximum Limits of Detection.
[3] As discussed in Section 7.5.2.2.1, plant tissue concentrations were derived by (a) multiplying maximum surface soil concentrations by soil-to-plant bioaccumulation factors, or (b) soil-to-plant uptake equations.
[4] The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FIR_{dove})(FC_{plant})(PDF_{plant})] + [(FIR_{dove})(SC_x)(PDS)]+[(WIR_{dove})(WC_x)]\}/BW_{dove}$$

Where:

DI_x = Dietary intake of chemical x by the mourning dove (mg/kg-body weight/day)
FIR_{dove} = Maximum food ingestion rate for the mourning dove (0.01723 kg/day - dry weight; see Table 7-16)
FC_{plant} = Maximum concentration of chemical x in plant tissue (chemical-specific - dry weight; see Table G-6 above)
PDF_{plant} = Proportion of diet composed of plants (0.95 - dry weight basis [unitless]; see Table 7-17)
SC_x = Concentration in surface soil (chemical specific - dry weight; see Table G-6 above)
PDS = Proportion of diet composed of surface soil (0.05, dry weight basis [unitless]; see Table 7-17)
WIR_{dove} = Maximum water ingestiong rate for the mourning dove (0.01449 L/day; see Table 7-16)
WC_x = Maximum concentration in surface water (chemical-specific; see Table G-6 above)
BW_{dove} = Minimum body weight for the mourning dove (0.115 kg; see Table 7-16)

[4] MATC values were derived by calculating the geometric mean of the NOAEL and LOAEL values.
[5] NOAEL-, LOAEL, and MATC-based screening level risk estimates (i.e., HQs) were derived by dividing dietary intakes by NOAEL, LOAEL-, and MATC-based toxicity reference values, respectively

TABLE G-7
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR AMERICAN ROBIN DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical	Surface Water Concentration [1] (mg/L)	Surface Soil Concentration [2] (mg/kg)	Soil-to-Invertebrate BAF/Uptake Equation (unitless)	Invertebrate Tissue Concentration [3] (mg/kg)	Dietary Intake [4] (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates [6]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [5] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Volatile Organics:											
1,1,1,2-Tetrachloroethane	0.0005	0.0026	3.15072	0.0082	0.00216	NA	NA	NA	---	---	---
Carbon tetrachloride	0.0005	0.0011	3.06980	0.0034	0.00096	NA	NA	NA	---	---	---
Chlorobenzene	0.0005	0.0011	2.96770	0.0033	0.00094	NA	NA	NA	---	---	---
Chloroform	0.0012	0.0012	3.79001	0.0045	0.00142	NA	NA	NA	---	---	---
Ethylbenzene	0.0005	0.0014	2.75918	0.0039	0.00109	NA	NA	NA	---	---	---
Pentachloroethane	0.0005	0.0067	2.81777	0.0189	0.00485	NA	NA	NA	---	---	---
Styrene	0.0005	0.0011	2.90656	0.0032	0.00092	NA	NA	NA	---	---	---
Toluene	0.0005	0.0011	3.05387	0.0034	0.00096	NA	NA	NA	---	---	---
Trichloroethene	0.0005	0.0014	3.08582	0.0043	0.00120	NA	NA	NA	---	---	---
Xylenes (total)	0.0005	0.0012	2.76637	0.0033	0.00095	40.50000	203.00000	90.67249	<0.01	<0.01	<0.01
Semivolatile Organics:											
1,2,4,5-Tetrachlorobenzene	0.0000	0.0460	1.86758	0.0859	0.02194	NA	NA	NA	---	---	---
1,2,4-Trichlorobenzene	0.0051	0.0011	2.20024	0.0024	0.00185	NA	NA	NA	---	---	---
1,2-Dichlorobenzene	0.0051	0.0014	2.55864	0.0036	0.00214	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
1,3-Dichlorobenzene	0.0051	0.0017	2.49293	0.0042	0.00231	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
1,4,-Dichlorobenzene	0.0051	0.0011	2.56531	0.0028	0.00195	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
2,3,4,6-Tetrachlorophenol	0.0100	0.0460	1.96223	0.0903	0.02542	NA	NA	NA	---	---	---
2,4,5-Trichlorophenol	0.0100	0.1100	2.37268	0.2610	0.06824	NA	NA	NA	---	---	---
2,4,6-Trichlorophenol	0.0100	0.1100	2.38506	0.2624	0.06857	NA	NA	NA	---	---	---
2,4-Dichlorophenol	0.0100	0.1000	2.80259	0.2803	0.07259	NA	NA	NA	---	---	---
2-Acetylaminofluorene	0.0051	0.4600	2.77358	1.2758	0.32077	NA	NA	NA	---	---	---
2-Chloronaphthalene	0.0051	0.0840	2.26412	0.1902	0.04931	NA	NA	NA	---	---	---
3,3'-Dichlorobenzidine	0.0051	0.2400	2.50594	0.6014	0.15252	NA	NA	NA	---	---	---
3,3'-Dimethylbenzidine	0.0051	0.9200	3.11000	2.8612	0.71468	NA	NA	NA	---	---	---
3-Methylcholanthrene	0.0051	0.4600	1.17528	0.5406	0.14411	NA	NA	NA	---	---	---
4-Bromophenyl phenyl ether	0.0051	0.0960	1.70059	0.1633	0.04317	NA	NA	NA	---	---	---
4-Chloro-3-methylphenol	0.0100	0.0980	2.78805	0.2732	0.07085	NA	NA	NA	---	---	---
4-Chlorophenyl phenyl ether	0.0051	0.0890	1.72286	0.1533	0.04059	NA	NA	NA	---	---	---
7,12-Dimethylbenz(a)anthracene	0.0051	0.2400	1.11568	0.2678	0.07234	2.00000	20.00000	6.32456	0.04	<0.01	0.01
Aramite, total	0.0051	0.0670	1.78213	0.1194	0.03182	NA	NA	NA	---	---	---
Bis(2-ethylhexyl)phthalate	0.0051	0.0780	0.93476	0.0729	0.02096	1.11000	5.55000	2.48204	0.02	<0.01	<0.01
Butyl benzyl phthalate	0.0051	0.0930	1.77288	0.1649	0.04348	NA	NA	NA	---	---	---
Diallate	0.0051	0.0780	1.94191	0.1515	0.03983	NA	NA	NA	---	---	---
Dibenzofuran	0.0051	0.0930	2.13816	0.1988	0.05164	NA	NA	NA	---	---	---
Diethyl phthalate	0.0051	0.1000	3.25912	0.3259	0.08237	NA	NA	NA	---	---	---
Di-n-butyl phthalate	0.0051	0.2400	1.88222	0.4517	0.11655	0.22200	1.11000	0.49641	0.52	0.10	0.23
Di-n-octyl phthalate	0.0051	0.0930	0.76704	0.0713	0.02100	50.00000	250.00000	111.80340	<0.01	<0.01	<0.01
Dinoseb	0.0051	0.0930	2.47355	0.2300	0.05914	0.26400	1.32000	0.59032	0.22	0.04	0.10
Hexachlorobenzene	0.0051	0.1100	1.34906	0.1484	0.04000	0.11000	0.57000	0.25040	0.36	0.07	0.16
Hexachlorobutadiene	0.0051	0.0033	1.78678	0.0059	0.00275	3.39000	17.00000	7.59144	<0.01	<0.01	<0.01
Hexachlorocyclopentadiene	0.0051	0.0520	1.53649	0.0799	0.02190	NA	NA	NA	---	---	---
Hexachloroethane	0.0051	0.0810	2.20597	0.1787	0.04646	NA	NA	NA	---	---	---
Hexachloropropene	0.0051	0.0740	1.99830	0.1479	0.03886	NA	NA	NA	---	---	---
Isosafrole	0.0051	0.0460	2.59890	0.1195	0.03126	NA	NA	NA	---	---	---
n-Nitrosodiphenylamine	0.0051	0.0850	2.74486	0.2333	0.05970	NA	NA	NA	---	---	---
p-Dimethylamino azobenzene	0.0051	0.2400	1.89697	0.4553	0.11740	NA	NA	NA	---	---	---
Pentachlorobenzene	0.0051	0.0460	1.58935	0.0731	0.02010	NA	NA	NA	---	---	---
Pentachloronitrobenzene	0.0051	0.2400	1.86758	0.4482	0.11571	7.07000	70.70000	22.35730	0.02	<0.01	<0.01
Pentachlorophenol	0.0100	0.2400	88.12000	21.1488	5.09094	6.73000	67.30000	21.28213	0.76	0.08	0.24
Pronamide	0.0100	0.0590	2.50594	0.1479	0.03962	NA	NA	NA	---	---	---
LLPAHs:											
2-Methylnaphthalene	0.0002	0.0064	2.28781	0.0146	0.00375	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Acenaphthene	0.0002	0.0460	2.25237	0.1036	0.02624	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Acenaphthylene	0.0002	0.0460	2.24068	0.1031	0.02611	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Anthracene	0.0002	0.0460	1.91183	0.0879	0.02248	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(a)anthracene	0.0002	0.0460	1.41742	0.0652	0.01701	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(a)pyrene	0.0002	0.0460	1.27400	0.0586	0.01543	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01

TABLE G-7
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR AMERICAN ROBIN DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Surface Water Concentration [1] (mg/L)	Surface Soil Concentration [2] (mg/kg)	Soil-to-Invertebrate BAF/Uptake Equation (unitless)	Invertebrate Tissue Concentration [3] (mg/kg)	Dietary Intake [4] (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates [6]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [5] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
LLPAHs (cont.):											
Benzo(b)fluoranthene	0.0002	0.0460	1.24451	0.0572	0.01510	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(g,h,i)perylene	0.0002	0.0460	1.09270	0.0503	0.01343	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(k)fluoranthene	0.0002	0.0460	1.24451	0.0572	0.01510	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Chrysene	0.0002	0.0460	1.41742	0.0652	0.01701	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Dibenzo(a,h)anthracene	0.0002	0.0930	1.09554	0.1019	0.02715	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Fluoranthene	0.0000	0.0460	1.64831	0.0758	0.01952	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Fluorene	0.0002	0.0460	2.08867	0.0961	0.02443	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	0.0002	0.0460	1.10701	0.0509	0.01358	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Naphthalene	0.0002	0.0460	2.60567	0.1199	0.03015	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Phenanthrene	0.0002	0.0060	1.91183	0.0115	0.00298	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Pyrene	0.0000	0.0460	1.65261	0.0760	0.01957	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Metals:											
Antimony	0.0003	0.6900	1.00000	0.6900	0.18531	4740.00000	47400.00000	14989.19611	<0.01	<0.01	<0.01
Arsenic	0.0005	1.8000	$\ln(C_e) = 0.706[\ln(C_s)] - 1.421$	0.3657	0.13873	2.24000	4.51000	3.17843	0.06	0.03	0.04
Barium	0.0214	210.0000	0.16000	33.6000	13.99867	20.80000	41.70000	29.45098	0.67	0.34	0.48
Beryllium	0.0000	0.6300	1.18200	0.7447	0.19669	NA	NA	NA	---	---	---
Cadmium	0.0010	0.4700	$\ln(C_e) = 0.795[\ln(C_s)] + 2.114$	4.5438	1.10529	1.47000	6.36000	3.05765	0.75	0.17	0.36
Chromium, total	0.0008	150.0000	3.16200	474.3000	118.19606	2.66000	15.60000	6.44174	44.43	7.58	18.35
Cobalt	0.0003	36.0000	0.29100	10.4760	3.53215	7.61000	18.30000	11.80097	0.46	0.19	0.30
Copper	0.0040	260.0000	$\ln(C_e) = 0.264[\ln(C_s)] + 1.675$	23.1737	12.89866	4.05000	12.10000	7.00036	3.18	1.07	1.84
Mercury	0.0002	0.0690	20.63000	1.4235	0.34403	0.02600	0.07800	0.04503	13.23	4.41	7.64
Nickel	0.0010	47.0000	4.73000	222.3100	54.74303	6.71000	18.60000	11.17166	8.16	2.94	4.90
Selenium	0.0008	1.2000	$\ln(C_e) = 0.733[\ln(C_s)] - 0.075$	1.0604	0.28881	0.29000	0.57900	0.40977	1.00	0.50	0.70
Silver	0.0010	0.3500	15.33800	5.3683	1.30003	2.02000	20.20000	6.38780	0.64	0.06	0.20
Thallium	0.0010	0.0730	1.00000	0.0730	0.01984	0.35000	1.75000	0.78262	0.06	0.01	0.03
Tin	20.0000	8.3000	1.00000	8.3000	7.08872	6.80000	16.90000	10.72007	1.04	0.42	0.66
Vanadium	0.0076	330.0000	0.08800	29.0400	16.28241	0.34400	0.68800	0.48649	47.33	23.67	33.47
Zinc	0.0079	100.0000	$\ln(C_e) = 0.328[\ln(C_s)] + 4.449$	387.4147	95.91104	66.10000	171.00000	106.31604	1.45	0.56	0.90

Notes:

BAF = Bioacumulation Factor
PAH = Polynuclear Aromatic Hydrocarbon
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration

HQ = Hazard Quotient
mg/kg-BW/day = milligram per kilogram-body weight per day
ln = natural logarithm
C_e = Concentration in earthworm tissue (mg/kg - dry weight)
C_s = Maximum concentration in surface soil (mg/kg - dry weight)

NA = Not Available
--- = Step 2 screening level risk estimate could not be calculated due to the lack of a toxicity reference value.
mg/kg = milligram per kilogram
mg/L = milligram per liter

(1) Maximum detected surface water concentrations or, in the case of non-detected chemicals, maximum Reporting Limits.

(2) Maximum detected surface soil concentrations or, in the case of non-detected chemicals, maximum Limits of Detection.

(3) As discussed in Section 7.5.2.2.1, soil invertebrate tissue concentrations were derived by (a) multiplying maximum surface soil concentrations by soil-to-invertebrate bioaccumulation factors or, (b) soil-to-invertebrate uptake equations.

(4) The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FIR_{robin})(FC_{invert})(PDF_{invert})] + [(FIR_{robin})(SC_x)(PDS)]+[(WIR_{robin})(WC_x)]\}/BW_{robin}$$

Where:

DI_x = Dietary intake of chemical x by the American robin (mg/kg-body weight/day)
FIR_{robin} = Maximum food ingestion rate for the American robin (0.01503 kg/day - dry weight; see Table 7-16)
FC_{invert} = Concentration of chemical x in soil invertebrate tissue (chemical-specific - dry weight; see Table G-7 above)
PDF_{invert} = Proportion of diet composed of soil invertebrates (0.895 - dry weight basis [unitless]; see Table 7-17)
SC_x = Maximum concentration in surface soil (chemical specific - dry weight; see Table G-7 above)
PDS = Proportion of diet composed of surface soil (0.105 - dry weight basis [unitless]; see Table 7-17)
WIR_{robin} = Maximum water ingestion rate for the robin (0.01361 L/day; see Table 7-16)
WC_x = Maximum concentration of surface water (chemical-specific; see Table G-7 above)
BW_{robin} = Minimum body weight for the American robin (0.056 kg; see Table 7-16)

(5) MATC values were derived by calculating the geometric mean of the NOAEL and LOAEL values.

(6) NOAEL-, LOAEL, and MATC-based screening level risk estimates (i.e., HQs) were derived by dividing dietary intakes by NOAEL, LOAEL-, and MATC-based toxicity reference values, respectively

TABLE G-8
FOOD ITEM CONCENTRATIONS, DIETARY DOSES, AND HAZARD QUOTIENT VALUES FOR RED TAILED HAWK DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Surface Water Concentration (1) (mg/L)	Surface Soil Concentration (2) (mg/kg)	Soil-to-Small Mammal BAF/Uptake Equation (unitless)	Small Mammal Concentration (3) (mg/kg)	Dietary Intake (4) (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates (6)		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC (5) (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Volatile Organics:											
1,1,1,2-Tetrachloroethane	0.0005	0.0026	$C_m = [(BAF_d)(DI)]/0.32$	0.0056	0.00062	NA	NA	NA	---	---	---
Carbon tetrachloride	0.0005	0.0011	$C_m = [(BAF_d)(DI)]/0.32$	0.0025	0.00030	NA	NA	NA	---	---	---
Chlorobenzene	0.0005	0.0011	$C_m = [(BAF_d)(DI)]/0.32$	0.0025	0.00030	NA	NA	NA	---	---	---
Chloroform	0.0012	0.0012	$C_m = [(BAF_d)(DI)]/0.32$	0.0038	0.00049	NA	NA	NA	---	---	---
Ethylbenzene	0.0005	0.0014	$C_m = [(BAF_d)(DI)]/0.32$	0.0028	0.00034	NA	NA	NA	---	---	---
Pentachloroethane	0.0005	0.0067	$C_m = [(BAF_d)(DI)]/0.32$	0.0123	0.00133	NA	NA	NA	---	---	---
Styrene	0.0005	0.0011	$C_m = [(BAF_d)(DI)]/0.32$	0.0024	0.00029	NA	NA	NA	---	---	---
Toluene	0.0005	0.0011	$C_m = [(BAF_d)(DI)]/0.32$	0.0025	0.00030	NA	NA	NA	---	---	---
Trichloroethene	0.0005	0.0014	$C_m = [(BAF_d)(DI)]/0.32$	0.0031	0.00037	NA	NA	NA	---	---	---
Xylenes (total)	0.0005	0.0012	$C_m = [(BAF_d)(DI)]/0.32$	0.0025	0.00030	40.50000	203.00000	90.67249	<0.01	<0.01	<0.01
Semivolatile Organics:											
1,2,4,5-Tetrachlorobenzene	0.0000	0.0460	$C_m = [(BAF_d)(DI)]/0.32$	0.0542	0.00568	NA	NA	NA	---	---	---
1,2,4-Trichlorobenzene	0.0051	0.0011	$C_m = [(BAF_d)(DI)]/0.32$	0.0058	0.00098	NA	NA	NA	---	---	---
1,2-Dichlorobenzene	0.0051	0.0014	$C_m = [(BAF_d)(DI)]/0.32$	0.0065	0.00106	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
1,3-Dichlorobenzene	0.0051	0.0017	$C_m = [(BAF_d)(DI)]/0.32$	0.0069	0.00110	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
1,4,-Dichlorobenzene	0.0051	0.0011	$C_m = [(BAF_d)(DI)]/0.32$	0.0060	0.00101	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
2,3,4,6-Tetrachlorophenol	0.0100	0.0460	$C_m = [(BAF_d)(DI)]/0.32$	0.0652	0.00759	NA	NA	NA	---	---	---
2,4,5-Trichlorophenol	0.0100	0.1100	$C_m = [(BAF_d)(DI)]/0.32$	0.1726	0.01884	NA	NA	NA	---	---	---
2,4,6-Trichlorophenol	0.0100	0.1100	$C_m = [(BAF_d)(DI)]/0.32$	0.1734	0.01893	NA	NA	NA	---	---	---
2,4-Dichlorophenol	0.0100	0.1000	$C_m = [(BAF_d)(DI)]/0.32$	0.1844	0.02009	NA	NA	NA	---	---	---
2-Acetylaminofluorene	0.0051	0.4600	$C_m = [(BAF_d)(DI)]/0.32$	0.8062	0.08492	NA	NA	NA	---	---	---
2-Chloronaphthalene	0.0051	0.0840	$C_m = [(BAF_d)(DI)]/0.32$	0.1240	0.01338	NA	NA	NA	---	---	---
3,3'-Dichlorobenzidine	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.3826	0.04050	NA	NA	NA	---	---	---
3,3'-Dimethylbenzidine	0.0051	0.9200	$C_m = [(BAF_d)(DI)]/0.32$	1.8013	0.18927	NA	NA	NA	---	---	---
3-Methylcholanthrene	0.0051	0.4600	$C_m = [(BAF_d)(DI)]/0.32$	0.3474	0.03682	NA	NA	NA	---	---	---
4-Bromophenyl phenyl ether	0.0051	0.0960	$C_m = [(BAF_d)(DI)]/0.32$	0.1073	0.01164	NA	NA	NA	---	---	---
4-Chloro-3-methylphenol	0.0100	0.0980	$C_m = [(BAF_d)(DI)]/0.32$	0.1800	0.01963	NA	NA	NA	---	---	---
4-Chlorophenyl phenyl ether	0.0051	0.0890	$C_m = [(BAF_d)(DI)]/0.32$	0.1010	0.01098	NA	NA	NA	---	---	---
7,12-Dimethylbenz(a)anthracene	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.1744	0.01867	2.00000	20.00000	6.32456	<0.01	<0.01	<0.01
Aramite, total	0.0051	0.0670	$C_m = [(BAF_d)(DI)]/0.32$	0.0796	0.00873	NA	NA	NA	---	---	---
Bis(2-ethylhexyl)phthalate	0.0051	0.0780	$C_m = [(BAF_d)(DI)]/0.32$	0.0507	0.00570	1.11000	5.55000	2.48204	<0.01	<0.01	<0.01
Butyl benzyl phthalate	0.0051	0.0930	$C_m = [(BAF_d)(DI)]/0.32$	0.1083	0.01174	NA	NA	NA	---	---	---
Diallate	0.0051	0.0780	$C_m = [(BAF_d)(DI)]/0.32$	0.0997	0.01084	NA	NA	NA	---	---	---
Dibenzofuran	0.0051	0.0930	$C_m = [(BAF_d)(DI)]/0.32$	0.1295	0.01396	NA	NA	NA	---	---	---
Diethyl phthalate	0.0051	0.1000	$C_m = [(BAF_d)(DI)]/0.32$	0.2089	0.02228	NA	NA	NA	---	---	---
Di-n-butyl phthalate	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.2892	0.03070	0.22200	1.11000	0.49641	0.14	0.03	0.06
Di-n-octyl phthalate	0.0051	0.0930	$C_m = [(BAF_d)(DI)]/0.32$	0.0499	0.00562	50.00000	250.00000	111.80340	<0.01	<0.01	<0.01
Dinoseb	0.0051	0.0930	$C_m = [(BAF_d)(DI)]/0.32$	0.1490	0.01600	0.26400	1.32000	0.59032	0.06	0.01	0.03
Hexachlorobenzene	0.0051	0.1100	$C_m = [(BAF_d)(DI)]/0.32$	0.0982	0.01068	0.11000	0.57000	0.25040	0.10	0.02	0.04
Hexachlorobutadiene	0.0051	0.0033	$C_m = [(BAF_d)(DI)]/0.32$	0.0079	0.00122	3.39000	17.00000	7.59144	<0.01	<0.01	<0.01
Hexachlorocyclopentadiene	0.0051	0.0520	$C_m = [(BAF_d)(DI)]/0.32$	0.0547	0.00612	NA	NA	NA	---	---	---
Hexachloroethane	0.0051	0.0810	$C_m = [(BAF_d)(DI)]/0.32$	0.1168	0.01263	NA	NA	NA	---	---	---
Hexachloropropene	0.0051	0.0740	$C_m = [(BAF_d)(DI)]/0.32$	0.0974	0.01060	NA	NA	NA	---	---	---
Isosafrole	0.0051	0.0460	$C_m = [(BAF_d)(DI)]/0.32$	0.0794	0.00871	NA	NA	NA	---	---	---
n-Nitrosodiphenylamine	0.0051	0.0850	$C_m = [(BAF_d)(DI)]/0.32$	0.1509	0.01621	NA	NA	NA	---	---	---
p-Dimethylamino azobenzene	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.2914	0.03094	NA	NA	NA	---	---	---
Pentachlorobenzene	0.0051	0.0460	$C_m = [(BAF_d)(DI)]/0.32$	0.0504	0.00567	NA	NA	NA	---	---	---
Pentachloronitrobenzene	0.0051	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	0.2870	0.03047	7.07000	70.70000	22.35730	<0.01	<0.01	<0.01
Pentachlorophenol	0.0100	0.2400	$C_m = [(BAF_d)(DI)]/0.32$	13.2083	1.38580	6.73000	67.30000	21.28213	0.21	0.02	0.07
Pronamide	0.0100	0.0590	$C_m = [(BAF_d)(DI)]/0.32$	0.1013	0.01137	NA	NA	NA	---	---	---

TABLE G-8
FOOD ITEM CONCENTRATIONS, DIETARY DOSES, AND HAZARD QUOTIENT VALUES FOR RED TAILED HAWK DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical	Surface Water Concentration (1) (mg/L)	Surface Soil Concentration (2) (mg/kg)	Soil-to-Small Mammal BAF/Uptake Equation (unitless)	Small Mammal Concentration (3) (mg/kg)	Dietary Intake (4) (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates (6)		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC (5) (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
LLPAHs:											
2-Methylnaphthalene	0.0002	0.0064	0.00000	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Acenaphthene	0.0002	0.0460	0.00000	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Acenaphthylene	0.0002	0.0460	0.00000	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Anthracene	0.0002	0.0460	0.00000	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(a)anthracene	0.0002	0.0460	0.00000	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(a)pyrene	0.0002	0.0460	0.00000	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(b)fluoranthene	0.0002	0.0460	0.00000	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(g,h,i)perylene	0.0002	0.0460	0.00000	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(k)fluoranthene	0.0002	0.0460	0.00000	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Chrysene	0.0002	0.0460	0.00000	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Dibenzo(a,h)anthracene	0.0002	0.0930	0.00000	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Fluoranthene	0.0000	0.0460	0.00000	0.0000	0.00000	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Fluorene	0.0002	0.0460	0.00000	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	0.0002	0.0460	0.00000	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Naphthalene	0.0002	0.0460	0.00000	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Phenanthrene	0.0002	0.0060	0.00000	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Pyrene	0.0000	0.0460	0.00000	0.0000	0.00000	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Metals:											
Antimony	0.0003	0.6900	$C_m = [(BAF_d)(DI)]/0.32$	0.0345	0.00364	4740.00000	47400.00000	14989.19611	<0.01	<0.01	<0.01
Arsenic	0.0005	1.8000	$\ln(C_m) = 0.8188[\ln(C_s)] - 4.8471$	0.0127	0.00137	2.24000	4.51000	3.17843	<0.01	<0.01	<0.01
Barium	0.0214	210.0000	0.11210	0.2785	0.03080	20.80000	41.70000	29.45098	<0.01	<0.01	<0.01
Beryllium	0.0000	0.6300	$C_m = [(BAF_d)(DI)]/0.32$	0.0371	0.00389	NA	NA	NA	---	---	---
Cadmium	0.0010	0.4700	$\ln(C_m) = 0.4865[\mathrm{In}(C_s)] - 0.4306$	0.4503	0.04729	1.47000	6.36000	3.05765	0.03	<0.01	0.02
Chromium, total	0.0008	150.0000	$\ln(C_m) = 0.7338[\ln(C_s)] - 1.4599$	9.1789	0.96257	2.66000	15.60000	6.44174	0.36	0.06	0.15
Cobalt	0.0003	36.0000	$\ln(C_m) = 1.3070[\ln(C_s)] - 4.4669$	1.2420	0.13027	7.61000	18.30000	11.80097	0.02	<0.01	0.01
Copper	0.0040	260.0000	$\ln(C_m) = 0.1444[\ln(C_s)] + 0.2042$	17.2009	1.80403	4.05000	12.10000	7.00036	0.45	0.15	0.26
Mercury	0.0002	0.0690	0.19200	0.0132	0.00140	0.02600	0.07800	0.04503	0.05	0.02	0.03
Nickel	0.0010	47.0000	$\ln(C_m) = 0.4658[\ln(C_s)] - 0.2462$	4.6983	0.49275	6.71000	18.60000	11.17166	0.07	0.03	0.04
Selenium	0.0008	1.2000	$\ln(C_m) = 0.3764[\ln(C_s)] - 0.4158$	0.7067	0.07416	0.29000	0.57900	0.40977	0.26	0.13	0.18
Silver	0.0010	0.3500	0.50130	0.1755	0.01847	2.02000	20.20000	6.38780	<0.01	<0.01	<0.01
Thallium	0.0010	0.0730	$C_m = [(BAF_d)(DI)]/0.32$	0.0473	0.00504	0.35000	1.75000	0.78262	0.01	<0.01	<0.01
Tin	20.0000	8.3000	$C_m = [(BAF_d)(DI)]/0.32$	21.8639	3.79001	6.80000	16.90000	10.72007	0.56	0.22	0.35
Vanadium	0.0076	330.0000	0.01790	5.9070	0.61999	0.34400	0.68800	0.48649	1.80	0.90	1.27
Zinc	0.0079	100.0000	$\ln(C_m) = 0.0738[\ln(C_s)] + 4.4713$	122.8743	12.88547	66.10000	171.00000	106.31604	0.19	0.08	0.12

Notes:

BAF = Bioaccumulation Factor
PAH = Polynuclear Aromatic Hydrocarbon
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
HQ = Hazard Quotient
mg/kg-BW/day = milligram per kilogram-body weight per day
ln = natural logarithm
C_m = Concentration in small mammal tissue (mg/kg - dry weight)
C_s = Maximum concentration in surface soil (mg/kg - dry weight)
BAF_d = small mammal diet-to-whole body bioaccumulation factor (wet weight)
DI_m = Small mammal dietary intake (mg/kg-BW/day)
NA = Not Available
--- = Step 2 screening level risk estimate could not be calculated due to the lack of a toxicity reference value.
mg/kg = milligram per kilogram
mg/L = milligram per liter

TABLE G-8
FOOD ITEM CONCENTRATIONS, DIETARY DOSES, AND HAZARD QUOTIENT VALUES FOR RED TAILED HAWK DIETARY
EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Notes (cont.):

(1) Maximum detected surface water concentrations or, in the case of non-detected chemicals, maximum Reporting Limits.

(2) Maximum detected surface soil concentrations or, in the case of non-detected chemicals, maximum Limits of Detection.

(3) As discussed in Section 7.5.2.2.1, small mammal (i.e., Norway rat) tissue concentrations were derived by (a) multiplying maximum surface soil concentrations by soil-to-small mammal bioaccumulation factors, (b) soil-to-small mammal uptake equations, or (c) multiplying small mammal dietary intakes (see Table G-10 for small mammal dietary intake values) by small mammal diet-to-whole body BAF values (BAF_d assumed to be 1.0 for all chemicals [wet weight basis]) and dividing the products by 0.32 (solids content of small mammals).

(4) The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FIR_{hawk})(FC_{sm})(PDF_{sm})] + [(FIR_{hawk})(SC_x)(PDS)]+[(WIR_{hawk})(WC_x)]\}/BW_{hawk}$$

Where:

DI_x = Dietary intake of chemical x by the red-tailed hawk (mg/kg-body weight/day)
FIR_{hawk} = Maximum food ingestion rate for the red-tailed hawk (0.09679 kg/day - dry weight; see Table 7-16)
FC_{sm}= Concentration of chemical x in small mammal tissue (chemical-specific - dry weight; see Table G-8 above)
PDF_{sm} = Proportion of diet composed of small mammals (1.0 - dry weight basis [unitless]; see Table 7-17)
SC_x = Maximum concentration in surface soil (chemical specific - dry weight; see Table G-8 above)
PDS = Proportion of diet composed of surface soil (0.0 - dry weight basis [unitless]; see Table 7-17)
WIR_{hawk} = Maximum water ingestion rate for the red tailed hawk (0.06910 L/day; see Table 7-16)
WC_x = Maximum concentration in surface water (chemical-specific; see Table G-8 above)
BW_{hawk} = Minimum body weight for the red-tailed hawk (0.923 kg; see Table 7-16)

(5) MATC values were derived by calculating the geometric mean of the NOAEL and LOAEL values.

(6) NOAEL-, LOAEL, and MATC-based screening level risk estimates (i.e., HQs) were derived by dividing dietary intakes by NOAEL, LOAEL-, and MATC-based toxicity reference values, respectively

TABLE G-9
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR BROWN FLOWER BAT DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical	Surface Water Concentration [1] (mg/L)	Surface Soil Concentration [2] (mg/kg)	Soil-to-Plant BAF/Uptake Equation (unitless)	Plant Tissue Concentration [3] (mg/kg)	Dietary Intake [4] (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates [6]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [5] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Volatile Organics:											
1,1,1,2-Tetrachloroethane	0.0005	0.0026	5.17618	0.0135	0.00242	NA	NA	NA	---	---	---
Carbon tetrachloride	0.0005	0.0011	4.71454	0.0052	0.00099	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
Chlorobenzene	0.0005	0.0011	4.17540	0.0046	0.00089	27.25000	54.50000	38.53732	<0.01	<0.01	<0.01
Chloroform	0.0012	0.0012	10.04745	0.0121	0.00231	15.00000	75.00000	33.54102	<0.01	<0.01	<0.01
Ethylbenzene	0.0005	0.0014	3.21442	0.0045	0.00087	136.00000	408.00000	235.55891	<0.01	<0.01	<0.01
Pentachloroethane	0.0005	0.0067	2.98295	0.0200	0.00355	NA	NA	NA	---	---	---
Styrene	0.0005	0.0011	3.87473	0.0043	0.00083	35.00000	175.00000	78.26238	<0.01	<0.01	<0.01
Toluene	0.0005	0.0011	4.62727	0.0051	0.00097	52.00000	260.00000	116.27553	<0.01	<0.01	<0.01
Trichloroethene	0.0005	0.0014	4.80345	0.0067	0.00126	5.00000	2.50000	3.53553	<0.01	<0.01	<0.01
Xylenes (total)	0.0005	0.0012	3.24458	0.0039	0.00077	2.06000	2.58000	2.30539	<0.01	<0.01	<0.01
Semivolatile Organics:											
1,2,4,5-Tetrachlorobenzene	0.0000	0.0460	0.79168	0.0364	0.00630	NA	NA	NA	---	---	---
1,2,4-Trichlorobenzene	0.0051	0.0011	1.42608	0.0016	0.00123	53.00000	106.00000	74.95332	<0.01	<0.01	<0.01
1,2-Dichlorobenzene	0.0051	0.0014	2.45160	0.0034	0.00155	171.00000	857.00000	382.81458	<0.01	<0.01	<0.01
1,3-Dichlorobenzene	0.0051	0.0017	2.23295	0.0038	0.00161	171.00000	857.00000	382.81458	<0.01	<0.01	<0.01
1,4,-Dichlorobenzene	0.0051	0.0014	2.47461	0.0027	0.00143	250.00000	500.00000	353.55339	<0.01	<0.01	<0.01
2,3,4,6-Tetrachlorophenol	0.0100	0.0460	0.94544	0.0435	0.00940	NA	NA	NA	---	---	---
2,4,5-Trichlorophenol	0.0100	0.1100	1.86980	0.2057	0.03748	160.00000	800.00000	357.77088	<0.01	<0.01	<0.01
2,4,6-Trichlorophenol	0.0100	0.1100	1.90507	0.2096	0.03815	160.00000	800.00000	357.77088	<0.01	<0.01	<0.01
2,4-Dichlorophenol	0.0100	0.1000	3.39973	0.3400	0.06073	88.00000	440.00000	196.77398	<0.01	<0.01	<0.01
2-Acetylaminofluorene	0.0051	0.4600	3.27504	1.5065	0.26177	NA	NA	NA	---	---	---
2-Chloronaphthalene	0.0051	0.0840	1.58041	0.1328	0.02394	NA	NA	NA	---	---	---
3,3'-Dichlorobenzidine	0.0051	0.2400	2.27506	0.5460	0.09548	NA	NA	NA	---	---	---
3,3'-Dimethylbenzidine	0.0051	0.9200	4.93997	4.5448	0.78777	NA	NA	NA	---	---	---
3-Methylcholanthrene	0.0051	0.4600	0.15011	0.0691	0.01291	NA	NA	NA	---	---	---
4-Bromophenyl phenyl ether	0.0051	0.0960	0.56559	0.0543	0.01035	NA	NA	NA	---	---	---
4-Chloro-3-methylphenol	0.0100	0.0980	3.33680	0.3270	0.05848	NA	NA	NA	---	---	---
4-Chlorophenyl phenyl ether	0.0051	0.0890	0.59263	0.0527	0.01009	NA	NA	NA	---	---	---
7,12-Dimethylbenz(a)anthracene	0.0051	0.2400	0.12453	0.0299	0.00613	NA	NA	NA	---	---	---
Aramite, total	0.0051	0.0670	0.66915	0.0448	0.00872	NA	NA	NA	---	---	---
Bis(2-ethylhexyl)phthalate	0.0051	0.0780	0.06598	0.0051	0.00185	18.30000	183.30000	57.91710	<0.01	<0.01	<0.01
Butyl benzyl phthalate	0.0051	0.0930	0.65677	0.0611	0.01153	480.00000	2400.00000	1073.31263	<0.01	<0.01	<0.01
Diallate	0.0051	0.0780	0.91077	0.0710	0.01325	NA	NA	NA	---	---	---
Dibenzofuran	0.0051	0.0930	1.28681	0.1197	0.02167	NA	NA	NA	---	---	---
Diethyl phthalate	0.0051	0.1000	5.84454	0.5845	0.10214	4583.00000	22915.00000	10247.89954	<0.01	<0.01	<0.01
Di-n-butyl phthalate	0.0051	0.2400	0.81418	0.1954	0.03478	550.00000	1833.00000	1004.06673	<0.01	<0.01	<0.01
Di-n-octyl phthalate	0.0051	0.0930	0.03244	0.0030	0.00148	55.00000	550.00000	173.92527	<0.01	<0.01	<0.01
Dinoseb	0.0051	0.0930	2.17124	0.2019	0.03591	NA	NA	NA	---	---	---
Hexachlorobenzene	0.0051	0.1100	0.24628	0.0271	0.00564	8.00000	16.00000	11.31371	<0.01	<0.01	<0.01
Hexachlorobutadiene	0.0051	0.0033	0.67543	0.0022	0.00134	4.00000	20.00000	8.94427	<0.01	<0.01	<0.01
Hexachlorocyclopentadiene	0.0051	0.0520	0.39290	0.0204	0.00449	10.00000	30.00000	17.32051	<0.01	<0.01	<0.01
Hexachloroethane	0.0051	0.0810	1.43946	0.1166	0.02114	NA	NA	NA	---	---	---
Hexachloropropene	0.0051	0.0740	1.00933	0.0747	0.01389	NA	NA	NA	---	---	---
Isosafrole	0.0051	0.0460	2.59293	0.1193	0.02160	NA	NA	NA	---	---	---
n-Nitrosodiphenylamine	0.0051	0.0850	3.15492	0.2682	0.04738	300.00000	1500.00000	670.82039	<0.01	<0.01	<0.01
p-Dimethylamino azobenzene	0.0051	0.2400	0.83732	0.2010	0.03575	NA	NA	NA	---	---	---
Pentachlorobenzene	0.0051	0.0460	0.44363	0.0204	0.00449	7.25000	36.25000	16.21149	<0.01	<0.01	<0.01
Pentachloronitrobenzene	0.0051	0.2400	0.79168	0.1900	0.03385	NA	NA	NA	---	---	---
Pentachlorophenol	0.0100	0.2400	46.02000	11.0448	1.91400	8.42000	22.65000	13.80989	0.23	0.08	0.14
Pronamide	0.0100	0.0590	2.27506	0.1342	0.02511	NA	NA	NA	---	---	---
LLPAHs:											
2-Methylnaphthalene	0.0002	0.0064	1.64058	0.0105	0.00186	65.60000	328.00000	146.68606	<0.01	<0.01	<0.01
Acenaphthene	0.0002	0.0460	$In(C_p) = -0.8556[ln(C_s]) - 5.562$	0.0535	0.00931	65.60000	328.00000	146.68606	<0.01	<0.01	<0.01
Acenaphthylene	0.0002	0.0460	1.52245	0.0700	0.01216	65.60000	328.00000	146.68606	<0.01	<0.01	<0.01
Anthracene	0.0002	0.0460	$ln(C_p) = 0.7784[ln(C_s)] - 0.9887$	0.0339	0.00590	65.60000	328.00000	146.68606	<0.01	<0.01	<0.01
Benzo(a)anthracene	0.0002	0.0460	$In(C_p) = 0.5944[In(C_s)] - 2.7078$	0.0107	0.00189	0.61500	3.01000	1.36057	<0.01	<0.01	<0.01
Benzo(a)pyrene	0.0002	0.0460	$ln(C_p) = 0.975[ln(C_s)] - 2.0615$	0.0063	0.00113	0.61500	3.01000	1.36057	<0.01	<0.01	<0.01

TABLE G-9
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR BROWN FLOWER BAT DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical	Surface Water Concentration [1] (mg/L)	Surface Soil Concentration [2] (mg/kg)	Soil-to-Plant BAF/Uptake Equation (unitless)	Plant Tissue Concentration [3] (mg/kg)	Dietary Intake [4] (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates [6]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [5] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
LLPAHs (cont.):											
Benzo(b)fluoranthene	0.0002	0.0460	0.48000	0.0221	0.00386	0.61500	3.01000	1.36057	<0.01	<0.01	<0.01
Benzo(g,h,i)perylene	0.0002	0.0460	$\ln(C_p) = 1.1829[\ln(C_s)] - 0.9313$	0.0103	0.00183	0.61500	3.01000	1.36057	<0.01	<0.01	<0.01
Benzo(k)fluoranthene	0.0002	0.0460	$\ln(C_p) = 0.8595[\ln(C_s)] - 2.1579$	0.0082	0.00146	0.61500	3.01000	1.36057	<0.01	<0.01	<0.01
Chrysene	0.0002	0.0460	$\ln(C_p) = 0.5944[\ln(C_s)] - 2.7078$	0.0107	0.00189	0.61500	3.01000	1.36057	<0.01	<0.01	<0.01
Dibenzo(a,h)anthracene	0.0002	0.0930	0.23000	0.0214	0.00374	0.61500	3.01000	1.36057	<0.01	<0.01	<0.01
Fluoranthene	0.0000	0.0460	6.00000	0.2760	0.04779	65.60000	328.00000	146.68606	<0.01	<0.01	<0.01
Fluorene	0.0002	0.0460	$\ln(C_p) = -0.8556[\ln(C_s)] - 5.562$	0.0535	0.00931	65.60000	328.00000	146.68606	<0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	0.0002	0.0460	0.15000	0.0069	0.00123	0.61500	3.01000	1.36057	<0.01	<0.01	<0.01
Naphthalene	0.0002	0.0460	48.00000	2.2080	0.38230	65.60000	328.00000	146.68606	<0.01	<0.01	<0.01
Phenanthrene	0.0002	0.0060	$\ln(C_p) = 0.6203[\ln(C_s)] - 0.1665$	0.0354	0.00617	65.60000	328.00000	146.68606	<0.01	<0.01	<0.01
Pyrene	0.0000	0.0460	3.70000	0.1702	0.02947	0.61500	3.01000	1.36057	0.05	<0.01	0.02
Metals:											
Antimony	0.0003	0.6900	$\ln(C_p) = 0.938[\ln(C_s)] - 3.233$	0.0278	0.00487	0.05900	0.59000	0.18657	0.08	<0.01	0.03
Arsenic	0.0005	1.8000	$\ln(C_p) = 0.564[\ln[C_s]) - 1.992$	0.1900	0.03299	1.04000	1.66000	1.31393	0.03	0.02	0.03
Barium	0.0214	210.0000	0.44700	93.8700	16.25525	51.80000	82.70000	65.45120	0.31	0.20	0.25
Beryllium	0.0000	0.6300	$\ln(C_p) = 0.7345[\ln[C_s]) - 0.5361$	0.4167	0.07214	0.53200	0.56700	0.54922	0.14	0.13	0.13
Cadmium	0.0010	0.4700	$\ln(C_p) = 0.546[\ln(C_s)] - 0.475$	0.4118	0.07148	0.77000	7.70000	2.43495	0.09	<0.01	0.03
Chromium, total	0.0008	150.0000	0.08390	12.5850	2.17892	2.40000	58.53000	11.85209	0.91	0.04	0.18
Cobalt	0.0003	36.0000	0.02480	0.8928	0.15463	7.33000	18.90000	11.77017	0.02	<0.01	0.01
Copper	0.0040	260.0000	$\ln(C_p) = 0.394[\ln(C_s)] + 0.668$	17.4425	3.02048	5.60000	9.34000	7.23215	0.54	0.32	0.42
Mercury	0.0002	0.0690	$\ln(C_p) = 0.544[\ln[C_s]) - 0.996$	0.0863	0.01497	0.03200	0.16000	0.07155	0.47	0.09	0.21
Nickel	0.0010	47.0000	$\ln(C_p) = 0.748[\ln(C_s)] - 2.224$	1.9269	0.33378	1.70000	3.40000	2.40416	0.20	0.10	0.14
Selenium	0.0008	1.2000	$\ln(C_p) = 1.104[\ln(C_s)] - 0.678$	0.6208	0.10762	0.14300	0.21500	0.17534	0.75	0.50	0.61
Silver	0.0010	0.3500	0.03670	0.0128	0.00241	6.02000	60.20000	19.03691	<0.01	<0.01	<0.01
Thallium	0.0010	0.0730	0.00400	0.0003	0.00024	0.00740	0.07400	0.02340	0.03	<0.01	0.01
Tin	20.0000	8.3000	0.03000	0.2490	3.78528	23.40000	35.00000	28.61818	0.16	0.11	0.13
Vanadium	0.0076	330.0000	0.00970	3.2010	0.55560	4.16000	8.31000	5.87959	0.13	0.07	0.09
Zinc	0.0079	100.0000	$\ln(C_p) = 0.554[\ln(C_s)] + 1.575$	61.9461	10.72589	75.40000	82.30000	78.77449	0.43	0.40	0.41

Notes:

BAF = Bioaccumulation Factor
PAH = Polynuclear Aromatic Hydrocarbon
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration

HQ = Hazard Quotient
mg/kg-BW/day = milligram per kilogram-body weight per day
ln = natural logarithm
C_p = Concentration in plant tissue (mg/kg - dry weight)
C_s = Maximum concentration in surface soil (mg/kg - dry weight)

NA = Not Available
--- = Step 2 screening level risk estimate could not be calculated due to the lack of a toxicity reference value.
mg/kg = milligram per kilogram
mg/L = milligram per liter

(1) Maximum detected surface water concentrations or, in the case of non-detected chemicals, maximum Reporting Limits.
(2) Maximum detected surface soil concentrations or, in the case of non-detected chemicals, maximum Limits of Detection.
(3) As discussed in Section 7.5.2.2.1, plant tissue concentrations were derived by (a) multiplying maximum surface soil concentrations by soil-to-plant bioaccumulation factors, or (b) soil-to-plant uptake equations.
(4) The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FI_{bat})(FC_{plant})(PDF_{plant})] + [(FIR_{bat})(SC_x)(PDS)]+[(WIR_{bat})(WC_x)]\}/BW_{bat}$$

Where:

DI_x = Dietary intake of chemical x by the brown flower bat (mg/kg-body weight/day)
FIR_{bat} = Maximum food ingestion rate for the brown flower bat (0.00277 kg/day - dry weight; see Table 7-16)
FC_{plant} = Concentration of chemical x in soil invertebrate tissue (chemical-specific - dry weight; see Table G-9 above)
PDF_{plant} = Proportion of diet composed of plants (1.0 - dry weight basis [unitless]; see Table 7-17)
SC_x = Maximum concentration in surface soil (chemical specific - dry weight; see Table G-9 above)
PDS = Proportion of diet composed of surface soil (0.0 - dry weight basis [unitless]; see Table 7-17)
WIR_{bat} = Maximum water ingestion rate for the brown flower bat (0.00299 L/day; see Table 7-16)
WC_x = Maximum concentration in surface water (chemical-specific; see Table G-9 above)
BW_{bat} = Minimum body weight for the brown flower bat (0.016 kg; see Table 7-16)

(4) MATC values were derived by calculating the geometric mean of the NOAEL and LOAEL values.
(5) NOAEL-, LOAEL, and MATC-based screening level risk estimates (i.e., HQs) were derived by dividing dietary intakes by NOAEL, LOAEL-, and MATC-based toxicity reference values, respectively.

TABLE G-10
FOOD ITEM CONCENTRATIONS AND DIETARY INTAKES FOR NORWAY RAT DIETARY EXPOSURES
TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical [1]	Surface Water Concentration [2] (mg/L)	Surface Soil Concentration [3] (mg/kg)	Soil-to-Invertebrate BAF (unitless)	Invertebrate Tissue Concentration [4] (mg/kg)	Dietary Intake [5] (mg/kg-BW/day)
Volatile Organics:					
1,1,1,2-Tetrachloroethane	0.0005	0.0026	3.15072	0.0082	0.00178
Carbon tetrachloride	0.0005	0.0011	3.06980	0.0034	0.00081
Chlorobenzene	0.0005	0.0011	2.96770	0.0033	0.00079
Chloroform	0.0012	0.0012	3.79001	0.0045	0.00123
Ethylbenzene	0.0005	0.0014	2.75918	0.0039	0.00091
Pentachloroethane	0.0005	0.0067	2.81777	0.0189	0.00393
Styrene	0.0005	0.0011	2.90656	0.0032	0.00078
Toluene	0.0005	0.0011	3.05387	0.0034	0.00081
Trichloroethene	0.0005	0.0014	3.08582	0.0043	0.00100
Xylenes (total)	0.0005	0.0012	2.76637	0.0033	0.00080
Semivolatile Organics:					
1,2,4,5-Tetrachlorobenzene	0.0000	0.0460	1.86758	0.0859	0.01734
1,2,4-Trichlorobenzene	0.0051	0.0011	2.20024	0.0024	0.00184
1,2-Dichlorobenzene	0.0051	0.0014	2.55864	0.0036	0.00207
1,3-Dichlorobenzene	0.0051	0.0017	2.49293	0.0042	0.00221
1,4,-Dichlorobenzene	0.0051	0.0011	2.56531	0.0028	0.00192
2,3,4,6-Tetrachlorophenol	0.0100	0.0460	1.96223	0.0903	0.02086
2,4,5-Trichlorophenol	0.0100	0.1100	2.37268	0.2610	0.05522
2,4,6-Trichlorophenol	0.0100	0.1100	2.38506	0.2624	0.05549
2,4-Dichlorophenol	0.0100	0.1000	2.80259	0.2803	0.05902
2-Acetylaminofluorene	0.0051	0.4600	2.77358	1.2758	0.25799
2-Chloronaphthalene	0.0051	0.0840	2.26412	0.1902	0.03967
3,3'-Dichlorobenzidine	0.0051	0.2400	2.50594	0.6014	0.12242
3,3'-Dimethylbenzidine	0.0051	0.9200	3.11000	2.8612	0.57643
3-Methylcholanthrene	0.0051	0.4600	1.17528	0.5406	0.11118
4-Bromophenyl phenyl ether	0.0051	0.0960	1.70059	0.1633	0.03434
4-Chloro-3-methylphenol	0.0100	0.0980	2.78805	0.2732	0.05761
4-Chlorophenyl phenyl ether	0.0051	0.0890	1.72286	0.1533	0.03233
7,12-Dimethylbenz(a)anthracene	0.0051	0.2400	1.11568	0.2678	0.05580
Aramite, total	0.0051	0.0670	1.78213	0.1194	0.02547
Bis(2-ethylhexyl)phthalate	0.0051	0.0780	0.93476	0.0729	0.01623
Butyl benzyl phthalate	0.0051	0.0930	1.77288	0.1649	0.03465
Diallate	0.0051	0.0780	1.94191	0.1515	0.03192
Dibenzofuran	0.0051	0.0930	2.13816	0.1988	0.04144
Diethyl phthalate	0.0051	0.1000	3.25912	0.3259	0.06684
Di-n-butyl phthalate	0.0051	0.2400	1.88222	0.4517	0.09253
Di-n-octyl phthalate	0.0051	0.0930	0.76704	0.0713	0.01598
Dinoseb	0.0051	0.0930	2.47355	0.2300	0.04767
Hexachlorobenzene	0.0051	0.1100	1.34906	0.1484	0.03143
Hexachlorobutadiene	0.0051	0.0033	1.78678	0.0059	0.00254

TABLE G-10
FOOD ITEM CONCENTRATIONS AND DIETARY INTAKES FOR NORWAY RAT DIETARY EXPOSURES
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical [1]	Surface Water Concentration [2] (mg/L)	Surface Soil Concentration [3] (mg/kg)	Soil-to-Invertebrate BAF (unitless)	Invertebrate Tissue Concentration [4] (mg/kg)	Dietary Intake [5] (mg/kg-BW/day)
Semivolatile Organics (cont.):					
Hexachlorocyclopentadiene	0.0051	0.0520	1.53649	0.0799	0.01752
Hexachloroethane	0.0051	0.0810	2.20597	0.1787	0.03736
Hexachloropropene	0.0051	0.0740	1.99830	0.1479	0.03118
Isosafrole	0.0051	0.0460	2.59890	0.1195	0.02541
n-Nitrosodiphenylamine	0.0051	0.0850	2.74486	0.2333	0.04829
p-Dimethylamino azobenzene	0.0051	0.2400	1.89697	0.4553	0.09324
Pentachlorobenzene	0.0051	0.0460	1.58935	0.0731	0.01614
Pentachloronitrobenzene	0.0051	0.2400	1.86758	0.4482	0.09183
Pentachlorophenol	0.0100	0.2400	88.12000	21.1488	4.22665
Pronamide	0.0100	0.0590	2.50594	0.1479	0.03242
Metals:					
Antimony	0.0003	0.6900	1.00000	0.6900	0.14066
Beryllium	0.0000	0.6300	1.18200	0.7447	0.15126
Thallium	0.0010	0.0730	1.00000	0.0730	0.01514
Tin	20.0000	8.3000	1.00000	8.3000	6.99646

Notes:

BAF = Bioaccumulation Factor
mg/kg = milligram per kilogram
mg/kg-BW/day = milligram per kilogram-body weight per day (dry weight basis)
mg/L = milligram per liter

(1) Only those chemicals with Norway rat tissue concentrations estimated using dietary intakes and diet-to-whole body BAF values are listed (see Table G-8).

(2) Maximum detected surface water concentrations, in the case of non-detected chemicals, maximum Reporting Limits.

(3) Maximum detected surface soil concentrations or, in the case of non-detected chemicals, maximum Limits of Detection.

(4) Soil invertebrate tissue concentrations were derived by multiplying maximum surface soil concentrations by soil-to-invertebrate bioaccumulation factors.

TABLE G-10
FOOD ITEM CONCENTRATIONS AND DIETARY INTAKES FOR NORWAY RAT DIETARY EXPOSURES
TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Notes (cont.):

(5) The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FIR_{rat})(FC_{invert})(PDF_{invert})] + [(FIR_{rat})(SC_x)(PDS)]+[(WIR_{rat})(WC_x)]\}/BW_{rat}$$

Where:

DI_x = Dietary intake of chemical x by the Norway rat (mg/kg-body weight/day)
FIR_{rat} = Maximum food ingestion rate for the Norway rat (0.04075 kg/day - dry weight basis; see Table 7-16)
FC_{invert} = Concentration of chemical x in soil invertebrate tissue (chemical-specific - dry weight basis; see Table G-10 above)
PDF_{invert} = Proportion of diet composed of soil invertebrates (0.98 - dry weight basis [unitless]; see Table 7-17)
SC_x = Maximum concentration in surface soil (chemical specific - dry weight basis; see Table G-10 above)
PDS = Proportion of diet composed of surface soil (0.02 - dry weight basis [unitless]; see Table 7-17)
WIR_{rat} = Maximum water ingestion rate for the rat (0.5305 L/day; see Table 7-16)
WC_x = Maximum concentration in surface water (chemical-specific; see Table G-10 above)
BW_{rat} = Minimum body weight for the Norway rat (0.200 kg; see Table 7-16)

TABLE G-11
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR MOURNING DOVE DIETARY EXPOSURES TO CHEMICALS IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical	Surface Water Concentration [1] (mg/L)	Subsurface Soil Concentration [2] (mg/kg)	Soil-to-Plant BAF/Uptake Equation (unitless)	Plant Tissue Concentration [3] (mg/kg)	Dietary Intake [4] (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates [6]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [5] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Volatile Organics:											
1,1,1,2-Tetrachloroethane	0.0005	0.0055	5.17618	0.0285	0.00416	NA	NA	NA	---	---	---
Carbon tetrachloride	0.0005	0.0055	4.71454	0.0259	0.00380	NA	NA	NA	---	---	---
Chlorobenzene	0.0005	0.0055	4.17540	0.0230	0.00337	NA	NA	NA	---	---	---
Chloroform	0.0012	0.0055	10.04745	0.0553	0.00806	NA	NA	NA	---	---	---
Ethylbenzene	0.0005	0.0055	3.21442	0.0177	0.00262	NA	NA	NA	---	---	---
Pentachloroethane	0.0005	0.0055	2.98295	0.0164	0.00244	NA	NA	NA	---	---	---
Styrene	0.0005	0.0055	3.87473	0.0213	0.00314	NA	NA	NA	---	---	---
Toluene	0.0005	0.0055	4.62727	0.0254	0.00373	NA	NA	NA	---	---	---
Trichloroethene	0.0005	0.0055	4.80345	0.0264	0.00387	NA	NA	NA	---	---	---
o-Xylene	0.0005	0.0055	3.24458	0.0178	0.00264	40.50000	203.00000	90.67249	<0.01	<0.01	<0.01
m,p-Xylene	0.0010	0.0002	3.24458	0.0006	0.00022	40.50000	203.00000	90.67249	<0.01	<0.01	<0.01
Xylenes (total)	0.0005	0.0002	3.24458	0.0006	0.00015	40.50000	203.00000	90.67249	<0.01	<0.01	<0.01
Semivolatile Organics:											
1,2,4,5-Tetrachlorobenzene	0.0051	0.2500	0.79168	0.1979	0.03069	NA	NA	NA	---	---	---
1,2,4-Trichlorobenzene	0.0051	0.2500	1.42608	0.3565	0.05328	NA	NA	NA	---	---	---
1,2-Dichlorobenzene	0.0051	0.2500	2.45160	0.6129	0.08978	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
1,3-Dichlorobenzene	0.0051	0.2500	2.23295	0.5582	0.08199	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
1,4-Dichlorobenzene	0.0051	0.2500	2.47461	0.6187	0.09060	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
2,3,4,6-Tetrachlorophenol	0.0100	0.4800	0.94544	0.4538	0.06947	NA	NA	NA	---	---	---
2,4,5-Trichlorophenol	0.0100	0.4800	1.86980	0.8975	0.13264	NA	NA	NA	---	---	---
2,4,6-Trichlorophenol	0.0100	0.4800	1.90507	0.9144	0.13505	NA	NA	NA	---	---	---
2,4-Dichlorophenol	0.0100	0.4800	3.39973	1.6319	0.23719	NA	NA	NA	---	---	---
2-Acetylaminofluorene	0.0051	0.2500	3.27504	0.8188	0.11909	NA	NA	NA	---	---	---
2-Chloronaphthalene	0.0051	0.2500	1.58041	0.3951	0.05877	NA	NA	NA	---	---	---
3,3'-Dichlorobenzidine	0.0051	0.2500	2.27506	0.5688	0.08349	NA	NA	NA	---	---	---
3,3'-Dimethylbenzidine	0.0051	0.2500	4.93997	1.2350	0.17835	NA	NA	NA	---	---	---
3-Methylcholanthrene	0.0051	0.2500	0.15011	0.0375	0.00786	NA	NA	NA	---	---	---
4-Bromophenyl phenyl ether	0.0051	0.2500	0.56559	0.1414	0.02265	NA	NA	NA	---	---	---
4-Chloro-3-methylphenol	0.0100	0.4800	3.33680	1.6017	0.23289	NA	NA	NA	---	---	---
4-Chlorophenyl phenyl ether	0.0051	0.2500	0.59263	0.1482	0.02361	NA	NA	NA	---	---	---
7,12-Dimethylbenz(a)anthracene	0.0051	0.2500	0.12453	0.0311	0.00695	2.00000	20.00000	6.32456	<0.01	<0.01	<0.01
Aramite, total	0.0051	0.2500	0.66915	0.1673	0.02633	NA	NA	NA	---	---	---
Bis(2-ethylhexyl)phthalate	0.0051	0.0830	0.06598	0.0055	0.00204	1.11000	5.55000	2.48204	<0.01	<0.01	<0.01
Butyl benzyl phthalate	0.0051	0.2500	0.65677	0.1642	0.02589	NA	NA	NA	---	---	---
Diallate, cis-	0.0051	0.2500	0.91077	0.2277	0.03493	NA	NA	NA	---	---	---
Diallate, trans-	0.0051	0.2500	0.91077	0.2277	0.03493	NA	NA	NA	---	---	---
Dibenzofuran	0.0051	0.2500	1.28681	0.3217	0.04832	NA	NA	NA	---	---	---
Diethyl phthalate	0.0051	0.2500	5.84454	1.4611	0.21054	NA	NA	NA	---	---	---
Di-n-butyl phthalate	0.0051	0.2500	0.81418	0.2035	0.03150	0.22200	1.11000	0.49641	0.14	0.03	0.06
Di-n-octyl phthalate	0.0051	0.0550	0.03244	0.0018	0.00131	50.00000	250.00000	111.80340	<0.01	<0.01	<0.01
Dinoseb	0.0051	0.2200	2.17124	0.4777	0.07030	0.26400	1.32000	0.59032	0.27	0.05	0.12
Hexachlorobenzene	0.0051	0.2500	0.24628	0.0616	0.01128	0.11000	0.57000	0.25040	0.10	0.02	0.05
Hexachlorobutadiene	0.0051	0.2500	0.67543	0.1689	0.02656	3.39000	17.00000	7.59144	<0.01	<0.01	<0.01
Hexachlorocyclopentadiene	0.0051	0.2500	0.39290	0.0982	0.01650	NA	NA	NA	---	---	---
Hexachloroethane	0.0051	0.2500	1.43946	0.3599	0.05375	NA	NA	NA	---	---	---
Hexachloropropene	0.0051	0.2500	1.00933	0.2523	0.03844	NA	NA	NA	---	---	---
Isosafrole	0.0051	0.2500	2.59293	0.6482	0.09481	NA	NA	NA	---	---	---
n-Nitrosodiphenylamine	0.0051	0.2500	3.15492	0.7887	0.11481	NA	NA	NA	---	---	---
p-Dimethylamino azobenzene	0.0051	0.2500	0.83732	0.2093	0.03232	NA	NA	NA	---	---	---
Pentachlorobenzene	0.0051	0.2500	0.44363	0.1109	0.01831	NA	NA	NA	---	---	---
Pentachloronitrobenzene	0.0051	0.2500	0.79168	0.1979	0.03069	7.07000	70.70000	22.35730	<0.01	<0.01	<0.01
Pentachlorophenol	0.0100	0.4800	46.02000	22.0896	3.14985	6.73000	67.30000	21.28213	0.47	0.05	0.15
Pronamide	0.0100	0.4800	2.27506	1.0920	0.16033	NA	NA	NA	---	---	---
LLPAHs:											
2-Methylnaphthalene	0.0002	0.0079	1.64058	0.0130	0.00193	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Acenaphthene	0.0002	0.0077	$\ln(C_p) = -0.8556[\ln[C_s]) - 5.562$	0.2470	0.03526	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Acenaphthylene	0.0002	0.0007	1.52245	0.0010	0.00017	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Anthracene	0.0002	0.0031	$\ln(C_p) = 0.7784[\ln(C_s)] - 0.9887$	0.0041	0.00064	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01

TABLE G-11
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR MOURNING DOVE DIETARY
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Chemical	Surface Water Concentration (1) (mg/L)	Subsurface Soil Concentration (2) (mg/kg)	Soil-to-Plant BAF/Uptake Equation (unitless)	Plant Tissue Concentration (3) (mg/kg)	Dietary Intake (4) (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates (6)		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC (5) (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
LLPAHs (cont.):											
Benzo(a)anthracene	0.0002	0.0120	$\ln(C_p) = 0.5944[\ln(C_s)] - 2.7078$	0.0048	0.00080	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(a)pyrene	0.0002	0.0030	$\ln(C_p) = 0.975[\ln(Cs)] - 2.0615$	0.0004	0.00011	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(b)fluoranthene	0.0002	0.0028	0.48000	0.0013	0.00024	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(g,h,i)perylene	0.0002	0.0019	$\ln(C_p) = 1.1829[\ln(C_s)] - 0.9313$	0.0002	0.00007	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(k)fluoranthene	0.0002	0.0041	$\ln(C_p) = 0.8595[\ln(C_s)] - 2.1579$	0.0010	0.00020	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Chrysene	0.0002	0.0150	$\ln(C_p) = 0.5944[\ln(C_s)] - 2.7078$	0.0055	0.00092	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Dibenzo(a,h)anthracene	0.0002	0.0004	0.23000	0.0001	0.00004	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Fluoranthene	0.0000	0.0210	6.00000	0.1260	0.01810	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Fluorene	0.0002	0.0060	$\ln(C_p) = -0.8556[\ln[C_s]) - 5.562$	0.3058	0.04361	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	0.0002	0.0028	0.15000	0.0004	0.00011	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Naphthalene	0.0002	0.0011	48.00000	0.0528	0.00755	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Phenanthrene	0.0002	0.0200	$\ln(C_p) = 0.6203[\ln(C_s)] - 0.1665$	0.0748	0.01082	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Pyrene	0.0000	0.0240	3.70000	0.0888	0.01283	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Organochlorine Pesticides:											
4,4'-DDD	0.0001	0.0004	0.20241	0.0001	0.00003	0.22700	2.27000	0.71784	<0.01	<0.01	<0.01
4,4'-DDE	0.0000	0.0035	0.14000	0.0005	0.00010	0.22700	2.27000	0.71784	<0.01	<0.01	<0.01
4,4'-DDT	0.0000	0.0013	0.07900	0.0001	0.00003	0.22700	2.27000	0.71784	<0.01	<0.01	<0.01
Aldrin	0.0001	0.0025	0.13930	0.0003	0.00007	0.07000	0.35000	0.15652	<0.01	<0.01	<0.01
alpha-BHC	0.0001	0.0025	1.73516	0.0043	0.00064	0.56300	2.25000	1.12550	<0.01	<0.01	<0.01
alpha-Chlordane	0.0001	0.0025	0.16481	0.0004	0.00008	2.14000	10.70000	4.78519	<0.01	<0.01	<0.01
beta-BHC	0.0001	0.0089	1.71903	0.0153	0.00225	0.56300	2.25000	1.12550	<0.01	<0.01	<0.01
Chlorobenzilate	0.0051	0.2500	0.72108	0.1803	0.02818	9.73000	19.73000	13.85543	<0.01	<0.01	<0.01
delta-BHC	0.0001	0.0025	1.26300	0.0032	0.00047	0.56300	2.25000	1.12550	<0.01	<0.01	<0.01
Dieldrin	0.0001	0.0049	2.22200	0.0109	0.00160	0.70900	3.78000	1.63708	<0.01	<0.01	<0.01
Endosulfan I	0.0001	0.0025	1.68721	0.0042	0.00063	10.00000	50.00000	22.36068	<0.01	<0.01	<0.01
Endosulfan II	0.0001	0.0049	1.68721	0.0083	0.00123	10.00000	50.00000	22.36068	<0.01	<0.01	<0.01
Endosulfan sulfate	0.0001	0.0049	1.97760	0.0097	0.00143	10.00000	50.00000	22.36068	<0.01	<0.01	<0.01
Endrin	0.0001	0.0006	0.53476	0.0003	0.00006	0.02100	0.10400	0.04673	<0.01	<0.01	<0.01
Endrin aldehyde	0.0001	0.0005	1.43946	0.0008	0.00013	0.02100	0.10400	0.04673	<0.01	<0.01	<0.01
gamma-BHC (lindane)	0.0001	0.0025	1.85242	0.0046	0.00068	4.00000	20.00000	8.94427	<0.01	<0.01	<0.01
gamma-Chlordane	0.0001	0.0025	0.16481	0.0004	0.00008	2.14000	10.70000	4.78519	<0.01	<0.01	<0.01
Heptachlor	0.0001	0.0002	0.17431	0.0000	0.00001	0.49000	2.17000	1.03116	<0.01	<0.01	<0.01
Heptachlor epoxide	0.0001	0.0025	0.56559	0.0014	0.00023	0.49000	2.17000	1.03116	<0.01	<0.01	<0.01
Isodrin	0.0051	0.2500	0.13930	0.0348	0.00747	NA	NA	NA	---	---	---
Kepone	0.0051	0.2300	0.42736	0.0983	0.01636	1.67000	8.35000	3.73423	<0.01	<0.01	<0.01
Methoxychlor	0.0005	0.0250	0.52486	0.0131	0.00212	355.00000	1775.00000	793.80413	<0.01	<0.01	<0.01
Toxaphene	0.0026	0.1200	0.35453	0.0425	0.00728	1.00000	5.00000	2.23607	<0.01	<0.01	<0.01
Metals:											
Antimony	0.0003	1.2000	$\ln(C_p) = 0.938[\ln(C_s)] - 3.233$	0.0468	0.01569	4740.00000	47400.00000	14989.19611	<0.01	<0.01	<0.01
Arsenic	0.0005	1.8000	$\ln(C_p) = 0.564[\ln[C_s]) - 1.992$	0.1900	0.04061	2.24000	4.51000	3.17843	0.02	<0.01	0.01
Barium	0.0214	267.0000	0.44700	119.3490	18.99565	20.80000	41.70000	29.45098	0.91	0.46	0.64
Beryllium	0.0010	0.9600	$\ln(C_p) = 0.7345[\ln[C_s]) - 0.5361$	0.5677	0.08815	NA	NA	NA	---	---	---
Cadmium	0.0010	0.7700	$\ln(C_p) = 0.546[\ln(C_s)] - 0.475$	0.5392	0.08266	1.47000	6.36000	3.05765	0.06	0.01	0.03
Chromium, total	0.0008	79.3000	0.08390	6.6533	1.54158	2.66000	15.60000	6.44174	0.58	0.10	0.24
Cobalt	0.0003	72.1000	0.02480	1.7881	0.79489	7.61000	18.30000	11.80097	0.10	0.04	0.07
Copper	0.0040	270.0000	$\ln(C_p) = 0.394[\ln(C_s)] + 0.668$	17.7038	4.54428	4.05000	12.10000	7.00036	1.12	0.38	0.65
Lead	0.0010	33.0000	$\ln(C_p) = 0.561[\ln(C_s)] - 1.328$	1.8843	0.51568	1.63000	3.26000	2.30517	0.32	0.16	0.22
Mercury	0.0002	0.1000	$\ln(C_p) = 0.544[\ln[C_s]) - 0.996$	0.1055	0.01580	0.02600	0.07800	0.04503	0.61	0.20	0.35
Nickel	0.0010	47.3000	$\ln(C_p) = 0.748[\ln(C_s)] - 2.224$	1.9361	0.63021	6.71000	18.60000	11.17166	0.09	0.03	0.06
Selenium	0.0008	2.6000	$\ln(C_p) = 1.104[\ln(C_s)] - 0.678$	1.4577	0.22712	0.29000	0.57900	0.40977	0.78	0.39	0.55
Silver	0.0010	0.5700	0.03670	0.0209	0.00738	2.02000	20.20000	6.38780	<0.01	<0.01	<0.01
Thallium	0.0010	0.5000	0.00400	0.0020	0.00416	0.35000	1.75000	0.78262	0.01	<0.01	<0.01
Tin	0.0200	26.0000	0.03000	0.7800	0.30840	6.80000	16.90000	10.72007	0.05	0.02	0.03
Vanadium	0.0076	282.0000	0.00970	2.7354	2.50354	0.34400	0.68800	0.48649	7.28	3.64	5.15
Zinc	0.0079	242.0000	$\ln(C_p) = 0.554[\ln(C_s)] + 1.575$	101.0759	16.20500	66.10000	171.00000	106.31604	0.25	0.09	0.15

TABLE G-11
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR MOURNING DOVE DIETARY EXPOSURES TO CHEMICALS IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Notes:

BAF = Bioaccumulation Factor
PAH = Polynuclear Aromatic Hydrocarbon
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
HQ = Hazard Quotient
mg/kg-BW/day = milligram per kilogram-body weight per day
ln = natural logarithm
C_p = Concentration in plant tissue (mg/kg - dry weight)
C_s = Maximum concentration in subsurface soil (mg/kg - dry weight)
NA = Not Available
--- = Step 2 screening level risk estimate could not be calculated due to the lack of a toxicity reference value.
mg/kg = milligram per kilogram
mg/L = milligram per liter

(1) Maximum detected surface water concentrations or, in the case of non-detected chemicals, maximum Reporting Limits.

(2) Maximum detected subsurface soil concentrations or, in the case of non-detected chemicals, maximum Reporting Limits.

(3) As discussed in Section 7.5.2.2.1, plant tissue concentrations were derived by (a) multiplying maximum subsurface soil concentrations by soil-to-plant bioaccumulation factors, or (b) soil-to-plant uptake equations.

(4) The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FIR_{dove})(FC_{plant})(PDF_{plant})] + [(FIR_{dove})(SC_x)(PDS)]+[(WIR_{dove})(WC_x)]\}/BW_{dove}$$

Where:

DI_x = Dietary intake of chemical x by the mourning dove (mg/kg-body weight/day)
FIR_{dove} = Maximum food ingestion rate for the mourning dove (0.01723 kg/day - dry weight; see Table 7-16)
FC_{plant} = Maximum concentration of chemical x in plant tissue (chemical-specific - dry weight; see Table G-11 above)
PDF_{plant} = Proportion of diet composed of plants (0.95 - dry weight basis [unitless]; see Table 7-17)
SC_x = Concentration in subsurface soil (chemical specific - dry weight; see Table G-11 above)
PDS = Proportion of diet composed of subsurface soil (0.05, dry weight basis [unitless]; see Table 7-17)
WIR_{dove} = Maximum water ingestion rate for the mourning dove (0.01449 L/day; see Table 7-16)
WC_x = Maximum concentration in surface water (chemical-specific; see Table G-11 above)
BW_{dove} = Minimum body weight for the mourning dove (0.115 kg; see Table 7-16)

(5) MATC values were derived by calculating the geometric mean of the NOAEL and LOAEL values.

(6) NOAEL-, LOAEL, and MATC-based screening level risk estimates (i.e., HQs) were derived by dividing dietary intakes by NOAEL, LOAEL-, and MATC-based toxicity reference values, respectively.

TABLE G-12
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR AMERICAN ROBIN DIETARY EXPOSURES TO CHEMICALS IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical	Surface Water Concentration [1] (mg/L)	Subsurface Soil Concentration [2] (mg/kg)	Soil-to-Invertebrate BAF/Uptake Equation (unitless)	Invertebrate Tissue Concentration [3] (mg/kg)	Dietary Intake [4] (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates [6]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [5] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Volatile Organics:											
1,1,1,2-Tetrachloroethane	0.0005	0.0055	3.15072	0.0173	0.00444	NA	NA	NA	---	---	---
Carbon tetrachloride	0.0005	0.0055	3.06980	0.0169	0.00433	NA	NA	NA	---	---	---
Chlorobenzene	0.0005	0.0055	2.96770	0.0163	0.00420	NA	NA	NA	---	---	---
Chloroform	0.0012	0.0055	3.79001	0.0208	0.00546	NA	NA	NA	---	---	---
Ethylbenzene	0.0005	0.0055	2.75918	0.0152	0.00392	NA	NA	NA	---	---	---
Pentachloroethane	0.0005	0.0055	2.70234	0.0149	0.00385	NA	NA	NA	---	---	---
Styrene	0.0005	0.0055	2.90656	0.0160	0.00412	NA	NA	NA	---	---	---
Toluene	0.0005	0.0055	3.05387	0.0168	0.00431	NA	NA	NA	---	---	---
Trichloroethene	0.0005	0.0055	3.08582	0.0170	0.00435	NA	NA	NA	---	---	---
o-Xylene	0.0005	0.0055	2.76637	0.0152	0.00393	40.50000	203.00000	90.67249	<0.01	<0.01	<0.01
m,p-Xylene	0.0010	0.0002	2.76637	0.0005	0.00037	40.50000	203.00000	90.67249	<0.01	<0.01	<0.01
Xylenes (total)	0.0005	0.0002	2.76637	0.0005	0.00025	40.50000	203.00000	90.67249	<0.01	<0.01	<0.01
Semivolatile Organics:											
1,2,4,5-Tetrachlorobenzene	0.0051	0.2500	1.86758	0.4669	0.12048	NA	NA	NA	---	---	---
1,2,4-Trichlorobenzene	0.0051	0.2500	2.20024	0.5501	0.14046	NA	NA	NA	---	---	---
1,2-Dichlorobenzene	0.0051	0.2500	2.55864	0.6397	0.16199	16.00000	80.00000	35.77709	0.01	<0.01	<0.01
1,3-Dichlorobenzene	0.0051	0.2500	2.49293	0.6232	0.15804	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
1,4-Dichlorobenzene	0.0051	0.2500	2.56531	0.6413	0.16239	16.00000	80.00000	35.77709	0.01	<0.01	<0.01
2,3,4,6-Tetrachlorophenol	0.0100	0.4800	1.96223	0.9419	0.24228	NA	NA	NA	---	---	---
2,4,5-Trichlorophenol	0.0100	0.4800	2.37268	1.1389	0.28962	NA	NA	NA	---	---	---
2,4,6-Trichlorophenol	0.0100	0.4800	2.38506	1.1448	0.29105	NA	NA	NA	---	---	---
2,4-Dichlorophenol	0.0100	0.4800	2.80259	1.3452	0.33920	NA	NA	NA	---	---	---
2-Acetylaminofluorene	0.0051	0.2500	2.77358	0.6934	0.17490	NA	NA	NA	---	---	---
2-Chloronaphthalene	0.0051	0.2500	2.26412	0.5660	0.14430	NA	NA	NA	---	---	---
3,3'-Dichlorobenzidine	0.0051	0.2500	2.50594	0.6265	0.15882	NA	NA	NA	---	---	---
3,3'-Dimethylbenzidine	0.0051	0.2500	3.11000	0.7775	0.19511	NA	NA	NA	---	---	---
3-Methylcholanthrene	0.0051	0.2500	1.17528	0.2938	0.07889	NA	NA	NA	---	---	---
4-Bromophenyl phenyl ether	0.0051	0.2500	1.70059	0.4251	0.11044	NA	NA	NA	---	---	---
4-Chloro-3-methylphenol	0.0100	0.4800	2.78805	1.3383	0.33753	NA	NA	NA	---	---	---
4-Chlorophenyl phenyl ether	0.0051	0.2500	1.72286	0.4307	0.11178	NA	NA	NA	---	---	---
7,12-Dimethylbenz(a)anthracene	0.0051	0.2500	1.11568	0.2789	0.07531	2.00000	20.00000	6.32456	0.04	<0.01	0.01
Aramite, total	0.0051	0.2500	1.78213	0.4455	0.11534	NA	NA	NA	---	---	---
Bis(2-ethylhexyl)phthalate	0.0051	0.0830	0.93476	0.0776	0.02222	1.11000	5.55000	2.48204	0.02	<0.01	<0.01
Butyl benzyl phthalate	0.0051	0.2500	1.77288	0.4432	0.11479	NA	NA	NA	---	---	---
Diallate, cis-	0.0051	0.2500	1.94191	0.4855	0.12494	NA	NA	NA	---	---	---
Diallate, trans-	0.0051	0.2500	1.94191	0.4855	0.12494	NA	NA	NA	---	---	---
Dibenzofuran	0.0051	0.2500	2.13816	0.5345	0.13673	NA	NA	NA	---	---	---
Diethyl phthalate	0.0051	0.2500	3.25912	0.8148	0.20407	NA	NA	NA	---	---	---
Di-n-butyl phthalate	0.0051	0.2500	1.88222	0.4706	0.12135	0.22200	1.11000	0.49641	0.55	0.11	0.24
Di-n-octyl phthalate	0.0051	0.0550	0.76704	0.0422	0.01293	50.00000	250.00000	111.80340	<0.01	<0.01	<0.01
Dinoseb	0.0051	0.2200	2.47355	0.5442	0.13820	0.26400	1.32000	0.59032	0.52	0.10	0.23
Hexachlorobenzene	0.0051	0.2500	1.34906	0.3373	0.08933	0.11000	0.57000	0.25040	0.81	0.16	0.36
Hexachlorobutadiene	0.0051	0.2500	1.78678	0.4467	0.11562	3.39000	17.00000	7.59144	0.03	<0.01	0.02
Hexachlorocyclopentadiene	0.0051	0.2500	1.53649	0.3841	0.10059	NA	NA	NA	---	---	---
Hexachloroethane	0.0051	0.2500	2.20597	0.5515	0.14080	NA	NA	NA	---	---	---
Hexachloropropene	0.0051	0.2500	1.99830	0.4996	0.12833	NA	NA	NA	---	---	---
Isosafrole	0.0051	0.2500	2.59890	0.6497	0.16441	NA	NA	NA	---	---	---
n-Nitrosodiphenylamine	0.0051	0.2500	2.74486	0.6862	0.17317	NA	NA	NA	---	---	---
p-Dimethylamino azobenzene	0.0051	0.2500	1.89697	0.4742	0.12224	NA	NA	NA	---	---	---
Pentachlorobenzene	0.0051	0.2500	1.58935	0.3973	0.10376	NA	NA	NA	---	---	---
Pentachloronitrobenzene	0.0051	0.2500	1.86758	0.4669	0.12048	7.07000	70.70000	22.35730	0.02	<0.01	<0.01
Pentachlorophenol	0.0100	0.4800	88.12000	42.2976	10.17946	6.73000	67.30000	21.28213	1.51	0.15	0.48
Pronamide	0.0100	0.4800	2.50594	1.2028	0.30499	NA	NA	NA	---	---	---
LLPAHs:											
2-Methylnaphthalene	0.0002	0.0079	2.28781	0.0181	0.00462	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Acenaphthene	0.0002	0.0077	2.25237	0.0173	0.00444	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Acenaphthylene	0.0002	0.0007	2.24068	0.0015	0.00042	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Anthracene	0.0002	0.0031	1.91183	0.0059	0.00156	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01

TABLE G-12
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR AMERICAN ROBIN DIETARY EXPOSURES TO CHEMICALS IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical	Surface Water Concentration [1] (mg/L)	Subsurface Soil Concentration [2] (mg/kg)	Soil-to-Invertebrate BAF/Uptake Equation (unitless)	Invertebrate Tissue Concentration [3] (mg/kg)	Dietary Intake [4] (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates [6]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [5] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
LLPAHs (cont.):											
Benzo(a)anthracene	0.0002	0.0120	1.41742	0.0170	0.00448	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(a)pyrene	0.0002	0.0030	1.27400	0.0038	0.00105	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(b)fluoranthene	0.0002	0.0028	1.24451	0.0035	0.00097	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(g,h,i)perylene	0.0002	0.0019	1.09270	0.0021	0.00060	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(k)fluoranthene	0.0002	0.0041	1.24451	0.0051	0.00139	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Chrysene	0.0002	0.0150	1.41742	0.0213	0.00558	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Dibenzo(a,h)anthracene	0.0002	0.0004	1.09554	0.0004	0.00016	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Fluoranthene	0.0000	0.0210	1.64831	0.0346	0.00891	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Fluorene	0.0002	0.0060	2.08867	0.0125	0.00323	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	0.0002	0.0028	1.10701	0.0031	0.00087	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Naphthalene	0.0002	0.0011	2.60567	0.0029	0.00077	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Phenanthrene	0.0002	0.0200	1.91183	0.0382	0.00980	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Pyrene	0.0000	0.0240	1.65261	0.0397	0.01021	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Organochlorine Pesticides:											
4,4'-DDD	0.0001	0.0004	$\ln(C_e) = 0.6975[\ln(C_s)] + 1.1613$	0.0134	0.00325	0.22700	2.27000	0.71784	0.01	<0.01	<0.01
4,4'-DDE	0.0000	0.0035	$\ln(C_e) = 0.8804[\ln(C_s)] + 2.4771$	0.0820	0.01979	0.22700	2.27000	0.71784	0.09	<0.01	0.03
4,4'-DDT	0.0000	0.0013	$\ln(C_e) = 0.8689[\ln(C_s)] + 2.1247$	0.0260	0.00629	0.22700	2.27000	0.71784	0.03	<0.01	<0.01
Aldrin	0.0001	0.0025	3.30000	0.0083	0.00207	0.07000	0.35000	0.15652	0.03	<0.01	0.01
alpha-BHC	0.0001	0.0025	2.32381	0.0058	0.00148	0.56300	2.25000	1.12550	<0.01	<0.01	<0.01
alpha-Chlordane	0.0001	0.0025	4.00000	0.0100	0.00249	2.14000	10.70000	4.78519	<0.01	<0.01	<0.01
beta-BHC	0.0001	0.0089	2.31777	0.0206	0.00522	0.56300	2.25000	1.12550	<0.01	<0.01	<0.01
Chlorobenzilate	0.0051	0.2500	1.81963	0.4549	0.11759	9.73000	19.73000	13.85543	0.01	<0.01	<0.01
delta-BHC	0.0001	0.0025	2.12706	0.0053	0.00136	0.56300	2.25000	1.12550	<0.01	<0.01	<0.01
Dieldrin	0.0001	0.0049	49.67000	0.2434	0.05864	0.70900	3.78000	1.63708	0.08	0.02	0.04
Endosulfan I	0.0001	0.0025	2.30574	0.0058	0.00147	10.00000	50.00000	22.36068	<0.01	<0.01	<0.01
Endosulfan II	0.0001	0.0049	2.30574	0.0113	0.00288	10.00000	50.00000	22.36068	<0.01	<0.01	<0.01
Endosulfan sulfate	0.0001	0.0049	2.41002	0.0118	0.00300	10.00000	50.00000	22.36068	<0.01	<0.01	<0.01
Endrin	0.0001	0.0006	3.60000	0.0020	0.00052	0.02100	0.10400	0.04673	0.02	<0.01	0.01
Endrin aldehyde	0.0001	0.0005	2.20597	0.0012	0.00033	0.02100	0.10400	0.04673	0.02	<0.01	<0.01
gamma-BHC (lindane)	0.0001	0.0025	26.60000	0.0665	0.01606	4.00000	20.00000	8.94427	<0.01	<0.01	<0.01
gamma-Chlordane	0.0001	0.0025	4.00000	0.0100	0.00249	2.14000	10.70000	4.78519	<0.01	<0.01	<0.01
Heptachlor	0.0001	0.0002	3.00000	0.0007	0.00018	0.49000	2.17000	1.03116	<0.01	<0.01	<0.01
Heptachlor epoxide	0.0001	0.0025	10.00000	0.0250	0.00609	0.49000	2.17000	1.03116	0.01	<0.01	<0.01
Isodrin	0.0051	0.2500	1.15107	0.2878	0.07743	NA	NA	NA	---	---	---
Kepone	0.0051	0.2300	1.57290	0.3618	0.09465	1.67000	8.35000	3.73423	0.06	0.01	0.03
Methoxychlor	0.0005	0.0250	1.66556	0.0416	0.01083	355.00000	1775.00000	793.80413	<0.01	<0.01	<0.01
Toxaphene	0.0026	0.1200	1.49314	0.1792	0.04707	1.00000	5.00000	2.23607	0.05	<0.01	0.02
Metals:											
Antimony	0.0003	1.2000	1.00000	1.2000	0.32223	4740.00000	47400.00000	14989.19611	<0.01	<0.01	<0.01
Arsenic	0.0005	1.8000	$\ln(C_e) = 0.706[\ln(C_s)] - 1.421$	0.3657	0.13873	2.24000	4.51000	3.17843	0.06	0.03	0.04
Barium	0.0214	267.0000	0.16000	42.7200	17.79690	20.80000	41.70000	29.45098	0.86	0.43	0.60
Beryllium	0.0010	0.9600	1.18200	1.1347	0.29996	NA	NA	NA	---	---	---
Cadmium	0.0010	0.7700	$\ln(C_e) = 0.795[\ln(C_s)] + 2.114$	6.7276	1.63849	1.47000	6.36000	3.05765	1.11	0.26	0.54
Chromium, total	0.0008	79.3000	3.16200	250.7466	62.48640	2.66000	15.60000	6.44174	23.49	4.01	9.70
Cobalt	0.0003	72.1000	0.29100	20.9811	7.07403	7.61000	18.30000	11.80097	0.93	0.39	0.60
Copper	0.0040	270.0000	$\ln(C_e) = 0.264[\ln(C_s)] + 1.675$	23.4058	13.23632	4.05000	12.10000	7.00036	3.27	1.09	1.89
Lead	0.0010	33.0000	$\ln(C_e) = 0.807[\ln(C_s)] - 2.18$	1.8997	1.38697	1.63000	3.26000	2.30517	0.85	0.43	0.60
Mercury	0.0002	0.1000	20.63000	2.0630	0.49858	0.02600	0.07800	0.04503	19.18	6.39	11.07
Nickel	0.0010	47.3000	4.73000	223.7290	55.09245	6.71000	18.60000	11.17166	8.21	2.96	4.93
Selenium	0.0008	2.6000	$\ln(C_e) = 0.733[\ln(C_s)] - 0.075$	1.8690	0.52256	0.29000	0.57900	0.40977	1.80	0.90	1.28
Silver	0.0010	0.5700	15.33800	8.7427	2.11705	2.02000	20.20000	6.38780	1.05	0.10	0.33
Thallium	0.0010	0.5000	1.00000	0.5000	0.13448	0.35000	1.75000	0.78262	0.38	0.08	0.17
Tin	0.0200	26.0000	1.00000	26.0000	6.98522	6.80000	16.90000	10.72007	1.03	0.41	0.65
Vanadium	0.0076	282.0000	0.08800	24.8160	13.91433	0.34400	0.68800	0.48649	40.45	20.22	28.60
Zinc	0.0079	242.0000	$\ln(C_e) = 0.328[\ln(C_s)] + 4.449$	517.6874	131.21663	66.10000	171.00000	106.31604	1.99	0.77	1.23

TABLE G-12
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR AMERICAN ROBIN DIETARY EXPOSURES TO CHEMICALS IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Notes:

BAF = Bioaccumulation Factor
PAH = Polynuclear Aromatic Hydrocarbon
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
HQ = Hazard Quotient
mg/kg-BW/day = milligram per kilogram-body weight per day
ln = natural logarithm
C_p = Concentration in plant tissue (mg/kg - dry weight)
C_s = Maximum concentration in subsurface soil (mg/kg - dry weight)
NA = Not Available
--- = Step 2 screening level risk estimate could not be calculated due to the lack of a toxicity reference value.
mg/kg = milligram per kilogram
mg/L = milligram per liter

(1) Maximum detected surface water concentrations or, in the case of non-detected chemicals, maximum Reporting Limits.

(2) Maximum detected subsurface soil concentrations or, in the case of non-detected chemicals, maximum Reporting Limits.

(3) As discussed in Section 7.5.2.2.1, soil invertebrate tissue concentrations were derived by (a) multiplying maximum subsurface soil concentrations by soil-to-invertebrate bioaccumulation factors or, (b) soil-to-invertebrate uptake equations.

(4) The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FIR_{robin})(FC_{invert})(PDF_{invert})] + [(FIR_{robin})(SC_x)(PDS)]+[(WIR_{robin})(WC_x)]\}/BW_{robin}$$

Where:

DI_x = Dietary intake of chemical x by the American robin (mg/kg-body weight/day)
FIR_{robin} = Maximum food ingestion rate for the American robin (0.01503 kg/day - dry weight; see Table 7-16)
FC_{invert} = Concentration of chemical x in soil invertebrate tissue (chemical-specific - dry weight; see Table G-12 above)
PDF_{invert} = Proportion of diet composed of soil invertebrates (0.895 - dry weight basis [unitless]; see Table 7-17)
SC_x = Maximum concentration in subsurface soil (chemical specific - dry weight; see Table G-12 above)
PDS = Proportion of diet composed of subsurface soil (0.105 - dry weight basis [unitless]; see Table 7-17)
WIR_{robin} = Maximum water ingestion rate for the robin (0.01361 L/day; see Table 7-16)
WC_x = Maximum concentration of surface water (chemical-specific; see Table G-12 above)
BW_{robin} = Minimum body weight for the American robin (0.056 kg; see Table 7-16)

(4) MATC values were derived by calculating the geometric mean of the NOAEL and LOAEL values.

(5) NOAEL-, LOAEL, and MATC-based screening level risk estimates (i.e., HQs) were derived by dividing dietary intakes by NOAEL, LOAEL-, and MATC-based toxicity reference values, respectively.

TABLE G-13
FOOD ITEM CONCENTRATIONS, DIETARY DOSES, AND HAZARD QUOTIENT VALUES FOR RED TAILED HAWK DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical	Surface Water Concentration (1) (mg/L)	Subsurface Soil Concentration (2) (mg/kg)	Soil-to-Small Mammal BAF/Uptake Equation (unitless)	Small Mammal Concentration (3) (mg/kg)	Dietary Intake (4) (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates (6)		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC (5) (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Volatile Organics:											
1,1,1,2-Tetrachloroethane	0.0005	0.0055	$C_m = [(BAF_d)(DI)]/0.32$	0.0113	0.00122	NA	NA	NA	---	---	---
Carbon tetrachloride	0.0005	0.0055	$C_m = [(BAF_d)(DI)]/0.32$	0.0110	0.00119	NA	NA	NA	---	---	---
Chlorobenzene	0.0005	0.0055	$C_m = [(BAF_d)(DI)]/0.32$	0.0107	0.00116	NA	NA	NA	---	---	---
Chloroform	0.0012	0.0055	$C_m = [(BAF_d)(DI)]/0.32$	0.0141	0.00157	NA	NA	NA	---	---	---
Ethylbenzene	0.0005	0.0055	$C_m = [(BAF_d)(DI)]/0.32$	0.0100	0.00108	NA	NA	NA	---	---	---
Pentachloroethane	0.0005	0.0055	$C_m = [(BAF_d)(DI)]/0.32$	0.0098	0.00106	NA	NA	NA	---	---	---
Styrene	0.0005	0.0055	$C_m = [(BAF_d)(DI)]/0.32$	0.0105	0.00113	NA	NA	NA	---	---	---
Toluene	0.0005	0.0055	$C_m = [(BAF_d)(DI)]/0.32$	0.0110	0.00119	NA	NA	NA	---	---	---
Trichloroethene	0.0005	0.0055	$C_m = [(BAF_d)(DI)]/0.32$	0.0111	0.00120	NA	NA	NA	---	---	---
o-Xylene	0.0005	0.0055	$C_m = [(BAF_d)(DI)]/0.32$	0.0100	0.00108	40.50000	203.00000	90.67249	<0.01	<0.01	<0.01
m,p-Xylene	0.0010	0.0002	$C_m = [(BAF_d)(DI)]/0.32$	0.0012	0.00020	40.50000	203.00000	90.67249	<0.01	<0.01	<0.01
Xylenes (total)	0.0005	0.0002	$C_m = [(BAF_d)(DI)]/0.32$	0.0007	0.00012	40.50000	203.00000	90.67249	<0.01	<0.01	<0.01
Semivolatile Organics:											
1,2,4,5-Tetrachlorobenzene	0.0051	0.2500	$C_m = [(BAF_d)(DI)]/0.32$	0.2988	0.03171	NA	NA	NA	---	---	---
1,2,4-Trichlorobenzene	0.0051	0.2500	$C_m = [(BAF_d)(DI)]/0.32$	0.3507	0.03715	NA	NA	NA	---	---	---
1,2-Dichlorobenzene	0.0051	0.2500	$C_m = [(BAF_d)(DI)]/0.32$	0.4066	0.04301	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
1,3-Dichlorobenzene	0.0051	0.2500	$C_m = [(BAF_d)(DI)]/0.32$	0.3963	0.04194	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
1,4-Dichlorobenzene	0.0051	0.2500	$C_m = [(BAFd)(DI)]/0.32$	0.4076	0.04312	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
2,3,4,6-Tetrachlorophenol	0.0100	0.4800	$C_m = [(BAF_d)(DI)]/0.32$	0.6021	0.06389	NA	NA	NA	---	---	---
2,4,5-Trichlorophenol	0.0100	0.4800	$C_m = [(BAF_d)(DI)]/0.32$	0.7251	0.07678	NA	NA	NA	---	---	---
2,4,6-Trichlorophenol	0.0100	0.4800	$C_m = [(BAF_d)(DI)]/0.32$	0.7288	0.07717	NA	NA	NA	---	---	---
2,4-Dichlorophenol	0.0100	0.4800	$C_m = [(BAF_d)(DI)]/0.32$	0.8538	0.09028	NA	NA	NA	---	---	---
2-Acetylaminofluorene	0.0051	0.2500	$C_m = [(BAF_d)(DI)]/0.32$	0.4401	0.04653	NA	NA	NA	---	---	---
2-Chloronaphthalene	0.0051	0.2500	$C_m = [(BAF_d)(DI)]/0.32$	0.3606	0.03820	NA	NA	NA	---	---	---
3,3'-Dichlorobenzidine	0.0051	0.2500	$C_m = [(BAF_d)(DI)]/0.32$	0.3983	0.04215	NA	NA	NA	---	---	---
3,3'-Dimethylbenzidine	0.0051	0.2500	$C_m = [(BAF_d)(DI)]/0.32$	0.4926	0.05203	NA	NA	NA	---	---	---
3-Methylcholanthrene	0.0051	0.2500	$C_m = [(BAF_d)(DI)]/0.32$	0.1908	0.02038	NA	NA	NA	---	---	---
4-Bromophenyl phenyl ether	0.0051	0.2500	$C_m = [(BAF_d)(DI)]/0.32$	0.2727	0.02898	NA	NA	NA	---	---	---
4-Chloro-3-methylphenol	0.0100	0.4800	$C_m = [(BAF_d)(DI)]/0.32$	0.8495	0.08983	NA	NA	NA	---	---	---
4-Chlorophenyl phenyl ether	0.0051	0.2500	$C_m = [(BAF_d)(DI)]/0.32$	0.2762	0.02934	NA	NA	NA	---	---	---
7,12-Dimethylbenz(a)anthracene	0.0051	0.2500	$C_m = [(BAF_d)(DI)]/0.32$	0.1815	0.01941	2.00000	20.00000	6.32456	<0.01	<0.01	<0.01
Aramite, total	0.0051	0.2500	$C_m = [(BAF_d)(DI)]/0.32$	0.2854	0.03031	NA	NA	NA	---	---	---
Bis(2-ethylhexyl)phthalate	0.0051	0.0830	$C_m = [(BAF_d)(DI)]/0.32$	0.0537	0.00601	1.11000	5.55000	2.48204	<0.01	<0.01	<0.01
Butyl benzyl phthalate	0.0051	0.2500	$C_m = [(BAF_d)(DI)]/0.32$	0.2840	0.03016	NA	NA	NA	---	---	---
Diallate, cis-	0.0051	0.2500	$C_m = [(BAF_d)(DI)]/0.32$	0.3104	0.03293	NA	NA	NA	---	---	---
Diallate, trans-	0.0051	0.2500	$C_m = [(BAF_d)(DI)]/0.32$	0.3104	0.03293	NA	NA	NA	---	---	---
Dibenzofuran	0.0051	0.2500	$C_m = [(BAF_d)(DI)]/0.32$	0.3410	0.03614	NA	NA	NA	---	---	---
Diethyl phthalate	0.0051	0.2500	$C_m = [(BAF_d)(DI)]/0.32$	0.5158	0.05447	NA	NA	NA	---	---	---
Di-n-butyl phthalate	0.0051	0.2500	$C_m = [(BAF_d)(DI)]/0.32$	0.3010	0.03195	0.22200	1.11000	0.49641	0.14	0.03	0.06
Di-n-octyl phthalate	0.0051	0.0550	$C_m = [(BAF_d)(DI)]/0.32$	0.0313	0.00366	50.00000	250.00000	111.80340	<0.01	<0.01	<0.01
Dinoseb	0.0051	0.2200	$C_m = [(BAF_d)(DI)]/0.32$	0.3466	0.03673	0.26400	1.32000	0.59032	0.14	0.03	0.06
Hexachlorobenzene	0.0051	0.2500	$C_m = [(BAF_d)(DI)]/0.32$	0.2179	0.02323	0.11000	0.57000	0.25040	0.21	0.04	0.09
Hexachlorobutadiene	0.0051	0.2500	$C_m = [(BAF_d)(DI)]/0.32$	0.2861	0.03039	3.39000	17.00000	7.59144	<0.01	<0.01	<0.01
Hexachlorocyclopentadiene	0.0051	0.2500	$C_m = [(BAF_d)(DI)]/0.32$	0.2471	0.02629	NA	NA	NA	---	---	---
Hexachloroethane	0.0051	0.2500	$C_m = [(BAF_d)(DI)]/0.32$	0.3515	0.03725	NA	NA	NA	---	---	---
Hexachloropropene	0.0051	0.2500	$C_m = [(BAF_d)(DI)]/0.32$	0.3191	0.03385	NA	NA	NA	---	---	---
Isosafrole	0.0051	0.2500	$C_m = [(BAF_d)(DI)]/0.32$	0.4128	0.04367	NA	NA	NA	---	---	---
n-Nitrosodiphenylamine	0.0051	0.2500	$C_m = [(BAF_d)(DI)]/0.32$	0.4356	0.04606	NA	NA	NA	---	---	---
p-Dimethylamino azobenzene	0.0051	0.2500	$C_m = [(BAF_d)(DI)]/0.32$	0.3033	0.03219	NA	NA	NA	---	---	---
Pentachlorobenzene	0.0051	0.2500	$C_m = [(BAF_d)(DI)]/0.32$	0.2554	0.02716	NA	NA	NA	---	---	---
Pentachloronitrobenzene	0.0051	0.2500	$C_m = [(BAF_d)(DI)]/0.32$	0.2988	0.03171	7.07000	70.70000	22.35730	<0.01	<0.01	<0.01

TABLE G-13
FOOD ITEM CONCENTRATIONS, DIETARY DOSES, AND HAZARD QUOTIENT VALUES FOR RED TAILED HAWK DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical	Surface Water Concentration [1] (mg/L)	Subsurface Soil Concentration [2] (mg/kg)	Soil-to-Small Mammal BAF/Uptake Equation (unitless)	Small Mammal Concentration [3] (mg/kg)	Dietary Intake [4] (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates [6]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [5] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Semivolatile Organics (cont.):											
Pentachlorophenol	0.0100	0.4800	$C_m = [(BAF_d)(DI)]/0.32$	26.4082	2.76998	6.73000	67.30000	21.28213	0.41	0.04	0.13
Pronamide	0.0100	0.4800	$C_m = [(BAF_d)(DI)]/0.32$	0.7650	0.08097	NA	NA	NA	---	---	---
LLPAHs:											
2-Methylnaphthalene	0.0002	0.0079	0.00	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Acenaphthene	0.0002	0.0077	0.00	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Acenaphthylene	0.0002	0.0007	0.00	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Anthracene	0.0002	0.0031	0.00	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(a)anthracene	0.0002	0.0120	0.00	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(a)pyrene	0.0002	0.0030	0.00	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(b)fluoranthene	0.0002	0.0028	0.00	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(g,h,i)perylene	0.0002	0.0019	0.00	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(k)fluoranthene	0.0002	0.0041	0.00	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Chrysene	0.0002	0.0150	0.00	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Dibenzo(a,h)anthracene	0.0002	0.0004	0.00	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Fluoranthene	0.0000	0.0210	0.00	0.0000	0.00000	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Fluorene	0.0002	0.0060	0.00	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	0.0002	0.0028	0.00	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Naphthalene	0.0002	0.0011	0.00	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Phenanthrene	0.0002	0.0200	0.00	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Pyrene	0.0000	0.0240	0.00	0.0000	0.00000	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Organochlorine Pesticides:											
4,4'-DDD	0.0001	0.0004	$C_m = [(BAF_d)(DI)]/0.32$	0.0084	0.00089	0.22700	2.27000	0.71784	<0.01	<0.01	<0.01
4,4'-DDE	0.0000	0.0035	$C_m = [(BAF_d)(DI)]/0.32$	0.0512	0.00537	0.22700	2.27000	0.71784	0.02	<0.01	<0.01
4,4'-DDT	0.0000	0.0013	$C_m = [(BAF_d)(DI)]/0.32$	0.0162	0.00170	0.22700	2.27000	0.71784	<0.01	<0.01	<0.01
Aldrin	0.0001	0.0025	$C_m = [(BAF_d)(DI)]/0.32$	0.0052	0.00055	0.07000	0.35000	0.15652	<0.01	<0.01	<0.01
alpha-BHC	0.0001	0.0025	$C_m = [(BAF_d)(DI)]/0.32$	0.0037	0.00039	0.56300	2.25000	1.12550	<0.01	<0.01	<0.01
alpha-Chlordane	0.0001	0.0025	$C_m = [(BAF_d)(DI)]/0.32$	0.0063	0.00067	2.14000	10.70000	4.78519	<0.01	<0.01	<0.01
beta-BHC	0.0001	0.0089	$C_m = [(BAF_d)(DI)]/0.32$	0.0130	0.00137	0.56300	2.25000	1.12550	<0.01	<0.01	<0.01
Chlorobenzilate	0.0051	0.2500	$C_m = [(BAF_d)(DI)]/0.32$	0.2913	0.03093	9.73000	19.73000	13.85543	<0.01	<0.01	<0.01
delta-BHC	0.0001	0.0025	$C_m = [(BAF_d)(DI)]/0.32$	0.0034	0.00036	0.56300	2.25000	1.12550	<0.01	<0.01	<0.01
Dieldrin	0.0001	0.0049	$C_m = [(BAF_d)(DI)]/0.32$	0.1520	0.01595	0.70900	3.78000	1.63708	0.02	<0.01	<0.01
Endosulfan I	0.0001	0.0025	$C_m = [(BAF_d)(DI)]/0.32$	0.0037	0.00039	10.00000	50.00000	22.36068	<0.01	<0.01	<0.01
Endosulfan II	0.0001	0.0049	$C_m = [(BAF_d)(DI)]/0.32$	0.0072	0.00076	10.00000	50.00000	22.36068	<0.01	<0.01	<0.01
Endosulfan sulfate	0.0001	0.0049	$C_m = [(BAF_d)(DI)]/0.32$	0.0075	0.00080	10.00000	50.00000	22.36068	<0.01	<0.01	<0.01
Endrin	0.0001	0.0006	$C_m = [(BAF_d)(DI)]/0.32$	0.0013	0.00015	0.02100	0.10400	0.04673	<0.01	<0.01	<0.01
Endrin aldehyde	0.0001	0.0005	$C_m = [(BAF_d)(DI)]/0.32$	0.0008	0.00009	0.02100	0.10400	0.04673	<0.01	<0.01	<0.01
gamma-BHC (lindane)	0.0001	0.0025	$C_m = [(BAF_d)(DI)]/0.32$	0.0416	0.00436	4.00000	20.00000	8.94427	<0.01	<0.01	<0.01
gamma-Chlordane	0.0001	0.0025	$C_m = [(BAF_d)(DI)]/0.32$	0.0063	0.00067	2.14000	10.70000	4.78519	<0.01	<0.01	<0.01
Heptachlor	0.0001	0.0002	$C_m = [(BAF_d)(DI)]/0.32$	0.0005	0.00005	0.49000	2.17000	1.03116	<0.01	<0.01	<0.01
Heptachlor epoxide	0.0001	0.0025	$C_m = [(BAF_d)(DI)]/0.32$	0.0157	0.00165	0.49000	2.17000	1.03116	<0.01	<0.01	<0.01
Isodrin	0.0051	0.2500	$C_m = [(BAF_d)(DI)]/0.32$	0.1870	0.01999	NA	NA	NA	---	---	---
Kepone	0.0051	0.2300	$C_m = [(BAF_d)(DI)]/0.32$	0.2329	0.02480	1.67000	8.35000	3.73423	0.01	<0.01	<0.01
Methoxychlor	0.0005	0.0250	$C_m = [(BAF_d)(DI)]/0.32$	0.0267	0.00284	355.00000	1775.00000	793.80413	<0.01	<0.01	<0.01
Toxaphene	0.0026	0.1200	$C_m = [(BAF_d)(DI)]/0.32$	0.1155	0.01231	1.00000	5.00000	2.23607	0.01	<0.01	<0.01
Metals:											
Antimony	0.0003	1.2000	$C_m = [(BAF_d)(DI)]/0.32$	0.0600	0.00631	4740.00000	47400.00000	14989.19611	<0.01	<0.01	<0.01
Arsenic	0.0005	1.8000	$\ln(C_m) = 0.8188[\ln(C_s)] - 4.8471$	0.0127	0.00137	2.24000	4.51000	3.17843	<0.01	<0.01	<0.01
Barium	0.0214	267.0000	0.1121	0.3540	0.03873	20.80000	41.70000	29.45098	<0.01	<0.01	<0.01
Beryllium	0.0010	0.9600	$C_m = [(BAF_d)(DI)]/0.32$	0.0566	0.00601	NA	NA	NA	---	---	---
Cadmium	0.0010	0.7700	$\ln(C_m) = 0.4865[\ln(C_s)] - 0.4306$	0.5725	0.06011	1.47000	6.36000	3.05765	0.04	<0.01	0.02
Chromium, total	0.0008	79.3000	$\ln(C_m) = 0.7338[\ln(C_s)] - 1.4599$	5.7499	0.60300	2.66000	15.60000	6.44174	0.23	0.04	0.09
Cobalt	0.0003	72.1000	$\ln(C_m) = 1.3070[\ln(C_s)] - 4.4669$	3.0787	0.32287	7.61000	18.30000	11.80097	0.04	0.02	0.03
Copper	0.0040	270.0000	$\ln(C_m) = 0.1444[\ln(C_s)] + 0.2042$	17.2949	1.81388	4.05000	12.10000	7.00036	0.45	0.15	0.26
Lead	0.0010	33.0000	$\ln(C_m) = 0.4422[\ln(Cs)] + 0.0761$	5.0645	0.53115	1.63000	3.26000	2.30517	0.33	0.16	0.23

TABLE G-13
FOOD ITEM CONCENTRATIONS, DIETARY DOSES, AND HAZARD QUOTIENT VALUES FOR RED TAILED HAWK DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical	Surface Water Concentration [1] (mg/L)	Subsurface Soil Concentration [2] (mg/kg)	Soil-to-Small Mammal BAF/Uptake Equation (unitless)	Small Mammal Concentration [3] (mg/kg)	Dietary Intake [4] (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates [6]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [5] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Metals (cont.):											
Mercury	0.0002	0.1000	0.192	0.0192	0.00203	0.02600	0.07800	0.04503	0.08	0.03	0.05
Nickel	0.0010	47.3000	$\ln(C_m) = 0.4658[\ln(C_s)] - 0.2462$	4.7122	0.49421	6.71000	18.60000	11.17166	0.07	0.03	0.04
Selenium	0.0008	2.6000	$\ln(C_m) = 0.3764[\ln(C_s)] - 0.4158$	0.9454	0.09919	0.29000	0.57900	0.40977	0.34	0.17	0.24
Silver	0.0010	0.5700	0.5013	0.2857	0.03004	2.02000	20.20000	6.38780	0.01	<0.01	<0.01
Thallium	0.0010	0.5000	$C_m = [(BAF_d)(DI)]/0.32$	0.3192	0.03355	0.35000	1.75000	0.78262	0.10	0.02	0.04
Tin	0.0200	26.0000	$C_m = [(BAF_d)(DI)]/0.32$	16.5718	1.73925	6.80000	16.90000	10.72007	0.26	0.10	0.16
Vanadium	0.0076	282.0000	0.0179	5.0478	0.52989	0.34400	0.68800	0.48649	1.54	0.77	1.09
Zinc	0.0079	242.0000	$\ln(C_m) = 0.0738[\ln(C_s)] + 4.4713$	131.1555	13.75386	66.10000	171.00000	106.31604	0.21	0.08	0.13

Notes:

BAF = Bioaccumulation Factor
PAH = Polynuclear Aromatic Hydrocarbon
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
HQ = Hazard Quotient
mg/kg-BW/day = milligram per kilogram-body weight per day
ln = natural logarithm
C_m = Concentration in small mammal tissue (mg/kg - dry weight)
C_s = Maximum concentration in subsurface soil (mg/kg - dry weight)
BAF_d = small mammal diet-to-whole body bioaccumulation factor (wet weight)
DI_m = Small mammal dietary intake (mg/kg-BW/day)
NA = Not Available
--- = Step 2 screening level risk estimate could not be calculated due to the lack of a toxicity reference value.
mg/kg = milligram per kilogram
mg/L = milligram per liter

[1] Maximum detected surface water concentrations or, in the case of non-detected chemicals, maximum Reporting Limits.

[2] Maximum detected subsurface soil concentrations or, in the case of non-detected chemicals, maximum Reporting Limits.

[3] As discussed in Section 7.5.2.2.1, small mammal (i.e., Norway rat) tissue concentrations were derived by (a) multiplying maximum subsurface soil concentrations by soil-to-small mammal bioaccumulation factors, (b) soil-to-small mammal uptake equations, or (c) multiplying small mammal dietary intakes (see Table G-15 for small mammal dietary intake values) by small mammal diet-to-whole body BAF values (BAF_d assumed to be 1.0 for all chemicals [wet weight basis]) and dividing the products by 0.32 (solids content of small mammals).

[4] The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FIR_{hawk})(FC_{sm})(PDF_{sm})] + [(FIR_{hawk})(SC_x)(PDS)]+[(WIR_{hawk})(WC_x)]\}/BW_{hawk}$$

Where:

DI_x = Dietary intake of chemical x by the red-tailed hawk (mg/kg-body weight/day)
FIR_{hawk} = Maximum food ingestion rate for the red-tailed hawk (0.09679 kg/day - dry weight; see Table 7-16)
FC_{sm}= Concentration of chemical x in small mammal tissue (chemical-specific - dry weight; see Table G-13 above)
PDF_{sm} = Proportion of diet composed of small mammals (1.0 - dry weight basis [unitless]; see Table 7-17)
SC_x = Maximum concentration in subsurface soil (chemical specific - dry weight; see Table G-13 above)
PDS = Proportion of diet composed of subsurface soil (0.0 - dry weight basis [unitless]; see Table 7-17)
WIR_{hawk} = Maximum water ingestion rate for the red tailed hawk (0.06910 L/day; see Table 7-16)
WC_x = Maximum concentration in surface water (chemical-specific; see Table G-13 above)
BW_{hawk} = Minimum body weight for the red-tailed hawk (0.923 kg; see Table 7-16)

[4] MATC values were derived by calculating the geometric mean of the NOAEL and LOAEL values.

[5] NOAEL-, LOAEL, and MATC-based screening level risk estimates (i.e., HQs) were derived by dividing dietary intakes by NOAEL, LOAEL-, and MATC-based toxicity reference values, respectively.

TABLE G-14
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR BROWN FLOWER BAT DIETARY EXPOSURES TO CHEMICALS IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical	Surface Water Concentration [1] (mg/L)	Subsurface Soil Concentration [2] (mg/kg)	Soil-to-Plant BAF/Uptake Equation (unitless)	Plant Tissue Concentration [3] (mg/kg)	Dietary Intake [4] (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates [6]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [5] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Volatile Organics:											
1,1,1,2-Tetrachloroethane	0.0005	0.0055	5.17618	0.0285	0.00502	NA	NA	NA	---	---	---
Carbon tetrachloride	0.0005	0.0055	4.71454	0.0259	0.00458	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
Chlorobenzene	0.0005	0.0055	4.17540	0.0230	0.00407	27.25000	54.50000	38.53732	<0.01	<0.01	<0.01
Chloroform	0.0012	0.0055	10.04745	0.0553	0.00979	15.00000	75.00000	33.54102	<0.01	<0.01	<0.01
Ethylbenzene	0.0005	0.0055	3.21442	0.0177	0.00315	136.00000	408.00000	235.55891	<0.01	<0.01	<0.01
Pentachloroethane	0.0005	0.0055	2.98295	0.0164	0.00293	NA	NA	NA	---	---	---
Styrene	0.0005	0.0055	3.87473	0.0213	0.00378	35.00000	175.00000	78.26238	<0.01	<0.01	<0.01
Toluene	0.0005	0.0055	4.62727	0.0254	0.00450	52.00000	260.00000	116.27553	<0.01	<0.01	<0.01
Trichloroethene	0.0005	0.0055	4.80345	0.0264	0.00467	5.00000	2.50000	3.53553	<0.01	<0.01	<0.01
o-Xylene	0.0005	0.0055	3.24458	0.0178	0.00318	2.06000	2.58000	2.30539	<0.01	<0.01	<0.01
m,p-Xylene	0.0010	0.0002	3.24458	0.0006	0.00029	2.06000	2.58000	2.30539	<0.01	<0.01	<0.01
Xylenes (total)	0.0005	0.0002	3.24458	0.0006	0.00020	2.06000	2.58000	2.30539	<0.01	<0.01	<0.01
Semivolatile Organics:											
1,2,4,5-Tetrachlorobenzene	0.0051	0.2500	0.79168	0.1979	0.03522	NA	NA	NA	---	---	---
1,2,4-Trichlorobenzene	0.0051	0.2500	1.42608	0.3565	0.06268	53.00000	106.00000	74.95332	<0.01	<0.01	<0.01
1,2-Dichlorobenzene	0.0051	0.2500	2.45160	0.6129	0.10706	171.00000	857.00000	382.81458	<0.01	<0.01	<0.01
1,3-Dichlorobenzene	0.0051	0.2500	2.23295	0.5582	0.09760	171.00000	857.00000	382.81458	<0.01	<0.01	<0.01
1,4-Dichlorobenzene	0.0051	0.2500	2.47461	0.6187	0.10806	250.00000	500.00000	353.55339	<0.01	<0.01	<0.01
2,3,4,6-Tetrachlorophenol	0.0100	0.4800	0.94544	0.4538	0.08044	NA	NA	NA	---	---	---
2,4,5-Trichlorophenol	0.0100	0.4800	1.86980	0.8975	0.15725	160.00000	800.00000	357.77088	<0.01	<0.01	<0.01
2,4,6-Trichlorophenol	0.0100	0.4800	1.90507	0.9144	0.16018	160.00000	800.00000	357.77088	<0.01	<0.01	<0.01
2,4-Dichlorophenol	0.0100	0.4800	3.39973	1.6319	0.28439	88.00000	440.00000	196.77398	<0.01	<0.01	<0.01
2-Acetylaminofluorene	0.0051	0.2500	3.27504	0.8188	0.14270	NA	NA	NA	---	---	---
2-Chloronaphthalene	0.0051	0.2500	1.58041	0.3951	0.06936	NA	NA	NA	---	---	---
3,3'-Dichlorobenzidine	0.0051	0.2500	2.27506	0.5688	0.09942	NA	NA	NA	---	---	---
3,3'-Dimethylbenzidine	0.0051	0.2500	4.93997	1.2350	0.21476	NA	NA	NA	---	---	---
3-Methylcholanthrene	0.0051	0.2500	0.15011	0.0375	0.00745	NA	NA	NA	---	---	---
4-Bromophenyl phenyl ether	0.0051	0.2500	0.56559	0.1414	0.02543	NA	NA	NA	---	---	---
4-Chloro-3-methylphenol	0.0100	0.4800	3.33680	1.6017	0.27916	NA	NA	NA	---	---	---
4-Chlorophenyl phenyl ether	0.0051	0.2500	0.59263	0.1482	0.02660	NA	NA	NA	---	---	---
7,12-Dimethylbenz(a)anthracene	0.0051	0.2500	0.12453	0.0311	0.00634	NA	NA	NA	---	---	---
Aramite, total	0.0051	0.2500	0.66915	0.1673	0.02992	NA	NA	NA	---	---	---
Bis(2-ethylhexyl)phthalate	0.0051	0.0830	0.06598	0.0055	0.00190	18.30000	183.30000	57.91710	<0.01	<0.01	<0.01
Butyl benzyl phthalate	0.0051	0.2500	0.65677	0.1642	0.02938	480.00000	2400.00000	1073.31263	<0.01	<0.01	<0.01
Diallate, cis-	0.0051	0.2500	0.91077	0.2277	0.04037	NA	NA	NA	---	---	---
Diallate, trans-	0.0051	0.2500	0.91077	0.2277	0.04037	NA	NA	NA	---	---	---
Dibenzofuran	0.0051	0.2500	1.28681	0.3217	0.05665	NA	NA	NA	---	---	---
Diethyl phthalate	0.0051	0.2500	5.84454	1.4611	0.25391	4583.00000	22915.00000	10247.89954	<0.01	<0.01	<0.01
Di-n-butyl phthalate	0.0051	0.2500	0.81418	0.2035	0.03619	550.00000	1833.00000	1004.06673	<0.01	<0.01	<0.01
Di-n-octyl phthalate	0.0051	0.0550	0.03244	0.0018	0.00126	55.00000	550.00000	173.92527	<0.01	<0.01	<0.01
Dinoseb	0.0051	0.2200	2.17124	0.4777	0.08365	NA	NA	NA	---	---	---
Hexachlorobenzene	0.0051	0.2500	0.24628	0.0616	0.01161	8.00000	16.00000	11.31371	<0.01	<0.01	<0.01
Hexachlorobutadiene	0.0051	0.2500	0.67543	0.1689	0.03019	4.00000	20.00000	8.94427	<0.01	<0.01	<0.01
Hexachlorocyclopentadiene	0.0051	0.2500	0.39290	0.0982	0.01796	10.00000	30.00000	17.32051	<0.01	<0.01	<0.01
Hexachloroethane	0.0051	0.2500	1.43946	0.3599	0.06326	NA	NA	NA	---	---	---
Hexachloropropene	0.0051	0.2500	1.00933	0.2523	0.04464	NA	NA	NA	---	---	---
Isosafrole	0.0051	0.2500	2.59293	0.6482	0.11318	NA	NA	NA	---	---	---
n-Nitrosodiphenylamine	0.0051	0.2500	3.15492	0.7887	0.13750	300.00000	1500.00000	670.82039	<0.01	<0.01	<0.01
p-Dimethylamino azobenzene	0.0051	0.2500	0.83732	0.2093	0.03719	NA	NA	NA	---	---	---
Pentachlorobenzene	0.0051	0.2500	0.44363	0.1109	0.02015	7.25000	36.25000	16.21149	<0.01	<0.01	<0.01
Pentachloronitrobenzene	0.0051	0.2500	0.79168	0.1979	0.03522	NA	NA	NA	---	---	---
Pentachlorophenol	0.0100	0.4800	46.02000	22.0896	3.82613	8.42000	22.65000	13.80989	0.45	0.17	0.28
Pronamide	0.0100	0.4800	2.27506	1.0920	0.19093	NA	NA	NA	---	---	---
LLPAHs:											
2-Methylnaphthalene	0.0002	0.0079	1.64058	0.0130	0.00228	65.60000	328.00000	146.68606	<0.01	<0.01	<0.01
Acenaphthene	0.0002	0.0077	$\ln(C_p) = -0.8556[\ln[C_s]) - 5.562$	0.2470	0.04281	65.60000	328.00000	146.68606	<0.01	<0.01	<0.01
Acenaphthylene	0.0002	0.0007	1.52245	0.0010	0.00021	65.60000	328.00000	146.68606	<0.01	<0.01	<0.01
Anthracene	0.0002	0.0031	$\ln(C_p) = 0.7784[\ln(C_s)] - 0.9887$	0.0041	0.00076	65.60000	328.00000	146.68606	<0.01	<0.01	<0.01

TABLE G-14
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR BROWN FLOWER BAT DIETARY EXPOSURES TO CHEMICALS IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical	Surface Water Concentration (1) (mg/L)	Subsurface Soil Concentration (2) (mg/kg)	Soil-to-Plant BAF/Uptake Equation (unitless)	Plant Tissue Concentration (3) (mg/kg)	Dietary Intake (4) (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates (6)		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC (5) (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
LLPAHs (cont.):											
Benzo(a)anthracene	0.0002	0.0120	$\ln(C_p) = 0.5944[\ln(C_s)] - 2.7078$	0.0048	0.00087	0.61500	3.01000	1.36057	<0.01	<0.01	<0.01
Benzo(a)pyrene	0.0002	0.0030	$\ln(C_p) = 0.975[\ln(C_s)] - 2.0615$	0.0004	0.00012	0.61500	3.01000	1.36057	<0.01	<0.01	<0.01
Benzo(b)fluoranthene	0.0002	0.0028	0.48000	0.0013	0.00027	0.61500	3.01000	1.36057	<0.01	<0.01	<0.01
Benzo(g,h,i)perylene	0.0002	0.0019	$\ln(C_p) = 1.1829[\ln(C_s)] - 0.9313$	0.0002	0.00008	0.61500	3.01000	1.36057	<0.01	<0.01	<0.01
Benzo(k)fluoranthene	0.0002	0.0041	$\ln(C_p) = 0.8595[\ln(C_s)] - 2.1579$	0.0010	0.00022	0.61500	3.01000	1.36057	<0.01	<0.01	<0.01
Chrysene	0.0002	0.0150	$\ln(C_p) = 0.5944[\ln(C_s)] - 2.7078$	0.0055	0.00099	0.61500	3.01000	1.36057	<0.01	<0.01	<0.01
Dibenzo(a,h)anthracene	0.0002	0.0004	0.23000	0.0001	0.00005	0.61500	3.01000	1.36057	<0.01	<0.01	<0.01
Fluoranthene	0.0000	0.0210	6.00000	0.1260	0.02182	65.60000	328.00000	146.68606	<0.01	<0.01	<0.01
Fluorene	0.0002	0.0060	$\ln(C_p) = -0.8556[\ln[C_s]) - 5.562$	0.3058	0.05298	65.60000	328.00000	146.68606	<0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	0.0002	0.0028	0.15000	0.0004	0.00011	0.61500	3.01000	1.36057	<0.01	<0.01	<0.01
Naphthalene	0.0002	0.0011	48.00000	0.0528	0.00918	65.60000	328.00000	146.68606	<0.01	<0.01	<0.01
Phenanthrene	0.0002	0.0200	$\ln(C_p) = 0.6203[\ln(C_s)] - 0.1665$	0.0748	0.01299	65.60000	328.00000	146.68606	<0.01	<0.01	<0.01
Pyrene	0.0000	0.0240	3.70000	0.0888	0.01538	0.61500	3.01000	1.36057	0.03	<0.01	0.01
Organochlorine Pesticides:											
4,4'-DDD	0.0001	0.0004	0.20241	0.0001	0.00003	0.14700	0.73500	0.32870	<0.01	<0.01	<0.01
4,4'-DDE	0.0000	0.0035	0.14000	0.0005	0.00009	0.14700	0.73500	0.32870	<0.01	<0.01	<0.01
4,4'-DDT	0.0000	0.0013	0.07900	0.0001	0.00002	0.14700	0.73500	0.32870	<0.01	<0.01	<0.01
Aldrin	0.0001	0.0025	0.13930	0.0003	0.00007	0.20000	1.00000	0.44721	<0.01	<0.01	<0.01
alpha-BHC	0.0001	0.0025	1.73516	0.0043	0.00076	0.01370	0.13700	0.04332	0.06	<0.01	0.02
alpha-Chlordane	0.0001	0.0025	0.16481	0.0004	0.00008	0.15000	0.75000	0.33541	<0.01	<0.01	<0.01
beta-BHC	0.0001	0.0089	1.71903	0.0153	0.00266	0.40000	2.00000	0.89443	<0.01	<0.01	<0.01
Chlorobenzilate	0.0051	0.2500	0.72108	0.1803	0.03216	5.00000	20.00000	10.00000	<0.01	<0.01	<0.01
delta-BHC	0.0001	0.0025	1.26300	0.0032	0.00056	0.01370	0.13700	0.04332	0.04	<0.01	0.01
Dieldrin	0.0001	0.0049	2.22200	0.0109	0.00190	0.01500	0.03000	0.02121	0.13	0.06	0.09
Endosulfan I	0.0001	0.0025	1.68721	0.0042	0.00074	0.15000	0.75000	0.33541	<0.01	<0.01	<0.01
Endosulfan II	0.0001	0.0049	1.68721	0.0083	0.00145	0.15000	0.75000	0.33541	<0.01	<0.01	<0.01
Endosulfan sulfate	0.0001	0.0049	1.97760	0.0097	0.00170	0.15000	0.75000	0.33541	0.01	<0.01	<0.01
Endrin	0.0001	0.0006	0.53476	0.0003	0.00007	0.09200	0.92000	0.29093	<0.01	<0.01	<0.01
Endrin aldehyde	0.0001	0.0005	1.43946	0.0008	0.00015	0.09200	0.92000	0.29093	<0.01	<0.01	<0.01
gamma-BHC (lindane)	0.0001	0.0025	1.85242	0.0046	0.00081	0.01370	0.13700	0.04332	0.06	<0.01	0.02
gamma-Chlordane	0.0001	0.0025	0.16481	0.0004	0.00008	0.15000	0.75000	0.33541	<0.01	<0.01	<0.01
Heptachlor	0.0001	0.0002	0.17431	0.0000	0.00002	0.15000	0.25000	0.19365	<0.01	<0.01	<0.01
Heptachlor epoxide	0.0001	0.0025	0.56559	0.0014	0.00025	0.15000	0.25000	0.19365	<0.01	<0.01	<0.01
Isodrin	0.0051	0.2500	0.13930	0.0348	0.00698	NA	NA	NA	---	---	---
Kepone	0.0051	0.2300	0.42736	0.0983	0.01797	0.08000	0.40000	0.17889	0.22	0.04	0.10
Methoxychlor	0.0005	0.0250	0.52486	0.0131	0.00237	5.01000	35.50000	13.33623	<0.01	<0.01	<0.01
Toxaphene	0.0026	0.1200	0.35453	0.0425	0.00785	8.00000	40.00000	17.88854	<0.01	<0.01	<0.01
Metals:											
Antimony	0.0003	1.2000	$\ln(C_p) = 0.938[\ln(C_s)] - 3.233$	0.0468	0.00815	0.05900	0.59000	0.18657	0.14	0.01	0.04
Arsenic	0.0005	1.8000	$\ln(C_p) = 0.564[\ln(C_s)] - 1.992$	0.1900	0.03299	1.04000	1.66000	1.31393	0.03	0.02	0.03
Barium	0.0214	267.0000	0.44700	119.3490	20.66630	51.80000	82.70000	65.45120	0.40	0.25	0.32
Beryllium	0.0010	0.9600	$\ln(C_p) = 0.7345[\ln(C_s)] - 0.5361$	0.5677	0.09848	0.53200	0.56700	0.54922	0.19	0.17	0.18
Cadmium	0.0010	0.7700	$\ln(C_p) = 0.546[\ln(C_s)] - 0.475$	0.5392	0.09353	0.77000	7.70000	2.43495	0.12	0.01	0.04
Chromium, total	0.0008	79.3000	0.08390	6.6533	1.15199	2.40000	58.53000	11.85209	0.48	0.02	0.10
Cobalt	0.0003	72.1000	0.02480	1.7881	0.30962	7.33000	18.90000	11.77017	0.04	0.02	0.03
Copper	0.0040	270.0000	$\ln(C_p) = 0.394[\ln(C_s)] + 0.668$	17.7038	3.06572	5.60000	9.34000	7.23215	0.55	0.33	0.42
Lead	0.0010	33.0000	$\ln(C_p) = 0.561[\ln(C_s)] - 1.328$	1.8843	0.32640	4.70000	8.90000	6.46761	0.07	0.04	0.05
Mercury	0.0002	0.1000	$\ln(C_p) = 0.544[\ln(C_s)] - 0.996$	0.1055	0.01831	0.03200	0.16000	0.07155	0.57	0.11	0.26
Nickel	0.0010	47.3000	$\ln(C_p) = 0.748[\ln(C_s)] - 2.224$	1.9361	0.33537	1.70000	3.40000	2.40416	0.20	0.10	0.14
Selenium	0.0008	2.6000	$\ln(C_p) = 1.104[\ln(C_s)] - 0.678$	1.4577	0.25251	0.14300	0.21500	0.17534	1.77	1.17	1.44
Silver	0.0010	0.5700	0.03670	0.0209	0.00381	6.02000	60.20000	19.03691	<0.01	<0.01	<0.01
Thallium	0.0010	0.5000	0.00400	0.0020	0.00053	0.00740	0.07400	0.02340	0.07	<0.01	0.02
Tin	0.0200	26.0000	0.03000	0.7800	0.13878	23.40000	35.00000	28.61818	<0.01	<0.01	<0.01
Vanadium	0.0076	282.0000	0.00970	2.7354	0.47499	4.16000	8.31000	5.87959	0.11	0.06	0.08
Zinc	0.0079	242.0000	$\ln(C_p) = 0.554[\ln(C_s)] + 1.575$	101.0759	17.50024	75.40000	82.30000	78.77449	0.23	0.21	0.22

TABLE G-14
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR BROWN FLOWER BAT DIETARY EXPOSURES TO CHEMICALS IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Notes:

BAF = Bioaccumulation Factor
PAH = Polynuclear Aromatic Hydrocarbon
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
HQ = Hazard Quotient
mg/kg-BW/day = milligram per kilogram-body weight per day
ln = natural logarithm
C_p = Concentration in plant tissue (mg/kg - dry weight)
C_s = Maximum concentration in subsurface soil (mg/kg - dry weight)
NA = Not Available
--- = Step 2 screening level risk estimate could not be calculated due to the lack of a toxicity reference value.
mg/kg = milligram per kilogram
mg/L = milligram per liter

(1) Maximum detected surface water concentrations or, in the case of non-detected chemicals, maximum Reporting Limits.
(2) Maximum detected subsurface soil concentrations or, in the case of non-detected chemicals, maximum Reporting Limits.
(3) As discussed in Section 7.5.2.2.1, plant tissue concentrations were derived by (a) multiplying maximum subsurface soil concentrations by soil-to-plant bioaccumulation factors, or (b) soil-to-plant uptake equations.
(4) The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FI_{bat})(FC_{plant})(PDF_{plant})] + [(FIR_{bat})(SC_x)(PDS)]+[(WIR_{bat})(WC_x)]\}/BW_{bat}$$

Where:

DI_x = Dietary intake of chemical x by the brown flower bat (mg/kg-body weight/day)
FIR_{bat} = Maximum food ingestion rate for the brown flower bat (0.00277 kg/day - dry weight; see Table 7-16)
FC_{plant} = Concentration of chemical x in soil invertebrate tissue (chemical-specific - dry weight; see Table G-14 above)
PDF_{plant} = Proportion of diet composed of plants (1.0 - dry weight basis [unitless]; see Table 7-17)
SC_x = Maximum concentration in subsurface soil (chemical specific - dry weight; see Table G-14 above)
PDS = Proportion of diet composed of subsurface soil (0.0 - dry weight basis [unitless]; see Table 7-17)
WIR_{bat} = Maximum water ingestion rate for the brown flower bat (0.00299 L/day; see Table 7-16)
WC_x = Maximum concentration in surface water (chemical-specific; see Table G-14 above)
BW_{bat} = Minimum body weight for the brown flower bat (0.016 kg; see Table 7-16)

(4) MATC values were derived by calculating the geometric mean of the NOAEL and LOAEL values.
(5) NOAEL-, LOAEL, and MATC-based screening level risk estimates (i.e., HQs) were derived by dividing dietary intakes by NOAEL, LOAEL-, and MATC-based toxicity reference values, respectively.

TABLE G-15
FOOD ITEM CONCENTRATIONS AND DIETARY INTAKES FOR NORWAY RAT DIETARY EXPOSURES
TO CHEMICALS IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical [1]	Surface Water Concentration [2] (mg/L)	Subsurface Soil Concentration [3] (mg/kg)	Soil-to-Invertebrate BAF (unitless)	Invertebrate Tissue Concentration [4] (mg/kg)	Dietary Intake [5] (mg/kg-BW/day)
Volatile Organics:					
1,1,1,2-Tetrachloroethane	0.0005	0.0055	3.15072	0.0173	0.00362
Pentachloroethane	0.0005	0.0055	2.70234	0.0149	0.00312
Carbon tetrachloride	0.0005	0.0055	3.06980	0.0169	0.00353
Chlorobenzene	0.0005	0.0055	2.96770	0.0163	0.00341
Chloroform	0.0012	0.0055	3.79001	0.0208	0.00450
Ethylbenzene	0.0005	0.0055	2.75918	0.0152	0.00319
Styrene	0.0005	0.0055	2.90656	0.0160	0.00335
Toluene	0.0005	0.0055	3.05387	0.0168	0.00351
Trichloroethene	0.0005	0.0055	3.08582	0.0170	0.00354
Xylene, m/p-	0.0010	0.0002	2.76637	0.0005	0.00037
Xylene, o-	0.0005	0.0055	2.76637	0.0152	0.00319
Xylenes (total)	0.0005	0.0002	2.76637	0.0005	0.00024
Semivolatile Organics:					
1,2,4,5-Tetrachlorobenzene	0.0051	0.2500	1.86758	0.4669	0.09560
1,2,4-Trichlorobenzene	0.0051	0.2500	2.20024	0.5501	0.11221
1,2-Dichlorobenzene	0.0051	0.2500	2.55864	0.6397	0.13010
1,3-Dichlorobenzene	0.0051	0.2500	2.49293	0.6232	0.12682
1,4-Dichlorobenzene	0.0051	0.2500	2.56531	0.6413	0.13043
2,3,4,6-Tetrachlorophenol	0.0100	0.4800	1.96223	0.9419	0.19268
2,4,5-Trichlorophenol	0.0100	0.4800	2.37268	1.1389	0.23202
2,4,6-Trichlorophenol	0.0100	0.4800	2.38506	1.1448	0.23321
2,4-Dichlorophenol	0.0100	0.4800	2.80259	1.3452	0.27323
2-Acetylaminofluorene	0.0051	0.2500	2.77358	0.6934	0.14083
2-Chloronaphthalene	0.0051	0.2500	2.26412	0.5660	0.11540
3,3'-Dichlorobenzidine	0.0051	0.2500	2.50594	0.6265	0.12747
3,3'-Dimethylbenzidine	0.0051	0.2500	3.11000	0.7775	0.15762
3-Methylcholanthrene	0.0051	0.2500	1.17528	0.2938	0.06104
4-Bromophenyphenyl ether	0.0051	0.2500	1.70059	0.4251	0.08727
4-Chloro-3-methylphenol	0.0100	0.4800	2.78805	1.3383	0.27183
4-Chlorophenylphenyl ether	0.0051	0.2500	1.72286	0.4307	0.08838
7,12-Dimethylbenz(a)anthracene	0.0051	0.2500	1.11568	0.2789	0.05807
Aramite	0.0051	0.2500	1.78213	0.4455	0.09134
bis(2-Ethylhexyl)phthalate	0.0051	0.0830	0.93476	0.0776	0.01718
Butylbenzylphthalate	0.0051	0.2500	1.77288	0.4432	0.09087
Diallate, cis-	0.0051	0.2500	1.94191	0.4855	0.09931
Diallate, trans-	0.0051	0.2500	1.94191	0.4855	0.09931
Dibenzofuran	0.0051	0.2500	2.13816	0.5345	0.10911
Diethylphthalate	0.0051	0.2500	3.25912	0.8148	0.16507
Di-n-butylphthalate	0.0051	0.2500	1.88222	0.4706	0.09633
Di-n-octylphthalate	0.0051	0.0550	0.76704	0.0422	0.01000

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Chemical [1]	Surface Water Concentration [2] (mg/L)	Subsurface Soil Concentration [3] (mg/kg)	Soil-to-Invertebrate BAF (unitless)	Invertebrate Tissue Concentration [4] (mg/kg)	Dietary Intake [5] (mg/kg-BW/day)
Semivolatile Organics (cont.):					
Dinoseb (2-sec-butyl-4,6-Dinitrophenol)	0.0051	0.2200	2.47355	0.5442	0.11091
Hexachlorobenzene	0.0051	0.2500	1.34906	0.3373	0.06972
Hexachlorobutadiene	0.0051	0.2500	1.78678	0.4467	0.09157
Hexachlorocyclopentadiene	0.0051	0.2500	1.53649	0.3841	0.07907
Hexachloroethane	0.0051	0.2500	2.20597	0.5515	0.11249
Hexachloropropene	0.0051	0.2500	1.99830	0.4996	0.10213
Isosafrole	0.0051	0.2500	2.59890	0.6497	0.13211
N-Nitrosodiphenylamine	0.0051	0.2500	2.74486	0.6862	0.13940
p-Dimethylaminoazobenzene	0.0051	0.2500	1.89697	0.4742	0.09707
Pentachlorobenzene	0.0051	0.2500	1.58935	0.3973	0.08171
Pentachloronitrobenzene	0.0051	0.2500	1.86758	0.4669	0.09560
Pentachlorophenol	0.0100	0.4800	88.12000	42.2976	8.45064
Pronamide	0.0100	0.4800	2.50594	1.2028	0.24479
Organochlorine Pesticides:					
4,4'-DDD	0.0001	0.0004	$In(C_e) = 0.6975[In(C_s)] + 1.1613$	0.0134	0.00270
4,4'-DDE	0.0000	0.0035	$In(C_e) = 0.8804[In(C_s)] + 2.4771$	0.0820	0.01638
4,4'-DDT	0.0000	0.0013	$In(C_e) = 0.8689[In(C_s)] + 2.1247$	0.0260	0.00520
Aldrin	0.0001	0.0025	3.30000	0.0083	0.00167
alpha-BHC	0.0001	0.0025	2.32381	0.0058	0.00118
alpha-Chlordane	0.0001	0.0025	4.00000	0.0100	0.00202
beta-BHC	0.0001	0.0089	2.31777	0.0206	0.00417
Chlorobenzilate	0.0051	0.2500	1.81963	0.4549	0.09321
delta-BHC	0.0001	0.0025	2.12706	0.0053	0.00109
Dieldrin	0.0001	0.0049	49.67000	0.2434	0.04865
Endosulfan I	0.0001	0.0025	2.30574	0.0058	0.00117
Endosulfan II	0.0001	0.0049	2.30574	0.0113	0.00230
Endosulfan sulfate	0.0001	0.0049	2.41002	0.0118	0.00240
Endrin	0.0001	0.0006	3.60000	0.0020	0.00043
Endrin aldehyde	0.0001	0.0005	2.20597	0.0012	0.00027
gamma-BHC (Lindane)	0.0001	0.0025	26.60000	0.0665	0.01330
gamma-Chlordane	0.0001	0.0025	4.00000	0.0100	0.00202
Heptachlor	0.0001	0.0002	3.00000	0.0007	0.00015
Heptachlor epoxide	0.0001	0.0025	10.00000	0.0250	0.00502
Isodrin	0.0051	0.2500	1.15107	0.2878	0.05983
Kepone	0.0051	0.2300	1.57290	0.3618	0.07453
Methoxychlor	0.0005	0.0250	1.66556	0.0416	0.00855
Toxaphene	0.0026	0.1200	1.49314	0.1792	0.03696

TABLE G-15
FOOD ITEM CONCENTRATIONS AND DIETARY INTAKES FOR NORWAY RAT DIETARY EXPOSURES
TO CHEMICALS IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical [1]	Surface Water Concentration [2] (mg/L)	Subsurface Soil Concentration [3] (mg/kg)	Soil-to-Invertebrate BAF (unitless)	Invertebrate Tissue Concentration [4] (mg/kg)	Dietary Intake [5] (mg/kg-BW/day)
Metals:					
Antimony	0.0003	1.2000	1.00000	1.2000	0.24458
Beryllium	0.0010	0.9600	1.18200	1.1347	0.23076
Thallium	0.0010	0.5000	1.00000	0.5000	0.10214
Tin	0.0200	26.0000	1.00000	26.0000	5.30297

Notes:

BAF = Bioaccumulation Factor
mg/kg = miligram per kilogram
mg/kg-BW/day = milligram per kilogram-body weight per day
mg/L = milligram per liter

(1) Only those chemicals with Norway rat tissue concentrations estimated using dietary intakes and diet-to-whole body BAF values are listed (see Table G-13).
(2) Maximum detected surface water concentrations or, in the case of non-detected chemicals, maximum Reporting Limits.
(3) Maximum detected subsurface soil concentrations or, in the case of non-detected chemicals, maximum Reporting Limits.
(4) Soil invertebrate tissue concentrations were derived by multiplying maximum surface soil concentrations by soil-to-invertebrate bioaccumulation factors.
(5) The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FIR_{rat})(FC_{invert})(PDF_{invert})] + [(FIR_{rat})(SC_x)(PDS)]+[(WIR_{rat})(WC_x)]\}/BW_{rat}$$

Where:

DI_x = Dietary intake of chemical x by the Norway rat (mg/kg-body weight/day)
FIR_{rat} = Maximum food ingestion rate for the Norway rat (0.04075 kg/day - dry weight basis; see Table 7-16)
FC_{invert} = Concentration of chemical x in soil invertebrate tissue (chemical-specific - dry weight basis; see Table G-15 above)
PDF_{invert} = Proportion of diet composed of soil invertebrates (0.98 - dry weight basis [unitless]; see Table 7-17)
SC_x = Maximum concentration in subsurface soil (chemical specific - dry weight basis; see Table G-15 above)
PDS = Proportion of diet composed of subsurface soil (0.02 - dry weight basis [unitless]; see Table 7-17)
WIR_{rat} = Maximum water ingestion rate for the rat (0.5305 L/day; see Table 7-16)
WC_x = Maximum concentration in surface water (chemical-specific; see Table G-15 above)
BW_{rat} = Minimum body weight for the Norway rat (0.200 kg; see Table 7-16)

TABLE G-16
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR MOURNING DOVE DIETARY EXPOSURES TO CHEMICALS IN SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Surface Water Concentration [1] (mg/L)	Subsurface Soil Concentration [2] (mg/kg)	Soil-to-Plant BAF/Uptake Equation (unitless)	Plant Tissue Concentration [3] (mg/kg)	Dietary Intake [4] (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates [6]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [5] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Volatile Organics:											
1,1,1,2-Tetrachloroethane	0.0005	0.0034	5.17618	0.0176	0.00259	NA	NA	NA	---	---	---
Carbon tetrachloride	0.0005	0.0014	4.71454	0.0066	0.00101	NA	NA	NA	---	---	---
Chlorobenzene	0.0005	0.0014	4.17540	0.0058	0.00091	NA	NA	NA	---	---	---
Chloroform	0.0012	0.0015	10.04745	0.0151	0.00231	NA	NA	NA	---	---	---
Ethylbenzene	0.0005	0.0018	3.21442	0.0058	0.00090	NA	NA	NA	---	---	---
Pentachloroethane	0.0005	0.0089	2.98295	0.0265	0.00391	NA	NA	NA	---	---	---
Styrene	0.0005	0.0014	3.87473	0.0054	0.00085	NA	NA	NA	---	---	---
Toluene	0.0005	0.0014	4.62727	0.0065	0.00100	NA	NA	NA	---	---	---
Trichloroethene	0.0005	0.0018	4.80345	0.0086	0.00131	NA	NA	NA	---	---	---
Xylenes (total)	0.0005	0.0015	3.24458	0.0049	0.00077	40.50000	203.00000	90.67249	<0.01	<0.01	<0.01
Semivolatile Organics:											
1,2,4,5-Tetrachlorobenzene	0.0000	0.0047	0.79168	0.0037	0.00056	NA	NA	NA	---	---	---
1,2,4-Trichlorobenzene	0.0051	0.0014	1.42608	0.0020	0.00094	NA	NA	NA	---	---	---
1,2-Dichlorobenzene	0.0051	0.0018	2.45160	0.0044	0.00128	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
1,3-Dichlorobenzene	0.0051	0.0023	2.23295	0.0051	0.00139	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
1,4-Dichlorobenzene	0.0051	0.0014	2.47461	0.0035	0.00115	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
2,3,4,6-Tetrachlorophenol	0.0100	0.0047	0.94544	0.0044	0.00193	NA	NA	NA	---	---	---
2,4,5-Trichlorophenol	0.0100	0.0110	1.86980	0.0206	0.00427	NA	NA	NA	---	---	---
2,4,6-Trichlorophenol	0.0100	0.0110	1.90507	0.0210	0.00433	NA	NA	NA	---	---	---
2,4-Dichlorophenol	0.0100	0.0100	3.39973	0.0340	0.00618	NA	NA	NA	---	---	---
2-Acetylaminofluorene	0.0051	0.0470	3.27504	0.1539	0.02291	NA	NA	NA	---	---	---
2-Chloronaphthalene	0.0051	0.0085	1.58041	0.0134	0.00262	NA	NA	NA	---	---	---
3,3'-Dichlorobenzidine	0.0051	0.0240	2.27506	0.0546	0.00860	NA	NA	NA	---	---	---
3,3'-Dimethylbenzidine	0.0051	0.0940	4.93997	0.4644	0.06746	NA	NA	NA	---	---	---
3-Methylcholanthrene	0.0051	0.0470	0.15011	0.0071	0.00200	NA	NA	NA	---	---	---
4-Bromophenyl phenyl ether	0.0051	0.0098	0.56559	0.0055	0.00151	NA	NA	NA	---	---	---
4-Chloro-3-methylphenol	0.0100	0.0100	3.33680	0.0334	0.00609	NA	NA	NA	---	---	---
4-Chlorophenyl phenyl ether	0.0051	0.0091	0.59263	0.0054	0.00148	NA	NA	NA	---	---	---
7,12-Dimethylbenz(a)anthracene	0.0051	0.0240	0.12453	0.0030	0.00125	2.00000	20.00000	6.32456	<0.01	<0.01	<0.01
Aramite, total	0.0051	0.0068	0.66915	0.0046	0.00134	NA	NA	NA	---	---	---
Bis(2-ethylhexyl)phthalate	0.0051	0.0590	0.06598	0.0039	0.00164	1.11000	5.55000	2.48204	<0.01	<0.01	<0.01
Butyl benzyl phthalate	0.0051	0.0095	0.65677	0.0062	0.00160	NA	NA	NA	---	---	---
Diallate	0.0000	0.0080	0.91077	0.0073	0.00110	NA	NA	NA	---	---	---
Dibenzofuran	0.0051	0.0095	1.28681	0.0122	0.00245	NA	NA	NA	---	---	---
Diethyl phthalate	0.0051	0.0110	5.84454	0.0643	0.00988	NA	NA	NA	---	---	---
Di-n-butyl phthalate	0.0051	0.0240	0.81418	0.0195	0.00360	0.22200	1.11000	0.49641	0.02	<0.01	<0.01
Di-n-octyl phthalate	0.0051	0.0095	0.03244	0.0003	0.00076	50.00000	250.00000	111.80340	<0.01	<0.01	<0.01
Dinoseb	0.0051	0.0095	2.17124	0.0206	0.00365	0.26400	1.32000	0.59032	0.01	<0.01	<0.01
Hexachlorobenzene	0.0051	0.0110	0.24628	0.0027	0.00111	0.11000	0.57000	0.25040	0.01	<0.01	<0.01
Hexachlorobutadiene	0.0051	0.0044	0.67543	0.0030	0.00110	3.39000	17.00000	7.59144	<0.01	<0.01	<0.01
Hexachlorocyclopentadiene	0.0051	0.0053	0.39290	0.0021	0.00098	NA	NA	NA	---	---	---
Hexachloroethane	0.0051	0.0083	1.43946	0.0119	0.00241	NA	NA	NA	---	---	---
Hexachloropropene	0.0051	0.0075	1.00933	0.0076	0.00178	NA	NA	NA	---	---	---
Isosafrole	0.0051	0.0047	2.59293	0.0122	0.00241	NA	NA	NA	---	---	---
n-Nitrosodiphenylamine	0.0051	0.0087	3.15492	0.0274	0.00462	NA	NA	NA	---	---	---
p-Dimethylamino azobenzene	0.0051	0.0240	0.83732	0.0201	0.00368	NA	NA	NA	---	---	---
Pentachlorobenzene	0.0051	0.0056	0.44363	0.0025	0.00104	NA	NA	NA	---	---	---
Pentachloronitrobenzene	0.0051	0.0240	0.79168	0.0190	0.00353	7.07000	70.70000	22.35730	<0.01	<0.01	<0.01
Pentachlorophenol	0.0100	0.0240	46.02000	1.1045	0.15869	6.73000	67.30000	21.28213	0.02	<0.01	<0.01
Pronamide	0.0100	0.0060	2.27506	0.0137	0.00325	NA	NA	NA	---	---	---
LLPAHs:											
2-Methylnaphthalene	0.0002	0.0047	1.64058	0.0077	0.00116	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Acenaphthene	0.0002	0.0047	$\ln(C_p) = -0.8556[\ln(C_s)] - 5.562$	0.3769	0.05372	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Acenaphthylene	0.0002	0.0047	1.52245	0.0072	0.00108	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Anthracene	0.0002	0.0047	$\ln(C_p) = 0.7784[\ln(C_s)] - 0.9887$	0.0057	0.00088	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(a)anthracene	0.0002	0.0047	$\ln(C_p) = 0.5944[\ln(C_s)] - 2.7078$	0.0028	0.00045	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(a)pyrene	0.0002	0.0047	$\ln(C_p) = 0.975[\ln(C_s)] - 2.0615$	0.0007	0.00016	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01

TABLE G-16
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR MOURNING DOVE DIETARY EXPOSURES TO CHEMICALS IN SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical	Surface Water Concentration [1] (mg/L)	Subsurface Soil Concentration [2] (mg/kg)	Soil-to-Plant BAF/Uptake Equation (unitless)	Plant Tissue Concentration [3] (mg/kg)	Dietary Intake [4] (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates [6]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [5] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
LLPAHs (cont.):											
Benzo(b)fluoranthene	0.0002	0.0047	0.48000	0.0023	0.00038	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(g,h,i)perylene	0.0002	0.0047	$\ln(C_p) = 1.1829[\ln(C_s)] - 0.9313$	0.0007	0.00016	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(k)fluoranthene	0.0002	0.0047	$\ln(C_p) = 0.8595[\ln(C_s)] - 2.1579$	0.0012	0.00023	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Chrysene	0.0002	0.0047	$\ln(C_p) = 0.5944[\ln(C_s)] - 2.7078$	0.0028	0.00045	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Dibenzo(a,h)anthracene	0.0002	0.0095	0.23000	0.0022	0.00041	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Fluoranthene	0.0000	0.0047	6.00000	0.0282	0.00405	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Fluorene	0.0002	0.0047	$\ln(C_p) = -0.8556[\ln(C_s)] - 5.562$	0.3769	0.05372	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	0.0002	0.0047	0.15000	0.0007	0.00016	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Naphthalene	0.0002	0.0047	48.00000	0.2256	0.03218	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Phenanthrene	0.0002	0.0046	$\ln(C_p) = 0.6203[\ln(C_s)] - 0.1665$	0.0301	0.00434	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Pyrene	0.0000	0.0047	3.70000	0.0174	0.00251	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Metals:											
Antimony	0.0003	0.7000	$\ln(C_p) = 0.938[\ln(C_s)] - 3.233$	0.0282	0.00930	4740.00000	47400.00000	14989.19611	<0.01	<0.01	<0.01
Arsenic	0.0005	1.2000	$\ln(C_p) = 0.564[\ln(C_s)] - 1.992$	0.1512	0.03058	2.24000	4.51000	3.17843	0.01	<0.01	<0.01
Barium	0.0214	120.0000	0.44700	53.6400	8.53886	20.80000	41.70000	29.45098	0.41	0.20	0.29
Beryllium	0.0000	0.5000	$\ln(C_p) = 0.7345[\ln(C_s)] - 0.5361$	0.3516	0.05381	NA	NA	NA	---	---	---
Cadmium	0.0010	0.4500	$\ln(C_p) = 0.546[\ln(C_s)] - 0.475$	0.4021	0.06075	1.47000	6.36000	3.05765	0.04	<0.01	0.02
Chromium, total	0.0008	120.0000	0.08390	10.0680	2.33273	2.66000	15.60000	6.44174	0.88	0.15	0.36
Cobalt	0.0003	24.0000	0.02480	0.5952	0.26463	7.61000	18.30000	11.80097	0.03	0.01	0.02
Copper	0.0040	210.0000	$\ln(C_p) = 0.394[\ln(C_s)] + 0.668$	16.0348	3.85705	4.05000	12.10000	7.00036	0.95	0.32	0.55
Mercury	0.0002	0.0830	$\ln(C_p) = 0.544[\ln(C_s)] - 0.996$	0.0954	0.01423	0.02600	0.07800	0.04503	0.55	0.18	0.32
Nickel	0.0010	44.0000	$\ln(C_p) = 0.748[\ln(C_s)] - 2.224$	1.8341	0.59097	6.71000	18.60000	11.17166	0.09	0.03	0.05
Selenium	0.0008	0.6900	$\ln(C_p) = 1.104[\ln(C_s)] - 0.678$	0.3370	0.05325	0.29000	0.57900	0.40977	0.18	0.09	0.13
Silver	0.0010	0.2600	0.03670	0.0095	0.00343	2.02000	20.20000	6.38780	<0.01	<0.01	<0.01
Thallium	0.0010	0.0370	0.00400	0.0001	0.00042	0.35000	1.75000	0.78262	<0.01	<0.01	<0.01
Tin	0.0200	3.6000	0.03000	0.1080	0.04487	6.80000	16.90000	10.72007	<0.01	<0.01	<0.01
Vanadium	0.0076	400.0000	0.00970	3.8800	3.55072	0.34400	0.68800	0.48649	10.32	5.16	7.30
Zinc	0.0079	77.0000	$\ln(C_p) = 0.554[\ln(C_s)] + 1.575$	53.5957	8.20863	66.10000	171.00000	106.31604	0.12	0.05	0.08

Notes:

BAF = Bioaccumulation Factor
PAH = Polynuclear Aromatic Hydrocarbon
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration

HQ = Hazard Quotient
mg/kg-BW/day = milligram per kilogram-body weight per day
ln = natural logarithm
C_p = Concentration in plant tissue (mg/kg - dry weight)
C_s = Maximum concentration in subsurface soil (mg/kg - dry weight)

NA = Not Available
--- = Step 2 screening level risk estimate could not be calculated due to the lack of a toxicity reference value.
mg/kg = milligram per kilogram
mg/L = milligram per liter

[1] Maximum detected surface water concentrations or, in the case of non-detected chemicals, maximum Reporting Limits.
[2] Maximum detected subsurface soil concentrations or, in the case of non-detected chemicals, maximum Limits of Detection.
[3] As discussed in Section 7.5.2.2.1, plant tissue concentrations were derived by (a) multiplying maximum subsurface soil concentrations by soil-to-plant bioaccumulation factors, or (b) soil-to-plant uptake equations.
[4] The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FIR_{dove})(FC_{plant})(PDF_{plant})] + [(FIR_{dove})(SC_x)(PDS)]+[(WIR_{dove})(WC_x)]\}/BW_{dove}$$

Where:

DI_x = Dietary intake of chemical x by the mourning dove (mg/kg-body weight/day)
FIR_{dove} = Maximum food ingestion rate for the mourning dove (0.01723 kg/day - dry weight; see Table 7-16)
FC_{plant} = Maximum concentration of chemical x in plant tissue (chemical-specific - dry weight; see Table G-16 above)
PDF_{plant} = Proportion of diet composed of plants (0.95 - dry weight basis [unitless]; see Table 7-17)
SC_x = Concentration in subsurface soil (chemical specific - dry weight; see Table G-16 above)
PDS = Proportion of diet composed of subsurface soil (0.05, dry weight basis [unitless]; see Table 7-17)
WIR_{dove} = Maximum water ingestion rate for the mourning dove (0.01449 L/day; see Table 7-16)
WC_x = Maximum concentration in surface water (chemical-specific; see Table G-16 above)
BW_{dove} = Minimum body weight for the mourning dove (0.115 kg; see Table 7-16)

[4] MATC values were derived by calculating the geometric mean of the NOAEL and LOAEL values.
[5] NOAEL-, LOAEL, and MATC-based screening level risk estimates (i.e., HQs) were derived by dividing dietary intakes by NOAEL, LOAEL-, and MATC-based toxicity reference values, respectively.

TABLE G-17
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR AMERICAN ROBIN DIETARY EXPOSURES TO CHEMICALS IN SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical	Surface Water Concentration [1] (mg/L)	Subsurface Soil Concentration [2] (mg/kg)	Soil-to-Invertebrate BAF/Uptake Equation (unitless)	Invertebrate Tissue Concentration [3] (mg/kg)	Dietary Intake [4] (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates [6]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [5] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Volatile Organics:											
1,1,1,2-Tetrachloroethane	0.0005	0.0034	3.15072	0.0107	0.00279	NA	NA	NA	---	---	---
Carbon tetrachloride	0.0005	0.0014	3.06980	0.0043	0.00119	NA	NA	NA	---	---	---
Chlorobenzene	0.0005	0.0014	2.96770	0.0042	0.00116	NA	NA	NA	---	---	---
Chloroform	0.0012	0.0015	3.79001	0.0057	0.00170	NA	NA	NA	---	---	---
Ethylbenzene	0.0005	0.0018	2.75918	0.0050	0.00137	NA	NA	NA	---	---	---
Pentachloroethane	0.0005	0.0089	2.70234	0.0241	0.00615	NA	NA	NA	---	---	---
Styrene	0.0005	0.0014	2.90656	0.0041	0.00114	NA	NA	NA	---	---	---
Toluene	0.0005	0.0014	3.05387	0.0043	0.00119	NA	NA	NA	---	---	---
Trichloroethene	0.0005	0.0018	3.08582	0.0056	0.00151	NA	NA	NA	---	---	---
Xylenes (total)	0.0005	0.0015	2.76637	0.0041	0.00116	40.50000	203.00000	90.67249	<0.01	<0.01	<0.01
Semivolatile Organics:											
1,2,4,5-Tetrachlorobenzene	0.0000	0.0047	1.86758	0.0088	0.00224	NA	NA	NA	---	---	---
1,2,4-Trichlorobenzene	0.0051	0.0014	2.20024	0.0031	0.00202	NA	NA	NA	---	---	---
1,2-Dichlorobenzene	0.0051	0.0018	2.55864	0.0046	0.00240	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
1,3-Dichlorobenzene	0.0051	0.0023	2.49293	0.0057	0.00268	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
1,4-Dichlorobenzene	0.0051	0.0014	2.56531	0.0036	0.00214	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
2,3,4,6-Tetrachlorophenol	0.0100	0.0047	1.96223	0.0092	0.00478	NA	NA	NA	---	---	---
2,4,5-Trichlorophenol	0.0100	0.0110	2.37268	0.0261	0.00901	NA	NA	NA	---	---	---
2,4,6-Trichlorophenol	0.0100	0.0110	2.38506	0.0262	0.00904	NA	NA	NA	---	---	---
2,4-Dichlorophenol	0.0100	0.0100	2.80259	0.0280	0.00945	NA	NA	NA	---	---	---
2-Acetylaminofluorene	0.0051	0.0470	2.77358	0.1304	0.03389	NA	NA	NA	---	---	---
2-Chloronaphthalene	0.0051	0.0085	2.26412	0.0192	0.00610	NA	NA	NA	---	---	---
3,3'-Dichlorobenzidine	0.0051	0.0240	2.50594	0.0601	0.01637	NA	NA	NA	---	---	---
3,3'-Dimethylbenzidine	0.0051	0.0940	3.11000	0.2923	0.07413	NA	NA	NA	---	---	---
3-Methylcholanthrene	0.0051	0.0470	1.17528	0.0552	0.01584	NA	NA	NA	---	---	---
4-Bromophenyl phenyl ether	0.0051	0.0098	1.70059	0.0167	0.00552	NA	NA	NA	---	---	---
4-Chloro-3-methylphenol	0.0100	0.0100	2.78805	0.0279	0.00941	NA	NA	NA	---	---	---
4-Chlorophenyl phenyl ether	0.0051	0.0091	1.72286	0.0157	0.00526	NA	NA	NA	---	---	---
7,12-Dimethylbenz(a)anthracene	0.0051	0.0240	1.11568	0.0268	0.00835	2.00000	20.00000	6.32456	<0.01	<0.01	<0.01
Aramite, total	0.0051	0.0068	1.78213	0.0121	0.00434	NA	NA	NA	---	---	---
Bis(2-ethylhexyl)phthalate	0.0051	0.0590	0.93476	0.0552	0.01615	1.11000	5.55000	2.48204	0.01	<0.01	<0.01
Butyl benzyl phthalate	0.0051	0.0095	1.77288	0.0168	0.00555	NA	NA	NA	---	---	---
Diallate	0.0000	0.0080	1.94191	0.0155	0.00396	NA	NA	NA	---	---	---
Dibenzofuran	0.0051	0.0095	2.13816	0.0203	0.00639	NA	NA	NA	---	---	---
Diethyl phthalate	0.0051	0.0110	3.25912	0.0359	0.01016	NA	NA	NA	---	---	---
Di-n-butyl phthalate	0.0051	0.0240	1.88222	0.0452	0.01277	0.22200	1.11000	0.49641	0.06	0.01	0.03
Di-n-octyl phthalate	0.0051	0.0095	0.76704	0.0073	0.00326	50.00000	250.00000	111.80340	<0.01	<0.01	<0.01
Dinoseb	0.0051	0.0095	2.47355	0.0235	0.00715	0.26400	1.32000	0.59032	0.03	<0.01	0.01
Hexachlorobenzene	0.0051	0.0110	1.34906	0.0148	0.00512	0.11000	0.57000	0.25040	0.05	<0.01	0.02
Hexachlorobutadiene	0.0051	0.0044	1.78678	0.0079	0.00325	3.39000	17.00000	7.59144	<0.01	<0.01	<0.01
Hexachlorocyclopentadiene	0.0051	0.0053	1.53649	0.0081	0.00335	NA	NA	NA	---	---	---
Hexachloroethane	0.0051	0.0083	2.20597	0.0183	0.00587	NA	NA	NA	---	---	---
Hexachloropropene	0.0051	0.0075	1.99830	0.0150	0.00505	NA	NA	NA	---	---	---
Isosafrole	0.0051	0.0047	2.59890	0.0122	0.00431	NA	NA	NA	---	---	---
n-Nitrosodiphenylamine	0.0051	0.0087	2.74486	0.0239	0.00722	NA	NA	NA	---	---	---
p-Dimethylamino azobenzene	0.0051	0.0240	1.89697	0.0455	0.01286	NA	NA	NA	---	---	---
Pentachlorobenzene	0.0051	0.0056	1.58935	0.0089	0.00354	NA	NA	NA	---	---	---
Pentachloronitrobenzene	0.0051	0.0240	1.86758	0.0448	0.01269	7.07000	70.70000	22.35730	<0.01	<0.01	<0.01
Pentachlorophenol	0.0100	0.0240	88.12000	2.1149	0.51128	6.73000	67.30000	21.28213	0.08	<0.01	0.02
Pronamide	0.0100	0.0060	2.50594	0.0150	0.00621	NA	NA	NA	---	---	---
LLPAHs:											
2-Methylnaphthalene	0.0002	0.0047	2.28781	0.0108	0.00277	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Acenaphthene	0.0002	0.0047	2.25237	0.0106	0.00273	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Acenaphthylene	0.0002	0.0047	2.24068	0.0105	0.00271	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Anthracene	0.0002	0.0047	1.91183	0.0090	0.00234	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(a)anthracene	0.0002	0.0047	1.41742	0.0067	0.00178	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(a)pyrene	0.0002	0.0047	1.27400	0.0060	0.00162	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(b)fluoranthene	0.0002	0.0047	1.24451	0.0058	0.00159	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01

TABLE G-17
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR AMERICAN ROBIN DIETARY EXPOSURES TO CHEMICALS IN SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENCANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Surface Water Concentration [1] (mg/L)	Subsurface Soil Concentration [2] (mg/kg)	Soil-to-Invertebrate BAF/Uptake Equation (unitless)	Invertebrate Tissue Concentration [3] (mg/kg)	Dietary Intake [4] (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates [6]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [5] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
LLPAHs (cont.):											
Benzo(g,h,i)perylene	0.0002	0.0047	1.09270	0.0051	0.00142	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(k)fluoranthene	0.0002	0.0047	1.24451	0.0058	0.00159	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Chrysene	0.0002	0.0047	1.41742	0.0067	0.00178	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Dibenzo(a,h)anthracene	0.0002	0.0095	1.09554	0.0104	0.00282	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Fluoranthene	0.0000	0.0047	1.64831	0.0077	0.00200	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Fluorene	0.0002	0.0047	2.08867	0.0098	0.00254	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	0.0002	0.0047	1.10701	0.0052	0.00143	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Naphthalene	0.0002	0.0047	2.60567	0.0122	0.00313	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Phenanthrene	0.0002	0.0046	1.91183	0.0088	0.00229	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Pyrene	0.0000	0.0047	1.65261	0.0078	0.00200	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Metals:											
Antimony	0.0003	0.7000	1.00000	0.7000	0.18800	4740.00000	47400.00000	14989.19611	<0.01	<0.01	<0.01
Arsenic	0.0005	1.2000	$\ln(C_e) = 0.706[\ln(C_s)] - 1.421$	0.2746	0.09994	2.24000	4.51000	3.17843	0.04	0.02	0.03
Barium	0.0214	120.0000	0.16000	19.2000	8.00147	20.80000	41.70000	29.45098	0.38	0.19	0.27
Beryllium	0.0000	0.5000	1.18200	0.5910	0.15610	NA	NA	NA	---	---	---
Cadmium	0.0010	0.4500	$\ln(C_e) = 0.795[\ln(C_s)] + 2.114$	4.3894	1.06763	1.47000	6.36000	3.05765	0.73	0.17	0.35
Chromium, total	0.0008	120.0000	3.16200	379.4400	94.55689	2.66000	15.60000	6.44174	35.55	6.06	14.68
Cobalt	0.0003	24.0000	0.29100	6.9840	2.35479	7.61000	18.30000	11.80097	0.31	0.13	0.20
Copper	0.0040	210.0000	$\ln(C_e) = 0.264[\ln(C_s)] + 1.675$	21.9033	11.18389	4.05000	12.10000	7.00036	2.76	0.92	1.60
Mercury	0.0002	0.0830	20.63000	1.7123	0.41383	0.02600	0.07800	0.04503	15.92	5.31	9.19
Nickel	0.0010	44.0000	4.73000	208.1200	51.24881	6.71000	18.60000	11.17166	7.64	2.76	4.59
Selenium	0.0008	0.6900	$\ln(C_e) = 0.733[\ln(C_s)] - 0.075$	0.7068	0.18947	0.29000	0.57900	0.40977	0.65	0.33	0.46
Silver	0.0010	0.2600	15.33800	3.9879	0.96580	2.02000	20.20000	6.38780	0.48	0.05	0.15
Thallium	0.0010	0.0370	1.00000	0.0370	0.01018	0.35000	1.75000	0.78262	0.03	<0.01	0.01
Tin	0.0200	3.6000	1.00000	3.6000	0.97137	6.80000	16.90000	10.72007	0.14	0.06	0.09
Vanadium	0.0076	400.0000	0.08800	35.2000	19.73586	0.34400	0.68800	0.48649	57.37	28.69	40.57
Zinc	0.0079	77.0000	$\ln(C_e) = 0.328[\ln(C_s)] + 4.449$	355.5864	87.61477	66.10000	171.00000	106.31604	1.33	0.51	0.82

Notes:

BAF = Bioaccumulation Factor
PAH = Polynuclear Aromatic Hydrocarbon
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration

HQ = Hazard Quotient
mg/kg-BW/day = milligram per kilogram-body weight per day
ln = natural logarithm
C_p = Concentration in plant tissue (mg/kg - dry weight)
C_s = Maximum concentration in subsurface soil (mg/kg - dry weight)

NA = Not Available
--- = Step 2 screening level risk estimate could not be calculated due to the lack of a toxicity reference value.
mg/kg = milligram per kilogram
mg/L = milligram per liter

[1] Maximum detected surface water concentrations or, in the case of non-detected chemicals, maximum Reporting Limits.
[2] Maximum detected subsurface soil concentrations or, in the case of non-detected chemicals, maximum Limits of Detection.
[2] As discussed in Section 7.5.2.2.1, soil invertebrate tissue concentrations were derived by (a) multiplying maximum subsurface soil concentrations by soil-to-invertebrate bioaccumulation factors or, (b) soil-to-invertebrate uptake equations.
[3] The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FIR_{robin})(FC_{invert})(PDF_{invert})] + [(FIR_{robin})(SC_x)(PDS)]+[(WIR_{robin})(WC_x)]\}/BW_{robin}$$

Where:

DI_x = Dietary intake of chemical x by the American robin (mg/kg-body weight/day)
FIR_{robin} = Maximum food ingestion rate for the American robin (0.01503 kg/day - dry weight; see Table 7-16)
FC_{invert} = Concentration of chemical x in soil invertebrate tissue (chemical-specific - dry weight; see Table G-17 above)
PDF_{invert} = Proportion of diet composed of soil invertebrates (0.895 - dry weight basis [unitless]; see Table 7-17)
SC_x = Maximum concentration in subsurface soil (chemical specific - dry weight; see Table G-17 above)
PDS = Proportion of diet composed of subsurface soil (0.105 - dry weight basis [unitless]; see Table 7-17)
WIR_{robin} = Maximum water ingestion rate for the robin (0.01361 L/day; see Table 7-16)
WC_x = Maximum concentration of surface water (chemical-specific; see Table G-17 above)
BW_{robin} = Minimum body weight for the American robin (0.056 kg; see Table 7-16)

[4] MATC values were derived by calculating the geometric mean of the NOAEL and LOAEL values.
[5] NOAEL-, LOAEL, and MATC-based screening level risk estimates (i.e., HQs) were derived by dividing dietary intakes by NOAEL, LOAEL-, and MATC-based toxicity reference values, respectively.

TABLE G-18
FOOD ITEM CONCENTRATIONS, DIETARY DOSES, AND HAZARD QUOTIENT VALUES FOR RED TAILED HAWK DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Surface Water Concentration [1] (mg/L)	Subsurface Soil Concentration [2] (mg/kg)	Soil-to-Small Mammal BAF/Uptake Equation (unitless)	Small Mammal Concentration [3] (mg/kg)	Dietary Intake [4] (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates [6]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [5] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Volatile Organics:											
1,1,1,2-Tetrachloroethane	0.0005	0.0034	$C_m = [(BAF_d)(DI)]/0.32$	0.0071	0.00079	NA	NA	NA	---	---	---
Carbon tetrachloride	0.0005	0.0014	$C_m = [(BAF_d)(DI)]/0.32$	0.0031	0.00036	NA	NA	NA	---	---	---
Chlorobenzene	0.0005	0.0014	$C_m = [(BAF_d)(DI)]/0.32$	0.0030	0.00035	NA	NA	NA	---	---	---
Chloroform	0.0012	0.0015	$C_m = [(BAF_d)(DI)]/0.32$	0.0046	0.00057	NA	NA	NA	---	---	---
Ethylbenzene	0.0005	0.0018	$C_m = [(BAF_d)(DI)]/0.32$	0.0035	0.00041	NA	NA	NA	---	---	---
Pentachloroethane	0.0005	0.0089	$C_m = [(BAF_d)(DI)]/0.32$	0.0155	0.00167	NA	NA	NA	---	---	---
Styrene	0.0005	0.0014	$C_m = [(BAF_d)(DI)]/0.32$	0.0030	0.00035	NA	NA	NA	---	---	---
Toluene	0.0005	0.0014	$C_m = [(BAF_d)(DI)]/0.32$	0.0031	0.00036	NA	NA	NA	---	---	---
Trichloroethene	0.0005	0.0018	$C_m = [(BAF_d)(DI)]/0.32$	0.0039	0.00045	NA	NA	NA	---	---	---
Xylenes (total)	0.0005	0.0015	$C_m = [(BAF_d)(DI)]/0.32$	0.0030	0.00035	40.50000	203.00000	90.67249	<0.01	<0.01	<0.01
Semivolatile Organics:											
1,2,4,5-Tetrachlorobenzene	0.0000	0.0047	$C_m = [(BAF_d)(DI)]/0.32$	0.0055	0.00058	NA	NA	NA	---	---	---
1,2,4-Trichlorobenzene	0.0051	0.0014	$C_m = [(BAF_d)(DI)]/0.32$	0.0062	0.00103	NA	NA	NA	---	---	---
1,2-Dichlorobenzene	0.0051	0.0018	$C_m = [(BAF_d)(DI)]/0.32$	0.0071	0.00113	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
1,3-Dichlorobenzene	0.0051	0.0023	$C_m = [(BAF_d)(DI)]/0.32$	0.0078	0.00120	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
1,4-Dichlorobenzene	0.0051	0.0014	$C_m = [(BAF_d)(DI)]/0.32$	0.0065	0.00106	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
2,3,4,6-Tetrachlorophenol	0.0100	0.0047	$C_m = [(BAF_d)(DI)]/0.32$	0.0141	0.00223	NA	NA	NA	---	---	---
2,4,5-Trichlorophenol	0.0100	0.0110	$C_m = [(BAF_d)(DI)]/0.32$	0.0247	0.00334	NA	NA	NA	---	---	---
2,4,6-Trichlorophenol	0.0100	0.0110	$C_m = [(BAF_d)(DI)]/0.32$	0.0248	0.00335	NA	NA	NA	---	---	---
2,4-Dichlorophenol	0.0100	0.0100	$C_m = [(BAF_d)(DI)]/0.32$	0.0259	0.00347	NA	NA	NA	---	---	---
2-Acetylaminofluorene	0.0051	0.0470	$C_m = [(BAF_d)(DI)]/0.32$	0.0862	0.00942	NA	NA	NA	---	---	---
2-Chloronaphthalene	0.0051	0.0085	$C_m = [(BAF_d)(DI)]/0.32$	0.0163	0.00210	NA	NA	NA	---	---	---
3,3'-Dichlorobenzidine	0.0051	0.0240	$C_m = [(BAF_d)(DI)]/0.32$	0.0421	0.00479	NA	NA	NA	---	---	---
3,3'-Dimethylbenzidine	0.0051	0.0940	$C_m = [(BAF_d)(DI)]/0.32$	0.1878	0.02008	NA	NA	NA	---	---	---
3-Methylcholanthrene	0.0051	0.0470	$C_m = [(BAF_d)(DI)]/0.32$	0.0393	0.00450	NA	NA	NA	---	---	---
4-Bromophenyl phenyl ether	0.0051	0.0098	$C_m = [(BAF_d)(DI)]/0.32$	0.0148	0.00193	NA	NA	NA	---	---	---
4-Chloro-3-methylphenol	0.0100	0.0100	$C_m = [(BAF_d)(DI)]/0.32$	0.0258	0.00346	NA	NA	NA	---	---	---
4-Chlorophenyl phenyl ether	0.0051	0.0091	$C_m = [(BAF_d)(DI)]/0.32$	0.0141	0.00186	NA	NA	NA	---	---	---
7,12-Dimethylbenz(a)anthracene	0.0051	0.0240	$C_m = [(BAF_d)(DI)]/0.32$	0.0212	0.00261	2.00000	20.00000	6.32456	<0.01	<0.01	<0.01
Aramite, total	0.0051	0.0068	$C_m = [(BAF_d)(DI)]/0.32$	0.0119	0.00163	NA	NA	NA	---	---	---
Bis(2-ethylhexyl)phthalate	0.0051	0.0590	$C_m = [(BAF_d)(DI)]/0.32$	0.0394	0.00451	1.11000	5.55000	2.48204	<0.01	<0.01	<0.01
Butyl benzyl phthalate	0.0051	0.0095	$C_m = [(BAF_d)(DI)]/0.32$	0.0149	0.00194	NA	NA	NA	---	---	---
Diallate	0.0000	0.0080	$C_m = [(BAF_d)(DI)]/0.32$	0.0098	0.00103	NA	NA	NA	---	---	---
Dibenzofuran	0.0051	0.0095	$C_m = [(BAF_d)(DI)]/0.32$	0.0170	0.00217	NA	NA	NA	---	---	---
Diethyl phthalate	0.0051	0.0110	$C_m = [(BAF_d)(DI)]/0.32$	0.0267	0.00319	NA	NA	NA	---	---	---
Di-n-butyl phthalate	0.0051	0.0240	$C_m = [(BAF_d)(DI)]/0.32$	0.0327	0.00381	0.22200	1.11000	0.49641	0.02	<0.01	<0.01
Di-n-octyl phthalate	0.0051	0.0095	$C_m = [(BAF_d)(DI)]/0.32$	0.0089	0.00131	50.00000	250.00000	111.80340	<0.01	<0.01	<0.01
Dinoseb	0.0051	0.0095	$C_m = [(BAF_d)(DI)]/0.32$	0.0190	0.00238	0.26400	1.32000	0.59032	<0.01	<0.01	<0.01
Hexachlorobenzene	0.0051	0.0110	$C_m = [(BAF_d)(DI)]/0.32$	0.0136	0.00181	0.11000	0.57000	0.25040	0.02	<0.01	<0.01
Hexachlorobutadiene	0.0051	0.0044	$C_m = [(BAF_d)(DI)]/0.32$	0.0092	0.00135	3.39000	17.00000	7.59144	<0.01	<0.01	<0.01
Hexachlorocyclopentadiene	0.0051	0.0053	$C_m = [(BAF_d)(DI)]/0.32$	0.0094	0.00137	NA	NA	NA	---	---	---
Hexachloroethane	0.0051	0.0083	$C_m = [(BAF_d)(DI)]/0.32$	0.0158	0.00203	NA	NA	NA	---	---	---
Hexachloropropene	0.0051	0.0075	$C_m = [(BAF_d)(DI)]/0.32$	0.0137	0.00182	NA	NA	NA	---	---	---
Isosafrole	0.0051	0.0047	$C_m = [(BAF_d)(DI)]/0.32$	0.0119	0.00163	NA	NA	NA	---	---	---
n-Nitrosodiphenylamine	0.0051	0.0087	$C_m = [(BAF_d)(DI)]/0.32$	0.0192	0.00240	NA	NA	NA	---	---	---
p-Dimethylamino azobenzene	0.0051	0.0240	$C_m = [(BAF_d)(DI)]/0.32$	0.0329	0.00384	NA	NA	NA	---	---	---
Pentachlorobenzene	0.0051	0.0056	$C_m = [(BAF_d)(DI)]/0.32$	0.0099	0.00142	NA	NA	NA	---	---	---
Pentachloronitrobenzene	0.0051	0.0240	$C_m = [(BAF_d)(DI)]/0.32$	0.0325	0.00379	7.07000	70.70000	22.35730	<0.01	<0.01	<0.01
Pentachlorophenol	0.0100	0.0240	$C_m = [(BAF_d)(DI)]/0.32$	1.3283	0.14004	6.73000	67.30000	21.28213	0.02	<0.01	<0.01
Pronamide	0.0100	0.0060	$C_m = [(BAF_d)(DI)]/0.32$	0.0177	0.00261	NA	NA	NA	---	---	---

TABLE G-18
FOOD ITEM CONCENTRATIONS, DIETARY DOSES, AND HAZARD QUOTIENT VALUES FOR RED TAILED HAWK DIETARY EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical	Surface Water Concentration (1) (mg/L)	Subsurface Soil Concentration (2) (mg/kg)	Soil-to-Small Mammal BAF/Uptake Equation (unitless)	Small Mammal Concentration (3) (mg/kg)	Dietary Intake (4) (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates (6)		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC (5) (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
LLPAHs:											
2-Methylnaphthalene	0.0002	0.0047	0.00	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Acenaphthene	0.0002	0.0047	0.00	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Acenaphthylene	0.0002	0.0047	0.00	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Anthracene	0.0002	0.0047	0.00	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(a)anthracene	0.0002	0.0047	0.00	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(a)pyrene	0.0002	0.0047	0.00	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(b)fluoranthene	0.0002	0.0047	0.00	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(g,h,i)perylene	0.0002	0.0047	0.00	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(k)fluoranthene	0.0002	0.0047	0.00	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Chrysene	0.0002	0.0047	0.00	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Dibenzo(a,h)anthracene	0.0002	0.0095	0.00	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Fluoranthene	0.0000	0.0047	0.00	0.0000	0.00000	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Fluorene	0.0002	0.0047	0.00	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	0.0002	0.0047	0.00	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Naphthalene	0.0002	0.0047	0.00	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Phenanthrene	0.0002	0.0046	0.00	0.0000	0.00002	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Pyrene	0.0000	0.0047	0.00	0.0000	0.00000	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Metals:											
Antimony	0.0003	0.7000	$C_m = [(BAF_d)(DI)]/0.32$	0.0350	0.00369	4740.00000	47400.00000	14989.19611	<0.01	<0.01	<0.01
Arsenic	0.0005	1.2000	$\ln(Cm) = 0.8188[\ln(Cs)] - 4.8471$	0.0091	0.00099	2.24000	4.51000	3.17843	<0.01	<0.01	<0.01
Barium	0.0214	120.0000	0.1121	0.1591	0.01829	20.80000	41.70000	29.45098	<0.01	<0.01	<0.01
Beryllium	0.0000	0.5000	$C_m = [(BAF_d)(DI)]/0.32$	0.0295	0.00309	NA	NA	NA	---	---	---
Cadmium	0.0010	0.4500	$\ln(C_m) = 0.4865[\ln(C_s)] - 0.4306$	0.4408	0.04630	1.47000	6.36000	3.05765	0.03	<0.01	0.02
Chromium, total	0.0008	120.0000	$\ln(C_m) = 0.7338[\ln(C_s)] - 1.4599$	7.7925	0.81720	2.66000	15.60000	6.44174	0.31	0.05	0.13
Cobalt	0.0003	24.0000	$\ln(C_m) = 1.3070[\ln(C_s)] - 4.4669$	0.7311	0.07669	7.61000	18.30000	11.80097	0.01	<0.01	<0.01
Copper	0.0040	210.0000	$\ln(C_m) = 0.1444[\ln(C_s)] + 0.2042$	16.6785	1.74925	4.05000	12.10000	7.00036	0.43	0.14	0.25
Mercury	0.0002	0.0830	0.192	0.0159	0.00169	0.02600	0.07800	0.04503	0.06	0.02	0.04
Nickel	0.0010	44.0000	$\ln(C_m) = 0.4658[\ln(C_s)] - 0.2462$	4.5561	0.47784	6.71000	18.60000	11.17166	0.07	0.03	0.04
Selenium	0.0008	0.6900	$\ln(C_m) = 0.3764[\ln(C_s)] - 0.4158$	0.5738	0.06023	0.29000	0.57900	0.40977	0.21	0.10	0.15
Silver	0.0010	0.2600	0.5013	0.1303	0.01374	2.02000	20.20000	6.38780	<0.01	<0.01	<0.01
Thallium	0.0010	0.0370	$C_m = [(BAF_d)(DI)]/0.32$	0.0244	0.00263	0.35000	1.75000	0.78262	<0.01	<0.01	<0.01
Tin	0.0200	3.6000	$C_m = [(BAF_d)(DI)]/0.32$	2.3088	0.24361	6.80000	16.90000	10.72007	0.04	0.01	0.02
Vanadium	0.0076	400.0000	0.0179	7.1600	0.75138	0.34400	0.68800	0.48649	2.18	1.09	1.54
Zinc	0.0079	77.0000	$\ln(C_m) = 0.0738[\ln(C_s)] + 4.4713$	120.5269	12.63932	66.10000	171.00000	106.31604	0.19	0.07	0.12

Notes:

BAF = Bioaccumulation Factor
PAH = Polynuclear Aromatic Hydrocarbon
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
HQ = Hazard Quotient
mg/kg-BW/day = milligram per kilogram-body weight per day
ln = natural logarithm
C_m = Concentration in small mammal tissue (mg/kg - dry weight)
C_s = Maximum concentration in subsurface soil (mg/kg - dry weight)
BAF_d = small mammal diet-to-whole body bioaccumulation factor (wet weight)
DI_m = Small mammal dietary intake (mg/kg-BW/day)
NA = Not Available
--- = Step 2 screening level risk estimate could not be calculated due to the lack of a toxicity reference value.
mg/kg = milligram per kilogram
mg/L = milligram per liter

TABLE G-18
FOOD ITEM CONCENTRATIONS, DIETARY DOSES, AND HAZARD QUOTIENT VALUES FOR RED TAILED HAWK DIETARY
EXPOSURES TO CHEMICALS IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Notes (cont.):

(1) Maximum detected surface water concentrations or, in the case of non-detected chemicals, maximum Reporting Limits.

(2) Maximum detected subsurface soil concentrations or, in the case of non-detected chemicals, maximum Limits of Detection.

(3) As discussed in Section 7.5.2.2.1, small mammal (i.e., Norway rat) tissue concentrations were derived by (a) multiplying maximum subsurface soil concentrations by soil-to-small mammal bioaccumulation factors, (b) soil-to-small mammal uptake equations, or (c) multiplying small mammal dietary intakes (see Table G-20 for small mammal dietary intake values) by small mammal diet-to-whole body BAF values (BAF_d assumed to be 1.0 for all chemicals [wet weight basis]) and dividing the products by 0.32 (solids content of small mammals).

(4) The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FIR_{hawk})(FC_{sm})(PDF_{sm})] + [(FIR_{hawk})(SC_x)(PDS)]+[(WIR_{hawk})(WC_x)]\}/BW_{hawk}$$

Where:

DI_x = Dietary intake of chemical x by the red-tailed hawk (mg/kg-body weight/day)
FIR_{hawk} = Maximum food ingestion rate for the red-tailed hawk (0.09679 kg/day - dry weight; see Table 7-16)
FC_{sm}= Concentration of chemical x in small mammal tissue (chemical-specific - dry weight; see Table G-18 above)
PDF_{sm} = Proportion of diet composed of small mammals (1.0 - dry weight basis [unitless]; see Table 7-17)
SC_x = Maximum concentration in subsurface soil (chemical specific - dry weight; see Table G-18 above)
PDS = Proportion of diet composed of subsurface soil (0.0 - dry weight basis [unitless]; see Table 7-17)
WIR_{hawk} = Maximum water ingestion rate for the red tailed hawk (0.06910 L/day; see Table 7-16)
WC_x = Maximum concentration in surface water (chemical-specific; see Table G-18 above)
BW_{hawk} = Minimum body weight for the red-tailed hawk (0.923 kg; see Table 7-16)

(4) MATC values were derived by calculating the geometric mean of the NOAEL and LOAEL values.

(5) NOAEL-, LOAEL, and MATC-based screening level risk estimates (i.e., HQs) were derived by dividing dietary intakes by NOAEL, LOAEL-, and MATC-based toxicity reference values, respectively.

TABLE G-19
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR BROWN FLOWER BAT DIETARY EXPOSURES TO CHEMICALS IN SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical	Surface Water Concentration [1] (mg/L)	Subsurface Soil Concentration [2] (mg/kg)	Soil-to-Plant BAF/Uptake Equation (unitless)	Plant Tissue Concentration [3] (mg/kg)	Dietary Intake [4] (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates [6]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [5] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Volatile Organics:											
1,1,1,2-Tetrachloroethane	0.0005	0.0034	5.17618	0.0176	0.00314	NA	NA	NA	---	---	---
Carbon tetrachloride	0.0005	0.0014	4.71454	0.0066	0.00124	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
Chlorobenzene	0.0005	0.0014	4.17540	0.0058	0.00111	27.25000	54.50000	38.53732	<0.01	<0.01	<0.01
Chloroform	0.0012	0.0015	10.04745	0.0151	0.00283	15.00000	75.00000	33.54102	<0.01	<0.01	<0.01
Ethylbenzene	0.0005	0.0018	3.21442	0.0058	0.00110	136.00000	408.00000	235.55891	<0.01	<0.01	<0.01
Pentachloroethane	0.0005	0.0089	2.98295	0.0265	0.00469	NA	NA	NA	---	---	---
Styrene	0.0005	0.0014	3.87473	0.0054	0.00103	35.00000	175.00000	78.26238	<0.01	<0.01	<0.01
Toluene	0.0005	0.0014	4.62727	0.0065	0.00122	52.00000	260.00000	116.27553	<0.01	<0.01	<0.01
Trichloroethene	0.0005	0.0018	4.80345	0.0086	0.00159	5.00000	2.50000	3.53553	<0.01	<0.01	<0.01
Xylenes (total)	0.0005	0.0015	3.24458	0.0049	0.00094	2.06000	2.58000	2.30539	<0.01	<0.01	<0.01
Semivolatile Organics:											
1,2,4,5-Tetrachlorobenzene	0.0000	0.0047	0.79168	0.0037	0.00064	NA	NA	NA	---	---	---
1,2,4-Trichlorobenzene	0.0051	0.0014	1.42608	0.0020	0.00130	53.00000	106.00000	74.95332	<0.01	<0.01	<0.01
1,2-Dichlorobenzene	0.0051	0.0018	2.45160	0.0044	0.00172	171.00000	857.00000	382.81458	<0.01	<0.01	<0.01
1,3-Dichlorobenzene	0.0051	0.0023	2.23295	0.0051	0.00184	171.00000	857.00000	382.81458	<0.01	<0.01	<0.01
1,4-Dichlorobenzene	0.0051	0.0014	2.47461	0.0035	0.00155	250.00000	500.00000	353.55339	<0.01	<0.01	<0.01
2,3,4,6-Tetrachlorophenol	0.0100	0.0047	0.94544	0.0044	0.00264	NA	NA	NA	---	---	---
2,4,5-Trichlorophenol	0.0100	0.0110	1.86980	0.0206	0.00543	160.00000	800.00000	357.77088	<0.01	<0.01	<0.01
2,4,6-Trichlorophenol	0.0100	0.0110	1.90507	0.0210	0.00550	160.00000	800.00000	357.77088	<0.01	<0.01	<0.01
2,4-Dichlorophenol	0.0100	0.0100	3.39973	0.0340	0.00776	88.00000	440.00000	196.77398	<0.01	<0.01	<0.01
2-Acetylaminofluorene	0.0051	0.0470	3.27504	0.1539	0.02760	NA	NA	NA	---	---	---
2-Chloronaphthalene	0.0051	0.0085	1.58041	0.0134	0.00328	NA	NA	NA	---	---	---
3,3'-Dichlorobenzidine	0.0051	0.0240	2.27506	0.0546	0.01041	NA	NA	NA	---	---	---
3,3'-Dimethylbenzidine	0.0051	0.0940	4.93997	0.4644	0.08135	NA	NA	NA	---	---	---
3-Methylcholanthrene	0.0051	0.0470	0.15011	0.0071	0.00218	NA	NA	NA	---	---	---
4-Bromophenyl phenyl ether	0.0051	0.0098	0.56559	0.0055	0.00191	NA	NA	NA	---	---	---
4-Chloro-3-methylphenol	0.0100	0.0100	3.33680	0.0334	0.00765	NA	NA	NA	---	---	---
4-Chlorophenyl phenyl ether	0.0051	0.0091	0.59263	0.0054	0.00189	NA	NA	NA	---	---	---
7,12-Dimethylbenz(a)anthracene	0.0051	0.0240	0.12453	0.0030	0.00147	NA	NA	NA	---	---	---
Aramite, total	0.0051	0.0068	0.66915	0.0046	0.00174	NA	NA	NA	---	---	---
Bis(2-ethylhexyl)phthalate	0.0051	0.0590	0.06598	0.0039	0.00163	18.30000	183.30000	57.91710	<0.01	<0.01	<0.01
Butyl benzyl phthalate	0.0051	0.0095	0.65677	0.0062	0.00203	480.00000	2400.00000	1073.31263	<0.01	<0.01	<0.01
Diallate	0.0000	0.0080	0.91077	0.0073	0.00126	NA	NA	NA	---	---	---
Dibenzofuran	0.0051	0.0095	1.28681	0.0122	0.00307	NA	NA	NA	---	---	---
Diethyl phthalate	0.0051	0.0110	5.84454	0.0643	0.01208	4583.00000	22915.00000	10247.89954	<0.01	<0.01	<0.01
Di-n-butyl phthalate	0.0051	0.0240	0.81418	0.0195	0.00434	550.00000	1833.00000	1004.06673	<0.01	<0.01	<0.01
Di-n-octyl phthalate	0.0051	0.0095	0.03244	0.0003	0.00101	55.00000	550.00000	173.92527	<0.01	<0.01	<0.01
Dinoseb	0.0051	0.0095	2.17124	0.0206	0.00453	NA	NA	NA	---	---	---
Hexachlorobenzene	0.0051	0.0110	0.24628	0.0027	0.00142	8.00000	16.00000	11.31371	<0.01	<0.01	<0.01
Hexachlorobutadiene	0.0051	0.0044	0.67543	0.0030	0.00147	4.00000	20.00000	8.94427	<0.01	<0.01	<0.01
Hexachlorocyclopentadiene	0.0051	0.0053	0.39290	0.0021	0.00131	10.00000	30.00000	17.32051	<0.01	<0.01	<0.01
Hexachloroethane	0.0051	0.0083	1.43946	0.0119	0.00302	NA	NA	NA	---	---	---
Hexachloropropene	0.0051	0.0075	1.00933	0.0076	0.00226	NA	NA	NA	---	---	---
Isosafrole	0.0051	0.0047	2.59293	0.0122	0.00306	NA	NA	NA	---	---	---
n-Nitrosodiphenylamine	0.0051	0.0087	3.15492	0.0274	0.00571	300.00000	1500.00000	670.82039	<0.01	<0.01	<0.01
p-Dimethylamino azobenzene	0.0051	0.0240	0.83732	0.0201	0.00443	NA	NA	NA	---	---	---
Pentachlorobenzene	0.0051	0.0056	0.44363	0.0025	0.00138	7.25000	36.25000	16.21149	<0.01	<0.01	<0.01
Pentachloronitrobenzene	0.0051	0.0240	0.79168	0.0190	0.00424	NA	NA	NA	---	---	---
Pentachlorophenol	0.0100	0.0240	46.02000	1.1045	0.19308	8.42000	22.65000	13.80989	0.02	<0.01	0.01
Pronamide	0.0100	0.0060	2.27506	0.0137	0.00423	NA	NA	NA	---	---	---
LLPAHs:											
2-Methylnaphthalene	0.0002	0.0047	1.64058	0.0077	0.00137	65.60000	328.00000	146.68606	<0.01	<0.01	<0.01
Acenaphthene	0.0002	0.0047	$In(C_p) = -0.8556[ln(C_s)] - 5.562$	0.3769	0.06529	65.60000	328.00000	146.68606	<0.01	<0.01	<0.01
Acenaphthylene	0.0002	0.0047	1.52245	0.0072	0.00128	65.60000	328.00000	146.68606	<0.01	<0.01	<0.01
Anthracene	0.0002	0.0047	$ln(C_p) = 0.7784[ln(C_s)] - 0.9887$	0.0057	0.00103	65.60000	328.00000	146.68606	<0.01	<0.01	<0.01
Benzo(a)anthracene	0.0002	0.0047	$In(C_p) = 0.5944[In(C_s)] - 2.7078$	0.0028	0.00052	0.61500	3.01000	1.36057	<0.01	<0.01	<0.01
Benzo(a)pyrene	0.0002	0.0047	$ln(C_p) = 0.975[ln(C_s)] - 2.0615$	0.0007	0.00016	0.61500	3.01000	1.36057	<0.01	<0.01	<0.01

TABLE G-19
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR BROWN FLOWER BAT DIETARY EXPOSURES TO CHEMICALS IN SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
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Chemical	Surface Water Concentration [1] (mg/L)	Subsurface Soil Concentration [2] (mg/kg)	Soil-to-Plant BAF/Uptake Equation (unitless)	Plant Tissue Concentration [3] (mg/kg)	Dietary Intake [4] (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates [6]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [5] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
LLPAHs (cont.):											
Benzo(b)fluoranthene	0.0002	0.0047	0.48000	0.0023	0.00043	0.61500	3.01000	1.36057	<0.01	<0.01	<0.01
Benzo(g,h,i)perylene	0.0002	0.0047	$\ln(C_p) = 1.1829[\ln(C_s)] - 0.9313$	0.0007	0.00016	0.61500	3.01000	1.36057	<0.01	<0.01	<0.01
Benzo(k)fluoranthene	0.0002	0.0047	$\ln(C_p) = 0.8595[\ln(C_s)] - 2.1579$	0.0012	0.00024	0.61500	3.01000	1.36057	<0.01	<0.01	<0.01
Chrysene	0.0002	0.0047	$\ln(C_p) = 0.5944[\ln(C_s)] - 2.7078$	0.0028	0.00052	0.61500	3.01000	1.36057	<0.01	<0.01	<0.01
Dibenzo(a,h)anthracene	0.0002	0.0095	0.23000	0.0022	0.00042	0.61500	3.01000	1.36057	<0.01	<0.01	<0.01
Fluoranthene	0.0000	0.0047	6.00000	0.0282	0.00489	65.60000	328.00000	146.68606	<0.01	<0.01	<0.01
Fluorene	0.0002	0.0047	$\ln(C_p) = -0.8556[\ln(C_s)] - 5.562$	0.3769	0.06529	65.60000	328.00000	146.68606	<0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	0.0002	0.0047	0.15000	0.0007	0.00016	0.61500	3.01000	1.36057	<0.01	<0.01	<0.01
Naphthalene	0.0002	0.0047	48.00000	0.2256	0.03910	65.60000	328.00000	146.68606	<0.01	<0.01	<0.01
Phenanthrene	0.0002	0.0046	$\ln(C_p) = 0.6203[\ln(C_s)] - 0.1665$	0.0301	0.00524	65.60000	328.00000	146.68606	<0.01	<0.01	<0.01
Pyrene	0.0000	0.0047	3.70000	0.0174	0.00301	0.61500	3.01000	1.36057	<0.01	<0.01	<0.01
Metals:											
Antimony	0.0003	0.7000	$\ln(C_p) = 0.938[\ln(C_s)] - 3.233$	0.0282	0.00494	0.05900	0.59000	0.18657	0.08	<0.01	0.03
Arsenic	0.0005	1.2000	$\ln(C_p) = 0.564[\ln(C_s)] - 1.992$	0.1512	0.02627	1.04000	1.66000	1.31393	0.03	0.02	0.02
Barium	0.0214	120.0000	0.44700	53.6400	9.29043	51.80000	82.70000	65.45120	0.18	0.11	0.14
Beryllium	0.0000	0.5000	$\ln(C_p) = 0.7345[\ln(C_s)] - 0.5361$	0.3516	0.06087	0.53200	0.56700	0.54922	0.11	0.11	0.11
Cadmium	0.0010	0.4500	$\ln(C_p) = 0.546[\ln(C_s)] - 0.475$	0.4021	0.06981	0.77000	7.70000	2.43495	0.09	<0.01	0.03
Chromium, total	0.0008	120.0000	0.08390	10.0680	1.74316	2.40000	58.53000	11.85209	0.73	0.03	0.15
Cobalt	0.0003	24.0000	0.02480	0.5952	0.10311	7.33000	18.90000	11.77017	0.01	<0.01	<0.01
Copper	0.0040	210.0000	$\ln(C_p) = 0.394[\ln(C_s)] + 0.668$	16.0348	2.77677	5.60000	9.34000	7.23215	0.50	0.30	0.38
Mercury	0.0002	0.0830	$\ln(C_p) = 0.544[\ln(C_s)] - 0.996$	0.0954	0.01655	0.03200	0.16000	0.07155	0.52	0.10	0.23
Nickel	0.0010	44.0000	$\ln(C_p) = 0.748[\ln(C_s)] - 2.224$	1.8341	0.31772	1.70000	3.40000	2.40416	0.19	0.09	0.13
Selenium	0.0008	0.6900	$\ln(C_p) = 1.104[\ln(C_s)] - 0.678$	0.3370	0.05848	0.14300	0.21500	0.17534	0.41	0.27	0.33
Silver	0.0010	0.2600	0.03670	0.0095	0.00184	6.02000	60.20000	19.03691	<0.01	<0.01	<0.01
Thallium	0.0010	0.0370	0.00400	0.0001	0.00021	0.00740	0.07400	0.02340	0.03	<0.01	<0.01
Tin	0.0200	3.6000	0.03000	0.1080	0.02244	23.40000	35.00000	28.61818	<0.01	<0.01	<0.01
Vanadium	0.0076	400.0000	0.00970	3.8800	0.67315	4.16000	8.31000	5.87959	0.16	0.08	0.11
Zinc	0.0079	77.0000	$\ln(C_p) = 0.554[\ln(C_s)] + 1.575$	53.5957	9.28023	75.40000	82.30000	78.77449	0.12	0.11	0.12

Notes:

BAF = Bioaccumulation Factor
PAH = Polynuclear Aromatic Hydrocarbon
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration

HQ = Hazard Quotient
mg/kg-BW/day = milligram per kilogram-body weight per day
ln = natural logarithm
C_p = Concentration in plant tissue (mg/kg - dry weight)
C_s = Maximum concentration in subsurface soil (mg/kg - dry weight)

NA = Not Available
--- = Step 2 screening level risk estimate could not be calculated due to the lack of a toxicity reference value.
mg/kg = milligram per kilogram
mg/L = milligram per liter

[1] Maximum detected surface water concentrations or, in the case of non-detected chemicals, maximum Reporting Limits.
[2] Maximum detected subsurface soil concentrations or, in the case of non-detected chemicals, maximum Limits of Detection.
[3] As discussed in Section 7.5.2.2.1, plant tissue concentrations were derived by (a) multiplying maximum subsurface soil concentrations by soil-to-plant bioaccumulation factors, or (b) soil-to-plant uptake equations.
[4] The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FI_{bat})(FC_{plant})(PDF_{plant})] + [(FIR_{bat})(SC_x)(PDS)]+[(WIR_{bat})(WC_x)]\}/BW_{bat}$$

Where:

DI_x = Dietary intake of chemical x by the brown flower bat (mg/kg-body weight/day)
FIR_{bat} = Maximum food ingestion rate for the brown flower bat (0.00277 kg/day - dry weight; see Table 7-16)
FC_{plant} = Concentration of chemical x in soil invertebrate tissue (chemical-specific - dry weight; see Table G-19 above)
PDF_{plant} = Proportion of diet composed of plants (1.0 - dry weight basis [unitless]; see Table 7-17)
SC_x = Maximum concentration in subsurface soil (chemical specific - dry weight; see Table G-19 above)
PDS = Proportion of diet composed of subsurface soil (0.0 - dry weight basis [unitless]; see Table 7-17)
WIR_{bat} = Maximum water ingestion rate for the brown flower bat (0.00299 L/day; see Table 7-16)
WC_x = Maximum concentration in surface water (chemical-specific; see Table G-19 above)
BW_{bat} = Minimum body weight for the brown flower bat (0.016 kg; see Table 7-16)

[4] MATC values were derived by calculating the geometric mean of the NOAEL and LOAEL values.
[5] NOAEL-, LOAEL, and MATC-based screening level risk estimates (i.e., HQs) were derived by dividing dietary intakes by NOAEL, LOAEL-, and MATC-based toxicity reference values, respectively.

APPENDIX G-20
FOOD ITEM CONCENTRATIONS AND DIETARY INTAKES FOR NORWAY RAT DIETARY EXPOSURES
TO CHEMICALS IN SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 2 SCREENING LEVEL RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical [1]	Surface Water Concentration [2] (mg/L)	Subsurface Soil Concentration [3] (mg/kg)	Soil-to-Invertebrate BAF (unitless)	Invertebrate Tissue Concentration [4] (mg/kg)	Dietary Intake [5] (mg/kg-BW/day)
Volatile Organics:					
1,1,1,2-Tetrachloroethane	0.0005	0.0034	3.15072	0.0107	0.00229
Pentachloroethane	0.0005	0.0089	2.70234	0.0241	0.00497
Carbon tetrachloride	0.0005	0.0014	3.06980	0.0043	0.00100
Chlorobenzene	0.0005	0.0014	2.96770	0.0042	0.00097
Chloroform	0.0012	0.0015	3.79001	0.0057	0.00146
Ethylbenzene	0.0005	0.0018	2.75918	0.0050	0.00113
Styrene	0.0005	0.0014	2.90656	0.0041	0.00095
Toluene	0.0005	0.0014	3.05387	0.0043	0.00099
Trichloroethene	0.0005	0.0018	3.08582	0.0056	0.00125
Xylenes (total)	0.0005	0.0015	2.76637	0.0041	0.00097
Semivolatile Organics:					
1,2,4,5-Tetrachlorobenzene	0.0000	0.0047	1.86758	0.0088	0.00177
1,2,4-Trichlorobenzene	0.0051	0.0014	2.20024	0.0031	0.00197
1,2-Dichlorobenzene	0.0051	0.0018	2.55864	0.0046	0.00228
1,3-Dichlorobenzene	0.0051	0.0023	2.49293	0.0057	0.00251
1,4-Dichlorobenzene	0.0051	0.0014	2.56531	0.0036	0.00208
2,3,4,6-Tetrachlorophenol	0.0100	0.0047	1.96223	0.0092	0.00451
2,4,5-Trichlorophenol	0.0100	0.0110	2.37268	0.0261	0.00791
2,4,6-Trichlorophenol	0.0100	0.0110	2.38506	0.0262	0.00794
2,4-Dichlorophenol	0.0100	0.0100	2.80259	0.0280	0.00829
2-Acetylaminofluorene	0.0051	0.0470	2.77358	0.1304	0.02757
2-Chloronaphthalene	0.0051	0.0085	2.26412	0.0192	0.00523
3,3'-Dichlorobenzidine	0.0051	0.0240	2.50594	0.0601	0.01346
3,3'-Dimethylbenzidine	0.0051	0.0940	3.11000	0.2923	0.06011
3-Methylcholanthrene	0.0051	0.0470	1.17528	0.0552	0.01257
4-Bromophenyphenyl ether	0.0051	0.0098	1.70059	0.0167	0.00472
4-Chloro-3-methylphenol	0.0100	0.0100	2.78805	0.0279	0.00826
4-Chlorophenylphenyl ether	0.0051	0.0091	1.72286	0.0157	0.00452
7,12-Dimethylbenz(a)anthracene	0.0051	0.0240	1.11568	0.0268	0.00680
Aramite	0.0051	0.0068	1.78213	0.0121	0.00380
bis(2-Ethylhexyl)phthalate	0.0051	0.0590	0.93476	0.0552	0.01261
Butylbenzylphthalate	0.0051	0.0095	1.77288	0.0168	0.00475
Diallate	0.0000	0.0080	1.94191	0.0155	0.00313
Dibenzofuran	0.0051	0.0095	2.13816	0.0203	0.00545
Diethylphthalate	0.0051	0.0110	3.25912	0.0359	0.00856
Di-n-butylphthalate	0.0051	0.0240	1.88222	0.0452	0.01047
Di-n-octylphthalate	0.0051	0.0095	0.76704	0.0073	0.00285
Dinoseb (2-sec-butyl-4,6-Dinitrophenol)	0.0051	0.0095	2.47355	0.0235	0.00608
Hexachlorobenzene	0.0051	0.0110	1.34906	0.0148	0.00436
Hexachlorobutadiene	0.0051	0.0044	1.78678	0.0079	0.00294

APPENDIX G-20
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CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical [1]	Surface Water Concentration [2] (mg/L)	Subsurface Soil Concentration [3] (mg/kg)	Soil-to-Invertebrate BAF (unitless)	Invertebrate Tissue Concentration [4] (mg/kg)	Dietary Intake [5] (mg/kg-BW/day)
Semivolatile Organics (cont.):					
Hexachlorocyclopentadiene	0.0051	0.0053	1.53649	0.0081	0.00300
Hexachloroethane	0.0051	0.0083	2.20597	0.0183	0.00504
Hexachloropropene	0.0051	0.0075	1.99830	0.0150	0.00438
Isosafrole	0.0051	0.0047	2.59890	0.0122	0.00381
N-Nitrosodiphenylamine	0.0051	0.0087	2.74486	0.0239	0.00616
p-Dimethylaminoazobenzene	0.0051	0.0240	1.89697	0.0455	0.01054
Pentachlorobenzene	0.0051	0.0056	1.58935	0.0089	0.00315
Pentachloronitrobenzene	0.0051	0.0240	1.86758	0.0448	0.01040
Pentachlorophenol	0.0100	0.0240	88.12000	2.1149	0.42505
Pronamide	0.0100	0.0060	2.50594	0.0150	0.00568
Metals:					
Antimony	0.0003	0.7000	1.00000	0.7000	0.14270
Beryllium	0.0000	0.5000	1.18200	0.5910	0.12005
Thallium	0.0010	0.0370	1.00000	0.0370	0.00780
Tin	0.0200	3.6000	1.00000	3.6000	0.73883

Notes:

BAF = Bioaccumulation Factor
mg/kg = miligram per kilogram
mg/kg-BW/day = milligram per kilogram-body weight per day
mg/L = milligram per liter

[1] Only those chemicals with Norway rat tissue concentrations estimated using dietary intakes and diet-to-whole body BAF values are listed (see Table G-18).
[2] Maximum detected surface water concentrations, in the case of non-detected chemicals, maximum Reporting Limits.
[3] Maximum detected subsurface soil concentrations or, in the case of non-detected chemicals, maximum Limits of Detection.
[4] Soil invertebrate tissue concentrations were derived by multiplying maximum surface soil concentrations by soil-to-invertebrate bioaccumulation factors.
[5] The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FIR_{rat})(FC_{invert})(PDF_{invert})] + [(FIR_{rat})(SC_x)(PDS)]+[(WIR_{rat})(WC_x)]\}/BW_{rat}$$

Where:

DI_x = Dietary intake of chemical x by the Norway rat (mg/kg-body weight/day)
FIR_{rat} = Maximum food ingestion rate for the Norway rat (0.04075 kg/day - dry weight basis; see Table 7-16)
FC_{invert} = Concentration of chemical x in soil invertebrate tissue (chemical-specific - dry weight basis; see Table G-20 above)
PDF_{invert} = Proportion of diet composed of soil invertebrates (0.98 - dry weight basis [unitless]; see Table 7-17)
SC_x = Maximum concentration in subsurface soil (chemical specific - dry weight basis; see Table G-20 above)
PDS = Proportion of diet composed of subsurface soil (0.02 - dry weight basis [unitless]; see Table 7-17)
WIR_{rat} = Maximum water ingestion rate for the rat (0.5305 L/day; see Table 7-16)
WC_x = Maximum concentration in surface water (chemical-specific; see Table G-20 above)
BW_{rat} = Minimum body weight for the Norway rat (0.200 kg; see Table 7-16)

TABLE G-21
FOOD ITEM CONCENTRATIONS, DIETARY DOSES, AND HAZARD QUOTIENT VALUES FOR GREEN HERON DIETARY EXPOSURES TO CHEMICALS IN SEDIMENT: STEP 2 SCREENING LEVEL RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Surface Water Concentration (1) (mg/L)	Sediment Concentration (2) (mg/kg)	Sediment-to-Fish BAF (unitless)	Fish Concentration (3) (mg/kg)	Dietary Intake (4) (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates (6)		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC (5) (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Volatile Organics:											
1,1,1,2-Tetrachloroethane	0.0005	0.012	1.00000	0.0120	0.00231	NA	NA	NA	---	---	---
Carbon tetrachloride	0.0005	0.012	1.00000	0.0120	0.00231	NA	NA	NA	---	---	---
Chlorobenzene	0.0005	0.012	1.00000	0.0120	0.00231	NA	NA	NA	---	---	---
Chloroform	0.0012	0.012	1.00000	0.0120	0.00242	NA	NA	NA	---	---	---
Ethylbenzene	0.0005	0.012	1.00000	0.0120	0.00231	NA	NA	NA	---	---	---
Pentachloroethane	0.0005	0.012	1.00000	0.0120	0.00231	NA	NA	NA	---	---	---
Styrene	0.0005	0.012	1.00000	0.0120	0.00231	NA	NA	NA	---	---	---
Toluene	0.0005	0.012	1.00000	0.0120	0.00231	NA	NA	NA	---	---	---
Trichloroethene	0.0005	0.012	1.00000	0.0120	0.00231	NA	NA	NA	---	---	---
Xylene, o-	0.0005	0.012	1.00000	0.0120	0.00231	40.50000	203.00000	90.67249	<0.01	<0.01	<0.01
Xylene, m/p-	0.0010	0.001	1.00000	0.0008	0.00030	40.50000	203.00000	90.67249	<0.01	<0.01	<0.01
Xylenes, Total	0.0005	0.001	1.00000	0.0008	0.00022	40.50000	203.00000	90.67249	<0.01	<0.01	<0.01
Semivolatile Organics:											
1,2,4,5-Tetrachlorobenzene	0.0051	0.360	1.00000	0.3600	0.06775	NA	NA	NA	---	---	---
1,2,4-Trichlorobenzene	0.0051	0.360	1.96836	0.7086	0.13259	NA	NA	NA	---	---	---
1,2-Dichlorobenzene	0.0051	0.360	1.25754	0.4527	0.08499	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
1,3-Dichlorobenzene	0.0051	0.360	0.22701	0.0817	0.01599	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
1,4-Dichlorobenzene	0.0051	0.360	1.00000	0.3600	0.06775	16.00000	80.00000	35.77709	<0.01	<0.01	<0.01
2,3,4,6-Tetrachlorophenol	0.0100	0.700	1.00000	0.7000	0.13175	NA	NA	NA	---	---	---
2,4,5-Trichlorophenol	0.0100	0.700	1.00000	0.7000	0.13175	NA	NA	NA	---	---	---
2,4,6-Trichlorophenol	0.0100	0.700	1.00000	0.7000	0.13175	NA	NA	NA	---	---	---
2,4-Dichlorophenol	0.0100	0.700	1.00000	0.7000	0.13175	NA	NA	NA	---	---	---
2-Acetylaminofluorene	0.0051	0.360	1.00000	0.3600	0.06775	NA	NA	NA	---	---	---
2-Chloronaphthalene	0.0051	0.360	1.00000	0.3600	0.06775	NA	NA	NA	---	---	---
3,3'-Dichlorobenzidine	0.0051	0.360	1.00000	0.3600	0.06775	NA	NA	NA	---	---	---
3,3'-Dimethylbenzidine	0.0051	0.360	1.00000	0.3600	0.06775	NA	NA	NA	---	---	---
3-Methylcholanthrene	0.0051	0.360	1.00000	0.3600	0.06775	NA	NA	NA	---	---	---
4-Bromophenyl phenyl ether	0.0051	0.360	1.00000	0.3600	0.06775	NA	NA	NA	---	---	---
4-Chloro-3-methylphenol	0.0100	0.700	1.00000	0.7000	0.13175	NA	NA	NA	---	---	---
4-Chlorophenyl phenyl ether	0.0051	0.360	1.00000	0.3600	0.06775	NA	NA	NA	---	---	---
7,12-Dimethylbenz(a)anthracene	0.0051	0.360	1.00000	0.3600	0.06775	2.00000	20.00000	6.32456	0.03	<0.01	0.01
Aramite, total	0.0051	0.360	1.00000	0.3600	0.06775	NA	NA	NA	---	---	---
Bis(2-ethylhexyl)phthalate	0.0051	0.730	34.67948	25.3160	4.70944	1.11000	5.55000	2.48204	4.24	0.85	1.90
Butyl benzyl phthalate	0.0051	0.063	1.00000	0.0630	0.01251	NA	NA	NA	---	---	---
Diallate, cis-	0.0051	0.360	1.00000	0.3600	0.06775	NA	NA	NA	---	---	---
Diallate, trans-	0.0051	0.360	1.00000	0.3600	0.06775	NA	NA	NA	---	---	---
Dibenzofuran	0.0051	0.360	0.40104	0.1444	0.02764	NA	NA	NA	---	---	---
Diethyl phthalate	0.0051	0.360	1.00000	0.3600	0.06775	NA	NA	NA	---	---	---
Di-n-butyl phthalate	0.0051	0.360	1.00000	0.3600	0.06775	0.22200	1.11000	0.49641	0.31	0.06	0.14
Di-n-octyl phthalate	0.0051	0.360	1.00000	0.3600	0.06775	50.00000	250.00000	111.80340	<0.01	<0.01	<0.01
Dinoseb	0.0051	0.360	1.00000	0.3600	0.06775	0.26400	1.32000	0.59032	0.26	0.05	0.11
Hexachlorobenzene	0.0051	0.360	1.01143	0.3641	0.06851	0.11000	0.57000	0.25040	0.62	0.12	0.27
Hexachlorobutadiene	0.0051	0.360	1.00000	0.3600	0.06775	3.39000	17.00000	7.59144	0.02	<0.01	<0.01
Hexachlorocyclopentadiene	0.0051	0.360	1.00000	0.3600	0.06775	NA	NA	NA	---	---	---
Hexachloroethane	0.0051	0.360	1.00000	0.3600	0.06775	NA	NA	NA	---	---	---
Hexachloropropene	0.0051	0.360	1.00000	0.3600	0.06775	NA	NA	NA	---	---	---
Isosafrole	0.0051	0.360	1.00000	0.3600	0.06775	NA	NA	NA	---	---	---
n-Nitrosodiphenylamine	0.0051	0.360	1.00000	0.3600	0.06775	NA	NA	NA	---	---	---
p-Dimethylamino azobenzene	0.0051	0.360	1.00000	0.3600	0.06775	NA	NA	NA	---	---	---
Pentachlorobenzene	0.0051	0.360	0.44952	0.1618	0.03089	NA	NA	NA	---	---	---
Pentachloronitrobenzene	0.0051	0.360	1.00000	0.3600	0.06775	7.07000	70.70000	22.35730	<0.01	<0.01	<0.01
Pentachlorophenol	0.0100	0.700	1.00000	0.7000	0.13175	6.73000	67.30000	21.28213	0.02	<0.01	<0.01
Pronamide	0.0100	0.690	1.00000	0.6900	0.12989	NA	NA	NA	---	---	---
LLPAHs:											
2-Methylnaphthalene	0.0002	0.004	2.04859	0.0090	0.00171	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Acenaphthene	0.0002	0.360	0.48099	0.1732	0.03224	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Acenaphthylene	0.0002	0.002	0.29893	0.0005	0.00012	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01

TABLE G-21
FOOD ITEM CONCENTRATIONS, DIETARY DOSES, AND HAZARD QUOTIENT VALUES FOR GREEN HERON DIETARY EXPOSURES TO CHEMICALS IN SEDIMENT: STEP 2 SCREENING LEVEL RISK CALCULATION
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Surface Water Concentration [1] (mg/L)	Sediment Concentration [2] (mg/kg)	Sediment-to-Fish BAF (unitless)	Fish Concentration [3] (mg/kg)	Dietary Intake [4] (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates [6]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [5] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
LLPAHs (cont.):											
Anthracene	0.0002	0.005	0.14722	0.0007	0.00016	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(a)anthracene	0.0002	0.005	0.34880	0.0017	0.00036	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(a)pyrene	0.0002	0.360	0.03967	0.0143	0.00269	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(b)fluoranthene	0.0002	0.360	0.04439	0.0160	0.00300	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(g,h,i)perylene	0.0002	0.360	0.63751	0.2295	0.04272	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Benzo(k)fluoranthene	0.0002	0.360	0.04093	0.0147	0.00277	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Chrysene	0.0002	0.007	0.25085	0.0017	0.00035	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Dibenzo(a,h)anthracene	0.0002	0.360	0.04082	0.0147	0.00277	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Fluoranthene	0.0000	0.036	0.10798	0.0039	0.00073	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Fluorene	0.0002	0.002	1.39787	0.0032	0.00063	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	0.0002	0.008	0.44896	0.0037	0.00073	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Naphthalene	0.0002	0.360	2.82824	1.0182	0.18941	39.50000	198.00000	88.43642	0.01	<0.01	<0.01
Phenanthrene	0.0002	0.006	0.70185	0.0044	0.00085	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Pyrene	0.0000	0.041	0.51954	0.0213	0.00396	39.50000	198.00000	88.43642	<0.01	<0.01	<0.01
Organochlorine Pesticides:											
4,4'-DDD	0.0001	0.006	17.24200	0.1017	0.01894	0.22700	2.27000	0.71784	0.08	<0.01	0.03
4,4'-DDE	0.0000	0.160	229.28800	36.6861	6.82343	0.22700	2.27000	0.71784	30.06	3.01	9.51
4,4'-DDT	0.0000	0.001	15.01400	0.0195	0.00363	0.22700	2.27000	0.71784	0.02	<0.01	<0.01
Aldrin	0.0001	0.001	20.22900	0.0134	0.00249	0.07000	0.35000	0.15652	0.04	<0.01	0.02
alpha-BHC	0.0001	0.004	20.22900	0.0728	0.01355	0.56300	2.25000	1.12550	0.02	<0.01	0.01
alpha-Chlordane	0.0001	0.025	20.55400	0.5139	0.09558	2.14000	10.70000	4.78519	0.04	<0.01	0.02
beta-BHC	0.0001	0.002	20.22900	0.0364	0.00678	0.56300	2.25000	1.12550	0.01	<0.01	<0.01
Chlorobenzilate	0.0051	0.360	1.00000	0.3600	0.06775	9.73000	19.73000	13.85543	<0.01	<0.01	<0.01
delta-BHC	0.0001	0.004	20.22900	0.0728	0.01355	0.56300	2.25000	1.12550	0.02	<0.01	0.01
Dieldrin	0.0001	0.001	105.48800	0.0949	0.01767	0.70900	3.78000	1.63708	0.02	<0.01	0.01
Endosulfan I	0.0001	0.004	20.22900	0.0728	0.01355	10.00000	50.00000	22.36068	<0.01	<0.01	<0.01
Endosulfan II	0.0001	0.007	20.22900	0.1416	0.02635	10.00000	50.00000	22.36068	<0.01	<0.01	<0.01
Endosulfan sulfate	0.0001	0.007	20.22900	0.1416	0.02635	10.00000	50.00000	22.36068	<0.01	<0.01	<0.01
Endrin	0.0001	0.007	20.22900	0.1416	0.02635	0.02100	0.10400	0.04673	1.25	0.25	0.56
Endrin aldehyde	0.0001	0.001	20.22900	0.0223	0.00415	0.02100	0.10400	0.04673	0.20	0.04	0.09
gamma-BHC (lindane)	0.0001	0.004	20.22900	0.0728	0.01355	4.00000	20.00000	8.94427	<0.01	<0.01	<0.01
gamma-Chlordane	0.0001	0.031	18.89800	0.5858	0.10897	2.14000	10.70000	4.78519	0.05	0.01	0.02
Heptachlor	0.0001	0.001	20.22900	0.0243	0.00452	0.49000	2.17000	1.03116	<0.01	<0.01	<0.01
Heptachlor epoxide	0.0001	0.004	20.22900	0.0728	0.01355	0.49000	2.17000	1.03116	0.03	<0.01	0.01
Isodrin	0.0051	0.360	1.00000	0.3600	0.06775	NA	NA	NA	---	---	---
Metals:											
Antimony	0.0003	0.800	1.00000	0.8000	0.14884	4740.00000	47400.00000	14989.19611	<0.01	<0.01	<0.01
Arsenic	0.0005	1.500	1.00000	1.5000	0.27907	2.24000	4.51000	3.17843	0.12	0.06	0.09
Barium	0.0214	164.000	1.00000	164.0000	30.50649	20.80000	41.70000	29.45098	1.47	0.73	1.04
Beryllium	0.0010	0.450	1.00000	0.4500	0.08385	NA	NA	NA	---	---	---
Cadmium	0.0010	0.990	2.00000	1.9800	0.36843	1.47000	6.36000	3.05765	0.25	0.06	0.12
Chromium, total	0.0008	42.100	1.00000	42.1000	7.83050	2.66000	15.60000	6.44174	2.94	0.50	1.22
Cobalt	0.0003	31.900	1.00000	31.9000	5.93329	7.61000	18.30000	11.80097	0.78	0.32	0.50
Copper	0.0040	187.000	1.00000	187.0000	34.78167	4.05000	12.10000	7.00036	8.59	2.87	4.97
Lead	0.0010	71.200	0.39000	27.7680	5.16486	1.63000	3.26000	2.30517	3.17	1.58	2.24
Mercury	0.0002	0.190	4.58000	0.8702	0.16188	0.02600	0.07800	0.04503	6.23	2.08	3.59
Nickel	0.0010	28.100	1.00000	28.1000	5.22661	6.71000	18.60000	11.17166	0.78	0.28	0.47
Selenium	0.0008	1.000	1.00000	1.0000	0.18611	0.29000	0.57900	0.40977	0.64	0.32	0.45
Silver	0.0010	0.230	1.00000	0.2300	0.04293	2.02000	20.20000	6.38780	0.02	<0.01	<0.01
Thallium	0.0010	0.140	1.00000	0.1400	0.02619	0.35000	1.75000	0.78262	0.07	0.01	0.03
Tin	0.0200	10.500	1.00000	10.5000	1.95605	6.80000	16.90000	10.72007	0.29	0.12	0.18
Vanadium	0.0076	232.000	1.00000	232.0000	43.15200	0.34400	0.68800	0.48649	125.44	62.72	88.70
Zinc	0.0079	357.000	4.82000	1720.7400	320.05016	66.10000	171.00000	106.31604	4.84	1.87	3.01

TABLE G-21
FOOD ITEM CONCENTRATIONS, DIETARY DOSES, AND HAZARD QUOTIENT VALUES FOR GREEN HERON DIETARY EXPOSURES TO CHEMICALS IN SEDIMENT: STEP 2 SCREENING LEVEL RISK CALCULATION
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CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Notes:

BAF = Bioaccumulation Factor
PAH = Polynuclear Aromatic Hydrocarbon
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
HQ = Hazard Quotient
mg/kg-BW/day = milligram per kilogram-body weight per day
ln = natural logarithm
NA = Not Available
--- = Step 2 screening level risk estimate could not be calculated due to the lack of a toxicity reference value.
mg/kg = milligram per kilogram
mg/L = milligram per liter

(1) Maximum detected surface water concentrations , in the case of non-detected chemicals, maximum Reporting Limits.
(2) Maximum detected sediment concentrations or, in the case of non-detected chemicals, maximum Reporting Limits/Limits of Detection.
(3) As discussed in Section 7.5.2.2.1, fish tissue concentrations were derived by multiplying maximum sediment concentrations by sediment-to-fish bioaccumulation factors.
(4) The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FIR_{heron})(FC_f)(PDF_f)] + [(FIR_{heron})(SC_x)(PDS)]+[(WIR_{heron})(WC_x)]\}/BW_{heron}$$

Where:

DI_x = Dietary intake of chemical x by the green heron (mg/kg-body weight/day)
FIR_{heron} = Maximum food ingestion rate for the green heron (0.02567 kg/day - dry weight; see Table 7-16)
FC_f= Concentration of chemical x in fish tissue (chemical-specific - dry weight; see Table G-21 above)
PDF_f = Proportion of diet composed of fish (1.0 - dry weight basis [unitless]; see Table 7-17)
SC_x = Maximum concentration in sediment (chemical specific - dry weight; see Table G-21 above)
PDS = Proportion of diet composed of sediment (0.0 - dry weight basis [unitless]; see Table 7-17)
WIR_{heron} = Maximum water ingestion rate for the green heron (0.02139 L/day; see Table 7-16)
WC_x = Maximum concentration of chemical x in drinking water (chemical specific; see Table G-21 above)
BW_{heron} = Minimum body weight for the green heron (0.138 kg; see Table 7-16)

(5) MATC values were derived by calculating the geometric mean of the NOAEL and LOAEL values.
(6) NOAEL-, LOAEL, and MATC-based screening level risk estimates (i.e., HQs) were derived by dividing dietary intakes by NOAEL, LOAEL-, and MATC-based toxicity reference values, respectively.

APPENDIX H
2010 SURFACE SOIL STATISTICS

General UCL Statistics for Data Sets with Non-Detects

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Beryllium: SWMU 59 Surface Soil, 2010 CMS Investigation

General Statistics

Number of Valid Data	19	Number of Detected Data	16
Number of Distinct Detected Data	14	Number of Non-Detect Data	3
		Percent Non-Detects	15.79%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.14	Minimum Detected	-1.966
Maximum Detected	0.62	Maximum Detected	-0.478
Mean of Detected	0.276	Mean of Detected	-1.358
SD of Detected	0.118	SD of Detected	0.379
Minimum Non-Detect	2.8	Minimum Non-Detect	1.03
Maximum Non-Detect	2.9	Maximum Non-Detect	1.065

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	19
Number treated as Detected	0
Single DL Non-Detect Percentage	100.00%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.857	Shapiro Wilk Test Statistic	0.972
5% Shapiro Wilk Critical Value	0.887	5% Shapiro Wilk Critical Value	0.887
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.459	Mean	-1.087
SD	0.447	SD	0.731
95% DL/2 (t) UCL	0.637	95% H-Stat (DL/2) UCL	0.65
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-1.358
		SD in Log Scale	0.352
		Mean in Original Scale	0.274
		SD in Original Scale	0.109
		95% t UCL	0.317
		95% Percentile Bootstrap UCL	0.314
		95% BCA Bootstrap UCL	0.325
		95% H-UCL	0.32

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	5.844	Data appear Gamma Distributed at 5% Significance Level
Theta Star	0.0473	
nu star	187	
A-D Test Statistic	0.304	**Nonparametric Statistics**
5% A-D Critical Value	0.74	Kaplan-Meier (KM) Method
K-S Test Statistic	0.74	Mean 0.276
5% K-S Critical Value	0.216	SD 0.114
Data appear Gamma Distributed at 5% Significance Level		SE of Mean 0.0296
		95% KM (t) UCL 0.327
Assuming Gamma Distribution		95% KM (z) UCL 0.325
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL 0.328
Minimum	0.14	95% KM (bootstrap t) UCL 0.355
Maximum	0.62	95% KM (BCA) UCL 0.328
Mean	0.279	95% KM (Percentile Bootstrap) UCL 0.327
Median	0.26	95% KM (Chebyshev) UCL 0.405
SD	0.109	97.5% KM (Chebyshev) UCL 0.461
k star	6.957	99% KM (Chebyshev) UCL 0.57
Theta star	0.0401	
Nu star	264.4	Potential UCLs to Use
AppChi2	227.7	95% KM (BCA) UCL 0.328
95% Gamma Approximate UCL (Use when n >= 40)	0.324	
95% Adjusted Gamma UCL (Use when n < 40)	0.328	

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Beryllium: NAPR Basewide Background, Surface Soil

General Statistics

Number of Valid Data	18	Number of Detected Data	16
Number of Distinct Detected Data	13	Number of Non-Detect Data	2
		Percent Non-Detects	11.11%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.085	Minimum Detected	-2.465
Maximum Detected	0.58	Maximum Detected	-0.545
Mean of Detected	0.315	Mean of Detected	-1.258
SD of Detected	0.134	SD of Detected	0.503
Minimum Non-Detect	0.04	Minimum Non-Detect	-3.219
Maximum Non-Detect	0.1	Maximum Non-Detect	-2.303

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	3
Number treated as Detected	15
Single DL Non-Detect Percentage	16.67%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.966	Shapiro Wilk Test Statistic	0.925
5% Shapiro Wilk Critical Value	0.887	5% Shapiro Wilk Critical Value	0.887
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.284	Mean	-1.502
SD	0.155	SD	0.868
95% DL/2 (t) UCL	0.348	95% H-Stat (DL/2) UCL	0.544
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	0.279	Mean in Log Scale	-1.378
SD	0.162	SD in Log Scale	0.589
95% MLE (t) UCL	0.345	Mean in Original Scale	0.291
95% MLE (Tiku) UCL	0.347	SD in Original Scale	0.145
		95% t UCL	0.35
		95% Percentile Bootstrap UCL	0.344
		95% BCA Bootstrap UCL	0.344
		95% H UCL	0.405

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	4.095	Data appear Normal at 5% Significance Level
Theta Star	0.077	
nu star	131	
A-D Test Statistic	0.416	
5% A-D Critical Value	0.741	
K-S Test Statistic	0.741	
5% K-S Critical Value	0.216	
Data appear Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution	
Gamma ROS Statistics using Extrapolated Data	
Minimum	0.000001
Maximum	0.58
Mean	0.28
Median	0.32
SD	0.162
k star	0.425
Theta star	0.66
Nu star	15.29
AppChi2	7.462
95% Gamma Approximate UCL (Use when n >= 40)	0.574
95% Adjusted Gamma UCL (Use when n < 40)	0.617

Note: DL/2 is not a recommended method.

Nonparametric Statistics	
Kaplan-Meier (KM) Method	
Mean	0.29
SD	0.142
SE of Mean	0.0346
95% KM (t) UCL	0.35
95% KM (z) UCL	0.347
95% KM (jackknife) UCL	0.348
95% KM (bootstrap t) UCL	0.349
95% KM (BCA) UCL	0.352
95% KM (Percentile Bootstrap) UCL	0.35
95% KM (Chebyshev) UCL	0.441
97.5% KM (Chebyshev) UCL	0.506
99% KM (Chebyshev) UCL	0.634
Potential UCLs to Use	
95% KM (t) UCL	0.35
95% KM (Percentile Bootstrap) UCL	0.35

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Chromium: SWMU 59 Surface Soil, 2010 CMS Investigation

General Statistics

Number of Valid Observations	19	Number of Distinct Observations	19

Raw Statistics

Minimum	5.3
Maximum	54.4
Mean	31.09
Geometric Mean	26.99
Median	30
SD	13.97
Std. Error of Mean	3.206
Coefficient of Variation	0.449
Skewness	-0.172

Log-transformed Statistics

Minimum of Log Data	1.668
Maximum of Log Data	3.996
Mean of log Data	3.295
SD of log Data	0.621

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.97
Shapiro Wilk Critical Value	0.901

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.859
Shapiro Wilk Critical Value	0.901

Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	36.65

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	36.23
95% Modified-t UCL (Johnson-1978)	36.63

Assuming Lognormal Distribution

95% H-UCL	44.71
95% Chebyshev (MVUE) UCL	53.48
97.5% Chebyshev (MVUE) UCL	62.63
99% Chebyshev (MVUE) UCL	80.6

Gamma Distribution Test

k star (bias corrected)	3.145
Theta Star	9.885
MLE of Mean	31.09
MLE of Standard Deviation	17.53
nu star	119.5
Approximate Chi Square Value (.05)	95.28
Adjusted Level of Significance	0.0369
Adjusted Chi Square Value	93.39
Anderson-Darling Test Statistic	0.56
Anderson-Darling 5% Critical Value	0.746
Kolmogorov-Smirnov Test Statistic	0.159
Kolmogorov-Smirnov 5% Critical Value	0.199

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL (Use when n >= 40)	39
95% Adjusted Gamma UCL (Use when n < 40)	39.79

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	36.36
95% Jackknife UCL	36.65
95% Standard Bootstrap UCL	36.25
95% Bootstrap-t UCL	36.57
95% Hall's Bootstrap UCL	36.34
95% Percentile Bootstrap UCL	36.13
95% BCA Bootstrap UCL	36.19
95% Chebyshev(Mean, Sd) UCL	45.06
97.5% Chebyshev(Mean, Sd) UCL	51.11
99% Chebyshev(Mean, Sd) UCL	62.99

Potential UCL to Use

Use 95% Student's-t UCL 36.65

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Note: For highly negative-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Chromium: NAPR Basewide Background, Surface Soil

General Statistics

Number of Valid Observations	20	Number of Distinct Observations	18

Raw Statistics		Log-transformed Statistics	
Minimum	5.9	Minimum of Log Data	1.775
Maximum	47	Maximum of Log Data	3.85
Mean	25.69	Mean of log Data	3.101
Geometric Mean	22.22	SD of log Data	0.601
Median	29.95		
SD	12.22		
Std. Error of Mean	2.733		
Coefficient of Variation	0.476		
Skewness	-0.153		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.922	Shapiro Wilk Test Statistic	0.873
Shapiro Wilk Critical Value	0.905	Shapiro Wilk Critical Value	0.905
Data appear Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	30.42	95% H-UCL	35.66
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	42.55
95% Adjusted-CLT UCL (Chen-1995)	30.09	97.5% Chebyshev (MVUE) UCL	49.57
95% Modified-t UCL (Johnson-1978)	30.4	99% Chebyshev (MVUE) UCL	63.35

Gamma Distribution Test		Data Distribution
k star (bias corrected)	3.096	Data appear Normal at 5% Significance Level
Theta Star	8.299	
MLE of Mean	25.69	
MLE of Standard Deviation	14.6	
nu star	123.8	
Approximate Chi Square Value (.05)	99.13	**Nonparametric Statistics**
Adjusted Level of Significance	0.038	95% CLT UCL 30.19
Adjusted Chi Square Value	97.38	95% Jackknife UCL 30.42
		95% Standard Bootstrap UCL 30.05
Anderson-Darling Test Statistic	1.052	95% Bootstrap-t UCL 30.41
Anderson-Darling 5% Critical Value	0.746	95% Hall's Bootstrap UCL 29.81
Kolmogorov-Smirnov Test Statistic	0.231	95% Percentile Bootstrap UCL 30.06
Kolmogorov-Smirnov 5% Critical Value	0.195	95% BCA Bootstrap UCL 29.99
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 37.6
		97.5% Chebyshev(Mean, Sd) UCL 42.76
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 52.88
95% Approximate Gamma UCL (Use when n >= 40)	32.09	
95% Adjusted Gamma UCL (Use when n < 40)	32.67	

Potential UCL to Use	Use 95% Student's-t UCL 30.42

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Note: For highly negative-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Cobalt: SWMU 59 Surface Soil, 2010 CMS Investigation

General Statistics

Number of Valid Observations	19	Number of Distinct Observations	18

Raw Statistics

Minimum	10.4
Maximum	45.2
Mean	22.75
Geometric Mean	21.61
Median	21.2
SD	7.703
Std. Error of Mean	1.767
Coefficient of Variation	0.339
Skewness	1.174

Log-transformed Statistics

Minimum of Log Data	2.342
Maximum of Log Data	3.811
Mean of log Data	3.073
SD of log Data	0.331

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.918
Shapiro Wilk Critical Value	0.901

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.976
Shapiro Wilk Critical Value	0.901

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	25.82

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	26.17
95% Modified-t UCL (Johnson-1978)	25.9

Assuming Lognormal Distribution

95% H-UCL	26.41
95% Chebyshev (MVUE) UCL	30.41
97.5% Chebyshev (MVUE) UCL	33.73
99% Chebyshev (MVUE) UCL	40.23

Gamma Distribution Test

k star (bias corrected)	8.334
Theta Star	2.73
MLE of Mean	22.75
MLE of Standard Deviation	7.881
nu star	316.7
Approximate Chi Square Value (.05)	276.5
Adjusted Level of Significance	0.0369
Adjusted Chi Square Value	273.2
Anderson-Darling Test Statistic	0.262
Anderson-Darling 5% Critical Value	0.741
Kolmogorov-Smirnov Test Statistic	0.102
Kolmogorov-Smirnov 5% Critical Value	0.199

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL (Use when n >= 40)	26.06
95% Adjusted Gamma UCL (Use when n < 40)	26.38

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	25.66
95% Jackknife UCL	25.82
95% Standard Bootstrap UCL	25.6
95% Bootstrap-t UCL	26.47
95% Hall's Bootstrap UCL	27.7
95% Percentile Bootstrap UCL	25.77
95% BCA Bootstrap UCL	25.97
95% Chebyshev(Mean, Sd) UCL	30.46
97.5% Chebyshev(Mean, Sd) UCL	33.79
99% Chebyshev(Mean, Sd) UCL	40.34

Potential UCL to Use

Use 95% Student's-t UCL 25.82

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Cobalt: NAPR Basewide Background, Surface Soil

General Statistics

Number of Valid Observations	19	Number of Distinct Observations	18

Raw Statistics		Log-transformed Statistics	
Minimum	9.5	Minimum of Log Data	2.251
Maximum	50.2	Maximum of Log Data	3.916
Mean	22.84	Mean of log Data	3.015
Geometric Mean	20.39	SD of log Data	0.484
Median	21.2		
SD	11.7		
Std. Error of Mean	2.685		
Coefficient of Variation	0.512		
Skewness	1.14		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.875	Shapiro Wilk Test Statistic	0.954
Shapiro Wilk Critical Value	0.901	Shapiro Wilk Critical Value	0.901
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	27.5	95% H-UCL	28.78
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	34.16
95% Adjusted-CLT UCL (Chen-1995)	28.01	97.5% Chebyshev (MVUE) UCL	39.09
95% Modified-t UCL (Johnson-1978)	27.61	99% Chebyshev (MVUE) UCL	48.77

Gamma Distribution Test		Data Distribution
k star (bias corrected)	3.87	Data appear Gamma Distributed at 5% Significance Level
Theta Star	5.903	
MLE of Mean	22.84	
MLE of Standard Deviation	11.61	
nu star	147.1	
Approximate Chi Square Value (.05)	120	**Nonparametric Statistics**
Adjusted Level of Significance	0.0369	95% CLT UCL 27.26
Adjusted Chi Square Value	117.9	95% Jackknife UCL 27.5
		95% Standard Bootstrap UCL 27.05
Anderson-Darling Test Statistic	0.456	95% Bootstrap-t UCL 28.74
Anderson-Darling 5% Critical Value	0.744	95% Hall's Bootstrap UCL 29.76
Kolmogorov-Smirnov Test Statistic	0.185	95% Percentile Bootstrap UCL 27.39
Kolmogorov-Smirnov 5% Critical Value	0.199	95% BCA Bootstrap UCL 27.87
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 34.55
		97.5% Chebyshev(Mean, Sd) UCL 39.61
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 49.56
95% Approximate Gamma UCL (Use when n >= 40)	27.99	
95% Adjusted Gamma UCL (Use when n < 40)	28.49	

Potential UCL to Use	Use 95% Approximate Gamma UCL 27.99

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Copper: SWMU 59 Surface Soil, 2010 CMS Investigation

General Statistics

Number of Valid Observations	19	Number of Distinct Observations	19

Raw Statistics

Minimum	24.8
Maximum	291
Mean	104.5
Geometric Mean	91.22
Median	94.2
SD	62.03
Std. Error of Mean	14.23
Coefficient of Variation	0.594
Skewness	2.051

Log-transformed Statistics

Minimum of Log Data	3.211
Maximum of Log Data	5.673
Mean of log Data	4.513
SD of log Data	0.534

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.759
Shapiro Wilk Critical Value	0.901

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.915
Shapiro Wilk Critical Value	0.901

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	129.2

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	135
95% Modified-t UCL (Johnson-1978)	130.3

Assuming Lognormal Distribution

95% H-UCL	136
95% Chebyshev (MVUE) UCL	162.2
97.5% Chebyshev (MVUE) UCL	187.3
99% Chebyshev (MVUE) UCL	236.5

Gamma Distribution Test

k star (bias corrected)	3.269
Theta Star	31.96
MLE of Mean	104.5
MLE of Standard Deviation	57.79
nu star	124.2
Approximate Chi Square Value (.05)	99.49
Adjusted Level of Significance	0.0369
Adjusted Chi Square Value	97.56
Anderson-Darling Test Statistic	0.95
Anderson-Darling 5% Critical Value	0.746
Kolmogorov-Smirnov Test Statistic	0.203
Kolmogorov-Smirnov 5% Critical Value	0.199

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL (Use when n >= 40)	130.5
95% Adjusted Gamma UCL (Use when n < 40)	133.1

Data Distribution

Data appear Lognormal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	127.9
95% Jackknife UCL	129.2
95% Standard Bootstrap UCL	126.7
95% Bootstrap-t UCL	154.5
95% Hall's Bootstrap UCL	284.4
95% Percentile Bootstrap UCL	129
95% BCA Bootstrap UCL	138.2
95% Chebyshev(Mean, Sd) UCL	166.5
97.5% Chebyshev(Mean, Sd) UCL	193.4
99% Chebyshev(Mean, Sd) UCL	246.1

Potential UCL to Use

Use 95% H-UCL 136

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Copper; NAPR Basewide Background, Surface Soil

General Statistics

Number of Valid Observations	18	Number of Distinct Observations	17

Raw Statistics		Log-transformed Statistics	
Minimum	13	Minimum of Log Data	2.565
Maximum	180	Maximum of Log Data	5.193
Mean	77.11	Mean of log Data	4.152
Geometric Mean	63.53	SD of log Data	0.685
Median	66.5		
SD	46.73		
Std. Error of Mean	11.01		
Coefficient of Variation	0.606		
Skewness	0.919		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.922	Shapiro Wilk Test Statistic	0.958
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	96.27	95% H-UCL	116.1
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	138.1
95% Adjusted-CLT UCL (Chen-1995)	97.77	97.5% Chebyshev (MVUE) UCL	163.6
95% Modified-t UCL (Johnson-1978)	96.67	99% Chebyshev (MVUE) UCL	213.7

Gamma Distribution Test		Data Distribution
k star (bias corrected)	2.317	Data appear Normal at 5% Significance Level
Theta Star	33.28	
MLE of Mean	77.11	
MLE of Standard Deviation	50.66	
nu star	83.41	
Approximate Chi Square Value (.05)	63.36	**Nonparametric Statistics**
Adjusted Level of Significance	0.0357	95% CLT UCL 95.23
Adjusted Chi Square Value	61.69	95% Jackknife UCL 96.27
		95% Standard Bootstrap UCL 94.95
Anderson-Darling Test Statistic	0.193	95% Bootstrap-t UCL 100.7
Anderson-Darling 5% Critical Value	0.748	95% Hall's Bootstrap UCL 100.1
Kolmogorov-Smirnov Test Statistic	0.12	95% Percentile Bootstrap UCL 95.07
Kolmogorov-Smirnov 5% Critical Value	0.205	95% BCA Bootstrap UCL 97.31
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 125.1
		97.5% Chebyshev(Mean, Sd) UCL 145.9
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 186.7
95% Approximate Gamma UCL (Use when n >= 40)	101.5	
95% Adjusted Gamma UCL (Use when n < 40)	104.3	

Potential UCL to Use	Use 95% Student's-t UCL 96.27

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Lead: SWMU 59 Surface Soil, 2010 CMS Investigation

General Statistics

Number of Valid Observations	19	Number of Distinct Observations	19

Raw Statistics		**Log-transformed Statistics**	
Minimum	2.6	Minimum of Log Data	0.956
Maximum	654	Maximum of Log Data	6.483
Mean	82.98	Mean of log Data	2.856
Geometric Mean	17.38	SD of log Data	1.553
Median	15.1		
SD	198.9		
Std. Error of Mean	45.64		
Coefficient of Variation	2.397		
Skewness	2.773		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.422	Shapiro Wilk Test Statistic	0.874
Shapiro Wilk Critical Value	0.901	Shapiro Wilk Critical Value	0.901
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	162.1	95% H-UCL	207.2
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	146.6
95% Adjusted-CLT UCL (Chen-1995)	189.1	97.5% Chebyshev (MVUE) UCL	187.8
95% Modified-t UCL (Johnson-1978)	167	99% Chebyshev (MVUE) UCL	268.7

Gamma Distribution Test		**Data Distribution**
k star (bias corrected)	0.387	Data do not follow a Discernable Distribution (0.05)
Theta Star	214.4	
MLE of Mean	82.98	
MLE of Standard Deviation	133.4	
nu star	14.71	
Approximate Chi Square Value (.05)	7.06	**Nonparametric Statistics**
Adjusted Level of Significance	0.0369	95% CLT UCL 158
Adjusted Chi Square Value	6.601	95% Jackknife UCL 162.1
		95% Standard Bootstrap UCL 156.5
Anderson-Darling Test Statistic	2.466	95% Bootstrap-t UCL 1049
Anderson-Darling 5% Critical Value	0.819	95% Hall's Bootstrap UCL 643.4
Kolmogorov-Smirnov Test Statistic	0.299	95% Percentile Bootstrap UCL 153.9
Kolmogorov-Smirnov 5% Critical Value	0.212	95% BCA Bootstrap UCL 186
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 281.9
		97.5% Chebyshev(Mean, Sd) UCL 368
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 537.1
95% Approximate Gamma UCL (Use when n >= 40)	172.9	
95% Adjusted Gamma UCL (Use when n < 40)	184.9	

Potential UCL to Use	Use 99% Chebyshev (Mean, Sd) UCL 537.1

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Lead: NAPR Basewide Background, Surface Soil

General Statistics

Number of Valid Observations	18	Number of Distinct Observations	16

Raw Statistics		**Log-transformed Statistics**	
Minimum	2	Minimum of Log Data	0.693
Maximum	21	Maximum of Log Data	3.045
Mean	8.678	Mean of log Data	1.838
Geometric Mean	6.281	SD of log Data	0.845
Median	5.5		
SD	6.872		
Std. Error of Mean	1.62		
Coefficient of Variation	0.792		
Skewness	0.755		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.838	Shapiro Wilk Test Statistic	0.904
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	11.5	95% H-UCL	14.74
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	16.99
95% Adjusted-CLT UCL (Chen-1995)	11.65	97.5% Chebyshev (MVUE) UCL	20.56
95% Modified-t UCL (Johnson-1978)	11.54	99% Chebyshev (MVUE) UCL	27.56

Gamma Distribution Test		**Data Distribution**
k star (bias corrected)	1.449	Data Follow Appr. Gamma Distribution at 5% Significance Level
Theta Star	5.987	
MLE of Mean	8.678	
MLE of Standard Deviation	7.208	
nu star	52.18	
Approximate Chi Square Value (.05)	36.58	**Nonparametric Statistics**
Adjusted Level of Significance	0.0357	95% CLT UCL 11.34
Adjusted Chi Square Value	35.33	95% Jackknife UCL 11.5
		95% Standard Bootstrap UCL 11.28
Anderson-Darling Test Statistic	0.766	95% Bootstrap-t UCL 12
Anderson-Darling 5% Critical Value	0.755	95% Hall's Bootstrap UCL 11.37
Kolmogorov-Smirnov Test Statistic	0.2	95% Percentile Bootstrap UCL 11.48
Kolmogorov-Smirnov 5% Critical Value	0.207	95% BCA Bootstrap UCL 11.65
Data follow Appr. Gamma Distribution at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 15.74
		97.5% Chebyshev(Mean, Sd) UCL 18.79
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 24.79
95% Approximate Gamma UCL (Use when n >= 40)	12.38	
95% Adjusted Gamma UCL (Use when n < 40)	12.81	

Potential UCL to Use	Use 95% Approximate Gamma UCL 12.38

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Mercury: SWMU 59 Surface Soil, 2010 CMS Investigation

General Statistics

Number of Valid Data	19	Number of Detected Data	15
Number of Distinct Detected Data	12	Number of Non-Detect Data	4
		Percent Non-Detects	21.05%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.009	Minimum Detected	-4.711
Maximum Detected	0.095	Maximum Detected	-2.354
Mean of Detected	0.0294	Mean of Detected	-3.852
SD of Detected	0.0275	SD of Detected	0.788
Minimum Non-Detect	0.038	Minimum Non-Detect	-3.27
Maximum Non-Detect	0.041	Maximum Non-Detect	-3.194

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	15
Number treated as Detected	4
Single DL Non-Detect Percentage	78.95%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.738	Shapiro Wilk Test Statistic	0.877
5% Shapiro Wilk Critical Value	0.881	5% Shapiro Wilk Critical Value	0.881
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.0274	Mean	-3.864
SD	0.0246	SD	0.695
95% DL/2 (t) UCL	0.0372	95% H-Stat (DL/2) UCL	0.0384
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	0.0732	Mean in Log Scale	-3.919
SD	0.0189	SD in Log Scale	0.722
95% MLE (t) UCL	0.0807	Mean in Original Scale	0.0266
95% MLE (Tiku) UCL	0.0893	SD in Original Scale	0.025
		95% t UCL	0.0366
		95% Percentile Bootstrap UCL	0.0361
		95% BCA Bootstrap UCL	0.0395
		95% H UCL	0.0378

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	1.391	Data do not follow a Discernable Distribution (0.05)	
Theta Star	0.0211		
nu star	41.73		
A-D Test Statistic	1.081	Nonparametric Statistics	
5% A-D Critical Value	0.751	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.751	Mean	0.0263
5% K-S Critical Value	0.225	SD	0.0245
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.00584
		95% KM (t) UCL	0.0364
Assuming Gamma Distribution		95% KM (z) UCL	0.0359
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.0364
Minimum	0.00464	95% KM (bootstrap t) UCL	0.0434
Maximum	0.095	95% KM (BCA) UCL	0.0366
Mean	0.0275	95% KM (Percentile Bootstrap) UCL	0.0359
Median	0.017	95% KM (Chebyshev) UCL	0.0518
SD	0.0251	97.5% KM (Chebyshev) UCL	0.0628
k star	1.501	99% KM (Chebyshev) UCL	0.0844
Theta star	0.0183		
Nu star	57.02	Potential UCLs to Use	
AppChi2	40.66	95% KM (BCA) UCL	0.0366
95% Gamma Approximate UCL (Use when n >= 40)	0.0386		
95% Adjusted Gamma UCL (Use when n < 40)	0.0398		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Mercury: NAPR Basewide Background, Surface Soil

General Statistics

Number of Valid Data	20	Number of Detected Data	17
Number of Distinct Detected Data	13	Number of Non-Detect Data	3
		Percent Non-Detects	15.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.012	Minimum Detected	-4.423
Maximum Detected	0.12	Maximum Detected	-2.12
Mean of Detected	0.0584	Mean of Detected	-2.963
SD of Detected	0.0267	SD of Detected	0.551
Minimum Non-Detect	0.02	Minimum Non-Detect	-3.912
Maximum Non-Detect	0.04	Maximum Non-Detect	-3.219

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	9
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	11
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	45.00%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.958	Shapiro Wilk Test Statistic	0.913
5% Shapiro Wilk Critical Value	0.892	5% Shapiro Wilk Critical Value	0.892
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.0516	Mean	-3.174
SD	0.0296	SD	0.735
95% DL/2 (t) UCL	0.063	95% H-Stat (DL/2) UCL	0.0805
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	0.0471	Mean in Log Scale	-3.099
SD	0.035	SD in Log Scale	0.612
95% MLE (t) UCL	0.0606	Mean in Original Scale	0.0528
95% MLE (Tiku) UCL	0.063	SD in Original Scale	0.0281
		95% t UCL	0.0637
		95% Percentile Bootstrap UCL	0.0629
		95% BCA Bootstrap UCL	0.0637
		95% H UCL	0.0734

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	3.566	Data appear Normal at 5% Significance Level	
Theta Star	0.0164		
nu star	121.2		
A-D Test Statistic	0.443	Nonparametric Statistics	
5% A-D Critical Value	0.742	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.742	Mean	0.0521
5% K-S Critical Value	0.21	SD	0.0284
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	0.00657
		95% KM (t) UCL	0.0634
Assuming Gamma Distribution		95% KM (z) UCL	0.0629
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.063
Minimum	0.000001	95% KM (bootstrap t) UCL	0.0633
Maximum	0.12	95% KM (BCA) UCL	0.0639
Mean	0.0512	95% KM (Percentile Bootstrap) UCL	0.0638
Median	0.054	95% KM (Chebyshev) UCL	0.0807
SD	0.0304	97.5% KM (Chebyshev) UCL	0.0931
k star	0.776	99% KM (Chebyshev) UCL	0.117
Theta star	0.066		
Nu star	31.03	Potential UCLs to Use	
AppChi2	19.31	95% KM (t) UCL	0.0634
95% Gamma Approximate UCL (Use when n >= 40)	0.0823	95% KM (Percentile Bootstrap) UCL	0.0638
95% Adjusted Gamma UCL (Use when n < 40)	0.0856		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Nickel: SWMU 59 Surface Soil, 2010 CMS Investigation

General Statistics

Number of Valid Observations	19	Number of Distinct Observations	18

Raw Statistics

Minimum	6.1
Maximum	27.5
Mean	15.29
Geometric Mean	13.99
Median	13.5
SD	6.484
Std. Error of Mean	1.488
Coefficient of Variation	0.424
Skewness	0.534

Log-transformed Statistics

Minimum of Log Data	1.808
Maximum of Log Data	3.314
Mean of log Data	2.639
SD of log Data	0.441

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.924
Shapiro Wilk Critical Value	0.901

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.951
Shapiro Wilk Critical Value	0.901

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	17.87

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	17.93
95% Modified-t UCL (Johnson-1978)	17.9

Assuming Lognormal Distribution

95% H-UCL	18.9
95% Chebyshev (MVUE) UCL	22.29
97.5% Chebyshev (MVUE) UCL	25.3
99% Chebyshev (MVUE) UCL	31.21

Gamma Distribution Test

k star (bias corrected)	4.922
Theta Star	3.106
MLE of Mean	15.29
MLE of Standard Deviation	6.892
nu star	187
Approximate Chi Square Value (.05)	156.4
Adjusted Level of Significance	0.0369
Adjusted Chi Square Value	153.9
Anderson-Darling Test Statistic	0.401
Anderson-Darling 5% Critical Value	0.742
Kolmogorov-Smirnov Test Statistic	0.153
Kolmogorov-Smirnov 5% Critical Value	0.199

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL (Use when n >= 40)	18.28
95% Adjusted Gamma UCL (Use when n < 40)	18.58

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	17.74
95% Jackknife UCL	17.87
95% Standard Bootstrap UCL	17.68
95% Bootstrap-t UCL	17.99
95% Hall's Bootstrap UCL	17.97
95% Percentile Bootstrap UCL	17.66
95% BCA Bootstrap UCL	17.85
95% Chebyshev(Mean, Sd) UCL	21.77
97.5% Chebyshev(Mean, Sd) UCL	24.58
99% Chebyshev(Mean, Sd) UCL	30.09

Potential UCL to Use

Use 95% Student's-t UCL 17.87

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Nickel: NAPR Basewide Background, Surface Soil

General Statistics

Number of Valid Observations	19	Number of Distinct Observations	19

Raw Statistics		Log-transformed Statistics	
Minimum	3.4	Minimum of Log Data	1.224
Maximum	19	Maximum of Log Data	2.944
Mean	10.54	Mean of log Data	2.226
Geometric Mean	9.265	SD of log Data	0.535
Median	8.6		
SD	5.228		
Std. Error of Mean	1.199		
Coefficient of Variation	0.496		
Skewness	0.295		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.899	Shapiro Wilk Test Statistic	0.925
Shapiro Wilk Critical Value	0.901	Shapiro Wilk Critical Value	0.901
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	12.62	95% H-UCL	13.84
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	16.51
95% Adjusted-CLT UCL (Chen-1995)	12.6	97.5% Chebyshev (MVUE) UCL	19.06
95% Modified-t UCL (Johnson-1978)	12.63	99% Chebyshev (MVUE) UCL	24.08

Gamma Distribution Test		Data Distribution
k star (bias corrected)	3.442	Data appear Gamma Distributed at 5% Significance Level
Theta Star	3.061	
MLE of Mean	10.54	
MLE of Standard Deviation	5.68	
nu star	130.8	
Approximate Chi Square Value (.05)	105.4	**Nonparametric Statistics**
Adjusted Level of Significance	0.0369	95% CLT UCL 12.51
Adjusted Chi Square Value	103.4	95% Jackknife UCL 12.62
		95% Standard Bootstrap UCL 12.46
Anderson-Darling Test Statistic	0.663	95% Bootstrap-t UCL 12.67
Anderson-Darling 5% Critical Value	0.745	95% Hall's Bootstrap UCL 12.39
Kolmogorov-Smirnov Test Statistic	0.163	95% Percentile Bootstrap UCL 12.51
Kolmogorov-Smirnov 5% Critical Value	0.199	95% BCA Bootstrap UCL 12.44
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 15.77
		97.5% Chebyshev(Mean, Sd) UCL 18.03
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 22.47
95% Approximate Gamma UCL (Use when n >= 40)	13.08	
95% Adjusted Gamma UCL (Use when n < 40)	13.33	

Potential UCL to Use	Use 95% Approximate Gamma UCL 13.08

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Selenium: SWMU 59 Surface Soil, 2010 CMS Investigation

General Statistics

Number of Valid Data	19	Number of Detected Data	15
Number of Distinct Detected Data	14	Number of Non-Detect Data	4
		Percent Non-Detects	21.05%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.21	Minimum Detected	-1.561
Maximum Detected	2.4	Maximum Detected	0.875
Mean of Detected	0.655	Mean of Detected	-0.648
SD of Detected	0.552	SD of Detected	0.653
Minimum Non-Detect	13.9	Minimum Non-Detect	2.632
Maximum Non-Detect	14.7	Maximum Non-Detect	2.688

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	19
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	0
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	100.00%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.712	Shapiro Wilk Test Statistic	0.951
5% Shapiro Wilk Critical Value	0.881	5% Shapiro Wilk Critical Value	0.881
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	2.02	Mean	-0.098
SD	2.759	SD	1.237
95% DL/2 (t) UCL	3.118	95% H-Stat (DL/2) UCL	4.621
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-0.648
		SD in Log Scale	0.576
		Mean in Original Scale	0.627
		SD in Original Scale	0.49
		95% t UCL	0.822
		95% Percentile Bootstrap UCL	0.829
		95% BCA Bootstrap UCL	0.905
		95% H-UCL	0.819

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	1.941	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	0.338		
nu star	58.22		
A-D Test Statistic	0.556	Nonparametric Statistics	
5% A-D Critical Value	0.746	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.746	Mean	0.655
5% K-S Critical Value	0.224	SD	0.534
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	0.143
		95% KM (t) UCL	0.903
Assuming Gamma Distribution		95% KM (z) UCL	0.89
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.904
Minimum	0.21	95% KM (bootstrap t) UCL	1.146
Maximum	2.4	95% KM (BCA) UCL	0.942
Mean	0.666	95% KM (Percentile Bootstrap) UCL	0.913
Median	0.57	95% KM (Chebyshev) UCL	1.277
SD	0.487	97.5% KM (Chebyshev) UCL	1.546
k star	2.525	99% KM (Chebyshev) UCL	2.074
Theta star	0.264		
Nu star	95.96	Potential UCLs to Use	
AppChi2	74.37	95% KM (BCA) UCL	0.942
95% Gamma Approximate UCL (Use when n >= 40)	0.859		
95% Adjusted Gamma UCL (Use when n < 40)	0.879		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Tin: SWMU 59 Surface Soil, 2010 CMS Investigation

General Statistics

Number of Valid Data	19	Number of Detected Data	11
Number of Distinct Detected Data	10	Number of Non-Detect Data	8
		Percent Non-Detects	42.11%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	3	Minimum Detected	1.099
Maximum Detected	36.5	Maximum Detected	3.597
Mean of Detected	8.455	Mean of Detected	1.832
SD of Detected	9.575	SD of Detected	0.703
Minimum Non-Detect	5.1	Minimum Non-Detect	1.629
Maximum Non-Detect	6.3	Maximum Non-Detect	1.841

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	15
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	4
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	78.95%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.557	Shapiro Wilk Test Statistic	0.844
5% Shapiro Wilk Critical Value	0.85	5% Shapiro Wilk Critical Value	0.85
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	6.108	Mean	1.505
SD	7.677	SD	0.656
95% DL/2 (t) UCL	9.162	95% H-Stat (DL/2) UCL	7.819
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	1.598
		SD in Log Scale	0.605
		Mean in Original Scale	6.424
		SD in Original Scale	7.554
		95% t UCL	9.429
		95% Percentile Bootstrap UCL	9.735
		95% BCA Bootstrap UCL	11.5
		95% H-UCL	8.022

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	1.368	Data do not follow a Discernable Distribution (0.05)	
Theta Star	6.179		
nu star	30.1		
A-D Test Statistic	1.092	Nonparametric Statistics	
5% A-D Critical Value	0.74	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.74	Mean	6.473
5% K-S Critical Value	0.259	SD	7.343
Data not Gamma Distributed at 5% Significance Level		SE of Mean	1.773
		95% KM (t) UCL	9.548
Assuming Gamma Distribution		95% KM (z) UCL	9.39
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	9.489
Minimum	0.573	95% KM (bootstrap t) UCL	16.75
Maximum	36.5	95% KM (BCA) UCL	10.05
Mean	6.368	95% KM (Percentile Bootstrap) UCL	9.633
Median	4.691	95% KM (Chebyshev) UCL	14.2
SD	7.652	97.5% KM (Chebyshev) UCL	17.55
k star	1.349	99% KM (Chebyshev) UCL	24.12
Theta star	4.719		
Nu star	51.28	Potential UCLs to Use	
AppChi2	35.83	95% KM (t) UCL	9.548
95% Gamma Approximate UCL (Use when n >= 40)	9.112	95% KM (% Bootstrap) UCL	9.633
95% Adjusted Gamma UCL (Use when n < 40)	9.409		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Tin: NAPR Basewide Background, Surface Soil

General Statistics

Number of Valid Data	19	Number of Detected Data	12
Number of Distinct Detected Data	9	Number of Non-Detect Data	7
		Percent Non-Detects	36.84%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	1.4	Minimum Detected	0.336
Maximum Detected	4	Maximum Detected	1.386
Mean of Detected	2.325	Mean of Detected	0.801
SD of Detected	0.737	SD of Detected	0.304
Minimum Non-Detect	0.69	Minimum Non-Detect	-0.371
Maximum Non-Detect	1.3	Maximum Non-Detect	0.262

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	7
Number treated as Detected	12
Single DL Non-Detect Percentage	36.84%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.902	Shapiro Wilk Test Statistic	0.943
5% Shapiro Wilk Critical Value	0.859	5% Shapiro Wilk Critical Value	0.859
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	1.651	Mean	0.239
SD	1.077	SD	0.801
95% DL/2 (t) UCL	2.079	95% H-Stat (DL/2) UCL	2.726
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	1.676	Mean in Log Scale	0.527
SD	1.079	SD in Log Scale	0.438
95% MLE (t) UCL	2.105	Mean in Original Scale	1.859
95% MLE (Tiku) UCL	2.15	SD in Original Scale	0.852
		95% t UCL	2.198
		95% Percentile Bootstrap UCL	2.195
		95% BCA Bootstrap UCL	2.214
		95% H UCL	2.281

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	8.868	Data appear Normal at 5% Significance Level
Theta Star	0.262	
nu star	212.8	
A-D Test Statistic	0.409	
5% A-D Critical Value	0.731	
K-S Test Statistic	0.731	
5% K-S Critical Value	0.245	
Data appear Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution		Nonparametric Statistics	
Gamma ROS Statistics using Extrapolated Data		Kaplan-Meier (KM) Method	
Minimum	0.000001	Mean	1.984
Maximum	4	SD	0.717
Mean	1.468	SE of Mean	0.172
Median	1.9	95% KM (t) UCL	2.282
SD	1.288	95% KM (z) UCL	2.267
k star	0.165	95% KM (jackknife) UCL	2.277
Theta star	8.908	95% KM (bootstrap t) UCL	2.374
Nu star	6.264	95% KM (BCA) UCL	2.358
AppChi2	1.776	95% KM (Percentile Bootstrap) UCL	2.337
95% Gamma Approximate UCL (Use when n >= 40)	5.178	95% KM (Chebyshev) UCL	2.733
95% Adjusted Gamma UCL (Use when n < 40)	5.836	97.5% KM (Chebyshev) UCL	3.057
		99% KM (Chebyshev) UCL	3.693
		Potential UCLs to Use	
		95% KM (t) UCL	2.282
		95% KM (Percentile Bootstrap) UCL	2.337

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Vanadium: SWMU 59 Surface Soil, 2010 CMS Investigation

General Statistics

Number of Valid Observations	19	Number of Distinct Observations	19

Raw Statistics		Log-transformed Statistics	
Minimum	72.8	Minimum of Log Data	4.288
Maximum	260	Maximum of Log Data	5.561
Mean	143	Mean of log Data	4.896
Geometric Mean	133.8	SD of log Data	0.37
Median	126		
SD	55.85		
Std. Error of Mean	12.81		
Coefficient of Variation	0.39		
Skewness	0.913		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.899	Shapiro Wilk Test Statistic	0.959
Shapiro Wilk Critical Value	0.901	Shapiro Wilk Critical Value	0.901
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	165.3	95% H-UCL	169
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	196.6
95% Adjusted-CLT UCL (Chen-1995)	167	97.5% Chebyshev (MVUE) UCL	219.9
95% Modified-t UCL (Johnson-1978)	165.7	99% Chebyshev (MVUE) UCL	265.7

Gamma Distribution Test		Data Distribution
k star (bias corrected)	6.472	Data appear Gamma Distributed at 5% Significance Level
Theta Star	22.1	
MLE of Mean	143	
MLE of Standard Deviation	56.22	
nu star	245.9	
Approximate Chi Square Value (.05)	210.6	**Nonparametric Statistics**
Adjusted Level of Significance	0.0369	95% CLT UCL 164.1
Adjusted Chi Square Value	207.8	95% Jackknife UCL 165.3
		95% Standard Bootstrap UCL 163
Anderson-Darling Test Statistic	0.45	95% Bootstrap-t UCL 168.2
Anderson-Darling 5% Critical Value	0.742	95% Hall's Bootstrap UCL 166.5
Kolmogorov-Smirnov Test Statistic	0.17	95% Percentile Bootstrap UCL 164.6
Kolmogorov-Smirnov 5% Critical Value	0.199	95% BCA Bootstrap UCL 166.1
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 198.9
		97.5% Chebyshev(Mean, Sd) UCL 223
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 270.5
95% Approximate Gamma UCL (Use when n >= 40)	167	
95% Adjusted Gamma UCL (Use when n < 40)	169.3	

Potential UCL to Use	Use 95% Approximate Gamma UCL 167

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Vanadium: NAPR Basewide Background, Surface Soil

General Statistics

Number of Valid Observations	18	Number of Distinct Observations	17

Raw Statistics		Log-transformed Statistics	
Minimum	35	Minimum of Log Data	3.555
Maximum	230	Maximum of Log Data	5.438
Mean	141.6	Mean of log Data	4.85
Geometric Mean	127.8	SD of log Data	0.502
Median	151.5		
SD	58.77		
Std. Error of Mean	13.85		
Coefficient of Variation	0.415		
Skewness	-0.0584		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.95	Shapiro Wilk Test Statistic	0.906
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	165.7	95% H-UCL	185.4
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	220.5
95% Adjusted-CLT UCL (Chen-1995)	164.1	97.5% Chebyshev (MVUE) UCL	253.7
95% Modified-t UCL (Johnson-1978)	165.6	99% Chebyshev (MVUE) UCL	318.9

Gamma Distribution Test		Data Distribution
k star (bias corrected)	4.237	Data appear Normal at 5% Significance Level
Theta Star	33.41	
MLE of Mean	141.6	
MLE of Standard Deviation	68.78	
nu star	152.5	
Approximate Chi Square Value (.05)	125	**Nonparametric Statistics**
Adjusted Level of Significance	0.0357	95% CLT UCL 164.4
Adjusted Chi Square Value	122.6	95% Jackknife UCL 165.7
		95% Standard Bootstrap UCL 164.6
Anderson-Darling Test Statistic	0.451	95% Bootstrap-t UCL 164.8
Anderson-Darling 5% Critical Value	0.743	95% Hall's Bootstrap UCL 163.2
Kolmogorov-Smirnov Test Statistic	0.166	95% Percentile Bootstrap UCL 163.9
Kolmogorov-Smirnov 5% Critical Value	0.204	95% BCA Bootstrap UCL 163.1
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 201.9
		97.5% Chebyshev(Mean, Sd) UCL 228.1
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 279.4
95% Approximate Gamma UCL (Use when n >= 40)	172.8	
95% Adjusted Gamma UCL (Use when n < 40)	176.1	

Potential UCL to Use	Use 95% Student's-t UCL 165.7

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Note: For highly negative-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Zinc: SWMU 59 Surface Soil, 2010 CMS Investigation

General Statistics

Number of Valid Observations	19	Number of Distinct Observations	19

Raw Statistics

Minimum	34.1
Maximum	747
Mean	141
Geometric Mean	96.83
Median	80.5
SD	176
Std. Error of Mean	40.38
Coefficient of Variation	1.249
Skewness	2.873

Log-transformed Statistics

Minimum of Log Data	3.529
Maximum of Log Data	6.616
Mean of log Data	4.573
SD of log Data	0.759

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.552
Shapiro Wilk Critical Value	0.901

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.83
Shapiro Wilk Critical Value	0.901

Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	211

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	235.9
95% Modified-t UCL (Johnson-1978)	215.5

Assuming Lognormal Distribution

95% H-UCL	194.6
95% Chebyshev (MVUE) UCL	230.1
97.5% Chebyshev (MVUE) UCL	274.9
99% Chebyshev (MVUE) UCL	362.7

Gamma Distribution Test

k star (bias corrected)	1.277
Theta Star	110.4
MLE of Mean	141
MLE of Standard Deviation	124.7
nu star	48.54
Approximate Chi Square Value (.05)	33.55
Adjusted Level of Significance	0.0369
Adjusted Chi Square Value	32.46
Anderson-Darling Test Statistic	2.156
Anderson-Darling 5% Critical Value	0.758
Kolmogorov-Smirnov Test Statistic	0.282
Kolmogorov-Smirnov 5% Critical Value	0.202

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL (Use when n >= 40)	204
95% Adjusted Gamma UCL (Use when n < 40)	210.8

Data Distribution

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

95% CLT UCL	207.4
95% Jackknife UCL	211
95% Standard Bootstrap UCL	206.1
95% Bootstrap-t UCL	377.1
95% Hall's Bootstrap UCL	461.9
95% Percentile Bootstrap UCL	209.7
95% BCA Bootstrap UCL	235.9
95% Chebyshev(Mean, Sd) UCL	317
97.5% Chebyshev(Mean, Sd) UCL	393.2
99% Chebyshev(Mean, Sd) UCL	542.8

Potential UCL to Use

Use 95% Chebyshev (Mean, Sd) UCL 317

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Zinc: NAPR Basewide Background, Surface Soil

General Statistics

Number of Valid Observations	18	Number of Distinct Observations	18

Raw Statistics		Log-transformed Statistics	
Minimum	6.2	Minimum of Log Data	1.825
Maximum	120	Maximum of Log Data	4.787
Mean	52.48	Mean of log Data	3.742
Geometric Mean	42.17	SD of log Data	0.751
Median	47		
SD	32.33		
Std. Error of Mean	7.621		
Coefficient of Variation	0.616		
Skewness	0.788		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.925	Shapiro Wilk Test Statistic	0.936
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	65.73	95% H-UCL	85.05
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	100.2
95% Adjusted-CLT UCL (Chen-1995)	66.52	97.5% Chebyshev (MVUE) UCL	119.8
95% Modified-t UCL (Johnson-1978)	65.97	99% Chebyshev (MVUE) UCL	158.3

Gamma Distribution Test		Data Distribution
k star (bias corrected)	2.07	Data appear Normal at 5% Significance Level
Theta Star	25.36	
MLE of Mean	52.48	
MLE of Standard Deviation	36.48	
nu star	74.51	
Approximate Chi Square Value (.05)	55.63	**Nonparametric Statistics**
Adjusted Level of Significance	0.0357	95% CLT UCL 65.01
Adjusted Chi Square Value	54.06	95% Jackknife UCL 65.73
		95% Standard Bootstrap UCL 64.86
Anderson-Darling Test Statistic	0.235	95% Bootstrap-t UCL 67.73
Anderson-Darling 5% Critical Value	0.75	95% Hall's Bootstrap UCL 68.15
Kolmogorov-Smirnov Test Statistic	0.119	95% Percentile Bootstrap UCL 64.96
Kolmogorov-Smirnov 5% Critical Value	0.206	95% BCA Bootstrap UCL 66.14
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 85.7
		97.5% Chebyshev(Mean, Sd) UCL 100.1
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 128.3
95% Approximate Gamma UCL (Use when n >= 40)	70.29	
95% Adjusted Gamma UCL (Use when n < 40)	72.32	

Potential UCL to Use	Use 95% Student's-t UCL 65.73

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Acetone: SWMU 59 Surface Soil, 2010 CMS Investigation

General Statistics

Number of Valid Data	19	Number of Detected Data	13
Number of Distinct Detected Data	13	Number of Non-Detect Data	6
		Percent Non-Detects	31.58%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	24	Minimum Detected	3.178
Maximum Detected	190	Maximum Detected	5.247
Mean of Detected	67.08	Mean of Detected	4.012
SD of Detected	46.81	SD of Detected	0.636
Minimum Non-Detect	9.6	Minimum Non-Detect	2.262
Maximum Non-Detect	17	Maximum Non-Detect	2.833

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	6
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	13
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	31.58%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.834	Shapiro Wilk Test Statistic	0.948
5% Shapiro Wilk Critical Value	0.866	5% Shapiro Wilk Critical Value	0.866
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	48.15	Mean	3.36
SD	47.76	SD	1.119
95% DL/2 (t) UCL	67.15	95% H-Stat (DL/2) UCL	112.2
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	38.71	Mean in Log Scale	3.522
SD	58.68	SD in Log Scale	0.908
95% MLE (t) UCL	62.05	Mean in Original Scale	49.63
95% MLE (Tiku) UCL	63.56	SD in Original Scale	46.45
		95% t UCL	68.11
		95% Percentile Bootstrap UCL	67.95
		95% BCA Bootstrap UCL	71.7
		95% H UCL	86.97

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	2.152	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	31.17		
nu star	55.94		
A-D Test Statistic	0.379	Nonparametric Statistics	
5% A-D Critical Value	0.74	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.74	Mean	53.47
5% K-S Critical Value	0.239	SD	42.25
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	10.09
		95% KM (t) UCL	70.97
Assuming Gamma Distribution		95% KM (z) UCL	70.07
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	70.52
Minimum	0.000001	95% KM (bootstrap t) UCL	82.38
Maximum	190	95% KM (BCA) UCL	73.68
Mean	45.89	95% KM (Percentile Bootstrap) UCL	70.89
Median	34	95% KM (Chebyshev) UCL	97.44
SD	49.87	97.5% KM (Chebyshev) UCL	116.5
k star	0.155	99% KM (Chebyshev) UCL	153.8
Theta star	296.3		
Nu star	5.885	Potential UCLs to Use	
AppChi2	1.582	95% KM (Percentile Bootstrap) UCL	70.89
95% Gamma Approximate UCL (Use when n >= 40)	170.8		
95% Adjusted Gamma UCL (Use when n < 40)	193.5		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

4,4'-DDE: SWMU 59 Surface Soil, 2010 CMS Investigation

General Statistics

Number of Valid Data	19	Number of Detected Data	10
Number of Distinct Detected Data	10	Number of Non-Detect Data	9
		Percent Non-Detects	47.37%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.46	Minimum Detected	-0.777
Maximum Detected	160	Maximum Detected	5.075
Mean of Detected	23.73	Mean of Detected	1.3
SD of Detected	50.51	SD of Detected	2.003
Minimum Non-Detect	3.6	Minimum Non-Detect	1.281
Maximum Non-Detect	19	Maximum Non-Detect	2.944

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	17
Number treated as Detected	2
Single DL Non-Detect Percentage	89.47%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.544	Shapiro Wilk Test Statistic	0.905
5% Shapiro Wilk Critical Value	0.842	5% Shapiro Wilk Critical Value	0.842
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	13.82	Mean	1.089
SD	37.33	SD	1.477
95% DL/2 (t) UCL	28.67	95% H-Stat (DL/2) UCL	28.42
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	0.758
		SD in Log Scale	1.567
		Mean in Original Scale	13.1
		SD in Original Scale	37.53
		95% t UCL	28.03
		95% Percentile Bootstrap UCL	29.11
		95% BCA Bootstrap UCL	40.71
		95% H-UCL	26.54

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	0.318	Data Follow Appr. Gamma Distribution at 5% Significance Level
Theta Star	74.67	
nu star	6.356	
A-D Test Statistic	0.903	
5% A-D Critical Value	0.803	
K-S Test Statistic	0.803	
5% K-S Critical Value	0.286	
Data follow Appr. Gamma Distribution at 5% Significance Level		

Assuming Gamma Distribution	
Gamma ROS Statistics using Extrapolated Data	
Minimum	0.000001
Maximum	160
Mean	12.54
Median	0.46
SD	37.72
k star	0.131
Theta star	95.77
Nu star	4.974
AppChi2	1.14
95% Gamma Approximate UCL (Use when n >= 40)	54.69
95% Adjusted Gamma UCL (Use when n < 40)	62.95

Note: DL/2 is not a recommended method.

Nonparametric Statistics	
Kaplan-Meier (KM) Method	
Mean	13.17
SD	36.51
SE of Mean	8.835
95% KM (t) UCL	28.49
95% KM (z) UCL	27.7
95% KM (jackknife) UCL	28.1
95% KM (bootstrap t) UCL	153.6
95% KM (BCA) UCL	29.63
95% KM (Percentile Bootstrap) UCL	29.19
95% KM (Chebyshev) UCL	51.68
97.5% KM (Chebyshev) UCL	68.34
99% KM (Chebyshev) UCL	101.1
Potential UCLs to Use	
95% KM (BCA) UCL	29.63

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

4,4'-DDT: SWMU 59 Surface Soil, 2010 CMS Investigation

General Statistics

Number of Valid Data	19	Number of Detected Data	9
Number of Distinct Detected Data	9	Number of Non-Detect Data	10
		Percent Non-Detects	52.63%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.66	Minimum Detected	-0.416
Maximum Detected	160	Maximum Detected	5.075
Mean of Detected	20.85	Mean of Detected	1.212
SD of Detected	52.37	SD of Detected	1.711
Minimum Non-Detect	3.6	Minimum Non-Detect	1.281
Maximum Non-Detect	19	Maximum Non-Detect	2.944

Note: Data have multiple DLs - Use of KM Method is recommended	Number treated as Non-Detect	18
For all methods (except KM, DL/2, and ROS Methods),	Number treated as Detected	1
Observations < Largest ND are treated as NDs	Single DL Non-Detect Percentage	94.74%

Warning: There are only 9 Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.446	Shapiro Wilk Test Statistic	0.827
5% Shapiro Wilk Critical Value	0.829	5% Shapiro Wilk Critical Value	0.829
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	11.32	Mean	1.02
SD	36.17	SD	1.209
95% DL/2 (t) UCL	25.71	95% H-Stat (DL/2) UCL	13.22
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	0.906
		SD in Log Scale	1.213
		Mean in Original Scale	10.94
		SD in Original Scale	36.23
		95% t UCL	25.35
		95% Percentile Bootstrap UCL	27.45
		95% BCA Bootstrap UCL	43.42
		95% H-UCL	11.92

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.318	Data do not follow a Discernable Distribution (0.05)	
Theta Star	65.57		
nu star	5.723		
A-D Test Statistic	1.438	**Nonparametric Statistics**	
5% A-D Critical Value	0.795	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.795	Mean	10.86
5% K-S Critical Value	0.299	SD	35.29
Data not Gamma Distributed at 5% Significance Level		SE of Mean	8.593
		95% KM (t) UCL	25.76
Assuming Gamma Distribution		95% KM (z) UCL	25
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	25.3
Minimum	0.000001	95% KM (bootstrap t) UCL	264.8
Maximum	160	95% KM (BCA) UCL	27.48
Mean	10.83	95% KM (Percentile Bootstrap) UCL	27.33
Median	0.85	95% KM (Chebyshev) UCL	48.32
SD	36.35	97.5% KM (Chebyshev) UCL	64.53
k star	0.127	99% KM (Chebyshev) UCL	96.36
Theta star	85.5		
Nu star	4.811	Potential UCLs to Use	
AppChi2	1.066	97.5% KM (Chebyshev) UCL	64.53
95% Gamma Approximate UCL (Use when n >= 40)	48.86		
95% Adjusted Gamma UCL (Use when n < 40)	56.43		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

General Background Statistics for Full Data Sets

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Coverage	90%
Different or Future K Values	1
Number of Bootstrap Operations	2000

Chromium: SWMU 59 Surface Soil, 2010 CMS Investigation

General Statistics

Total Number of Observations	19	Number of Distinct Observations	19
Tolerance Factor	1.949		

Raw Statistics

Minimum	5.3
Maximum	54.4
Second Largest	51.2
First Quartile	21.95
Median	30
Third Quartile	41.75
Mean	31.09
Geometric Mean	26.99
SD	13.97
Coefficient of Variation	0.449
Skewness	-0.172

Log-Transformed Statistics

Minimum	1.668
Maximum	3.996
Second Largest	3.936
First Quartile	3.083
Median	3.401
Third Quartile	3.732
Mean	3.295
SD	0.621

Background Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.97
Shapiro Wilk Critical Value	0.901

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.859
Shapiro Wilk Critical Value	0.901

Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

95% UTL with 90% Coverage	58.32
95% UPL (t)	55.95
90% Percentile (z)	49
95% Percentile (z)	54.07
99% Percentile (z)	63.6

Assuming Lognormal Distribution

95% UTL with 90% Coverage	90.52
95% UPL (t)	81.45
90% Percentile (z)	59.81
95% Percentile (z)	74.94
99% Percentile (z)	114.4

Gamma Distribution Test

k star	3.145
Theta Star	9.885
MLE of Mean	31.09
MLE of Standard Deviation	17.53
nu star	119.5

A-D Test Statistic	0.56
5% A-D Critical Value	0.746
K-S Test Statistic	0.159
5% K-S Critical Value	0.199

Data appear Gamma Distributed at 5% Significance Level

Data Distribution Test

Data appear Normal at 5% Significance Level

Nonparametric Statistics

90% Percentile	46.8
95% Percentile	51.52
99% Percentile	53.82

Assuming Gamma Distribution

90% Percentile	54.6
95% Percentile	64.37
99% Percentile	85.51
95% WH Approx. Gamma UPL	66.31
95% HW Approx. Gamma UPL	68.94
95% WH Approx. Gamma UTL with 90% Coverage	71.07
95% HW Approx. Gamma UTL with 90% Coverage	74.38

95% UTL with 90% Coverage	54.4
95% Percentile Bootstrap UTL with 90% Coverage	54.4
95% BCA Bootstrap UTL with 90% Coverage	51.84
95% UPL	54.4
95% Chebyshev UPL	93.58
Upper Threshold Limit Based upon IQR	71.45

Chromium: NAPR Basewide Background, Surface Soil

General Statistics

Total Number of Observations	20	Number of Distinct Observations	18
Tolerance Factor	1.926		

Raw Statistics		Log-Transformed Statistics	
Minimum	5.9	Minimum	1.775
Maximum	47	Maximum	3.85
Second Largest	44.1	Second Largest	3.786
First Quartile	12	First Quartile	2.485
Median	29.95	Median	3.4
Third Quartile	33.7	Third Quartile	3.517
Mean	25.69	Mean	3.101
Geometric Mean	22.22	SD	0.601
SD	12.22		
Coefficient of Variation	0.476		
Skewness	-0.153		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.922	Shapiro Wilk Test Statistic	0.873
Shapiro Wilk Critical Value	0.905	Shapiro Wilk Critical Value	0.905
Data appear Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	49.23	95% UTL with 90% Coverage	70.67
95% UPL (t)	47.35	95% UPL (t)	64.42
90% Percentile (z)	41.35	90% Percentile (z)	47.98
95% Percentile (z)	45.79	95% Percentile (z)	59.69
99% Percentile (z)	54.12	99% Percentile (z)	89.89

Gamma Distribution Test		Data Distribution Test
k star	3.096	Data appear Normal at 5% Significance Level
Theta Star	8.299	
MLE of Mean	25.69	
MLE of Standard Deviation	14.6	
nu star	123.8	
A-D Test Statistic	1.052	Nonparametric Statistics
5% A-D Critical Value	0.746	90% Percentile 38.07
K-S Test Statistic	0.231	95% Percentile 44.25
5% K-S Critical Value	0.195	99% Percentile 46.45
Data not Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution			
90% Percentile	45.27	95% UTL with 90% Coverage	47
95% Percentile	53.43	95% Percentile Bootstrap UTL with 90% Coverage	47
99% Percentile	71.1	95% BCA Bootstrap UTL with 90% Coverage	47
		95% UPL	46.86
		95% Chebyshev UPL	80.28
95% WH Approx. Gamma UPL	55.08	Upper Threshold Limit Based upon IQR	66.25
95% HW Approx. Gamma UPL	56.83		
95% WH Approx. Gamma UTL with 90% Coverage	58.71		
95% HW Approx. Gamma UTL with 90% Coverage	60.91		

Cobalt: SWMU 59 Surface Soil, 2010 CMS Investigation

General Statistics

Total Number of Observations	19	Number of Distinct Observations	18
Tolerance Factor	1.949		

Raw Statistics		Log-Transformed Statistics	
Minimum	10.4	Minimum	2.342
Maximum	45.2	Maximum	3.811
Second Largest	30.2	Second Largest	3.408
First Quartile	18.35	First Quartile	2.91
Median	21.2	Median	3.054
Third Quartile	26.65	Third Quartile	3.283
Mean	22.75	Mean	3.073
Geometric Mean	21.61	SD	0.331
SD	7.703		
Coefficient of Variation	0.339		
Skewness	1.174		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.918	Shapiro Wilk Test Statistic	0.976
Shapiro Wilk Critical Value	0.901	Shapiro Wilk Critical Value	0.901
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	37.77	95% UTL with 90% Coverage	41.19
95% UPL (t)	36.46	95% UPL (t)	38.94
90% Percentile (z)	32.62	90% Percentile (z)	33.03
95% Percentile (z)	35.42	95% Percentile (z)	37.25
99% Percentile (z)	40.67	99% Percentile (z)	46.67

Gamma Distribution Test		Data Distribution Test
k star	8.334	Data appear Normal at 5% Significance Level
Theta Star	2.73	
MLE of Mean	22.75	
MLE of Standard Deviation	7.881	
nu star	316.7	
A-D Test Statistic	0.262	Nonparametric Statistics
5% A-D Critical Value	0.741	90% Percentile 29.24
K-S Test Statistic	0.102	95% Percentile 31.7
5% K-S Critical Value	0.199	99% Percentile 42.5
Data appear Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution			
90% Percentile	33.26	95% UTL with 90% Coverage	45.2
95% Percentile	37.07	95% Percentile Bootstrap UTL with 90% Coverage	45.2
99% Percentile	44.97	95% BCA Bootstrap UTL with 90% Coverage	45.2
		95% UPL	45.2
		95% Chebyshev UPL	57.2
95% WH Approx. Gamma UPL	37.63	Upper Threshold Limit Based upon IQR	39.1
95% HW Approx. Gamma UPL	37.9		
95% WH Approx. Gamma UTL with 90% Coverage	39.43		
95% HW Approx. Gamma UTL with 90% Coverage	39.79		

Cobalt: NAPR Basewide Background, Surface Soil

General Statistics

Total Number of Observations	19	Number of Distinct Observations	18
Tolerance Factor	1.949		

Raw Statistics		Log-Transformed Statistics	
Minimum	9.5	Minimum	2.251
Maximum	50.2	Maximum	3.916
Second Largest	48	Second Largest	3.871
First Quartile	14	First Quartile	2.639
Median	21.2	Median	3.054
Third Quartile	28	Third Quartile	3.332
Mean	22.84	Mean	3.015
Geometric Mean	20.39	SD	0.484
SD	11.7		
Coefficient of Variation	0.512		
Skewness	1.14		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.875	Shapiro Wilk Test Statistic	0.954
Shapiro Wilk Critical Value	0.901	Shapiro Wilk Critical Value	0.901
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	45.65	95% UTL with 90% Coverage	52.37
95% UPL (t)	43.66	95% UPL (t)	48.24
90% Percentile (z)	37.84	90% Percentile (z)	37.91
95% Percentile (z)	42.09	95% Percentile (z)	45.2
99% Percentile (z)	50.07	99% Percentile (z)	62.87

Gamma Distribution Test		Data Distribution Test
k star	3.87	Data appear Gamma Distributed at 5% Significance Level
Theta Star	5.903	
MLE of Mean	22.84	
MLE of Standard Deviation	11.61	
nu star	147.1	
A-D Test Statistic	0.456	
5% A-D Critical Value	0.744	
K-S Test Statistic	0.185	
5% K-S Critical Value	0.199	
Data appear Gamma Distributed at 5% Significance Level		

Nonparametric Statistics	
90% Percentile	36
95% Percentile	48.22
99% Percentile	49.8

Assuming Gamma Distribution			
90% Percentile	38.41	95% UTL with 90% Coverage	50.2
95% Percentile	44.67	95% Percentile Bootstrap UTL with 90% Coverage	50.2
99% Percentile	58.06	95% BCA Bootstrap UTL with 90% Coverage	50.2
		95% UPL	50.2
		95% Chebyshev UPL	75.18
95% WH Approx. Gamma UPL	45.76	Upper Threshold Limit Based upon IQR	49
95% HW Approx. Gamma UPL	46.25		
95% WH Approx. Gamma UTL with 90% Coverage	48.8		
95% HW Approx. Gamma UTL with 90% Coverage	49.51		

Copper: SWMU 59 Surface Soil, 2010 CMS Investigation

General Statistics

Total Number of Observations	19	Number of Distinct Observations	19
Tolerance Factor	1.949		

Raw Statistics		Log-Transformed Statistics	
Minimum	24.8	Minimum	3.211
Maximum	291	Maximum	5.673
Second Largest	237	Second Largest	5.468
First Quartile	76.45	First Quartile	4.337
Median	94.2	Median	4.545
Third Quartile	106.5	Third Quartile	4.668
Mean	104.5	Mean	4.513
Geometric Mean	91.22	SD	0.534
SD	62.03		
Coefficient of Variation	0.594		
Skewness	2.051		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.759	Shapiro Wilk Test Statistic	0.915
Shapiro Wilk Critical Value	0.901	Shapiro Wilk Critical Value	0.901
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	225.4	95% UTL with 90% Coverage	258.1
95% UPL (t)	214.8	95% UPL (t)	235.8
90% Percentile (z)	184	90% Percentile (z)	180.8
95% Percentile (z)	206.5	95% Percentile (z)	219.5
99% Percentile (z)	248.8	99% Percentile (z)	315.8

Gamma Distribution Test		Data Distribution Test
k star	3.269	Data appear Lognormal at 5% Significance Level
Theta Star	31.96	
MLE of Mean	104.5	
MLE of Standard Deviation	57.79	
nu star	124.2	
A-D Test Statistic	0.95	
5% A-D Critical Value	0.746	
K-S Test Statistic	0.203	
5% K-S Critical Value	0.199	
Data not Gamma Distributed at 5% Significance Level		

Nonparametric Statistics	
90% Percentile	148.2
95% Percentile	242.4
99% Percentile	281.3

Assuming Gamma Distribution			
90% Percentile	182	95% UTL with 90% Coverage	291
95% Percentile	214	95% Percentile Bootstrap UTL with 90% Coverage	291
99% Percentile	283.1	95% BCA Bootstrap UTL with 90% Coverage	291
		95% UPL	291
		95% Chebyshev UPL	381.9
95% WH Approx. Gamma UPL	219	Upper Threshold Limit Based upon IQR	151.6
95% HW Approx. Gamma UPL	221.7		
95% WH Approx. Gamma UTL with 90% Coverage	234.5		
95% HW Approx. Gamma UTL with 90% Coverage	238.4		

Copper: NAPR Basewide Background, Surface Soil

General Statistics

Total Number of Observations	18	Number of Distinct Observations	17
Tolerance Factor	1.974		

Raw Statistics		Log-Transformed Statistics	
Minimum	13	Minimum	2.565
Maximum	180	Maximum	5.193
Second Largest	169	Second Largest	5.13
First Quartile	45.93	First Quartile	3.821
Median	66.5	Median	4.197
Third Quartile	99.63	Third Quartile	4.601
Mean	77.11	Mean	4.152
Geometric Mean	63.53	SD	0.685
SD	46.73		
Coefficient of Variation	0.606		
Skewness	0.919		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.922	Shapiro Wilk Test Statistic	0.958
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	169.3	95% UTL with 90% Coverage	245.5
95% UPL (t)	160.6	95% UPL (t)	216
90% Percentile (z)	137	90% Percentile (z)	152.8
95% Percentile (z)	154	95% Percentile (z)	196
99% Percentile (z)	185.8	99% Percentile (z)	312.5

Gamma Distribution Test		Data Distribution Test
k star	2.317	Data appear Normal at 5% Significance Level
Theta Star	33.28	
MLE of Mean	77.11	
MLE of Standard Deviation	50.66	
nu star	83.41	
A-D Test Statistic	0.193	**Nonparametric Statistics**
5% A-D Critical Value	0.748	90% Percentile 141.7
K-S Test Statistic	0.12	95% Percentile 170.7
5% K-S Critical Value	0.205	99% Percentile 178.1
Data appear Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution			
90% Percentile	144.9	95% UTL with 90% Coverage	180
95% Percentile	174.7	95% Percentile Bootstrap UTL with 90% Coverage	180
99% Percentile	240.2	95% BCA Bootstrap UTL with 90% Coverage	180
		95% UPL	180
		95% Chebyshev UPL	286.4
95% WH Approx. Gamma UPL	181.2	Upper Threshold Limit Based upon IQR	180.2
95% HW Approx. Gamma UPL	187		
95% WH Approx. Gamma UTL with 90% Coverage	197.4		
95% HW Approx. Gamma UTL with 90% Coverage	205.4		

Lead: SWMU 59 Surface Soil, 2010 CMS Investigation

General Statistics

Total Number of Observations	19	Number of Distinct Observations	19
Tolerance Factor	1.949		

Raw Statistics		Log-Transformed Statistics	
Minimum	2.6	Minimum	0.956
Maximum	654	Maximum	6.483
Second Largest	638	Second Largest	6.458
First Quartile	6.15	First Quartile	1.804
Median	15.1	Median	2.715
Third Quartile	29.15	Third Quartile	3.37
Mean	82.98	Mean	2.856
Geometric Mean	17.38	SD	1.553
SD	198.9		
Coefficient of Variation	2.397		
Skewness	2.773		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.422	Shapiro Wilk Test Statistic	0.874
Shapiro Wilk Critical Value	0.901	Shapiro Wilk Critical Value	0.901
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	470.7	95% UTL with 90% Coverage	358.5
95% UPL (t)	436.9	95% UPL (t)	275.4
90% Percentile (z)	337.9	90% Percentile (z)	127.2
95% Percentile (z)	410.2	95% Percentile (z)	223.6
99% Percentile (z)	545.7	99% Percentile (z)	644.2

Gamma Distribution Test		Data Distribution Test
k star	0.387	Data do not follow a Discernable Distribution (0.05)
Theta Star	214.4	
MLE of Mean	82.98	
MLE of Standard Deviation	133.4	
nu star	14.71	
A-D Test Statistic	2.466	**Nonparametric Statistics**
5% A-D Critical Value	0.819	90% Percentile 168.6
K-S Test Statistic	0.299	95% Percentile 639.6
5% K-S Critical Value	0.212	99% Percentile 651.1
Data not Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution			
90% Percentile	235.7	95% UTL with 90% Coverage	654
95% Percentile	348.7	95% Percentile Bootstrap UTL with 90% Coverage	654
99% Percentile	633.7	95% BCA Bootstrap UTL with 90% Coverage	654
		95% UPL	654
		95% Chebyshev UPL	972.6
95% WH Approx. Gamma UPL	307.9	Upper Threshold Limit Based upon IQR	63.65
95% HW Approx. Gamma UPL	292.6		
95% WH Approx. Gamma UTL with 90% Coverage	359.3		
95% HW Approx. Gamma UTL with 90% Coverage	348		

Lead: NAPR Basewide Background, Surface Soil

General Statistics

Total Number of Observations	18	Number of Distinct Observations	16
Tolerance Factor	1.974		

Raw Statistics		Log-Transformed Statistics	
Minimum	2	Minimum	0.693
Maximum	21	Maximum	3.045
Second Largest	21	Second Largest	3.045
First Quartile	3.325	First Quartile	1.201
Median	5.5	Median	1.684
Third Quartile	14.98	Third Quartile	2.699
Mean	8.678	Mean	1.838
Geometric Mean	6.281	SD	0.845
SD	6.872		
Coefficient of Variation	0.792		
Skewness	0.755		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.838	Shapiro Wilk Test Statistic	0.904
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	22.24	95% UTL with 90% Coverage	33.29
95% UPL (t)	20.96	95% UPL (t)	28.44
90% Percentile (z)	17.48	90% Percentile (z)	18.55
95% Percentile (z)	19.98	95% Percentile (z)	25.21
99% Percentile (z)	24.66	99% Percentile (z)	44.84

Gamma Distribution Test		Data Distribution Test
k star	1.449	Data Follow Appr. Gamma Distribution at 5% Significance Level
Theta Star	5.987	
MLE of Mean	8.678	
MLE of Standard Deviation	7.208	
nu star	52.18	
A-D Test Statistic	0.766	
5% A-D Critical Value	0.755	
K-S Test Statistic	0.2	
5% K-S Critical Value	0.207	
Data follow Appx. Gamma Distribution at 5% Significance Level		

Nonparametric Statistics	
90% Percentile	18.9
95% Percentile	21
99% Percentile	21

Assuming Gamma Distribution			
90% Percentile	18.24	95% UTL with 90% Coverage	21
95% Percentile	22.87	95% Percentile Bootstrap UTL with 90% Coverage	21
99% Percentile	33.35	95% BCA Bootstrap UTL with 90% Coverage	21
		95% UPL	21
		95% Chebyshev UPL	39.45
95% WH Approx. Gamma UPL	24.01	Upper Threshold Limit Based upon IQR	32.45
95% HW Approx. Gamma UPL	24.79		
95% WH Approx. Gamma UTL with 90% Coverage	26.63		
95% HW Approx. Gamma UTL with 90% Coverage	27.77		

Nickel: SWMU 59 Surface Soil, 2010 CMS Investigation

General Statistics

Total Number of Observations	19	Number of Distinct Observations	18
Tolerance Factor	1.949		

Raw Statistics		Log-Transformed Statistics	
Minimum	6.1	Minimum	1.808
Maximum	27.5	Maximum	3.314
Second Largest	26.8	Second Largest	3.288
First Quartile	11.35	First Quartile	2.429
Median	13.5	Median	2.603
Third Quartile	21.45	Third Quartile	3.065
Mean	15.29	Mean	2.639
Geometric Mean	13.99	SD	0.441
SD	6.484		
Coefficient of Variation	0.424		
Skewness	0.534		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.924	Shapiro Wilk Test Statistic	0.951
Shapiro Wilk Critical Value	0.901	Shapiro Wilk Critical Value	0.901
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	27.93	95% UTL with 90% Coverage	33.06
95% UPL (t)	26.83	95% UPL (t)	30.67
90% Percentile (z)	23.6	90% Percentile (z)	24.63
95% Percentile (z)	25.96	95% Percentile (z)	28.91
99% Percentile (z)	30.37	99% Percentile (z)	39.04

Gamma Distribution Test		Data Distribution Test
k star	4.922	Data appear Normal at 5% Significance Level
Theta Star	3.106	
MLE of Mean	15.29	
MLE of Standard Deviation	6.892	
nu star	187	
A-D Test Statistic	0.401	
5% A-D Critical Value	0.742	
K-S Test Statistic	0.153	
5% K-S Critical Value	0.199	
Data appear Gamma Distributed at 5% Significance Level		

Nonparametric Statistics	
90% Percentile	23.2
95% Percentile	26.87
99% Percentile	27.37

Assuming Gamma Distribution			
90% Percentile	24.52	95% UTL with 90% Coverage	27.5
95% Percentile	28.1	95% Percentile Bootstrap UTL with 90% Coverage	27.5
99% Percentile	35.68	95% BCA Bootstrap UTL with 90% Coverage	27.5
		95% UPL	27.5
		95% Chebyshev UPL	44.29
95% WH Approx. Gamma UPL	28.72	Upper Threshold Limit Based upon IQR	36.6
95% HW Approx. Gamma UPL	29.12		
95% WH Approx. Gamma UTL with 90% Coverage	30.44		
95% HW Approx. Gamma UTL with 90% Coverage	30.97		

Nickel: NAPR Basewide Background, Surface Soil

General Statistics

Total Number of Observations	19	Number of Distinct Observations	19
Tolerance Factor	1.949		

Raw Statistics		Log-Transformed Statistics	
Minimum	3.4	Minimum	1.224
Maximum	19	Maximum	2.944
Second Largest	18.1	Second Largest	2.896
First Quartile	6.1	First Quartile	1.807
Median	8.6	Median	2.152
Third Quartile	15.55	Third Quartile	2.743
Mean	10.54	Mean	2.226
Geometric Mean	9.265	SD	0.535
SD	5.228		
Coefficient of Variation	0.496		
Skewness	0.295		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.899	Shapiro Wilk Test Statistic	0.925
Shapiro Wilk Critical Value	0.901	Shapiro Wilk Critical Value	0.901
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	20.73	95% UTL with 90% Coverage	26.31
95% UPL (t)	19.84	95% UPL (t)	24.02
90% Percentile (z)	17.24	90% Percentile (z)	18.4
95% Percentile (z)	19.14	95% Percentile (z)	22.35
99% Percentile (z)	22.7	99% Percentile (z)	32.19

Gamma Distribution Test		Data Distribution Test
k star	3.442	Data appear Gamma Distributed at 5% Significance Level
Theta Star	3.061	
MLE of Mean	10.54	
MLE of Standard Deviation	5.68	
nu star	130.8	
A-D Test Statistic	0.663	Nonparametric Statistics
5% A-D Critical Value	0.745	90% Percentile 17.22
K-S Test Statistic	0.163	95% Percentile 18.19
5% K-S Critical Value	0.199	99% Percentile 18.84
Data appear Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution			
90% Percentile	18.15	95% UTL with 90% Coverage	19
95% Percentile	21.27	95% Percentile Bootstrap UTL with 90% Coverage	19
99% Percentile	27.99	95% BCA Bootstrap UTL with 90% Coverage	19
		95% UPL	19
		95% Chebyshev UPL	33.92
95% WH Approx. Gamma UPL	21.89	Upper Threshold Limit Based upon IQR	29.73
95% HW Approx. Gamma UPL	22.31		
95% WH Approx. Gamma UTL with 90% Coverage	23.41		
95% HW Approx. Gamma UTL with 90% Coverage	23.98		

Vanadium: SWMU 59 Surface Soil, 2010 CMS Investigation

General Statistics

Total Number of Observations	19	Number of Distinct Observations	19
Tolerance Factor	1.949		

Raw Statistics		Log-Transformed Statistics	
Minimum	72.8	Minimum	4.288
Maximum	260	Maximum	5.561
Second Largest	249	Second Largest	5.517
First Quartile	104.5	First Quartile	4.649
Median	126	Median	4.836
Third Quartile	176.5	Third Quartile	5.172
Mean	143	Mean	4.896
Geometric Mean	133.8	SD	0.37
SD	55.85		
Coefficient of Variation	0.39		
Skewness	0.913		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.899	Shapiro Wilk Test Statistic	0.959
Shapiro Wilk Critical Value	0.901	Shapiro Wilk Critical Value	0.901
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	251.9	95% UTL with 90% Coverage	275.2
95% UPL (t)	242.4	95% UPL (t)	258.4
90% Percentile (z)	214.6	90% Percentile (z)	215
95% Percentile (z)	234.9	95% Percentile (z)	245.9
99% Percentile (z)	273	99% Percentile (z)	316.4

Gamma Distribution Test		Data Distribution Test
k star	6.472	Data appear Gamma Distributed at 5% Significance Level
Theta Star	22.1	
MLE of Mean	143	
MLE of Standard Deviation	56.22	
nu star	245.9	
A-D Test Statistic	0.45	
5% A-D Critical Value	0.742	
K-S Test Statistic	0.17	
5% K-S Critical Value	0.199	
Data appear Gamma Distributed at 5% Significance Level		

Nonparametric Statistics	
90% Percentile	230.6
95% Percentile	250.1
99% Percentile	258

Assuming Gamma Distribution			
90% Percentile	218.2	95% UTL with 90% Coverage	260
95% Percentile	246.3	95% Percentile Bootstrap UTL with 90% Coverage	260
99% Percentile	305.1	95% BCA Bootstrap UTL with 90% Coverage	260
		95% UPL	260
		95% Chebyshev UPL	392.8
95% WH Approx. Gamma UPL	250.7	Upper Threshold Limit Based upon IQR	284.5
95% HW Approx. Gamma UPL	252.3		
95% WH Approx. Gamma UTL with 90% Coverage	264.1		
95% HW Approx. Gamma UTL with 90% Coverage	266.4		

Vanadium: NAPR Basewide Background, Surface Soil

General Statistics

Total Number of Observations	18	Number of Distinct Observations	17
Tolerance Factor	1.974		

Raw Statistics		Log-Transformed Statistics	
Minimum	35	Minimum	3.555
Maximum	230	Maximum	5.438
Second Largest	227	Second Largest	5.425
First Quartile	86.05	First Quartile	4.454
Median	151.5	Median	5.021
Third Quartile	180	Third Quartile	5.193
Mean	141.6	Mean	4.85
Geometric Mean	127.8	SD	0.502
SD	58.77		
Coefficient of Variation	0.415		
Skewness	-0.0584		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.95	Shapiro Wilk Test Statistic	0.906
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	257.6	95% UTL with 90% Coverage	344
95% UPL (t)	246.6	95% UPL (t)	313.3
90% Percentile (z)	216.9	90% Percentile (z)	243.1
95% Percentile (z)	238.2	95% Percentile (z)	291.7
99% Percentile (z)	278.3	99% Percentile (z)	410.6

Gamma Distribution Test		Data Distribution Test
k star	4.237	Data appear Normal at 5% Significance Level
Theta Star	33.41	
MLE of Mean	141.6	
MLE of Standard Deviation	68.78	
nu star	152.5	
A-D Test Statistic	0.451	Nonparametric Statistics
5% A-D Critical Value	0.743	90% Percentile 225.6
K-S Test Statistic	0.166	95% Percentile 227.5
5% K-S Critical Value	0.204	99% Percentile 229.5
Data appear Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution			
90% Percentile	233.7	95% UTL with 90% Coverage	230
95% Percentile	270.3	95% Percentile Bootstrap UTL with 90% Coverage	230
99% Percentile	348.2	95% BCA Bootstrap UTL with 90% Coverage	230
		95% UPL	230
		95% Chebyshev UPL	404.8
95% WH Approx. Gamma UPL	277.4	Upper Threshold Limit Based upon IQR	320.9
95% HW Approx. Gamma UPL	284.2		
95% WH Approx. Gamma UTL with 90% Coverage	296.8		
95% HW Approx. Gamma UTL with 90% Coverage	305.6		

Zinc: SWMU 59 Surface Soil, 2010 CMS Investigation

General Statistics

Total Number of Observations	19	Number of Distinct Observations	19
Tolerance Factor	1.949		

Raw Statistics

Minimum	34.1
Maximum	747
Second Largest	468
First Quartile	61.1
Median	80.5
Third Quartile	112
Mean	141
Geometric Mean	96.83
SD	176
Coefficient of Variation	1.249
Skewness	2.873

Log-Transformed Statistics

Minimum	3.529
Maximum	6.616
Second Largest	6.148
First Quartile	4.112
Median	4.388
Third Quartile	4.714
Mean	4.573
SD	0.759

Background Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.552
Shapiro Wilk Critical Value	0.901

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.83
Shapiro Wilk Critical Value	0.901

Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

95% UTL with 90% Coverage	484.1
95% UPL (t)	454.2
90% Percentile (z)	366.6
95% Percentile (z)	430.5
99% Percentile (z)	550.5

Assuming Lognormal Distribution

95% UTL with 90% Coverage	425.1
95% UPL (t)	373.7
90% Percentile (z)	256.1
95% Percentile (z)	337.5
99% Percentile (z)	566.1

Gamma Distribution Test

k star	1.277
Theta Star	110.4
MLE of Mean	141
MLE of Standard Deviation	124.7
nu star	48.54

A-D Test Statistic	2.156
5% A-D Critical Value	0.758
K-S Test Statistic	0.282
5% K-S Critical Value	0.202

Data not Gamma Distributed at 5% Significance Level

Data Distribution Test

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

90% Percentile	279.2
95% Percentile	495.9
99% Percentile	696.8

Assuming Gamma Distribution

90% Percentile	305.6
95% Percentile	387.8
99% Percentile	575.5
95% WH Approx. Gamma UPL	393.3
95% HW Approx. Gamma UPL	387.1
95% WH Approx. Gamma UTL with 90% Coverage	434.2
95% HW Approx. Gamma UTL with 90% Coverage	430.1

95% UTL with 90% Coverage	747
95% Percentile Bootstrap UTL with 90% Coverage	747
95% BCA Bootstrap UTL with 90% Coverage	747
95% UPL	747
95% Chebyshev UPL	928.2
Upper Threshold Limit Based upon IQR	188.4

Zinc: NAPR Basewide Background, Surface Soil

General Statistics

Total Number of Observations	18	Number of Distinct Observations	18
Tolerance Factor	1.974		

Raw Statistics		Log-Transformed Statistics	
Minimum	6.2	Minimum	1.825
Maximum	120	Maximum	4.787
Second Largest	108	Second Largest	4.682
First Quartile	34.05	First Quartile	3.528
Median	47	Median	3.849
Third Quartile	65.15	Third Quartile	4.176
Mean	52.48	Mean	3.742
Geometric Mean	42.17	SD	0.751
SD	32.33		
Coefficient of Variation	0.616		
Skewness	0.788		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.925	Shapiro Wilk Test Statistic	0.936
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	116.3	95% UTL with 90% Coverage	185.9
95% UPL (t)	110.3	95% UPL (t)	161.5
90% Percentile (z)	93.91	90% Percentile (z)	110.5
95% Percentile (z)	105.7	95% Percentile (z)	145.1
99% Percentile (z)	127.7	99% Percentile (z)	242.2

Gamma Distribution Test		Data Distribution Test
k star	2.07	Data appear Normal at 5% Significance Level
Theta Star	25.36	
MLE of Mean	52.48	
MLE of Standard Deviation	36.48	
nu star	74.51	
A-D Test Statistic	0.235	**Nonparametric Statistics**
5% A-D Critical Value	0.75	90% Percentile 106.6
K-S Test Statistic	0.119	95% Percentile 109.8
5% K-S Critical Value	0.206	99% Percentile 118
Data appear Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution			
90% Percentile	101.2	95% UTL with 90% Coverage	120
95% Percentile	123.1	95% Percentile Bootstrap UTL with 90% Coverage	120
99% Percentile	171.6	95% BCA Bootstrap UTL with 90% Coverage	120
		95% UPL	120
		95% Chebyshev UPL	197.3
95% WH Approx. Gamma UPL	128	Upper Threshold Limit Based upon IQR	111.8
95% HW Approx. Gamma UPL	133.4		
95% WH Approx. Gamma UTL with 90% Coverage	140		
95% HW Approx. Gamma UTL with 90% Coverage	147.2		

Gehan Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Beryllium, SWMU 59

Background Data: BerylliumBG

Raw Statistics

	Site	Background
Number of Valid Data	19	18
Number of Non-Detect Data	3	2
Number of Detect Data	16	16
Minimum Non-Detect	2.8	0.04
Maximum Non-Detect	2.9	0.1
Percent Non detects	15.79%	11.11%
Minimum Detected	0.14	0.085
Maximum Detected	0.62	0.58
Mean of Detected Data	0.276	0.315
Median of Detected Data	0.245	0.325
SD of Detected Data	0.118	0.134

Site vs Background Gehan Test

H0: Mean/Median of Site or AOC <= Mean/Median of background

Gehan z Test Value	-0.518
Critical z (0.95)	1.645
P-Value	0.698

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Site <= Background

P-Value >= alpha (0.05)

t-Test Site vs Background Comparison for Full Data Sets without NDs

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Chromium, SWMU 59

Background Data: ChromiumBG

Raw Statistics

	Site	Background
Number of Valid Observations	19	20
Number of Distinct Observations	19	18
Minimum	5.3	5.9
Maximum	54.4	47
Mean	31.09	25.69
Median	30	29.95
SD	13.97	12.22
SE of Mean	3.206	2.733

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

Method	DF	t-Test Value	Critical t (0.050)	P-Value
Pooled (Equal Variance)	37	1.286	1.687	0.103
Welch-Satterthwaite (Unequal Varianc	35.8	1.282	1.688	0.104

Pooled SD 13.103

Conclusion with Alpha = 0.050

* Student t (Pooled) Test: Do Not Reject H0, Conclude Site <= Background
* Welch-Satterthwaite Test: Do Not Reject H0, Conclude Site <= Background

Test of Equality of Variances

Variance of Site	195.2
Variance of Background	149.4

Numerator DF	Denominator DF	F-Test Value	P-Value
18	19	1.307	0.567

Conclusion with Alpha = 0.05

* Two variances appear to be equal

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Cobalt, SWMU 59

Background Data: CobaltBG

Raw Statistics

	Site	Background
Number of Valid Data	19	19
Number of Non-Detect Data	0	0
Number of Detect Data	19	19
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	10.4	9.5
Maximum Detected	45.2	50.2
Mean of Detected Data	22.75	22.84
Median of Detected Data	21.2	21.2
SD of Detected Data	7.703	11.7

Wilcoxon-Mann-Whitney Site vs Background Test

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	384.5
WMW Test U-Stat	194.5
WMW Critical Value (0.050)	237
Approximate P-Value	0.347

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Site <= Background

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Copper, SWMU 59

Background Data: CopperBG

Raw Statistics

	Site	Background
Number of Valid Data	19	18
Number of Non-Detect Data	0	0
Number of Detect Data	19	18
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	24.8	13
Maximum Detected	291	180
Mean of Detected Data	104.5	77.11
Median of Detected Data	94.2	66.5
SD of Detected Data	62.03	46.73

Wilcoxon-Mann-Whitney Site vs Background Test

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	416
WMW Test U-Stat	226
WMW Critical Value (0.050)	225
Approximate P-Value	0.0489

Conclusion with Alpha = 0.05

Reject H0, Conclude Site > Background

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Lead, SWMU 59

Background Data: LeadBG

Raw Statistics

	Site	Background
Number of Valid Data	19	18
Number of Non-Detect Data	0	0
Number of Detect Data	19	18
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	2.6	2
Maximum Detected	654	21
Mean of Detected Data	82.98	8.678
Median of Detected Data	15.1	5.5
SD of Detected Data	198.9	6.872

Wilcoxon-Mann-Whitney Site vs Background Test

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	435
WMW Test U-Stat	245
WMW Critical Value (0.050)	225
Approximate P-Value	0.0128

Conclusion with Alpha = 0.05

Reject H0, Conclude Site > Background

Gehan Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Mercury, SWMU 59

Background Data: MercuryBG

Raw Statistics

	Site	Background
Number of Valid Data	19	20
Number of Non-Detect Data	4	3
Number of Detect Data	15	17
Minimum Non-Detect	0.038	0.02
Maximum Non-Detect	0.041	0.04
Percent Non detects	21.05%	15.00%
Minimum Detected	0.009	0.012
Maximum Detected	0.095	0.12
Mean of Detected Data	0.0294	0.0584
Median of Detected Data	0.017	0.06
SD of Detected Data	0.0275	0.0267

Site vs Background Gehan Test

H0: Mean/Median of Site or AOC <= Mean/Median of background

Gehan z Test Value	-2.75
Critical z (0.95)	1.645
P-Value	0.997

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Site <= Background

P-Value >= alpha (0.05)

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Nickel, SWMU 59

Background Data: NickelBG

Raw Statistics

	Site	Background
Number of Valid Data	19	19
Number of Non-Detect Data	0	0
Number of Detect Data	19	19
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	6.1	3.4
Maximum Detected	27.5	19
Mean of Detected Data	15.29	10.54
Median of Detected Data	13.5	8.6
SD of Detected Data	6.484	5.228

Wilcoxon-Mann-Whitney Site vs Background Test

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	442
WMW Test U-Stat	252
WMW Critical Value (0.050)	237
Approximate P-Value	0.0191

Conclusion with Alpha = 0.05

Reject H0, Conclude Site > Background

Gehan Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Tin, SWMU 59

Background Data: TinBG

Raw Statistics

	Site	Background
Number of Valid Data	19	19
Number of Non-Detect Data	8	7
Number of Detect Data	11	12
Minimum Non-Detect	5.1	0.69
Maximum Non-Detect	6.3	1.3
Percent Non detects	42.11%	36.84%
Minimum Detected	3	1.4
Maximum Detected	36.5	4
Mean of Detected Data	8.455	2.325
Median of Detected Data	5.7	2.2
SD of Detected Data	9.575	0.737

Site vs Background Gehan Test

H0: Mean/Median of Site or AOC <= Mean/Median of background

Gehan z Test Value	3.633
Critical z (0.95)	1.645
P-Value	0.0001403

Conclusion with Alpha = 0.05

Reject H0, Conclude Site > Background

P-Value < alpha (0.05)

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Vanadium, SWMU 59

Background Data: VanadiumBG

Raw Statistics

	Site	Background
Number of Valid Data	19	18
Number of Non-Detect Data	0	0
Number of Detect Data	19	18
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	72.8	35
Maximum Detected	260	230
Mean of Detected Data	143	141.6
Median of Detected Data	126	151.5
SD of Detected Data	55.85	58.77

Wilcoxon-Mann-Whitney Site vs Background Test

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	364.5
WMW Test U-Stat	174.5
WMW Critical Value (0.050)	225
Approximate P-Value	0.464

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Site <= Background

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Zinc, SWMU 59

Background Data: ZincBG

Raw Statistics

	Site	Background
Number of Valid Data	19	18
Number of Non-Detect Data	0	0
Number of Detect Data	19	18
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	34.1	6.2
Maximum Detected	747	120
Mean of Detected Data	141	52.48
Median of Detected Data	80.5	47
SD of Detected Data	176	32.33

Wilcoxon-Mann-Whitney Site vs Background Test

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	460
WMW Test U-Stat	270
WMW Critical Value (0.050)	225
Approximate P-Value	0.00138

Conclusion with Alpha = 0.05

Reject H0, Conclude Site > Background

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Beryllium, SWMU 59

Background Data: BerylliumBG

Raw Statistics

	Site	Background
Number of Valid Data	19	18
Number of Non-Detect Data	3	2
Number of Detect Data	16	16
Minimum Non-Detect	2.8	0.04
Maximum Non-Detect	2.9	0.1
Percent Non detects	15.79%	11.11%
Minimum Detected	0.14	0.085
Maximum Detected	0.62	0.58
Mean of Detected Data	0.276	0.315
Median of Detected Data	0.245	0.325
SD of Detected Data	0.118	0.134

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.053)	4
Approximate K Value (0.053)	4
Number of Site Observations in 'R' Largest	4

Non-Detect Values in the 'R' Largest - Cannot complete Quantile Test

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Chromium, SWMU 59

Background Data: ChromiumBG

Raw Statistics

	Site	Background
Number of Valid Data	19	20
Number of Non-Detect Data	0	0
Number of Detect Data	19	20
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	5.3	5.9
Maximum Detected	54.4	47
Mean of Detected Data	31.09	25.69
Median of Detected Data	30	29.95
SD of Detected Data	13.97	12.22

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.053)	4
Approximate K Value (0.053)	4
Number of Site Observations in 'R' Largest	3
Calculated Alpha	0.0471

Conclusion with Alpha = 0.053

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Cobalt, SWMU 59

Background Data: CobaltBG

Raw Statistics

	Site	Background
Number of Valid Data	19	19
Number of Non-Detect Data	0	0
Number of Detect Data	19	19
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	10.4	9.5
Maximum Detected	45.2	50.2
Mean of Detected Data	22.75	22.84
Median of Detected Data	21.2	21.2
SD of Detected Data	7.703	11.7

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.053)	4
Approximate K Value (0.053)	4
Number of Site Observations in 'R' Largest	1
Calculated Alpha	0.0525

Conclusion with Alpha = 0.053

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Copper, SWMU 59

Background Data: CopperBG

Raw Statistics

	Site	Background
Number of Valid Data	19	18
Number of Non-Detect Data	0	0
Number of Detect Data	19	18
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	24.8	13
Maximum Detected	291	180
Mean of Detected Data	104.5	77.11
Median of Detected Data	94.2	66.5
SD of Detected Data	62.03	46.73

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.053)	4
Approximate K Value (0.053)	4
Number of Site Observations in 'R' Largest	2
Calculated Alpha	0.0587

Conclusion with Alpha = 0.053

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Mercury, SWMU 59

Background Data: MercuryBG

Raw Statistics

	Site	Background
Number of Valid Data	19	20
Number of Non-Detect Data	4	3
Number of Detect Data	15	17
Minimum Non-Detect	0.038	0.02
Maximum Non-Detect	0.041	0.04
Percent Non detects	21.05%	15.00%
Minimum Detected	0.009	0.012
Maximum Detected	0.095	0.12
Mean of Detected Data	0.0294	0.0584
Median of Detected Data	0.017	0.06
SD of Detected Data	0.0275	0.0267

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.053)	4
Approximate K Value (0.053)	4
Number of Site Observations in 'R' Largest	2
Calculated Alpha	0.0471

Conclusion with Alpha = 0.053

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Nickel, SWMU 59

Background Data: NickelBG

Raw Statistics

	Site	Background
Number of Valid Data	19	19
Number of Non-Detect Data	0	0
Number of Detect Data	19	19
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	6.1	3.4
Maximum Detected	27.5	19
Mean of Detected Data	15.29	10.54
Median of Detected Data	13.5	8.6
SD of Detected Data	6.484	5.228

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.053)	4
Approximate K Value (0.053)	4
R Value Adjusted for Ties in Data	5
K Value Adjusted for Ties in Data	5
Number of Site Observations in 'R' Largest	5
Calculated Alpha	0.0525

Conclusion with Alpha = 0.053

Reject H0, Conclude Site Concentration > Background Concentration

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Tin

Background Data: TinBG

Raw Statistics

	Site	Background
Number of Valid Data	19	19
Number of Non-Detect Data	8	7
Number of Detect Data	11	12
Minimum Non-Detect	5.1	0.69
Maximum Non-Detect	6.3	1.3
Percent Non detects	42.11%	36.84%
Minimum Detected	3	1.4
Maximum Detected	36.5	4
Mean of Detected Data	8.455	2.325
Median of Detected Data	5.7	2.2
SD of Detected Data	9.575	0.737

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.053)	4
Approximate K Value (0.053)	4
R Value Adjusted for Ties in Data	5
K Value Adjusted for Ties in Data	5
Number of Site Observations in 'R' Largest	5

Non-Detect Values in the 'R' Largest - Cannot complete Quantile Test

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Vanadium, SWMU 59

Background Data: VanadiumBG

Raw Statistics

	Site	Background
Number of Valid Data	19	18
Number of Non-Detect Data	0	0
Number of Detect Data	19	18
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	72.8	35
Maximum Detected	260	230
Mean of Detected Data	143	141.6
Median of Detected Data	126	151.5
SD of Detected Data	55.85	58.77

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.053)	4
Approximate K Value (0.053)	4
Number of Site Observations in 'R' Largest	2
Calculated Alpha	0.0587

Conclusion with Alpha = 0.053

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Zinc, SWMU 59

Background Data: ZincBG

Raw Statistics

	Site	Background
Number of Valid Data	19	18
Number of Non-Detect Data	0	0
Number of Detect Data	19	18
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	34.1	6.2
Maximum Detected	747	120
Mean of Detected Data	141	52.48
Median of Detected Data	80.5	47
SD of Detected Data	176	32.33

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

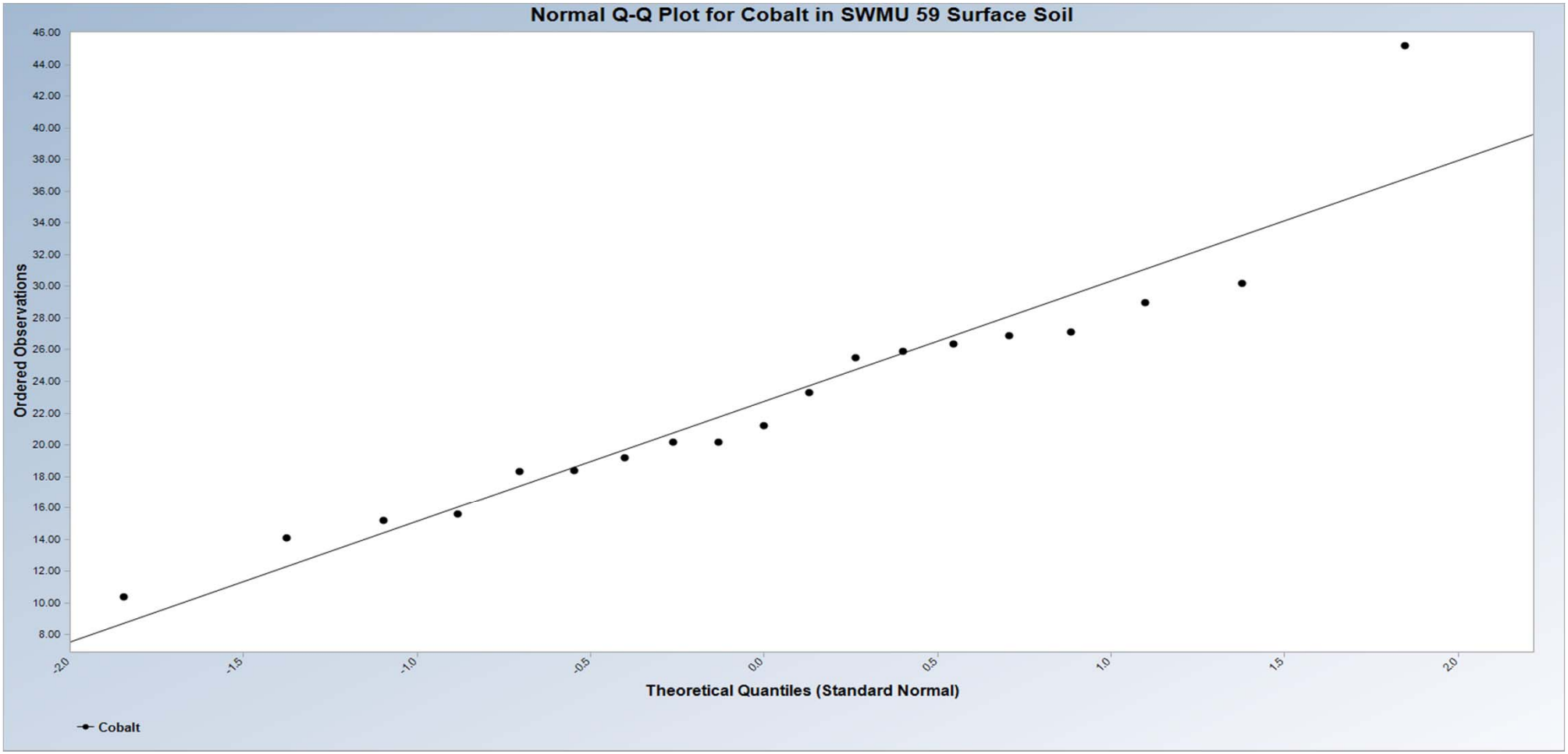
Approximate R Value (0.053)	4
Approximate K Value (0.053)	4
Number of Site Observations in 'R' Largest	4
Calculated Alpha	0.0587

Conclusion with Alpha = 0.053

Reject H0, Conclude Site Concentration > Background Concentration

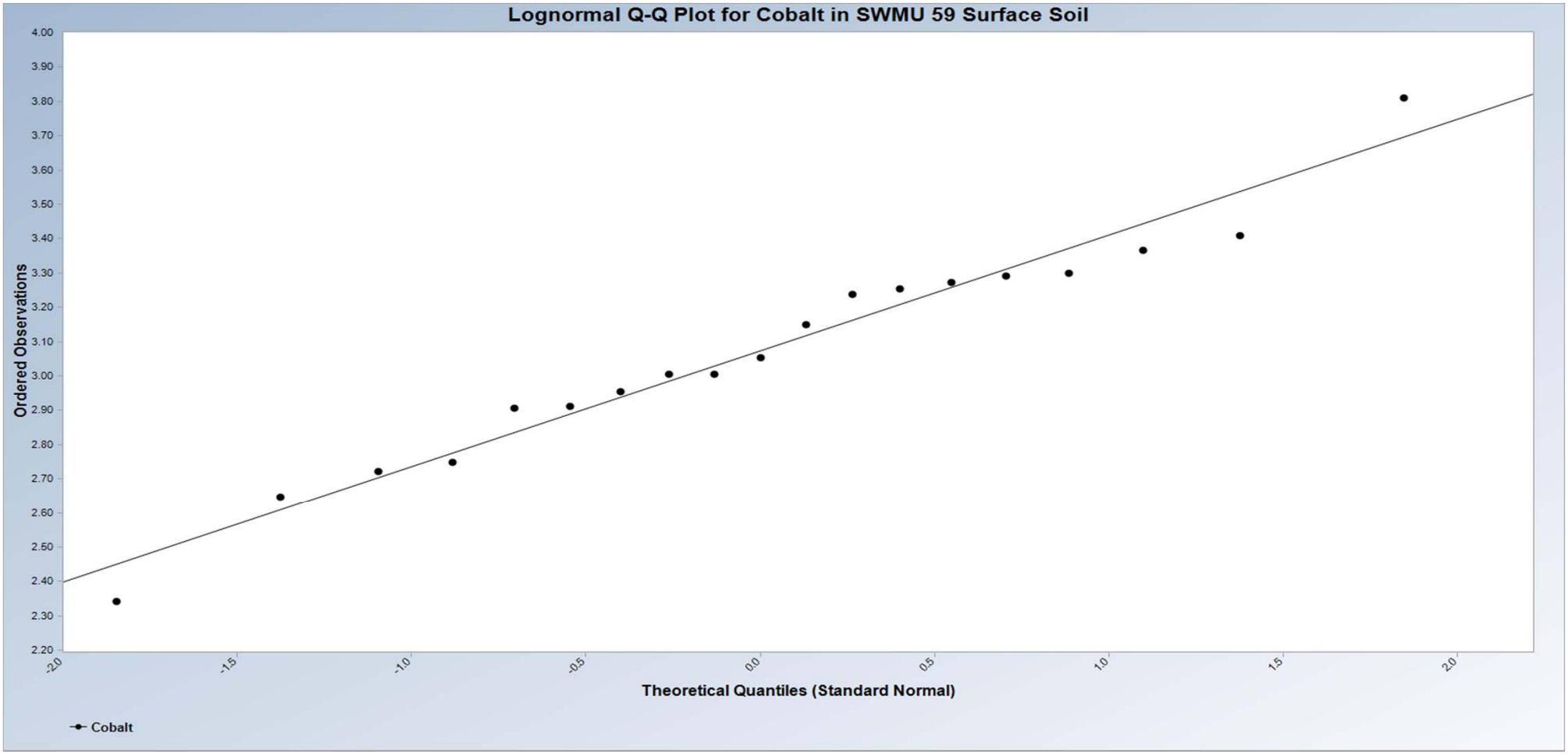
APPENDIX H

PROBABILITY PLOT - COBALT IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



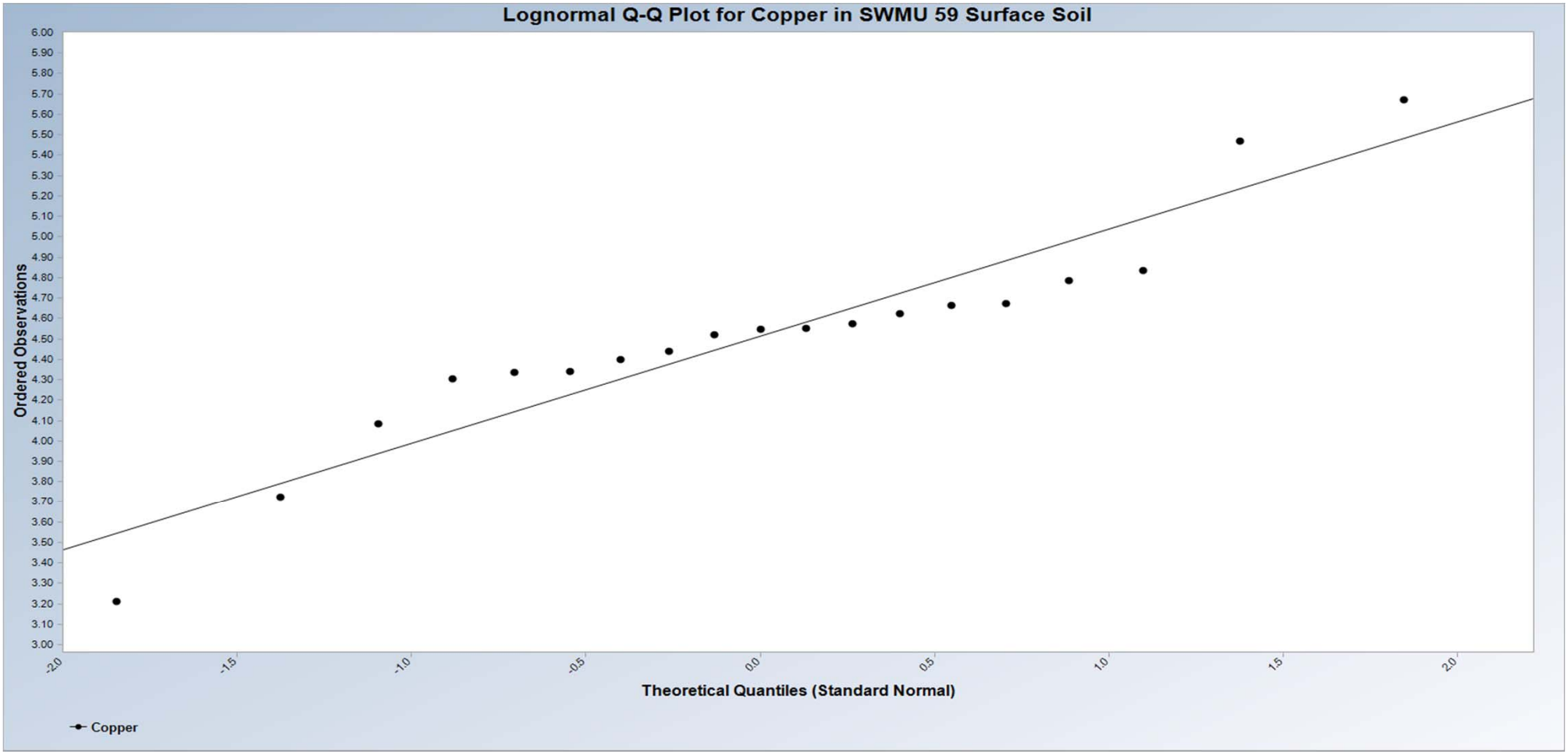
APPENDIX H

PROBABILITY PLOT - COBALT IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



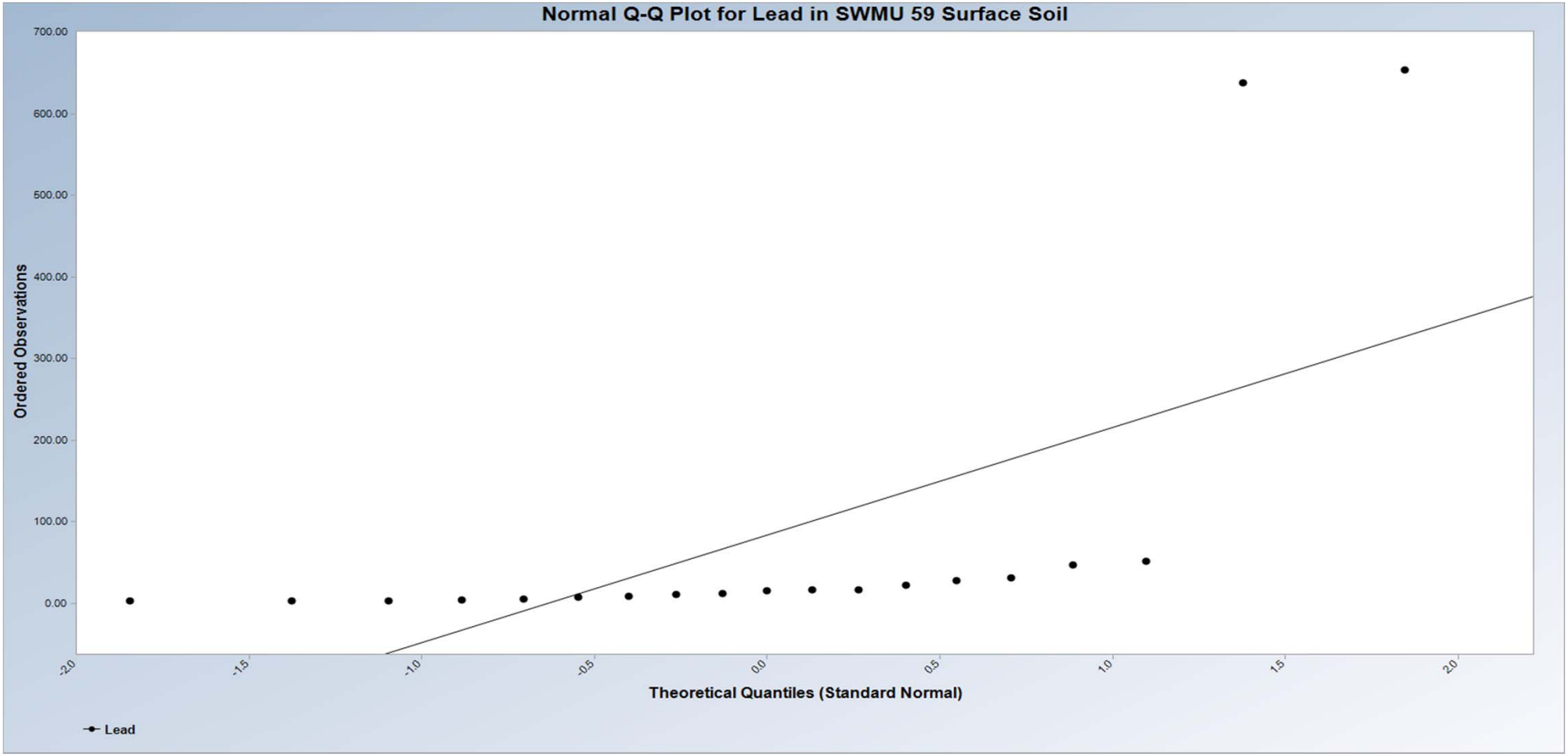
APPENDIX H

PROBABILITY PLOT - COPPER IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



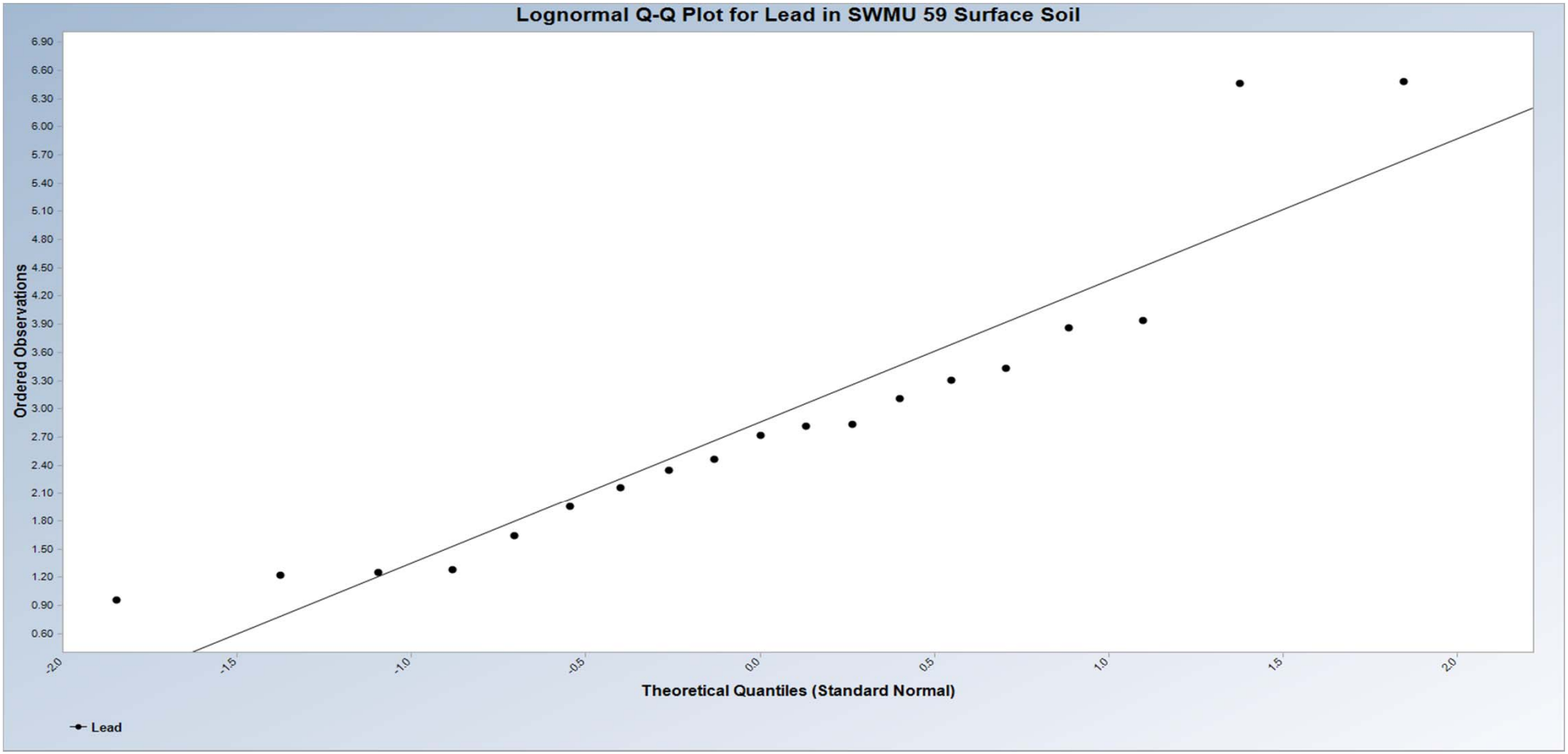
APPENDIX H

PROBABILITY PLOT - LEAD IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



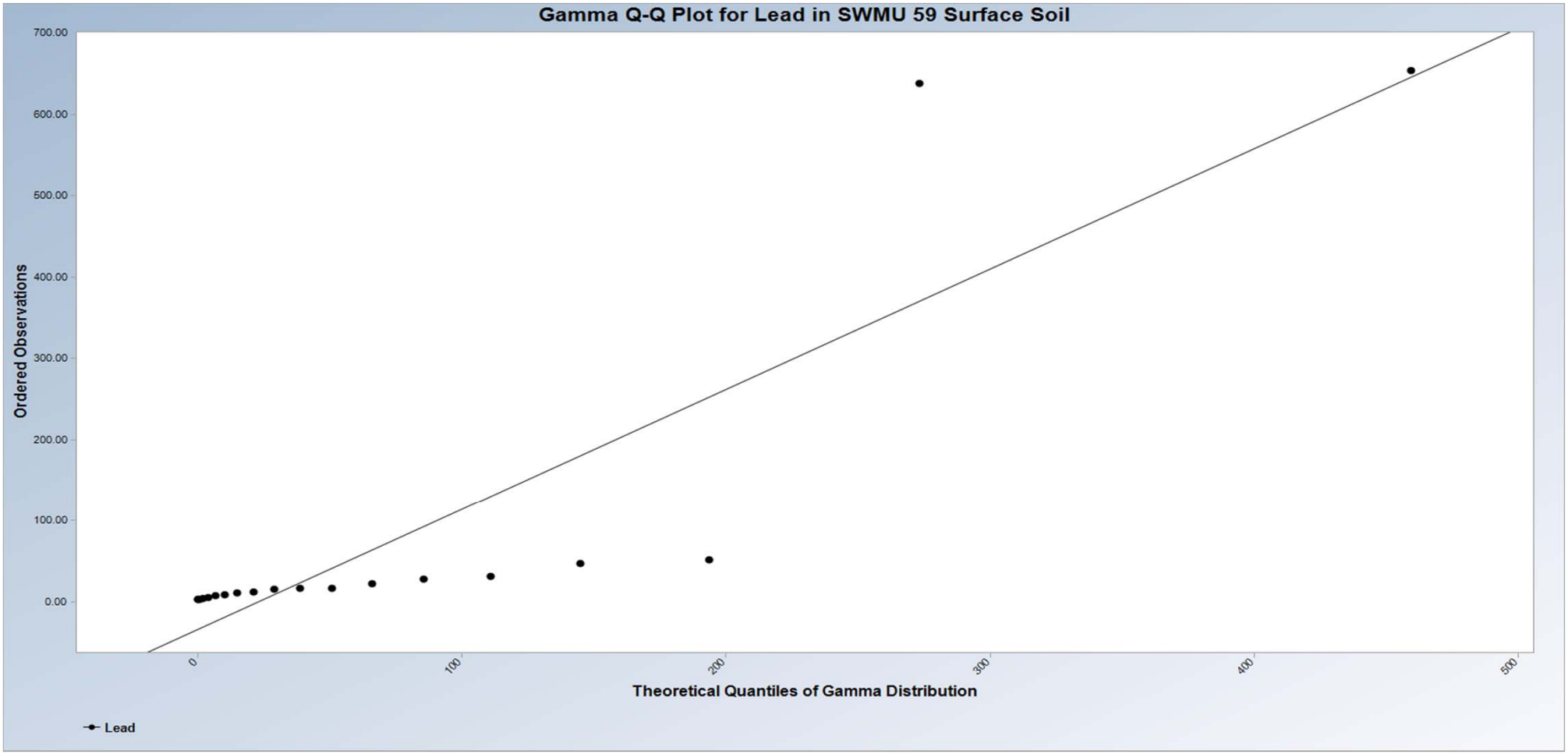
APPENDIX H

PROBABILITY PLOT - LEAD IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



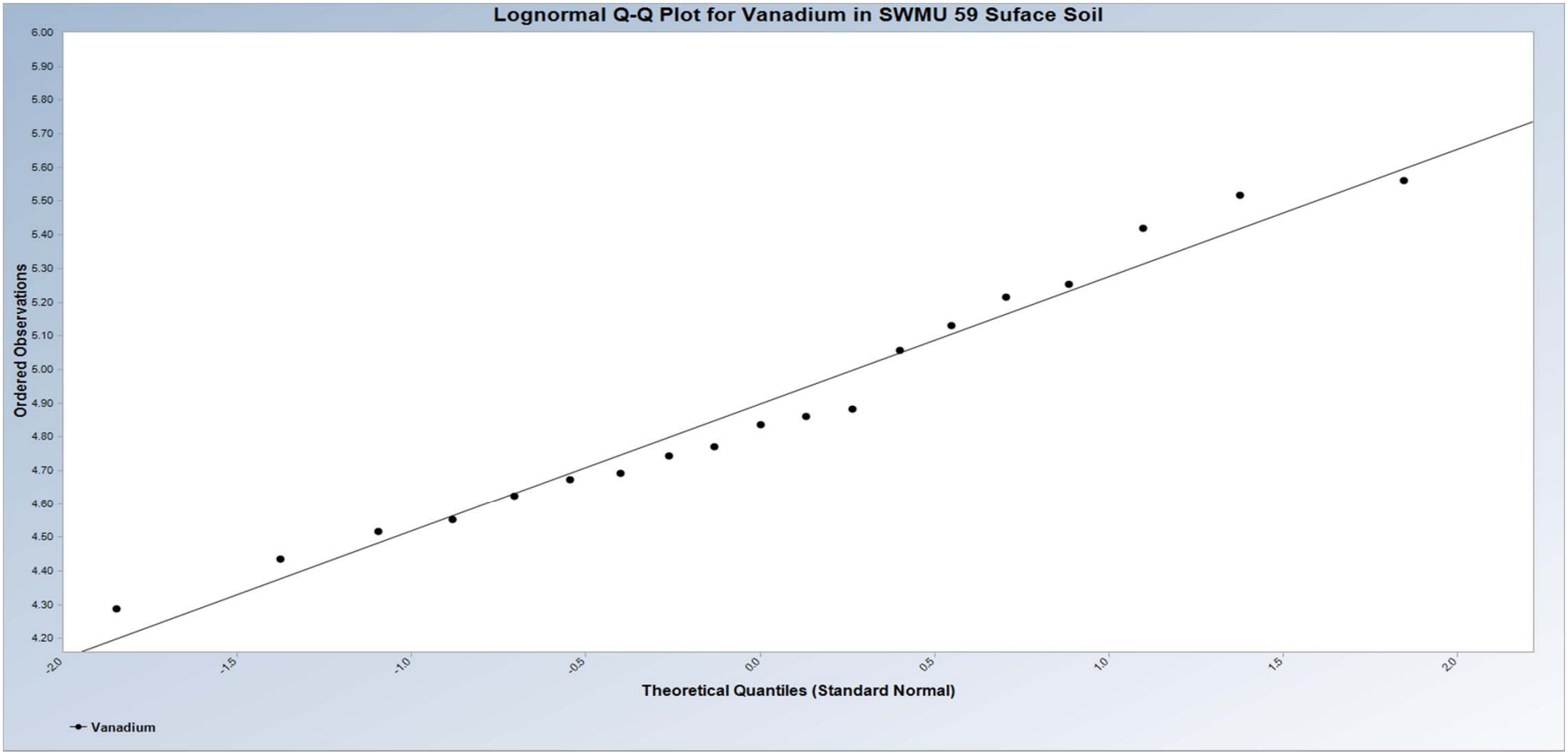
APPENDIX H

PROBABILITY PLOT - LEAD IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



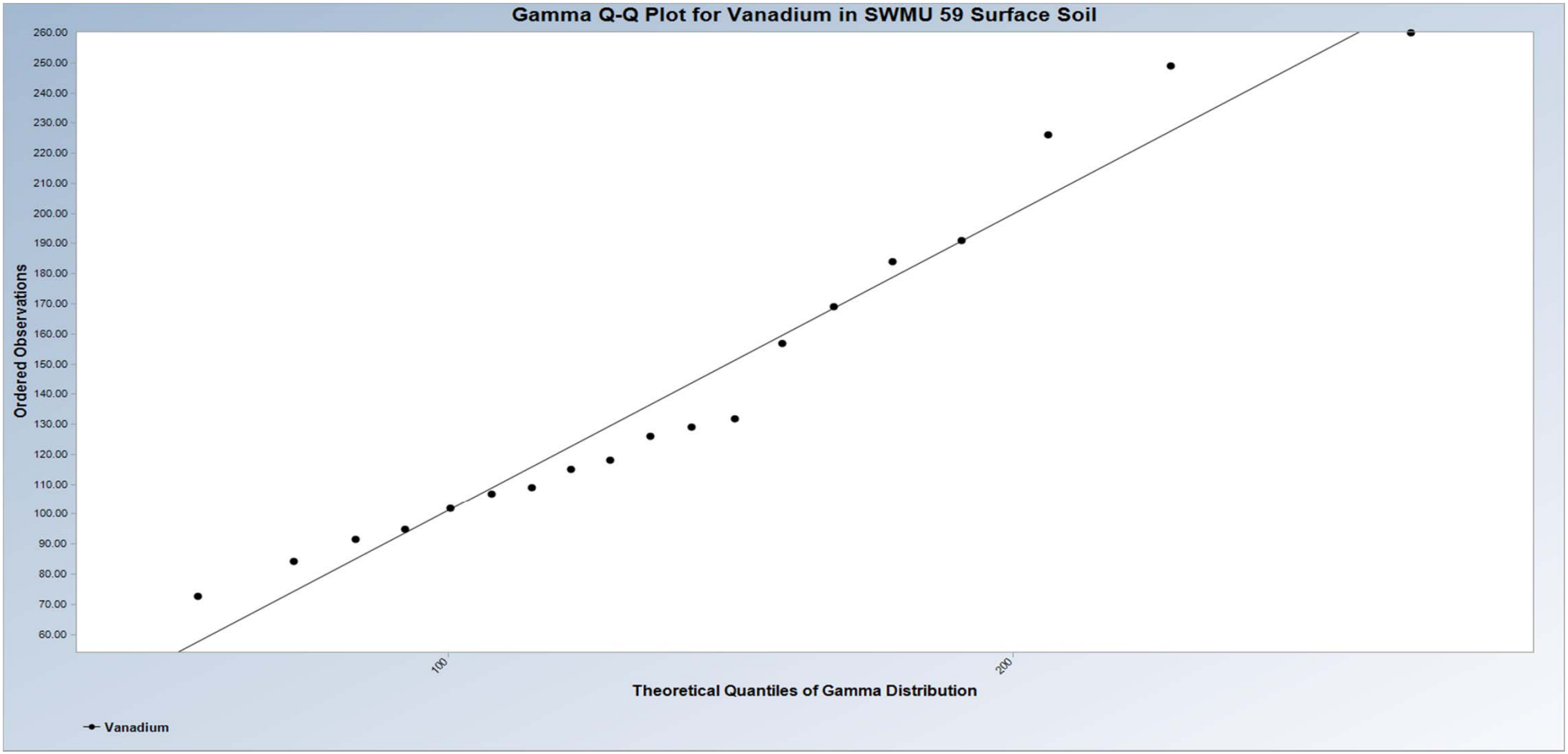
APPENDIX H

PROBABILITY PLOT - VANADIUM IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



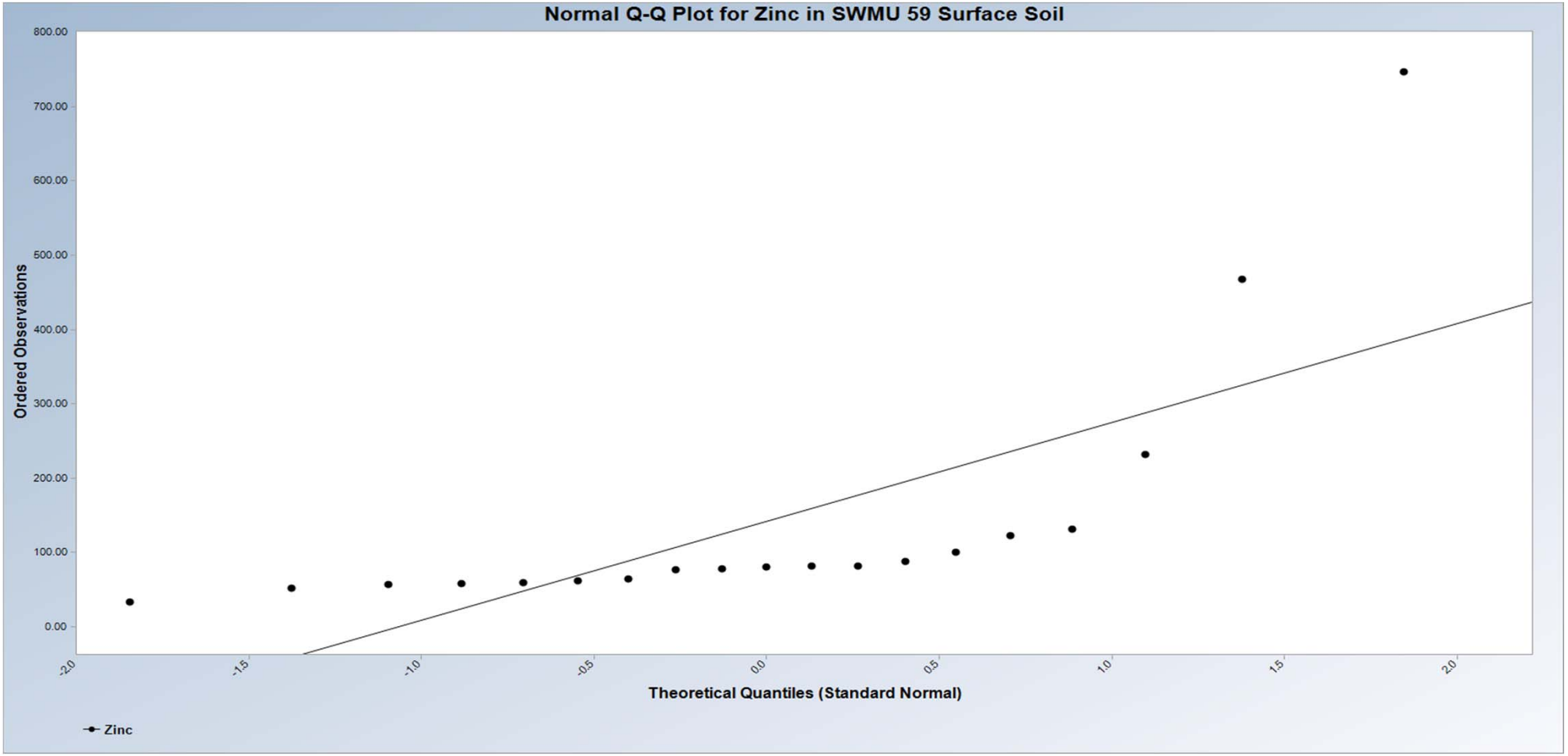
APPENDIX H

PROBABILITY PLOT - VANADIUM IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



APPENDIX H

PROBABILITY PLOT - ZINC IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



APPENDIX H

PROBABILITY PLOT - ZINC IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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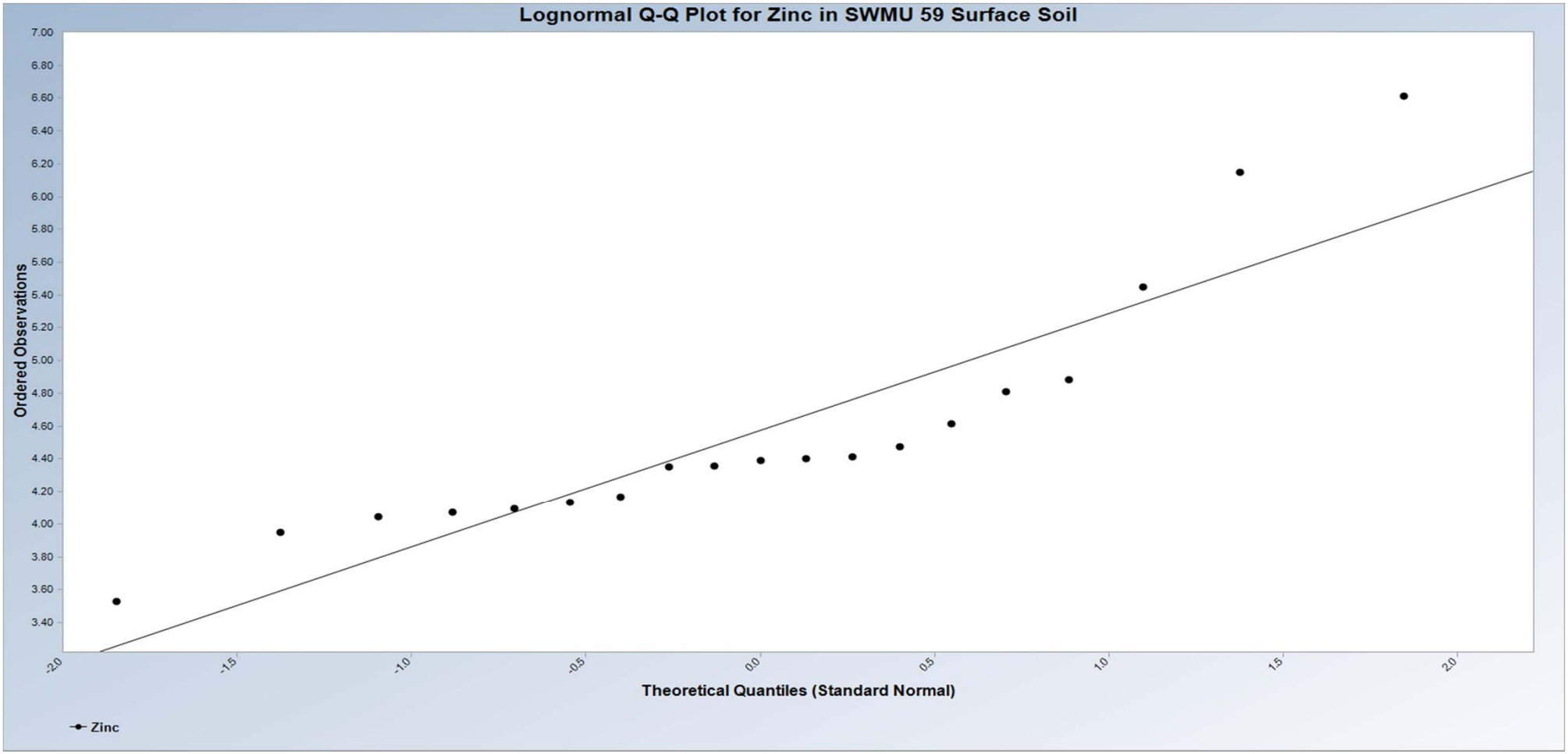

APPENDIX H

PROBABILITY PLOT - ZINC IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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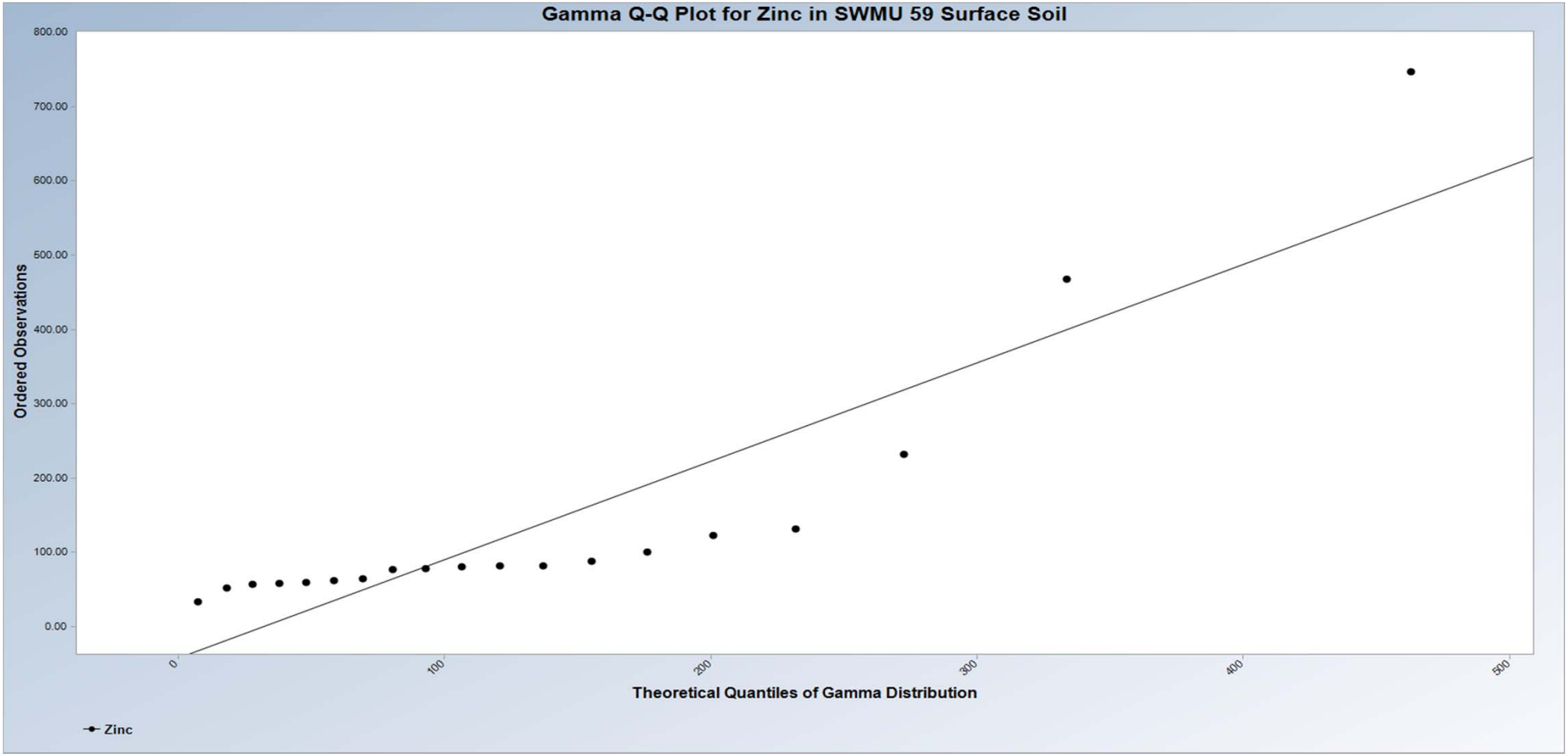
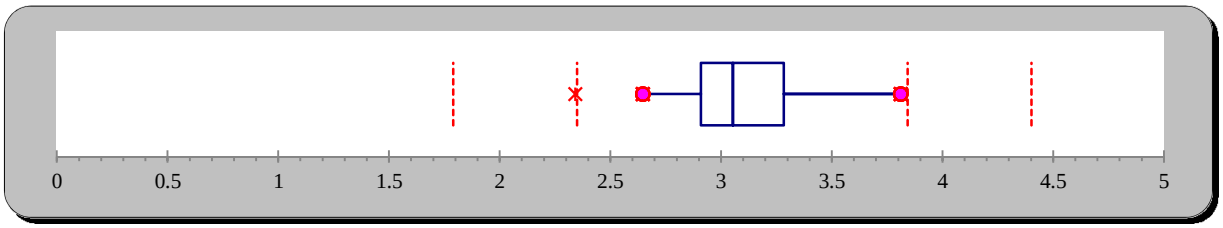
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



Box and Whisker Plot

Cobalt: SWMU 59 Surface Soil, 2010 CMS Investigation
(Log-Transformed Analytical Data)

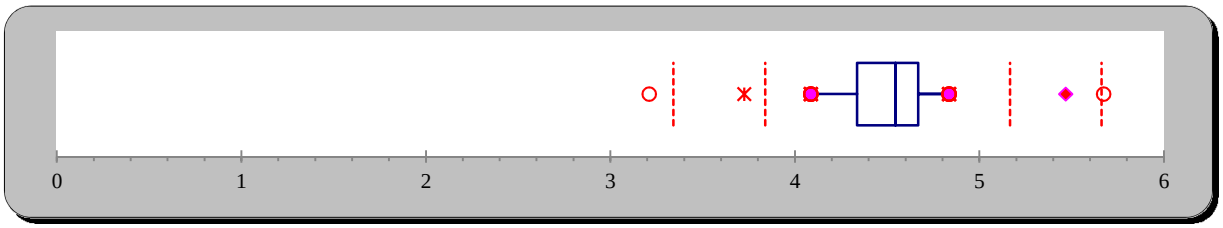
Lower Whisker	Lower Hinge	Median	Upper Hinge	Upper Whisker
2.6461748	2.9096259	3.0540012	3.2827451	3.8110971



Box and Whisker Plot

Copper: SWMU 59 Surface Soil, 2010 CMS Investigation
(Log-Transformed Analytical Data)

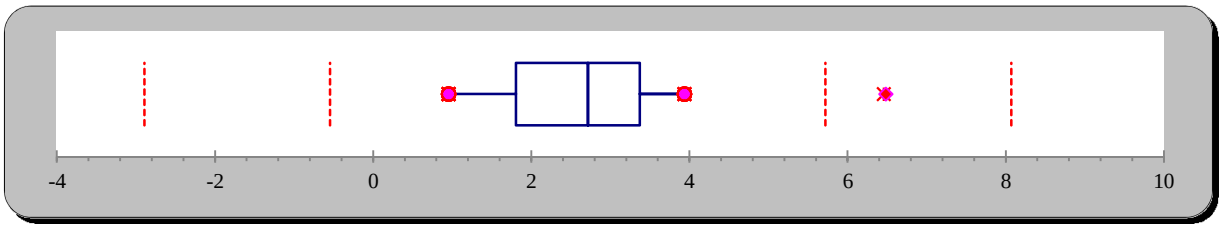
Lower Whisker	Lower Hinge	Median	Upper Hinge	Upper Whisker
4.0859763	4.336635	4.5454202	4.668134	4.8362819



Box and Whisker Plot

Lead: SWMU 59 Surface Soil, 2010 CMS Investigation
(Log-Transformed Analytical Data)

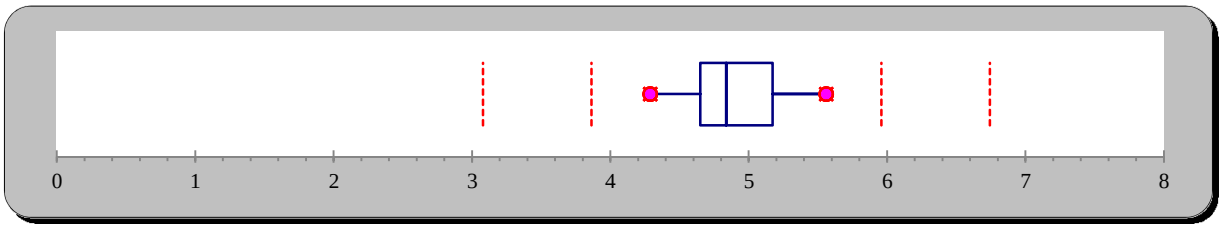
Lower Whisker	Lower Hinge	Median	Upper Hinge	Upper Whisker
0.9555114	1.8043767	2.7146947	3.370437	3.9376908



Box and Whisker Plot

Vanadium: SWMU 59 Surface Soil, 2010 CMS Investigation
(Log-Transformed Analytical Data)

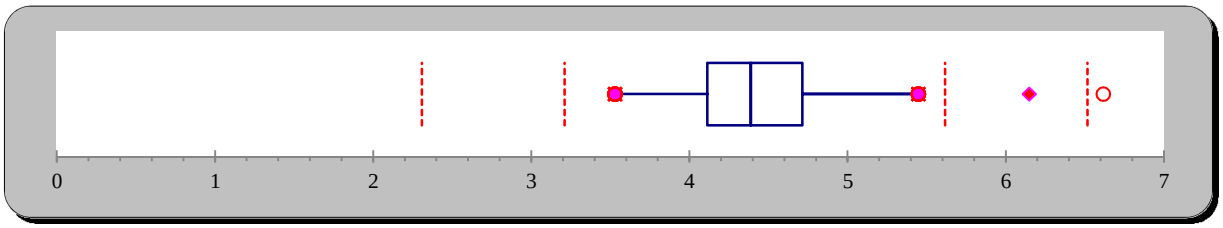
Lower Whisker	Lower Hinge	Median	Upper Hinge	Upper Whisker
4.287716	4.6489008	4.8362819	5.1724172	5.5606816



Box and Whisker Plot

Zinc: SWMU 59 Surface Soil, 2010 CMS Investigation
(Log-Transformed Analytical Data)

Lower Whisker	Lower Hinge	Median	Upper Hinge	Upper Whisker
3.5292974	4.112319	4.3882572	4.7136524	5.4467374



APPENDIX I
2012 SURFACE SOIL STATISTICS

General UCL Statistics for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Beryllium: SWMU 59 Surface Soil, 2012 CMS Investigation

General Statistics

Number of Valid Observations	10	Number of Distinct Observations	10

Raw Statistics		**Log-transformed Statistics**	
Minimum	0.097	Minimum of Log Data	-2.333
Maximum	0.63	Maximum of Log Data	-0.462
Mean	0.286	Mean of log Data	-1.392
Geometric Mean	0.249	SD of log Data	0.574
Median	0.27		
SD	0.156		
Std. Error of Mean	0.0493		
Coefficient of Variation	0.546		
Skewness	1.049		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.923	Shapiro Wilk Test Statistic	0.96
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	0.376	95% H-UCL	0.458
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.521
95% Adjusted-CLT UCL (Chen-1995)	0.384	97.5% Chebyshev (MVUE) UCL	0.622
95% Modified-t UCL (Johnson-1978)	0.379	99% Chebyshev (MVUE) UCL	0.82

Gamma Distribution Test		**Data Distribution**
k star (bias corrected)	2.689	Data appear Normal at 5% Significance Level
Theta Star	0.106	
MLE of Mean	0.286	
MLE of Standard Deviation	0.174	
nu star	53.78	
Approximate Chi Square Value (.05)	37.93	**Nonparametric Statistics**
Adjusted Level of Significance	0.0267	95% CLT UCL 0.367
Adjusted Chi Square Value	35.63	95% Jackknife UCL 0.376
		95% Standard Bootstrap UCL 0.363
Anderson-Darling Test Statistic	0.202	95% Bootstrap-t UCL 0.405
Anderson-Darling 5% Critical Value	0.73	95% Hall's Bootstrap UCL 0.436
Kolmogorov-Smirnov Test Statistic	0.127	95% Percentile Bootstrap UCL 0.367
Kolmogorov-Smirnov 5% Critical Value	0.268	95% BCA Bootstrap UCL 0.387
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 0.501
		97.5% Chebyshev(Mean, Sd) UCL 0.594
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 0.777
95% Approximate Gamma UCL (Use when n >= 40)	0.405	
95% Adjusted Gamma UCL (Use when n < 40)	0.431	

Potential UCL to Use		Use 95% Student's-t UCL	0.376

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Beryllium: NAPR Basewide Background, Surface Soil

General Statistics

Number of Valid Data	18	Number of Detected Data	16
Number of Distinct Detected Data	13	Number of Non-Detect Data	2
		Percent Non-Detects	11.11%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.085	Minimum Detected	-2.465
Maximum Detected	0.58	Maximum Detected	-0.545
Mean of Detected	0.315	Mean of Detected	-1.258
SD of Detected	0.134	SD of Detected	0.503
Minimum Non-Detect	0.04	Minimum Non-Detect	-3.219
Maximum Non-Detect	0.1	Maximum Non-Detect	-2.303

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	3
Number treated as Detected	15
Single DL Non-Detect Percentage	16.67%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.966	Shapiro Wilk Test Statistic	0.925
5% Shapiro Wilk Critical Value	0.887	5% Shapiro Wilk Critical Value	0.887
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.284	Mean	-1.502
SD	0.155	SD	0.868
95% DL/2 (t) UCL	0.348	95% H-Stat (DL/2) UCL	0.544
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	0.279	Mean in Log Scale	-1.378
SD	0.162	SD in Log Scale	0.589
95% MLE (t) UCL	0.345	Mean in Original Scale	0.291
95% MLE (Tiku) UCL	0.347	SD in Original Scale	0.145
		95% t UCL	0.35
		95% Percentile Bootstrap UCL	0.344
		95% BCA Bootstrap UCL	0.344
		95% H UCL	0.405

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	4.095	Data appear Normal at 5% Significance Level
Theta Star	0.077	
nu star	131	
A-D Test Statistic	0.416	
5% A-D Critical Value	0.741	
K-S Test Statistic	0.741	
5% K-S Critical Value	0.216	
Data appear Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution		Nonparametric Statistics	
Gamma ROS Statistics using Extrapolated Data		Kaplan-Meier (KM) Method	
Minimum	0.000001	Mean	0.29
Maximum	0.58	SD	0.142
Mean	0.28	SE of Mean	0.0346
Median	0.32	95% KM (t) UCL	0.35
SD	0.162	95% KM (z) UCL	0.347
k star	0.425	95% KM (jackknife) UCL	0.348
Theta star	0.66	95% KM (bootstrap t) UCL	0.349
Nu star	15.29	95% KM (BCA) UCL	0.352
AppChi2	7.462	95% KM (Percentile Bootstrap) UCL	0.35
95% Gamma Approximate UCL (Use when n >= 40)	0.574	95% KM (Chebyshev) UCL	0.441
95% Adjusted Gamma UCL (Use when n < 40)	0.617	97.5% KM (Chebyshev) UCL	0.506
		99% KM (Chebyshev) UCL	0.634
		Potential UCLs to Use	
		95% KM (t) UCL	0.35
		95% KM (Percentile Bootstrap) UCL	0.35

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Cadmium: SWMU 59 Surface Soil, 2012 CMS Investigation

General Statistics

Number of Valid Observations	10	Number of Distinct Observations	9

Raw Statistics		Log-transformed Statistics	
Minimum	0.047	Minimum of Log Data	-3.058
Maximum	0.47	Maximum of Log Data	-0.755
Mean	0.133	Mean of log Data	-2.25
Geometric Mean	0.105	SD of log Data	0.636
Median	0.105		
SD	0.123		
Std. Error of Mean	0.0389		
Coefficient of Variation	0.929		
Skewness	2.759		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.618	Shapiro Wilk Test Statistic	0.887
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	0.204	95% H-UCL	0.216
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.24
95% Adjusted-CLT UCL (Chen-1995)	0.233	97.5% Chebyshev (MVUE) UCL	0.289
95% Modified-t UCL (Johnson-1978)	0.209	99% Chebyshev (MVUE) UCL	0.385

Gamma Distribution Test		Data Distribution
k star (bias corrected)	1.704	Data appear Lognormal at 5% Significance Level
Theta Star	0.0777	
MLE of Mean	0.133	
MLE of Standard Deviation	0.101	
nu star	34.09	
Approximate Chi Square Value (.05)	21.73	**Nonparametric Statistics**
Adjusted Level of Significance	0.0267	95% CLT UCL 0.197
Adjusted Chi Square Value	20.04	95% Jackknife UCL 0.204
		95% Standard Bootstrap UCL 0.194
Anderson-Darling Test Statistic	0.831	95% Bootstrap-t UCL 0.362
Anderson-Darling 5% Critical Value	0.734	95% Hall's Bootstrap UCL 0.49
Kolmogorov-Smirnov Test Statistic	0.271	95% Percentile Bootstrap UCL 0.203
Kolmogorov-Smirnov 5% Critical Value	0.269	95% BCA Bootstrap UCL 0.221
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 0.302
		97.5% Chebyshev(Mean, Sd) UCL 0.375
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 0.52
95% Approximate Gamma UCL (Use when n >= 40)	0.208	
95% Adjusted Gamma UCL (Use when n < 40)	0.225	

Potential UCL to Use		Use 95% H-UCL	0.216

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Chromium: SWMU 59 Surface Soil, 2012 CMS Investigation

General Statistics

Number of Valid Observations	10	Number of Distinct Observations	10

Raw Statistics		Log-transformed Statistics	
Minimum	32	Minimum of Log Data	3.466
Maximum	150	Maximum of Log Data	5.011
Mean	64.5	Mean of log Data	4.051
Geometric Mean	57.47	SD of log Data	0.49
Median	56		
SD	35.73		
Std. Error of Mean	11.3		
Coefficient of Variation	0.554		
Skewness	1.669		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.837	Shapiro Wilk Test Statistic	0.945
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	85.21	95% H-UCL	92.92
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	107.9
95% Adjusted-CLT UCL (Chen-1995)	89.45	97.5% Chebyshev (MVUE) UCL	126.9
95% Modified-t UCL (Johnson-1978)	86.2	99% Chebyshev (MVUE) UCL	164.3

Gamma Distribution Test		Data Distribution
k star (bias corrected)	3.213	Data appear Gamma Distributed at 5% Significance Level
Theta Star	20.07	
MLE of Mean	64.5	
MLE of Standard Deviation	35.98	
nu star	64.26	
Approximate Chi Square Value (.05)	46.82	**Nonparametric Statistics**
Adjusted Level of Significance	0.0267	95% CLT UCL 83.08
Adjusted Chi Square Value	44.24	95% Jackknife UCL 85.21
		95% Standard Bootstrap UCL 81.75
Anderson-Darling Test Statistic	0.318	95% Bootstrap-t UCL 99.06
Anderson-Darling 5% Critical Value	0.729	95% Hall's Bootstrap UCL 172.6
Kolmogorov-Smirnov Test Statistic	0.136	95% Percentile Bootstrap UCL 82.3
Kolmogorov-Smirnov 5% Critical Value	0.268	95% BCA Bootstrap UCL 90
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 113.7
		97.5% Chebyshev(Mean, Sd) UCL 135.1
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 176.9
95% Approximate Gamma UCL (Use when n >= 40)	88.53	
95% Adjusted Gamma UCL (Use when n < 40)	93.69	

Potential UCL to Use	Use 95% Approximate Gamma UCL 88.53

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Chromium: NAPR Basewide Background, Surface Soil

General Statistics

Number of Valid Observations	20	Number of Distinct Observations	18

Raw Statistics

Minimum	5.9
Maximum	47
Mean	25.69
Geometric Mean	22.22
Median	29.95
SD	12.22
Std. Error of Mean	2.733
Coefficient of Variation	0.476
Skewness	-0.153

Log-transformed Statistics

Minimum of Log Data	1.775
Maximum of Log Data	3.85
Mean of log Data	3.101
SD of log Data	0.601

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.922
Shapiro Wilk Critical Value	0.905

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.873
Shapiro Wilk Critical Value	0.905

Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	30.42

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	30.09
95% Modified-t UCL (Johnson-1978)	30.4

Assuming Lognormal Distribution

95% H-UCL	35.66
95% Chebyshev (MVUE) UCL	42.55
97.5% Chebyshev (MVUE) UCL	49.57
99% Chebyshev (MVUE) UCL	63.35

Gamma Distribution Test

k star (bias corrected)	3.096
Theta Star	8.299
MLE of Mean	25.69
MLE of Standard Deviation	14.6
nu star	123.8
Approximate Chi Square Value (.05)	99.13
Adjusted Level of Significance	0.038
Adjusted Chi Square Value	97.38
Anderson-Darling Test Statistic	1.052
Anderson-Darling 5% Critical Value	0.746
Kolmogorov-Smirnov Test Statistic	0.231
Kolmogorov-Smirnov 5% Critical Value	0.195

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL (Use when n >= 40)	32.09
95% Adjusted Gamma UCL (Use when n < 40)	32.67

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	30.19
95% Jackknife UCL	30.42
95% Standard Bootstrap UCL	30.05
95% Bootstrap-t UCL	30.41
95% Hall's Bootstrap UCL	29.81
95% Percentile Bootstrap UCL	30.06
95% BCA Bootstrap UCL	29.99
95% Chebyshev(Mean, Sd) UCL	37.6
97.5% Chebyshev(Mean, Sd) UCL	42.76
99% Chebyshev(Mean, Sd) UCL	52.88

Potential UCL to Use — Use 95% Student's-t UCL 30.42

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Note: For highly negative-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Cobalt: SWMU 59 Surface Soil, 2012 CMS Investigation

General Statistics

Number of Valid Observations	10	Number of Distinct Observations	10

Raw Statistics

Minimum	6
Maximum	36
Mean	20.1
Geometric Mean	18.36
Median	19.5
SD	8.171
Std. Error of Mean	2.584
Coefficient of Variation	0.407
Skewness	0.326

Log-transformed Statistics

Minimum of Log Data	1.792
Maximum of Log Data	3.584
Mean of log Data	2.91
SD of log Data	0.484

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.982
Shapiro Wilk Critical Value	0.842

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.912
Shapiro Wilk Critical Value	0.842

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	24.84

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	24.63
95% Modified-t UCL (Johnson-1978)	24.88

Assuming Lognormal Distribution

95% H-UCL	29.43
95% Chebyshev (MVUE) UCL	34.21
97.5% Chebyshev (MVUE) UCL	40.2
99% Chebyshev (MVUE) UCL	51.96

Gamma Distribution Test

k star (bias corrected)	4.044
Theta Star	4.97
MLE of Mean	20.1
MLE of Standard Deviation	9.995
nu star	80.88
Approximate Chi Square Value (.05)	61.16
Adjusted Level of Significance	0.0267
Adjusted Chi Square Value	58.19
Anderson-Darling Test Statistic	0.253
Anderson-Darling 5% Critical Value	0.729
Kolmogorov-Smirnov Test Statistic	0.152
Kolmogorov-Smirnov 5% Critical Value	0.267

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL (Use when n >= 40)	26.58
95% Adjusted Gamma UCL (Use when n < 40)	27.94

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	24.35
95% Jackknife UCL	24.84
95% Standard Bootstrap UCL	24.21
95% Bootstrap-t UCL	25.29
95% Hall's Bootstrap UCL	26.31
95% Percentile Bootstrap UCL	24.3
95% BCA Bootstrap UCL	24.5
95% Chebyshev(Mean, Sd) UCL	31.36
97.5% Chebyshev(Mean, Sd) UCL	36.24
99% Chebyshev(Mean, Sd) UCL	45.81

Potential UCL to Use

Use 95% Student's-t UCL 24.84

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Cobalt: NAPR Basewide Background, Surface Soil

General Statistics

Number of Valid Observations	19	Number of Distinct Observations	18

Raw Statistics		Log-transformed Statistics	
Minimum	9.5	Minimum of Log Data	2.251
Maximum	50.2	Maximum of Log Data	3.916
Mean	22.84	Mean of log Data	3.015
Geometric Mean	20.39	SD of log Data	0.484
Median	21.2		
SD	11.7		
Std. Error of Mean	2.685		
Coefficient of Variation	0.512		
Skewness	1.14		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.875	Shapiro Wilk Test Statistic	0.954
Shapiro Wilk Critical Value	0.901	Shapiro Wilk Critical Value	0.901
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	27.5	95% H-UCL	28.78
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	34.16
95% Adjusted-CLT UCL (Chen-1995)	28.01	97.5% Chebyshev (MVUE) UCL	39.09
95% Modified-t UCL (Johnson-1978)	27.61	99% Chebyshev (MVUE) UCL	48.77

Gamma Distribution Test		Data Distribution
k star (bias corrected)	3.87	Data appear Gamma Distributed at 5% Significance Level
Theta Star	5.903	
MLE of Mean	22.84	
MLE of Standard Deviation	11.61	
nu star	147.1	
Approximate Chi Square Value (.05)	120	**Nonparametric Statistics**
Adjusted Level of Significance	0.0369	95% CLT UCL 27.26
Adjusted Chi Square Value	117.9	95% Jackknife UCL 27.5
		95% Standard Bootstrap UCL 27.05
Anderson-Darling Test Statistic	0.456	95% Bootstrap-t UCL 28.74
Anderson-Darling 5% Critical Value	0.744	95% Hall's Bootstrap UCL 29.76
Kolmogorov-Smirnov Test Statistic	0.185	95% Percentile Bootstrap UCL 27.39
Kolmogorov-Smirnov 5% Critical Value	0.199	95% BCA Bootstrap UCL 27.87
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 34.55
		97.5% Chebyshev(Mean, Sd) UCL 39.61
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 49.56
95% Approximate Gamma UCL (Use when n >= 40)	27.99	
95% Adjusted Gamma UCL (Use when n < 40)	28.49	

Potential UCL to Use	Use 95% Approximate Gamma UCL 27.99

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Copper: SWMU 59 Surface Soil, 2012 CMS Investigation

General Statistics

Number of Valid Observations	10	Number of Distinct Observations	10

Raw Statistics

Minimum	50
Maximum	260
Mean	108.9
Geometric Mean	98.49
Median	99.5
SD	58.68
Std. Error of Mean	18.56
Coefficient of Variation	0.539
Skewness	2.133

Log-transformed Statistics

Minimum of Log Data	3.912
Maximum of Log Data	5.561
Mean of log Data	4.59
SD of log Data	0.451

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.779
Shapiro Wilk Critical Value	0.842

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.949
Shapiro Wilk Critical Value	0.842

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	142.9

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	152.8
95% Modified-t UCL (Johnson-1978)	145

Assuming Lognormal Distribution

95% H-UCL	150.6
95% Chebyshev (MVUE) UCL	175.8
97.5% Chebyshev (MVUE) UCL	205.2
99% Chebyshev (MVUE) UCL	263

Gamma Distribution Test

k star (bias corrected)	3.663
Theta Star	29.73
MLE of Mean	108.9
MLE of Standard Deviation	56.9
nu star	73.26
Approximate Chi Square Value (.05)	54.55
Adjusted Level of Significance	0.0267
Adjusted Chi Square Value	51.76
Anderson-Darling Test Statistic	0.418
Anderson-Darling 5% Critical Value	0.729
Kolmogorov-Smirnov Test Statistic	0.188
Kolmogorov-Smirnov 5% Critical Value	0.267

Data appear Gamma Distributed at 5% Significance Level

Data Distribution

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	139.4
95% Jackknife UCL	142.9
95% Standard Bootstrap UCL	136.9
95% Bootstrap-t UCL	173.4
95% Hall's Bootstrap UCL	275.8
95% Percentile Bootstrap UCL	142.1
95% BCA Bootstrap UCL	152.9
95% Chebyshev(Mean, Sd) UCL	189.8
97.5% Chebyshev(Mean, Sd) UCL	224.8
99% Chebyshev(Mean, Sd) UCL	293.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (Use when n >= 40)	146.3
95% Adjusted Gamma UCL (Use when n < 40)	154.2

Potential UCL to Use

Use 95% Approximate Gamma UCL 146.3

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Copper: NAPR Basewide Background, Surface Soil

General Statistics

Number of Valid Observations	18	Number of Distinct Observations	17

Raw Statistics

Minimum	13
Maximum	180
Mean	77.11
Geometric Mean	63.53
Median	66.5
SD	46.73
Std. Error of Mean	11.01
Coefficient of Variation	0.606
Skewness	0.919

Log-transformed Statistics

Minimum of Log Data	2.565
Maximum of Log Data	5.193
Mean of log Data	4.152
SD of log Data	0.685

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.922
Shapiro Wilk Critical Value	0.897

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.958
Shapiro Wilk Critical Value	0.897

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	96.27

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	97.77
95% Modified-t UCL (Johnson-1978)	96.67

Assuming Lognormal Distribution

95% H-UCL	116.1
95% Chebyshev (MVUE) UCL	138.1
97.5% Chebyshev (MVUE) UCL	163.6
99% Chebyshev (MVUE) UCL	213.7

Gamma Distribution Test

k star (bias corrected)	2.317
Theta Star	33.28
MLE of Mean	77.11
MLE of Standard Deviation	50.66
nu star	83.41
Approximate Chi Square Value (.05)	63.36
Adjusted Level of Significance	0.0357
Adjusted Chi Square Value	61.69
Anderson-Darling Test Statistic	0.193
Anderson-Darling 5% Critical Value	0.748
Kolmogorov-Smirnov Test Statistic	0.12
Kolmogorov-Smirnov 5% Critical Value	0.205

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL (Use when n >= 40)	101.5
95% Adjusted Gamma UCL (Use when n < 40)	104.3

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	95.23
95% Jackknife UCL	96.27
95% Standard Bootstrap UCL	94.95
95% Bootstrap-t UCL	100.7
95% Hall's Bootstrap UCL	100.1
95% Percentile Bootstrap UCL	95.07
95% BCA Bootstrap UCL	97.31
95% Chebyshev(Mean, Sd) UCL	125.1
97.5% Chebyshev(Mean, Sd) UCL	145.9
99% Chebyshev(Mean, Sd) UCL	186.7

Potential UCL to Use

Use 95% Student's-t UCL 96.27

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Mercury: NAPR Basewide Background, Surface Soil

General Statistics

Number of Valid Data	20	Number of Detected Data	17
Number of Distinct Detected Data	13	Number of Non-Detect Data	3
		Percent Non-Detects	15.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.012	Minimum Detected	-4.423
Maximum Detected	0.12	Maximum Detected	-2.12
Mean of Detected	0.0584	Mean of Detected	-2.963
SD of Detected	0.0267	SD of Detected	0.551
Minimum Non-Detect	0.02	Minimum Non-Detect	-3.912
Maximum Non-Detect	0.04	Maximum Non-Detect	-3.219

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	9
Number treated as Detected	11
Single DL Non-Detect Percentage	45.00%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.958	Shapiro Wilk Test Statistic	0.913
5% Shapiro Wilk Critical Value	0.892	5% Shapiro Wilk Critical Value	0.892
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.0516	Mean	-3.174
SD	0.0296	SD	0.735
95% DL/2 (t) UCL	0.063	95% H-Stat (DL/2) UCL	0.0805
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	0.0471	Mean in Log Scale	-3.099
SD	0.035	SD in Log Scale	0.612
95% MLE (t) UCL	0.0606	Mean in Original Scale	0.0528
95% MLE (Tiku) UCL	0.063	SD in Original Scale	0.0281
		95% t UCL	0.0637
		95% Percentile Bootstrap UCL	0.0629
		95% BCA Bootstrap UCL	0.0637
		95% H UCL	0.0734

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	3.566	Data appear Normal at 5% Significance Level
Theta Star	0.0164	
nu star	121.2	
A-D Test Statistic	0.443	**Nonparametric Statistics**
5% A-D Critical Value	0.742	Kaplan-Meier (KM) Method
K-S Test Statistic	0.742	Mean 0.0521
5% K-S Critical Value	0.21	SD 0.0284
Data appear Gamma Distributed at 5% Significance Level		SE of Mean 0.00657
		95% KM (t) UCL 0.0634
Assuming Gamma Distribution		95% KM (z) UCL 0.0629
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL 0.063
Minimum	0.000001	95% KM (bootstrap t) UCL 0.0633
Maximum	0.12	95% KM (BCA) UCL 0.0639
Mean	0.0512	95% KM (Percentile Bootstrap) UCL 0.0638
Median	0.054	95% KM (Chebyshev) UCL 0.0807
SD	0.0304	97.5% KM (Chebyshev) UCL 0.0931
k star	0.776	99% KM (Chebyshev) UCL 0.117
Theta star	0.066	
Nu star	31.03	Potential UCLs to Use
AppChi2	19.31	95% KM (t) UCL 0.0634
95% Gamma Approximate UCL (Use when n >= 40)	0.0823	95% KM (Percentile Bootstrap) UCL 0.0638
95% Adjusted Gamma UCL (Use when n < 40)	0.0856	

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Nickel: SWMU 59 Surface Soil, 2012 CMS Investigation

General Statistics

Number of Valid Observations	10	Number of Distinct Observations	7

Raw Statistics

Minimum	15
Maximum	47
Mean	26.1
Geometric Mean	24.36
Median	26.5
SD	10.34
Std. Error of Mean	3.271
Coefficient of Variation	0.396
Skewness	0.749

Log-transformed Statistics

Minimum of Log Data	2.708
Maximum of Log Data	3.85
Mean of log Data	3.193
SD of log Data	0.391

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.889
Shapiro Wilk Critical Value	0.842

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.904
Shapiro Wilk Critical Value	0.842

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	32.1

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	32.31
95% Modified-t UCL (Johnson-1978)	32.23

Assuming Lognormal Distribution

95% H-UCL	34.48
95% Chebyshev (MVUE) UCL	40.31
97.5% Chebyshev (MVUE) UCL	46.46
99% Chebyshev (MVUE) UCL	58.55

Gamma Distribution Test

k star (bias corrected)	5.244
Theta Star	4.977
MLE of Mean	26.1
MLE of Standard Deviation	11.4
nu star	104.9
Approximate Chi Square Value (.05)	82.25
Adjusted Level of Significance	0.0267
Adjusted Chi Square Value	78.77
Anderson-Darling Test Statistic	0.507
Anderson-Darling 5% Critical Value	0.727
Kolmogorov-Smirnov Test Statistic	0.232
Kolmogorov-Smirnov 5% Critical Value	0.267

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL (Use when n >= 40)	33.28
95% Adjusted Gamma UCL (Use when n < 40)	34.75

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	31.48
95% Jackknife UCL	32.1
95% Standard Bootstrap UCL	31.33
95% Bootstrap-t UCL	33.09
95% Hall's Bootstrap UCL	32.49
95% Percentile Bootstrap UCL	31.3
95% BCA Bootstrap UCL	31.8
95% Chebyshev(Mean, Sd) UCL	40.36
97.5% Chebyshev(Mean, Sd) UCL	46.53
99% Chebyshev(Mean, Sd) UCL	58.65

Potential UCL to Use Use 95% Student's-t UCL 32.1

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Nickel: NAPR Basewide Background, Surface Soil

General Statistics

Number of Valid Observations	19	Number of Distinct Observations	19

Raw Statistics		Log-transformed Statistics	
Minimum	3.4	Minimum of Log Data	1.224
Maximum	19	Maximum of Log Data	2.944
Mean	10.54	Mean of log Data	2.226
Geometric Mean	9.265	SD of log Data	0.535
Median	8.6		
SD	5.228		
Std. Error of Mean	1.199		
Coefficient of Variation	0.496		
Skewness	0.295		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.899	Shapiro Wilk Test Statistic	0.925
Shapiro Wilk Critical Value	0.901	Shapiro Wilk Critical Value	0.901
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	12.62	95% H-UCL	13.84
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	16.51
95% Adjusted-CLT UCL (Chen-1995)	12.6	97.5% Chebyshev (MVUE) UCL	19.06
95% Modified-t UCL (Johnson-1978)	12.63	99% Chebyshev (MVUE) UCL	24.08

Gamma Distribution Test		Data Distribution
k star (bias corrected)	3.442	Data appear Gamma Distributed at 5% Significance Level
Theta Star	3.061	
MLE of Mean	10.54	
MLE of Standard Deviation	5.68	
nu star	130.8	
Approximate Chi Square Value (.05)	105.4	**Nonparametric Statistics**
Adjusted Level of Significance	0.0369	95% CLT UCL 12.51
Adjusted Chi Square Value	103.4	95% Jackknife UCL 12.62
		95% Standard Bootstrap UCL 12.46
Anderson-Darling Test Statistic	0.663	95% Bootstrap-t UCL 12.67
Anderson-Darling 5% Critical Value	0.745	95% Hall's Bootstrap UCL 12.39
Kolmogorov-Smirnov Test Statistic	0.163	95% Percentile Bootstrap UCL 12.51
Kolmogorov-Smirnov 5% Critical Value	0.199	95% BCA Bootstrap UCL 12.44
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 15.77
		97.5% Chebyshev(Mean, Sd) UCL 18.03
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 22.47
95% Approximate Gamma UCL (Use when n >= 40)	13.08	
95% Adjusted Gamma UCL (Use when n < 40)	13.33	

Potential UCL to Use	Use 95% Approximate Gamma UCL 13.08

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Tin: NAPR Basewide Background, Surface Soil

General Statistics

Number of Valid Data	19	Number of Detected Data	12
Number of Distinct Detected Data	9	Number of Non-Detect Data	7
		Percent Non-Detects	36.84%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	1.4	Minimum Detected	0.336
Maximum Detected	4	Maximum Detected	1.386
Mean of Detected	2.325	Mean of Detected	0.801
SD of Detected	0.737	SD of Detected	0.304
Minimum Non-Detect	0.69	Minimum Non-Detect	-0.371
Maximum Non-Detect	1.3	Maximum Non-Detect	0.262

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	7
Number treated as Detected	12
Single DL Non-Detect Percentage	36.84%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.902	Shapiro Wilk Test Statistic	0.943
5% Shapiro Wilk Critical Value	0.859	5% Shapiro Wilk Critical Value	0.859
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	1.651	Mean	0.239
SD	1.077	SD	0.801
95% DL/2 (t) UCL	2.079	95% H-Stat (DL/2) UCL	2.726
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	1.676	Mean in Log Scale	0.527
SD	1.079	SD in Log Scale	0.438
95% MLE (t) UCL	2.105	Mean in Original Scale	1.859
95% MLE (Tiku) UCL	2.15	SD in Original Scale	0.852
		95% t UCL	2.198
		95% Percentile Bootstrap UCL	2.195
		95% BCA Bootstrap UCL	2.214
		95% H UCL	2.281

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	8.868	Data appear Normal at 5% Significance Level
Theta Star	0.262	
nu star	212.8	
A-D Test Statistic	0.409	
5% A-D Critical Value	0.731	
K-S Test Statistic	0.731	
5% K-S Critical Value	0.245	
Data appear Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution		Nonparametric Statistics	
Gamma ROS Statistics using Extrapolated Data		Kaplan-Meier (KM) Method	
Minimum	0.000001	Mean	1.984
Maximum	4	SD	0.717
Mean	1.468	SE of Mean	0.172
Median	1.9	95% KM (t) UCL	2.282
SD	1.288	95% KM (z) UCL	2.267
k star	0.165	95% KM (jackknife) UCL	2.277
Theta star	8.908	95% KM (bootstrap t) UCL	2.374
Nu star	6.264	95% KM (BCA) UCL	2.358
AppChi2	1.776	95% KM (Percentile Bootstrap) UCL	2.337
95% Gamma Approximate UCL (Use when n >= 40)	5.178	95% KM (Chebyshev) UCL	2.733
95% Adjusted Gamma UCL (Use when n < 40)	5.836	97.5% KM (Chebyshev) UCL	3.057
		99% KM (Chebyshev) UCL	3.693
		Potential UCLs to Use	
		95% KM (t) UCL	2.282
		95% KM (Percentile Bootstrap) UCL	2.337

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Vanadium: SWMU 59 Surface Soil, 2012 CMS Investigation

General Statistics

Number of Valid Observations	10	Number of Distinct Observations	8

Raw Statistics		Log-transformed Statistics	
Minimum	110	Minimum of Log Data	4.7
Maximum	330	Maximum of Log Data	5.799
Mean	206	Mean of log Data	5.275
Geometric Mean	195.3	SD of log Data	0.349
Median	205		
SD	69.63		
Std. Error of Mean	22.02		
Coefficient of Variation	0.338		
Skewness	0.362		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.956	Shapiro Wilk Test Statistic	0.962
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	246.4	95% H-UCL	262.7
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	306.3
95% Adjusted-CLT UCL (Chen-1995)	244.9	97.5% Chebyshev (MVUE) UCL	349.5
95% Modified-t UCL (Johnson-1978)	246.8	99% Chebyshev (MVUE) UCL	434.5

Gamma Distribution Test		Data Distribution
k star (bias corrected)	6.748	Data appear Normal at 5% Significance Level
Theta Star	30.53	
MLE of Mean	206	
MLE of Standard Deviation	79.3	
nu star	135	
Approximate Chi Square Value (.05)	109.1	**Nonparametric Statistics**
Adjusted Level of Significance	0.0267	95% CLT UCL 242.2
Adjusted Chi Square Value	105.1	95% Jackknife UCL 246.4
		95% Standard Bootstrap UCL 240.1
Anderson-Darling Test Statistic	0.257	95% Bootstrap-t UCL 251.4
Anderson-Darling 5% Critical Value	0.725	95% Hall's Bootstrap UCL 246.1
Kolmogorov-Smirnov Test Statistic	0.175	95% Percentile Bootstrap UCL 243
Kolmogorov-Smirnov 5% Critical Value	0.267	95% BCA Bootstrap UCL 243
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 302
		97.5% Chebyshev(Mean, Sd) UCL 343.5
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 425.1
95% Approximate Gamma UCL (Use when n >= 40)	254.8	
95% Adjusted Gamma UCL (Use when n < 40)	264.6	

Potential UCL to Use	Use 95% Student's-t UCL 246.4

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Vanadium: NAPR Basewide Background, Surface Soil

General Statistics

Number of Valid Observations	18	Number of Distinct Observations	17

Raw Statistics		Log-transformed Statistics	
Minimum	35	Minimum of Log Data	3.555
Maximum	230	Maximum of Log Data	5.438
Mean	141.6	Mean of log Data	4.85
Geometric Mean	127.8	SD of log Data	0.502
Median	151.5		
SD	58.77		
Std. Error of Mean	13.85		
Coefficient of Variation	0.415		
Skewness	-0.0584		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.95	Shapiro Wilk Test Statistic	0.906
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	165.7	95% H-UCL	185.4
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	220.5
95% Adjusted-CLT UCL (Chen-1995)	164.1	97.5% Chebyshev (MVUE) UCL	253.7
95% Modified-t UCL (Johnson-1978)	165.6	99% Chebyshev (MVUE) UCL	318.9

Gamma Distribution Test		Data Distribution
k star (bias corrected)	4.237	Data appear Normal at 5% Significance Level
Theta Star	33.41	
MLE of Mean	141.6	
MLE of Standard Deviation	68.78	
nu star	152.5	
Approximate Chi Square Value (.05)	125	**Nonparametric Statistics**
Adjusted Level of Significance	0.0357	95% CLT UCL 164.4
Adjusted Chi Square Value	122.6	95% Jackknife UCL 165.7
		95% Standard Bootstrap UCL 164.6
Anderson-Darling Test Statistic	0.451	95% Bootstrap-t UCL 164.8
Anderson-Darling 5% Critical Value	0.743	95% Hall's Bootstrap UCL 163.2
Kolmogorov-Smirnov Test Statistic	0.166	95% Percentile Bootstrap UCL 163.9
Kolmogorov-Smirnov 5% Critical Value	0.204	95% BCA Bootstrap UCL 163.1
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 201.9
		97.5% Chebyshev(Mean, Sd) UCL 228.1
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 279.4
95% Approximate Gamma UCL (Use when n >= 40)	172.8	
95% Adjusted Gamma UCL (Use when n < 40)	176.1	

Potential UCL to Use	Use 95% Student's-t UCL 165.7

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Note: For highly negative-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Zinc: SWMU 59 Surface Soil, 2012 CMS Investigation

General Statistics

Number of Valid Observations	10	Number of Distinct Observations	10

Raw Statistics

Minimum	42
Maximum	100
Mean	63.4
Geometric Mean	61
Median	62.5
SD	18.8
Std. Error of Mean	5.946
Coefficient of Variation	0.297
Skewness	0.628

Log-transformed Statistics

Minimum of Log Data	3.738
Maximum of Log Data	4.605
Mean of log Data	4.111
SD of log Data	0.292

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.921
Shapiro Wilk Critical Value	0.842

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.936
Shapiro Wilk Critical Value	0.842

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	74.3

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	74.44
95% Modified-t UCL (Johnson-1978)	74.5

Assuming Lognormal Distribution

95% H-UCL	77.09
95% Chebyshev (MVUE) UCL	89.04
97.5% Chebyshev (MVUE) UCL	100.1
99% Chebyshev (MVUE) UCL	122

Gamma Distribution Test

k star (bias corrected)	9.238
Theta Star	6.863
MLE of Mean	63.4
MLE of Standard Deviation	20.86
nu star	184.8
Approximate Chi Square Value (.05)	154.3
Adjusted Level of Significance	0.0267
Adjusted Chi Square Value	149.5
Anderson-Darling Test Statistic	0.347
Anderson-Darling 5% Critical Value	0.725
Kolmogorov-Smirnov Test Statistic	0.168
Kolmogorov-Smirnov 5% Critical Value	0.266

Data appear Gamma Distributed at 5% Significance Level

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	73.18
95% Jackknife UCL	74.3
95% Standard Bootstrap UCL	72.92
95% Bootstrap-t UCL	75.85
95% Hall's Bootstrap UCL	74.71
95% Percentile Bootstrap UCL	73.1
95% BCA Bootstrap UCL	73.9
95% Chebyshev(Mean, Sd) UCL	89.32
97.5% Chebyshev(Mean, Sd) UCL	100.5
99% Chebyshev(Mean, Sd) UCL	122.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (Use when n >= 40)	75.91
95% Adjusted Gamma UCL (Use when n < 40)	78.36

Potential UCL to Use

Use 95% Student's-t UCL 74.3

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Zinc: NAPR Basewide Background, Surface Soil

General Statistics

Number of Valid Observations	18	Number of Distinct Observations	18

Raw Statistics

Minimum	6.2
Maximum	120
Mean	52.48
Geometric Mean	42.17
Median	47
SD	32.33
Std. Error of Mean	7.621
Coefficient of Variation	0.616
Skewness	0.788

Log-transformed Statistics

Minimum of Log Data	1.825
Maximum of Log Data	4.787
Mean of log Data	3.742
SD of log Data	0.751

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.925
Shapiro Wilk Critical Value	0.897

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.936
Shapiro Wilk Critical Value	0.897

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	65.73

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	66.52
95% Modified-t UCL (Johnson-1978)	65.97

Assuming Lognormal Distribution

95% H-UCL	85.05
95% Chebyshev (MVUE) UCL	100.2
97.5% Chebyshev (MVUE) UCL	119.8
99% Chebyshev (MVUE) UCL	158.3

Gamma Distribution Test

k star (bias corrected)	2.07
Theta Star	25.36
MLE of Mean	52.48
MLE of Standard Deviation	36.48
nu star	74.51
Approximate Chi Square Value (.05)	55.63
Adjusted Level of Significance	0.0357
Adjusted Chi Square Value	54.06
Anderson-Darling Test Statistic	0.235
Anderson-Darling 5% Critical Value	0.75
Kolmogorov-Smirnov Test Statistic	0.119
Kolmogorov-Smirnov 5% Critical Value	0.206

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL (Use when n >= 40)	70.29
95% Adjusted Gamma UCL (Use when n < 40)	72.32

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	65.01
95% Jackknife UCL	65.73
95% Standard Bootstrap UCL	64.86
95% Bootstrap-t UCL	67.73
95% Hall's Bootstrap UCL	68.15
95% Percentile Bootstrap UCL	64.96
95% BCA Bootstrap UCL	66.14
95% Chebyshev(Mean, Sd) UCL	85.7
97.5% Chebyshev(Mean, Sd) UCL	100.1
99% Chebyshev(Mean, Sd) UCL	128.3

Potential UCL to Use	Use 95% Student's-t UCL 65.73

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

General Background Statistics for Full Data Sets

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Coverage	90%
Different or Future K Values	1
Number of Bootstrap Operations	2000

Chromium: SWMU 59 Surface Soil, 2012 CMS Investigation

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
Tolerance Factor	2.355		

Raw Statistics

Minimum	32
Maximum	150
Second Largest	91
First Quartile	38.75
Median	56
Third Quartile	72.5
Mean	64.5
Geometric Mean	57.47
SD	35.73
Coefficient of Variation	0.554
Skewness	1.669

Log-Transformed Statistics

Minimum	3.466
Maximum	5.011
Second Largest	4.511
First Quartile	3.65
Median	4.021
Third Quartile	4.284
Mean	4.051
SD	0.49

Background Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.837
Shapiro Wilk Critical Value	0.842

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.945
Shapiro Wilk Critical Value	0.842

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% UTL with 90% Coverage	148.6
95% UPL (t)	133.2
90% Percentile (z)	110.3
95% Percentile (z)	123.3
99% Percentile (z)	147.6

Assuming Lognormal Distribution

95% UTL with 90% Coverage	182.2
95% UPL (t)	147.4
90% Percentile (z)	107.7
95% Percentile (z)	128.7
99% Percentile (z)	179.7

Gamma Distribution Test

k star	3.213
Theta Star	20.07
MLE of Mean	64.5
MLE of Standard Deviation	35.98
nu star	64.26

A-D Test Statistic	0.318
5% A-D Critical Value	0.729
K-S Test Statistic	0.136
5% K-S Critical Value	0.268

Data appear Gamma Distributed at 5% Significance Level

Data Distribution Test

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

90% Percentile	96.9
95% Percentile	123.5
99% Percentile	144.7

Assuming Gamma Distribution

90% Percentile	112.7
95% Percentile	132.7
99% Percentile	175.9
95% WH Approx. Gamma UPL	139.4
95% HW Approx. Gamma UPL	140.9
95% WH Approx. Gamma UTL with 90% Coverage	163.9
95% HW Approx. Gamma UTL with 90% Coverage	167.4

95% UTL with 90% Coverage	150
95% Percentile Bootstrap UTL with 90% Coverage	150
95% BCA Bootstrap UTL with 90% Coverage	150
95% UPL	150
95% Chebyshev UPL	227.8
Upper Threshold Limit Based upon IQR	123.1

Chromium: NAPR Basewide Background, Surface Soil

General Statistics

Total Number of Observations	20	Number of Distinct Observations	18
Tolerance Factor	1.926		

Raw Statistics		Log-Transformed Statistics	
Minimum	5.9	Minimum	1.775
Maximum	47	Maximum	3.85
Second Largest	44.1	Second Largest	3.786
First Quartile	12	First Quartile	2.485
Median	29.95	Median	3.4
Third Quartile	33.7	Third Quartile	3.517
Mean	25.69	Mean	3.101
Geometric Mean	22.22	SD	0.601
SD	12.22		
Coefficient of Variation	0.476		
Skewness	-0.153		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.922	Shapiro Wilk Test Statistic	0.873
Shapiro Wilk Critical Value	0.905	Shapiro Wilk Critical Value	0.905
Data appear Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	49.23	95% UTL with 90% Coverage	70.67
95% UPL (t)	47.35	95% UPL (t)	64.42
90% Percentile (z)	41.35	90% Percentile (z)	47.98
95% Percentile (z)	45.79	95% Percentile (z)	59.69
99% Percentile (z)	54.12	99% Percentile (z)	89.89

Gamma Distribution Test		Data Distribution Test
k star	3.096	Data appear Normal at 5% Significance Level
Theta Star	8.299	
MLE of Mean	25.69	
MLE of Standard Deviation	14.6	
nu star	123.8	
A-D Test Statistic	1.052	**Nonparametric Statistics**
5% A-D Critical Value	0.746	90% Percentile 38.07
K-S Test Statistic	0.231	95% Percentile 44.25
5% K-S Critical Value	0.195	99% Percentile 46.45
Data not Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution			
90% Percentile	45.27	95% UTL with 90% Coverage	47
95% Percentile	53.43	95% Percentile Bootstrap UTL with 90% Coverage	47
99% Percentile	71.1	95% BCA Bootstrap UTL with 90% Coverage	47
		95% UPL	46.86
		95% Chebyshev UPL	80.28
95% WH Approx. Gamma UPL	55.08	Upper Threshold Limit Based upon IQR	66.25
95% HW Approx. Gamma UPL	56.83		
95% WH Approx. Gamma UTL with 90% Coverage	58.71		
95% HW Approx. Gamma UTL with 90% Coverage	60.91		

Cobalt: SWMU 59 Surface Soil, 2012 CMS Investigation

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
Tolerance Factor	2.355		

Raw Statistics

Minimum	6
Maximum	36
Second Largest	27
First Quartile	15.5
Median	19.5
Third Quartile	24.25
Mean	20.1
Geometric Mean	18.36
SD	8.171
Coefficient of Variation	0.407
Skewness	0.326

Log-Transformed Statistics

Minimum	1.792
Maximum	3.584
Second Largest	3.296
First Quartile	2.739
Median	2.97
Third Quartile	3.187
Mean	2.91
SD	0.484

Background Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.982
Shapiro Wilk Critical Value	0.842

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.912
Shapiro Wilk Critical Value	0.842

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% UTL with 90% Coverage	39.34
95% UPL (t)	35.81
90% Percentile (z)	30.57
95% Percentile (z)	33.54
99% Percentile (z)	39.11

Assuming Lognormal Distribution

95% UTL with 90% Coverage	57.42
95% UPL (t)	46.57
90% Percentile (z)	34.15
95% Percentile (z)	40.71
99% Percentile (z)	56.63

Gamma Distribution Test

k star	4.044
Theta Star	4.97
MLE of Mean	20.1
MLE of Standard Deviation	9.995
nu star	80.88
A-D Test Statistic	0.253
5% A-D Critical Value	0.729
K-S Test Statistic	0.152
5% K-S Critical Value	0.267

Data appear Gamma Distributed at 5% Significance Level

Data Distribution Test

Data appear Normal at 5% Significance Level

Nonparametric Statistics

90% Percentile	27.9
95% Percentile	31.95
99% Percentile	35.19
95% UTL with 90% Coverage	36
95% Percentile Bootstrap UTL with 90% Coverage	36
95% BCA Bootstrap UTL with 90% Coverage	36
95% UPL	36
95% Chebyshev UPL	57.46
Upper Threshold Limit Based upon IQR	37.38

Assuming Gamma Distribution

90% Percentile	33.5
95% Percentile	38.85
99% Percentile	50.27
95% WH Approx. Gamma UPL	40.57
95% HW Approx. Gamma UPL	41.69
95% WH Approx. Gamma UTL with 90% Coverage	47.01
95% HW Approx. Gamma UTL with 90% Coverage	48.87

Cobalt: NAPR Basewide Background, Surface Soil

General Statistics

Total Number of Observations	19	Number of Distinct Observations	18
Tolerance Factor	1.949		

Raw Statistics		Log-Transformed Statistics	
Minimum	9.5	Minimum	2.251
Maximum	50.2	Maximum	3.916
Second Largest	48	Second Largest	3.871
First Quartile	14	First Quartile	2.639
Median	21.2	Median	3.054
Third Quartile	28	Third Quartile	3.332
Mean	22.84	Mean	3.015
Geometric Mean	20.39	SD	0.484
SD	11.7		
Coefficient of Variation	0.512		
Skewness	1.14		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.875	Shapiro Wilk Test Statistic	0.954
Shapiro Wilk Critical Value	0.901	Shapiro Wilk Critical Value	0.901
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	45.65	95% UTL with 90% Coverage	52.37
95% UPL (t)	43.66	95% UPL (t)	48.24
90% Percentile (z)	37.84	90% Percentile (z)	37.91
95% Percentile (z)	42.09	95% Percentile (z)	45.2
99% Percentile (z)	50.07	99% Percentile (z)	62.87

Gamma Distribution Test		Data Distribution Test
k star	3.87	Data appear Gamma Distributed at 5% Significance Level
Theta Star	5.903	
MLE of Mean	22.84	
MLE of Standard Deviation	11.61	
nu star	147.1	
A-D Test Statistic	0.456	
5% A-D Critical Value	0.744	
K-S Test Statistic	0.185	
5% K-S Critical Value	0.199	
Data appear Gamma Distributed at 5% Significance Level		

Nonparametric Statistics	
90% Percentile	36
95% Percentile	48.22
99% Percentile	49.8

Assuming Gamma Distribution			
90% Percentile	38.41	95% UTL with 90% Coverage	50.2
95% Percentile	44.67	95% Percentile Bootstrap UTL with 90% Coverage	50.2
99% Percentile	58.06	95% BCA Bootstrap UTL with 90% Coverage	50.2
		95% UPL	50.2
		95% Chebyshev UPL	75.18
95% WH Approx. Gamma UPL	45.76	Upper Threshold Limit Based upon IQR	49
95% HW Approx. Gamma UPL	46.25		
95% WH Approx. Gamma UTL with 90% Coverage	48.8		
95% HW Approx. Gamma UTL with 90% Coverage	49.51		

Copper: SWMU 59 Surface Soil, 2012 CMS Investigation

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
Tolerance Factor	2.355		

Raw Statistics		Log-Transformed Statistics	
Minimum	50	Minimum	3.912
Maximum	260	Maximum	5.561
Second Largest	130	Second Largest	4.868
First Quartile	74	First Quartile	4.302
Median	99.5	Median	4.6
Third Quartile	117.5	Third Quartile	4.766
Mean	108.9	Mean	4.59
Geometric Mean	98.49	SD	0.451
SD	58.68		
Coefficient of Variation	0.539		
Skewness	2.133		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.779	Shapiro Wilk Test Statistic	0.949
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	247.1	95% UTL with 90% Coverage	284.6
95% UPL (t)	221.7	95% UPL (t)	234.2
90% Percentile (z)	184.1	90% Percentile (z)	175.5
95% Percentile (z)	205.4	95% Percentile (z)	206.7
99% Percentile (z)	245.4	99% Percentile (z)	280.9

Gamma Distribution Test		Data Distribution Test
k star	3.663	Data appear Gamma Distributed at 5% Significance Level
Theta Star	29.73	
MLE of Mean	108.9	
MLE of Standard Deviation	56.9	
nu star	73.26	
A-D Test Statistic	0.418	
5% A-D Critical Value	0.729	
K-S Test Statistic	0.188	
5% K-S Critical Value	0.267	
Data appear Gamma Distributed at 5% Significance Level		

Nonparametric Statistics	
90% Percentile	143
95% Percentile	201.5
99% Percentile	248.3

Assuming Gamma Distribution			
90% Percentile	185.2	95% UTL with 90% Coverage	260
95% Percentile	216.1	95% Percentile Bootstrap UTL with 90% Coverage	260
99% Percentile	282.5	95% BCA Bootstrap UTL with 90% Coverage	260
		95% UPL	260
		95% Chebyshev UPL	377.2
95% WH Approx. Gamma UPL	225.6	Upper Threshold Limit Based upon IQR	182.8
95% HW Approx. Gamma UPL	227.2		
95% WH Approx. Gamma UTL with 90% Coverage	263.1		
95% HW Approx. Gamma UTL with 90% Coverage	267.1		

Copper: NAPR Basewide Background, Surface Soil

General Statistics

Total Number of Observations	18	Number of Distinct Observations	17
Tolerance Factor	1.974		

Raw Statistics		Log-Transformed Statistics	
Minimum	13	Minimum	2.565
Maximum	180	Maximum	5.193
Second Largest	169	Second Largest	5.13
First Quartile	45.93	First Quartile	3.821
Median	66.5	Median	4.197
Third Quartile	99.63	Third Quartile	4.601
Mean	77.11	Mean	4.152
Geometric Mean	63.53	SD	0.685
SD	46.73		
Coefficient of Variation	0.606		
Skewness	0.919		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.922	Shapiro Wilk Test Statistic	0.958
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	169.3	95% UTL with 90% Coverage	245.5
95% UPL (t)	160.6	95% UPL (t)	216
90% Percentile (z)	137	90% Percentile (z)	152.8
95% Percentile (z)	154	95% Percentile (z)	196
99% Percentile (z)	185.8	99% Percentile (z)	312.5

Gamma Distribution Test		Data Distribution Test
k star	2.317	Data appear Normal at 5% Significance Level
Theta Star	33.28	
MLE of Mean	77.11	
MLE of Standard Deviation	50.66	
nu star	83.41	
A-D Test Statistic	0.193	**Nonparametric Statistics**
5% A-D Critical Value	0.748	90% Percentile 141.7
K-S Test Statistic	0.12	95% Percentile 170.7
5% K-S Critical Value	0.205	99% Percentile 178.1
Data appear Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution			
90% Percentile	144.9	95% UTL with 90% Coverage	180
95% Percentile	174.7	95% Percentile Bootstrap UTL with 90% Coverage	180
99% Percentile	240.2	95% BCA Bootstrap UTL with 90% Coverage	180
		95% UPL	180
		95% Chebyshev UPL	286.4
95% WH Approx. Gamma UPL	181.2	Upper Threshold Limit Based upon IQR	180.2
95% HW Approx. Gamma UPL	187		
95% WH Approx. Gamma UTL with 90% Coverage	197.4		
95% HW Approx. Gamma UTL with 90% Coverage	205.4		

Nickel: SWMU 59 Surface Soil, 2012 CMS Investigation

General Statistics

Total Number of Observations	10	Number of Distinct Observations	7
Tolerance Factor	2.355		

Raw Statistics		Log-Transformed Statistics	
Minimum	15	Minimum	2.708
Maximum	47	Maximum	3.85
Second Largest	33	Second Largest	3.497
First Quartile	17	First Quartile	2.833
Median	26.5	Median	3.268
Third Quartile	32.25	Third Quartile	3.473
Mean	26.1	Mean	3.193
Geometric Mean	24.36	SD	0.391
SD	10.34		
Coefficient of Variation	0.396		
Skewness	0.749		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.889	Shapiro Wilk Test Statistic	0.904
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	50.46	95% UTL with 90% Coverage	61.19
95% UPL (t)	45.99	95% UPL (t)	51.67
90% Percentile (z)	39.36	90% Percentile (z)	40.21
95% Percentile (z)	43.11	95% Percentile (z)	46.35
99% Percentile (z)	50.16	99% Percentile (z)	60.51

Gamma Distribution Test		Data Distribution Test
k star	5.244	Data appear Normal at 5% Significance Level
Theta Star	4.977	
MLE of Mean	26.1	
MLE of Standard Deviation	11.4	
nu star	104.9	
A-D Test Statistic	0.507	**Nonparametric Statistics**
5% A-D Critical Value	0.727	90% Percentile 34.4
K-S Test Statistic	0.232	95% Percentile 40.7
5% K-S Critical Value	0.267	99% Percentile 45.74
Data appear Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution			
90% Percentile	41.35	95% UTL with 90% Coverage	47
95% Percentile	47.23	95% Percentile Bootstrap UTL with 90% Coverage	47
99% Percentile	59.61	95% BCA Bootstrap UTL with 90% Coverage	47
		95% UPL	47
		95% Chebyshev UPL	73.39
95% WH Approx. Gamma UPL	48.98	Upper Threshold Limit Based upon IQR	55.13
95% HW Approx. Gamma UPL	49.55		
95% WH Approx. Gamma UTL with 90% Coverage	55.95		
95% HW Approx. Gamma UTL with 90% Coverage	57.03		

Nickel: NAPR Basewide Background, Surface Soil

General Statistics

Total Number of Observations	19	Number of Distinct Observations	19
Tolerance Factor	1.949		

Raw Statistics		Log-Transformed Statistics	
Minimum	3.4	Minimum	1.224
Maximum	19	Maximum	2.944
Second Largest	18.1	Second Largest	2.896
First Quartile	6.1	First Quartile	1.807
Median	8.6	Median	2.152
Third Quartile	15.55	Third Quartile	2.743
Mean	10.54	Mean	2.226
Geometric Mean	9.265	SD	0.535
SD	5.228		
Coefficient of Variation	0.496		
Skewness	0.295		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.899	Shapiro Wilk Test Statistic	0.925
Shapiro Wilk Critical Value	0.901	Shapiro Wilk Critical Value	0.901
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	20.73	95% UTL with 90% Coverage	26.31
95% UPL (t)	19.84	95% UPL (t)	24.02
90% Percentile (z)	17.24	90% Percentile (z)	18.4
95% Percentile (z)	19.14	95% Percentile (z)	22.35
99% Percentile (z)	22.7	99% Percentile (z)	32.19

Gamma Distribution Test		Data Distribution Test
k star	3.442	Data appear Gamma Distributed at 5% Significance Level
Theta Star	3.061	
MLE of Mean	10.54	
MLE of Standard Deviation	5.68	
nu star	130.8	
A-D Test Statistic	0.663	
5% A-D Critical Value	0.745	
K-S Test Statistic	0.163	
5% K-S Critical Value	0.199	
Data appear Gamma Distributed at 5% Significance Level		

Nonparametric Statistics	
90% Percentile	17.22
95% Percentile	18.19
99% Percentile	18.84

Assuming Gamma Distribution			
90% Percentile	18.15	95% UTL with 90% Coverage	19
95% Percentile	21.27	95% Percentile Bootstrap UTL with 90% Coverage	19
99% Percentile	27.99	95% BCA Bootstrap UTL with 90% Coverage	19
		95% UPL	19
		95% Chebyshev UPL	33.92
95% WH Approx. Gamma UPL	21.89	Upper Threshold Limit Based upon IQR	29.73
95% HW Approx. Gamma UPL	22.31		
95% WH Approx. Gamma UTL with 90% Coverage	23.41		
95% HW Approx. Gamma UTL with 90% Coverage	23.98		

Vanadium: SWMU 59 Surface Soil, 2012 CMS Investigation

General Statistics

Total Number of Observations	10	Number of Distinct Observations	8
Tolerance Factor	2.355		

Raw Statistics		Log-Transformed Statistics	
Minimum	110	Minimum	4.7
Maximum	330	Maximum	5.799
Second Largest	280	Second Largest	5.635
First Quartile	147.5	First Quartile	4.99
Median	205	Median	5.316
Third Quartile	240	Third Quartile	5.481
Mean	206	Mean	5.275
Geometric Mean	195.3	SD	0.349
SD	69.63		
Coefficient of Variation	0.338		
Skewness	0.362		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.956	Shapiro Wilk Test Statistic	0.962
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	370	95% UTL with 90% Coverage	443.9
95% UPL (t)	339.9	95% UPL (t)	381.8
90% Percentile (z)	295.2	90% Percentile (z)	305.3
95% Percentile (z)	320.5	95% Percentile (z)	346.5
99% Percentile (z)	368	99% Percentile (z)	439.5

Gamma Distribution Test		Data Distribution Test
k star	6.748	Data appear Normal at 5% Significance Level
Theta Star	30.53	
MLE of Mean	206	
MLE of Standard Deviation	79.3	
nu star	135	
A-D Test Statistic	0.257	
5% A-D Critical Value	0.725	
K-S Test Statistic	0.175	
5% K-S Critical Value	0.267	
Data appear Gamma Distributed at 5% Significance Level		

Nonparametric Statistics	
90% Percentile	285
95% Percentile	307.5
99% Percentile	325.5

Assuming Gamma Distribution			
90% Percentile	311.9	95% UTL with 90% Coverage	330
95% Percentile	351.4	95% Percentile Bootstrap UTL with 90% Coverage	330
99% Percentile	433.7	95% BCA Bootstrap UTL with 90% Coverage	330
		95% UPL	330
		95% Chebyshev UPL	524.3
95% WH Approx. Gamma UPL	362.4	Upper Threshold Limit Based upon IQR	378.8
95% HW Approx. Gamma UPL	366.5		
95% WH Approx. Gamma UTL with 90% Coverage	408.6		
95% HW Approx. Gamma UTL with 90% Coverage	415.9		

Vanadium: NAPR Basewide Background, Surface Soil

General Statistics

Total Number of Observations	18	Number of Distinct Observations	17
Tolerance Factor	1.974		

Raw Statistics		Log-Transformed Statistics	
Minimum	35	Minimum	3.555
Maximum	230	Maximum	5.438
Second Largest	227	Second Largest	5.425
First Quartile	86.05	First Quartile	4.454
Median	151.5	Median	5.021
Third Quartile	180	Third Quartile	5.193
Mean	141.6	Mean	4.85
Geometric Mean	127.8	SD	0.502
SD	58.77		
Coefficient of Variation	0.415		
Skewness	-0.0584		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.95	Shapiro Wilk Test Statistic	0.906
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	257.6	95% UTL with 90% Coverage	344
95% UPL (t)	246.6	95% UPL (t)	313.3
90% Percentile (z)	216.9	90% Percentile (z)	243.1
95% Percentile (z)	238.2	95% Percentile (z)	291.7
99% Percentile (z)	278.3	99% Percentile (z)	410.6

Gamma Distribution Test		Data Distribution Test
k star	4.237	Data appear Normal at 5% Significance Level
Theta Star	33.41	
MLE of Mean	141.6	
MLE of Standard Deviation	68.78	
nu star	152.5	
A-D Test Statistic	0.451	Nonparametric Statistics
5% A-D Critical Value	0.743	90% Percentile 225.6
K-S Test Statistic	0.166	95% Percentile 227.5
5% K-S Critical Value	0.204	99% Percentile 229.5
Data appear Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution			
90% Percentile	233.7	95% UTL with 90% Coverage	230
95% Percentile	270.3	95% Percentile Bootstrap UTL with 90% Coverage	230
99% Percentile	348.2	95% BCA Bootstrap UTL with 90% Coverage	230
		95% UPL	230
		95% Chebyshev UPL	404.8
95% WH Approx. Gamma UPL	277.4	Upper Threshold Limit Based upon IQR	320.9
95% HW Approx. Gamma UPL	284.2		
95% WH Approx. Gamma UTL with 90% Coverage	296.8		
95% HW Approx. Gamma UTL with 90% Coverage	305.6		

Zinc: SWMU 59 Surface Soil, 2012 CMS Investigation

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
Tolerance Factor	2.355		

Raw Statistics		Log-Transformed Statistics	
Minimum	42	Minimum	3.738
Maximum	100	Maximum	4.605
Second Largest	78	Second Largest	4.357
First Quartile	47	First Quartile	3.849
Median	62.5	Median	4.131
Third Quartile	75.25	Third Quartile	4.321
Mean	63.4	Mean	4.111
Geometric Mean	61	SD	0.292
SD	18.8		
Coefficient of Variation	0.297		
Skewness	0.628		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.921	Shapiro Wilk Test Statistic	0.936
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	107.7	95% UTL with 90% Coverage	121.3
95% UPL (t)	99.55	95% UPL (t)	106.9
90% Percentile (z)	87.5	90% Percentile (z)	88.67
95% Percentile (z)	94.33	95% Percentile (z)	98.59
99% Percentile (z)	107.1	99% Percentile (z)	120.3

Gamma Distribution Test		Data Distribution Test
k star	9.238	Data appear Normal at 5% Significance Level
Theta Star	6.863	
MLE of Mean	63.4	
MLE of Standard Deviation	20.86	
nu star	184.8	
A-D Test Statistic	0.347	Nonparametric Statistics
5% A-D Critical Value	0.725	90% Percentile 80.2
K-S Test Statistic	0.168	95% Percentile 90.1
5% K-S Critical Value	0.266	99% Percentile 98.02
Data appear Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution			
90% Percentile	91.17	95% UTL with 90% Coverage	100
95% Percentile	101.1	95% Percentile Bootstrap UTL with 90% Coverage	100
99% Percentile	121.7	95% BCA Bootstrap UTL with 90% Coverage	100
		95% UPL	100
		95% Chebyshev UPL	149.4
95% WH Approx. Gamma UPL	103.7	Upper Threshold Limit Based upon IQR	117.6
95% HW Approx. Gamma UPL	104.4		
95% WH Approx. Gamma UTL with 90% Coverage	115.2		
95% HW Approx. Gamma UTL with 90% Coverage	116.5		

Zinc: NAPR Basewide Background, Surface Soil

General Statistics

Total Number of Observations	18	Number of Distinct Observations	18
Tolerance Factor	1.974		

Raw Statistics		Log-Transformed Statistics	
Minimum	6.2	Minimum	1.825
Maximum	120	Maximum	4.787
Second Largest	108	Second Largest	4.682
First Quartile	34.05	First Quartile	3.528
Median	47	Median	3.849
Third Quartile	65.15	Third Quartile	4.176
Mean	52.48	Mean	3.742
Geometric Mean	42.17	SD	0.751
SD	32.33		
Coefficient of Variation	0.616		
Skewness	0.788		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.925	Shapiro Wilk Test Statistic	0.936
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	116.3	95% UTL with 90% Coverage	185.9
95% UPL (t)	110.3	95% UPL (t)	161.5
90% Percentile (z)	93.91	90% Percentile (z)	110.5
95% Percentile (z)	105.7	95% Percentile (z)	145.1
99% Percentile (z)	127.7	99% Percentile (z)	242.2

Gamma Distribution Test		Data Distribution Test
k star	2.07	Data appear Normal at 5% Significance Level
Theta Star	25.36	
MLE of Mean	52.48	
MLE of Standard Deviation	36.48	
nu star	74.51	
A-D Test Statistic	0.235	**Nonparametric Statistics**
5% A-D Critical Value	0.75	90% Percentile 106.6
K-S Test Statistic	0.119	95% Percentile 109.8
5% K-S Critical Value	0.206	99% Percentile 118
Data appear Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution			
90% Percentile	101.2	95% UTL with 90% Coverage	120
95% Percentile	123.1	95% Percentile Bootstrap UTL with 90% Coverage	120
99% Percentile	171.6	95% BCA Bootstrap UTL with 90% Coverage	120
		95% UPL	120
		95% Chebyshev UPL	197.3
95% WH Approx. Gamma UPL	128	Upper Threshold Limit Based upon IQR	111.8
95% HW Approx. Gamma UPL	133.4		
95% WH Approx. Gamma UTL with 90% Coverage	140		
95% HW Approx. Gamma UTL with 90% Coverage	147.2		

Gehan Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Beryllium, SWMU 59

Background Data: BerylliumBG

Raw Statistics

	Site	Background
Number of Valid Data	10	18
Number of Non-Detect Data	0	2
Number of Detect Data	10	16
Minimum Non-Detect	N/A	0.04
Maximum Non-Detect	N/A	0.1
Percent Non detects	0.00%	11.11%
Minimum Detected	0.097	0.085
Maximum Detected	0.63	0.58
Mean of Detected Data	0.286	0.315
Median of Detected Data	0.27	0.325
SD of Detected Data	0.156	0.134

Site vs Background Gehan Test

H0: Mean/Median of Site or AOC <= Mean/Median of background

Gehan z Test Value	-0.072
Critical z (0.95)	1.645
P-Value	0.529

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Site <= Background

P-Value >= alpha (0.05)

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Chromium, SWMU 59

Background Data: ChromiumBG

Raw Statistics

	Site	Background
Number of Valid Data	10	20
Number of Non-Detect Data	0	0
Number of Detect Data	10	20
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	32	5.9
Maximum Detected	150	47
Mean of Detected Data	64.5	25.69
Median of Detected Data	56	29.95
SD of Detected Data	35.73	12.22

Wilcoxon-Mann-Whitney Site vs Background Test

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	238.5
WMW Test U-Stat	183.5
WMW Critical Value (0.050)	137
Approximate P-Value	0.0001304

Conclusion with Alpha = 0.05

Reject H0, Conclude Site > Background

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Cobalt, SWMU 59

Background Data: CobaltBG

Raw Statistics

	Site	Background
Number of Valid Data	10	19
Number of Non-Detect Data	0	0
Number of Detect Data	10	19
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	6	9.5
Maximum Detected	36	50.2
Mean of Detected Data	20.1	22.84
Median of Detected Data	19.5	21.2
SD of Detected Data	8.171	11.7

Wilcoxon-Mann-Whitney Site vs Background Test

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	144.5
WMW Test U-Stat	89.5
WMW Critical Value (0.050)	131
Approximate P-Value	0.608

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Site <= Background

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Copper, SWMU 59

Background Data: CopperBG

Raw Statistics

	Site	Background
Number of Valid Data	10	18
Number of Non-Detect Data	0	0
Number of Detect Data	10	18
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	50	13
Maximum Detected	260	180
Mean of Detected Data	108.9	77.11
Median of Detected Data	99.5	66.5
SD of Detected Data	58.68	46.73

Wilcoxon-Mann-Whitney Site vs Background Test

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	181.5
WMW Test U-Stat	126.5
WMW Critical Value (0.050)	124
Approximate P-Value	0.0422

Conclusion with Alpha = 0.05

Reject H0, Conclude Site > Background

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Nickel, SWMU 59

Background Data: NickelBG

Raw Statistics

	Site	Background
Number of Valid Data	10	19
Number of Non-Detect Data	0	0
Number of Detect Data	10	19
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	15	3.4
Maximum Detected	47	19
Mean of Detected Data	26.1	10.54
Median of Detected Data	26.5	8.6
SD of Detected Data	10.34	5.228

Wilcoxon-Mann-Whitney Site vs Background Test

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	229.5
WMW Test U-Stat	174.5
WMW Critical Value (0.050)	131
Approximate P-Value	0.0001446

Conclusion with Alpha = 0.05

Reject H0, Conclude Site > Background

t-Test Site vs Background Comparison for Full Data Sets without NDs

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Vanadium

Background Data: VanadiumBG

Raw Statistics

	Site	Background
Number of Valid Observations	10	18
Number of Distinct Observations	8	17
Minimum	110	35
Maximum	330	230
Mean	206	141.6
Median	205	151.5
SD	69.63	58.77
SE of Mean	22.02	13.85

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

Method	DF	t-Test Value	Critical t (0.050)	P-Value
Pooled (Equal Variance)	26	2.604	1.706	0.008
Welch-Satterthwaite (Unequal Varian	16.2	2.477	1.746	0.012

Pooled SD 62.744

Conclusion with Alpha = 0.050

* Student t (Pooled) Test: Reject H0, Conclude Site > Background
* Welch-Satterthwaite Test: Reject H0, Conclude Site > Background

Test of Equality of Variances

Variance of Site	4849
Variance of Background	3454

Numerator DF	Denominator DF	F-Test Value	P-Value
9	17	1.404	0.523

Conclusion with Alpha = 0.05

* Two variances appear to be equal

t-Test Site vs Background Comparison for Full Data Sets without NDs

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Zinc

Background Data: ZincBG

Raw Statistics

	Site	Background
Number of Valid Observations	10	18
Number of Distinct Observations	10	18
Minimum	42	6.2
Maximum	100	120
Mean	63.4	52.48
Median	62.5	47
SD	18.8	32.33
SE of Mean	5.946	7.621

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

Method	DF	t-Test Value	Critical t (0.050)	P-Value
Pooled (Equal Variance)	26	0.976	1.706	0.169
Welch-Satterthwaite (Unequal Varian	25.9	1.13	1.706	0.134

Pooled SD 28.388

Conclusion with Alpha = 0.050

* Student t (Pooled) Test: Do Not Reject H0, Conclude Site <= Background
* Welch-Satterthwaite Test: Do Not Reject H0, Conclude Site <= Background

Test of Equality of Variances

Variance of Site	353.6
Variance of Background	1045

Numerator DF	Denominator DF	F-Test Value	P-Value
17	9	2.956	0.102

Conclusion with Alpha = 0.05

* Two variances appear to be equal

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Beryllium, SWMU 59

Background Data: BerylliumBG

Raw Statistics

	Site	Background
Number of Valid Data	10	18
Number of Non-Detect Data	0	2
Number of Detect Data	10	16
Minimum Non-Detect	N/A	0.04
Maximum Non-Detect	N/A	0.1
Percent Non detects	0.00%	11.11%
Minimum Detected	0.097	0.085
Maximum Detected	0.63	0.58
Mean of Detected Data	0.286	0.315
Median of Detected Data	0.27	0.325
SD of Detected Data	0.156	0.134

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.056)	8
Approximate K Value (0.056)	5
R Value Adjusted for Ties in Data	10
K Value Adjusted for Ties in Data	7
Number of Site Observations in 'R' Largest	3
Calculated Alpha	0.0772

Conclusion with Alpha = 0.056

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Chromium, SWMU 59

Background Data: ChromiumBG

Raw Statistics

	Site	Background
Number of Valid Data	10	20
Number of Non-Detect Data	0	0
Number of Detect Data	10	20
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	32	5.9
Maximum Detected	150	47
Mean of Detected Data	64.5	25.69
Median of Detected Data	56	29.95
SD of Detected Data	35.73	12.22

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.056)	8
Approximate K Value (0.056)	5
Number of Site Observations in 'R' Largest	7
Calculated Alpha	0.0563

Conclusion with Alpha = 0.056

Reject H0, Conclude Site Concentration > Background Concentration

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Cobalt, SWMU 59

Background Data: CobaltBG

Raw Statistics

	Site	Background
Number of Valid Data	10	19
Number of Non-Detect Data	0	0
Number of Detect Data	10	19
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	6	9.5
Maximum Detected	36	50.2
Mean of Detected Data	20.1	22.84
Median of Detected Data	19.5	21.2
SD of Detected Data	8.171	11.7

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.056)	8
Approximate K Value (0.056)	5
R Value Adjusted for Ties in Data	9
K Value Adjusted for Ties in Data	6
Number of Site Observations in 'R' Largest	2
Calculated Alpha	0.0658

Conclusion with Alpha = 0.056

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Copper, SWMU 59

Background Data: CopperBG

Raw Statistics

	Site	Background
Number of Valid Data	10	18
Number of Non-Detect Data	0	0
Number of Detect Data	10	18
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	50	13
Maximum Detected	260	180
Mean of Detected Data	108.9	77.11
Median of Detected Data	99.5	66.5
SD of Detected Data	58.68	46.73

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.056)	8
Approximate K Value (0.056)	5
Number of Site Observations in 'R' Largest	4
Calculated Alpha	0.0772

Conclusion with Alpha = 0.056

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Nickel, SWMU 59

Background Data: NickelBG

Raw Statistics

	Site	Background
Number of Valid Data	10	19
Number of Non-Detect Data	0	0
Number of Detect Data	10	19
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	15	3.4
Maximum Detected	47	19
Mean of Detected Data	26.1	10.54
Median of Detected Data	26.5	8.6
SD of Detected Data	10.34	5.228

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.056)	8
Approximate K Value (0.056)	5
Number of Site Observations in 'R' Largest	6
Calculated Alpha	0.0658

Conclusion with Alpha = 0.056

Reject H0, Conclude Site Concentration > Background Concentration

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Vanadium, SWMU 59

Background Data: VanadiumBG

Raw Statistics

	Site	Background
Number of Valid Data	10	18
Number of Non-Detect Data	0	0
Number of Detect Data	10	18
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	110	35
Maximum Detected	330	230
Mean of Detected Data	206	141.6
Median of Detected Data	205	151.5
SD of Detected Data	69.63	58.77

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.056)	8
Approximate K Value (0.056)	5
Number of Site Observations in 'R' Largest	5
Calculated Alpha	0.0772

Conclusion with Alpha = 0.056

Reject H0, Conclude Site Concentration > Background Concentration

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Zinc, SWMU 59

Background Data: ZincBG

Raw Statistics

	Site	Background
Number of Valid Data	10	18
Number of Non-Detect Data	0	0
Number of Detect Data	10	18
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	42	6.2
Maximum Detected	100	120
Mean of Detected Data	63.4	52.48
Median of Detected Data	62.5	47
SD of Detected Data	18.8	32.33

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

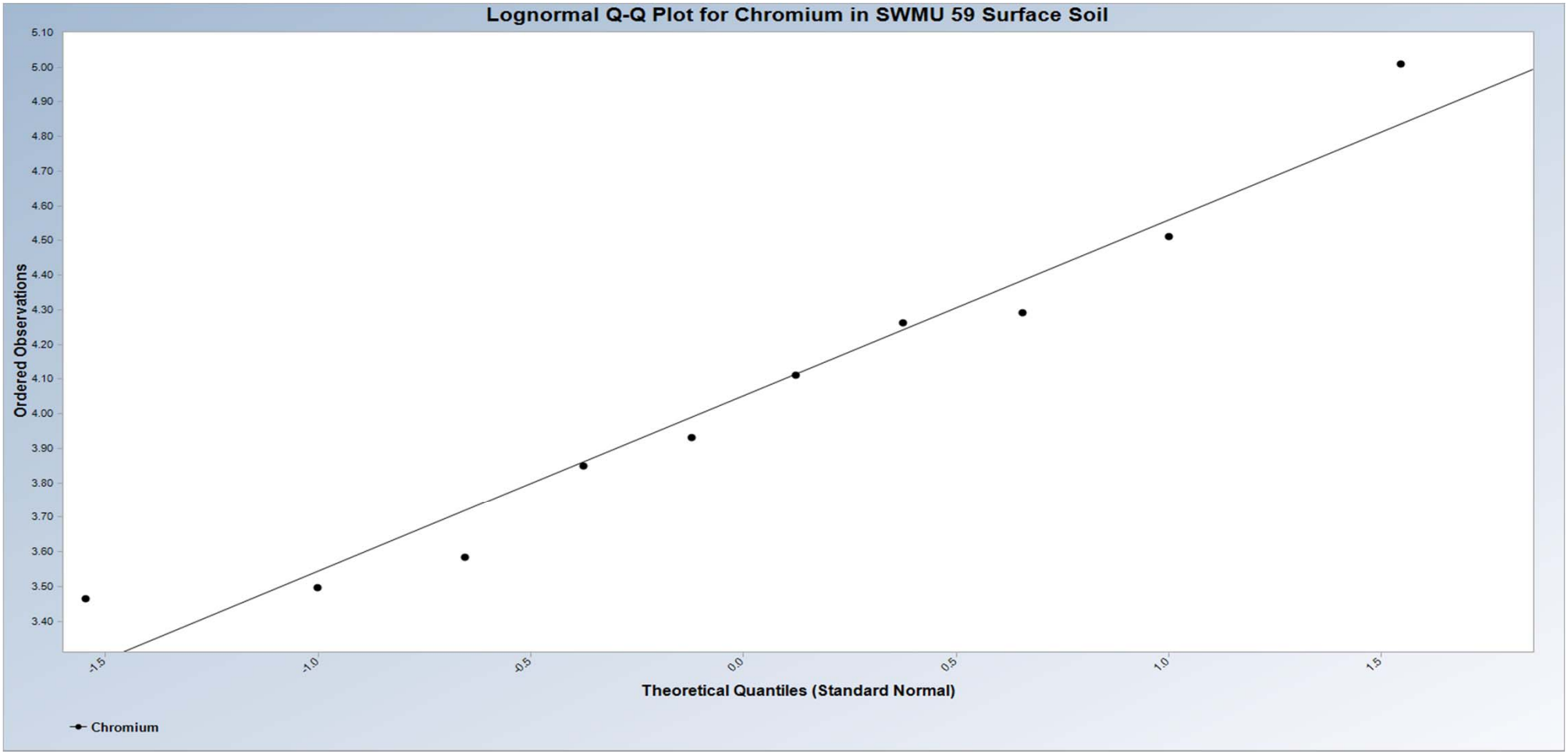
Approximate R Value (0.056)	8
Approximate K Value (0.056)	5
Number of Site Observations in 'R' Largest	5
Calculated Alpha	0.0772

Conclusion with Alpha = 0.056

Reject H0, Conclude Site Concentration > Background Concentration

APPENDIX I

PROBABILITY PLOT - CHROMIUM IN SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



APPENDIX I

PROBABILITY PLOT - CHROMIUM IN SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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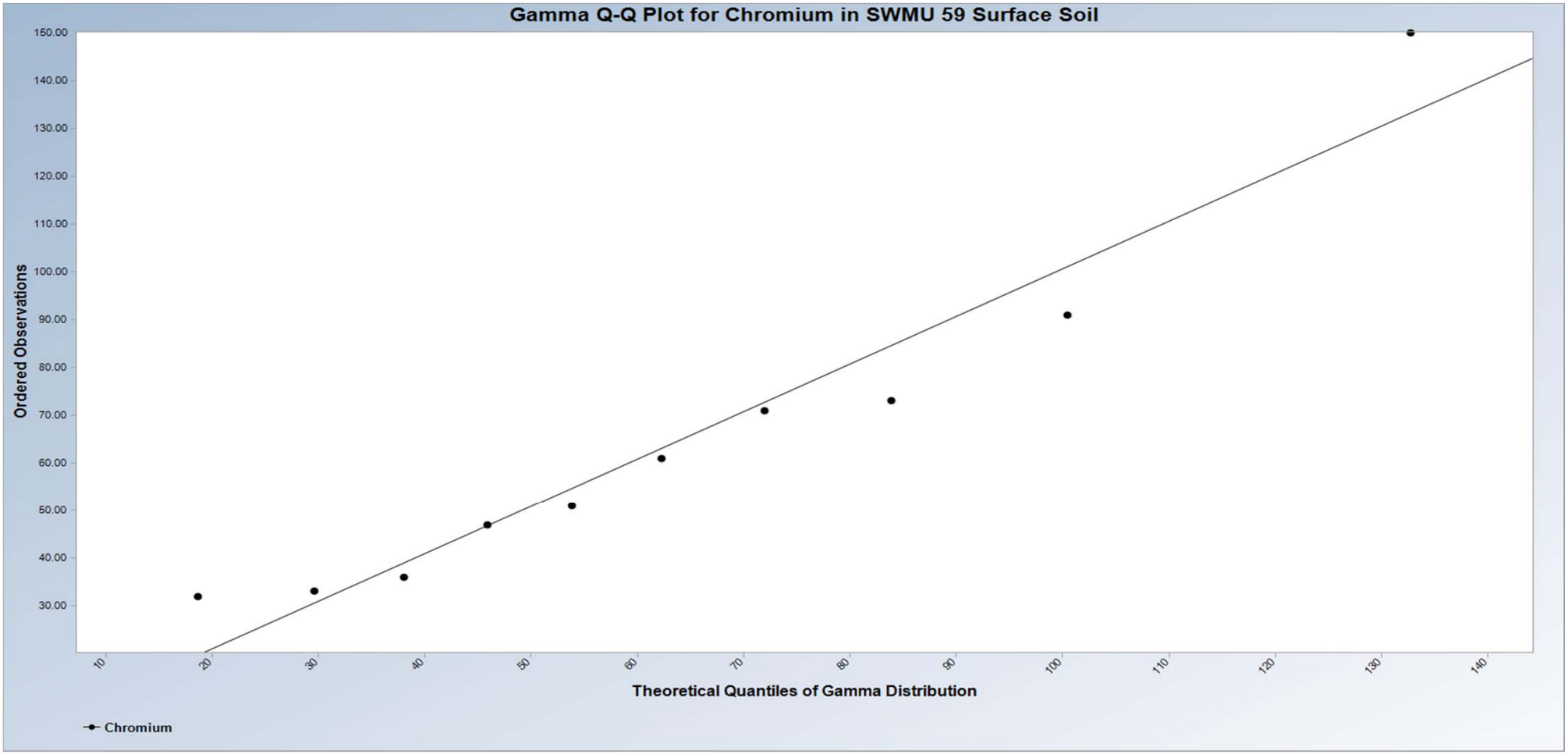

APPENDIX I

PROBABILITY PLOT - COBALT IN SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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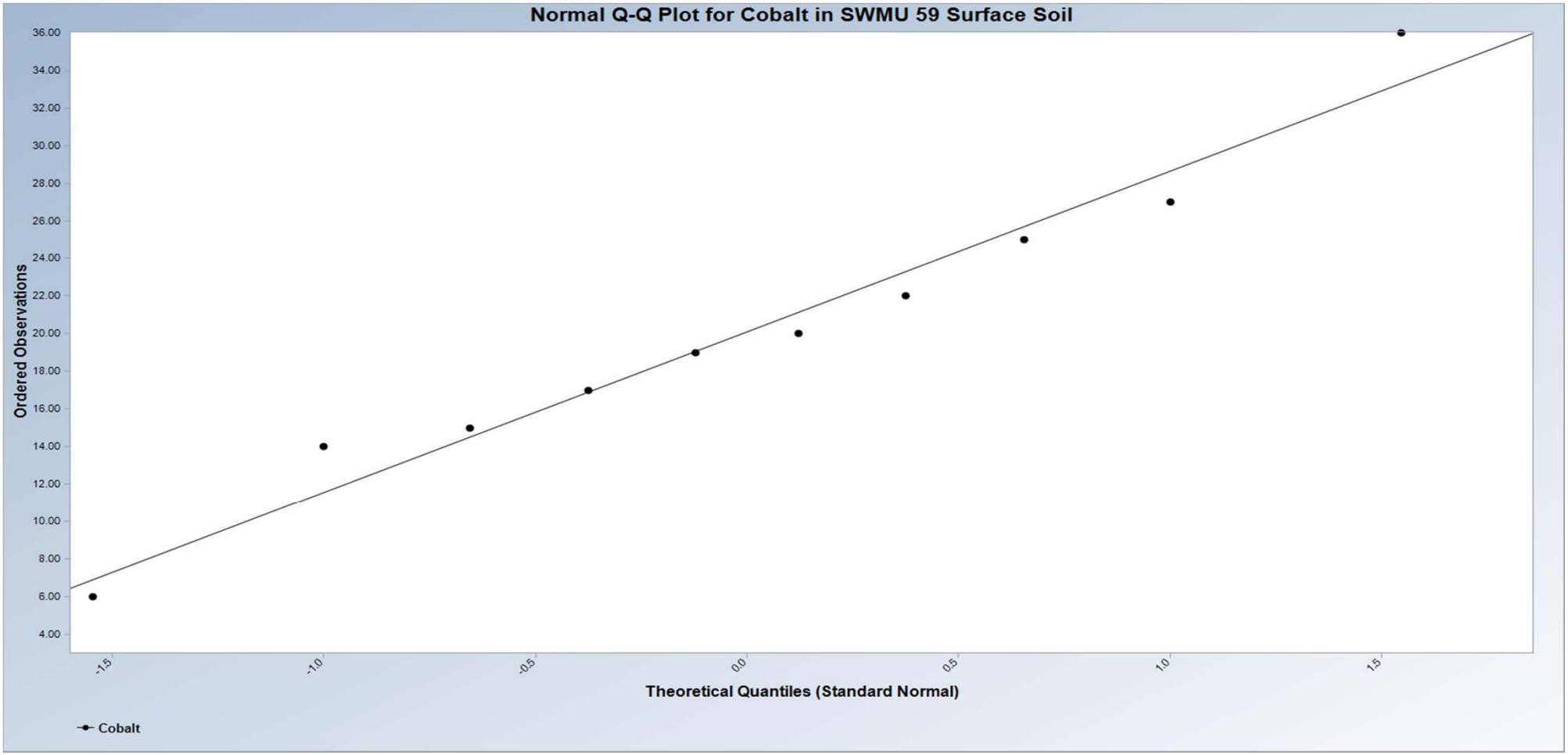

APPENDIX I

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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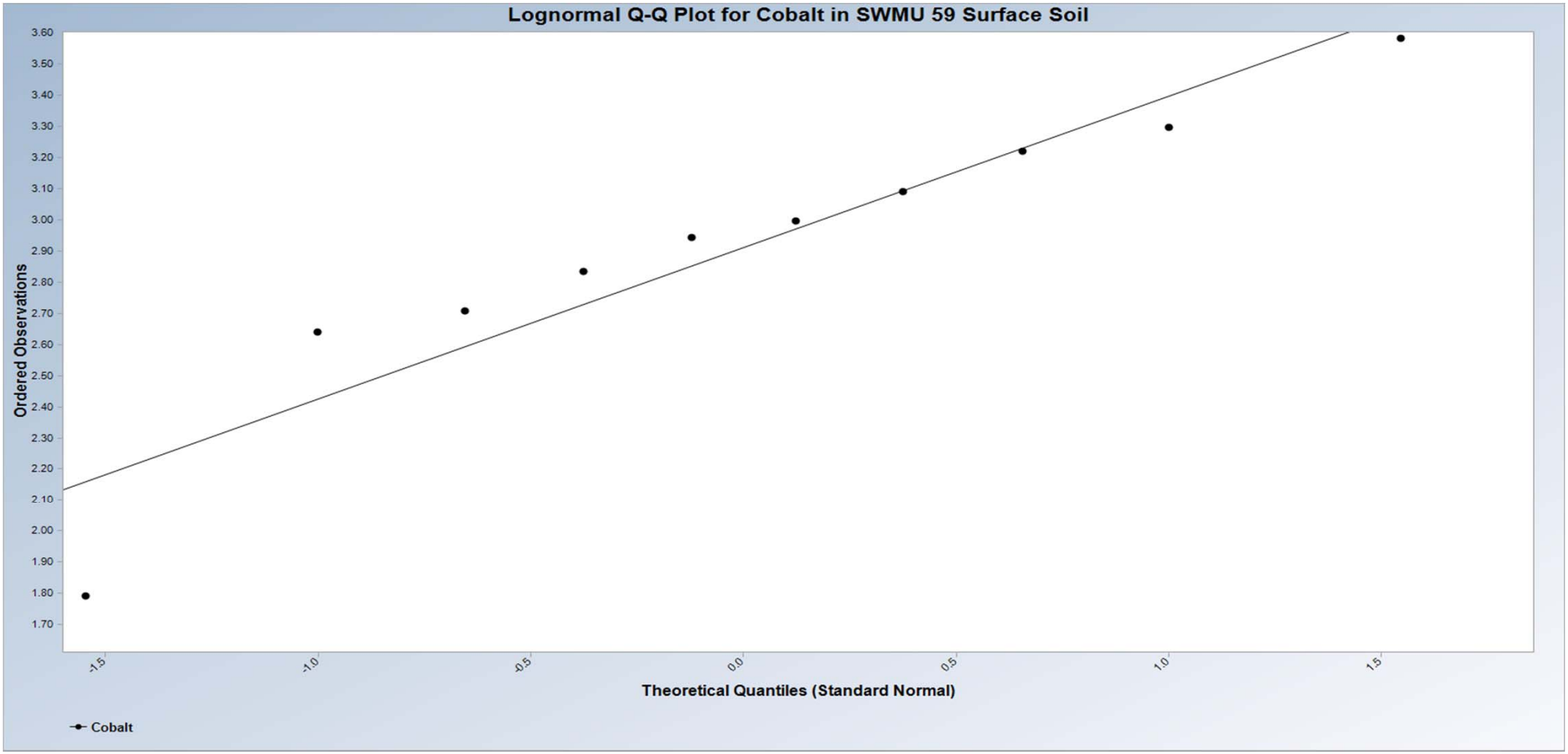

APPENDIX I

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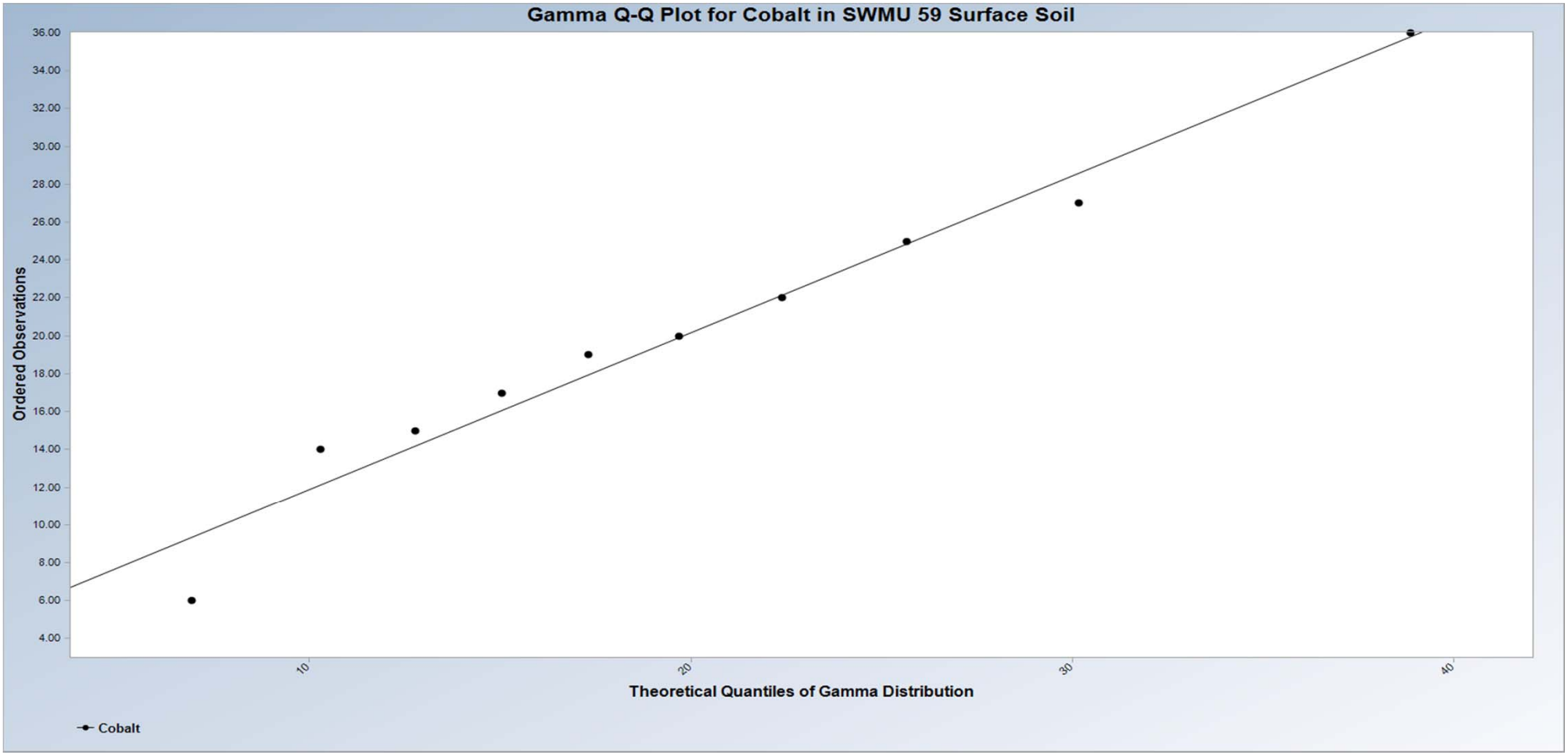
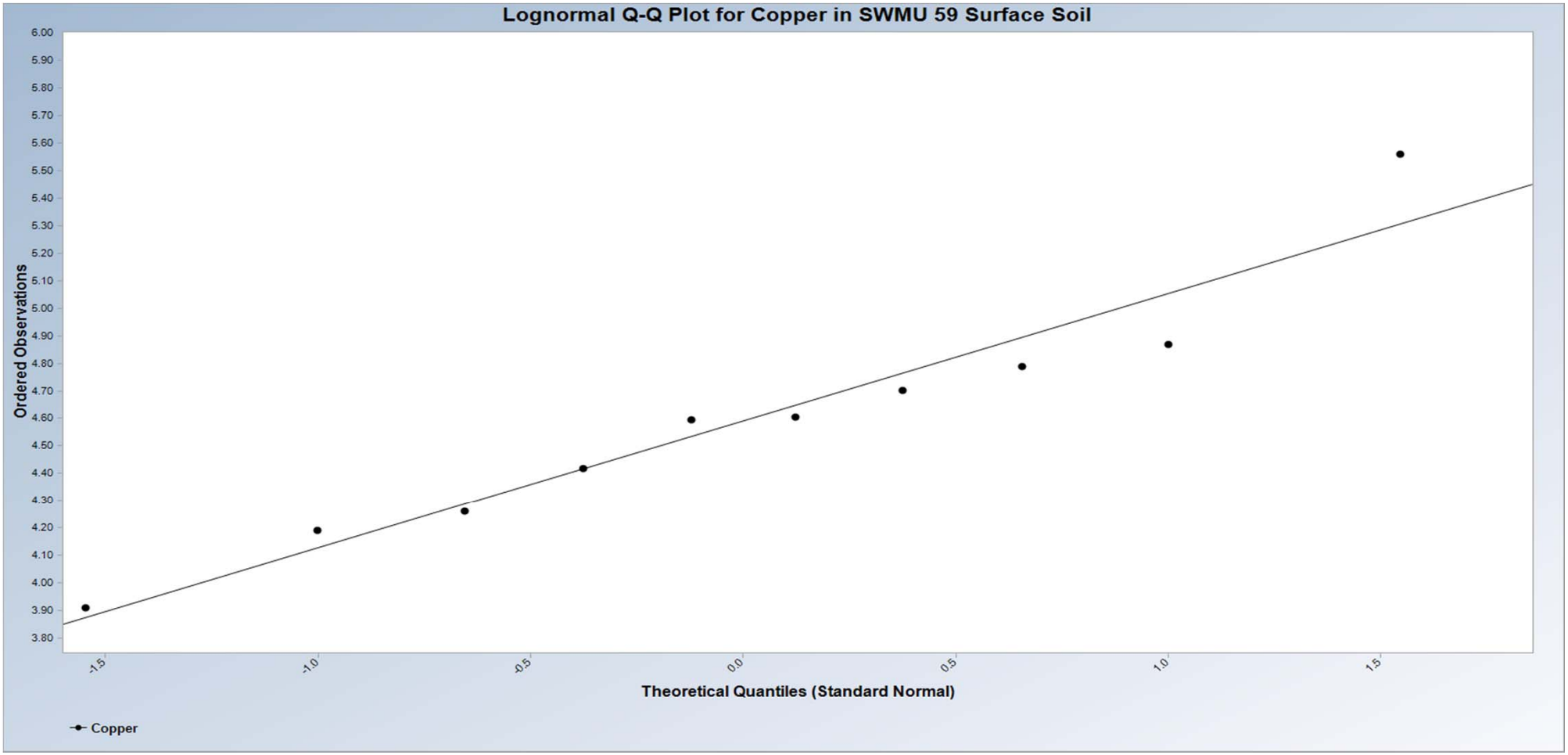


APPENDIX I

PROBABILITY PLOT - COPPER IN SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



APPENDIX I

PROBABILITY PLOT - COPPER IN SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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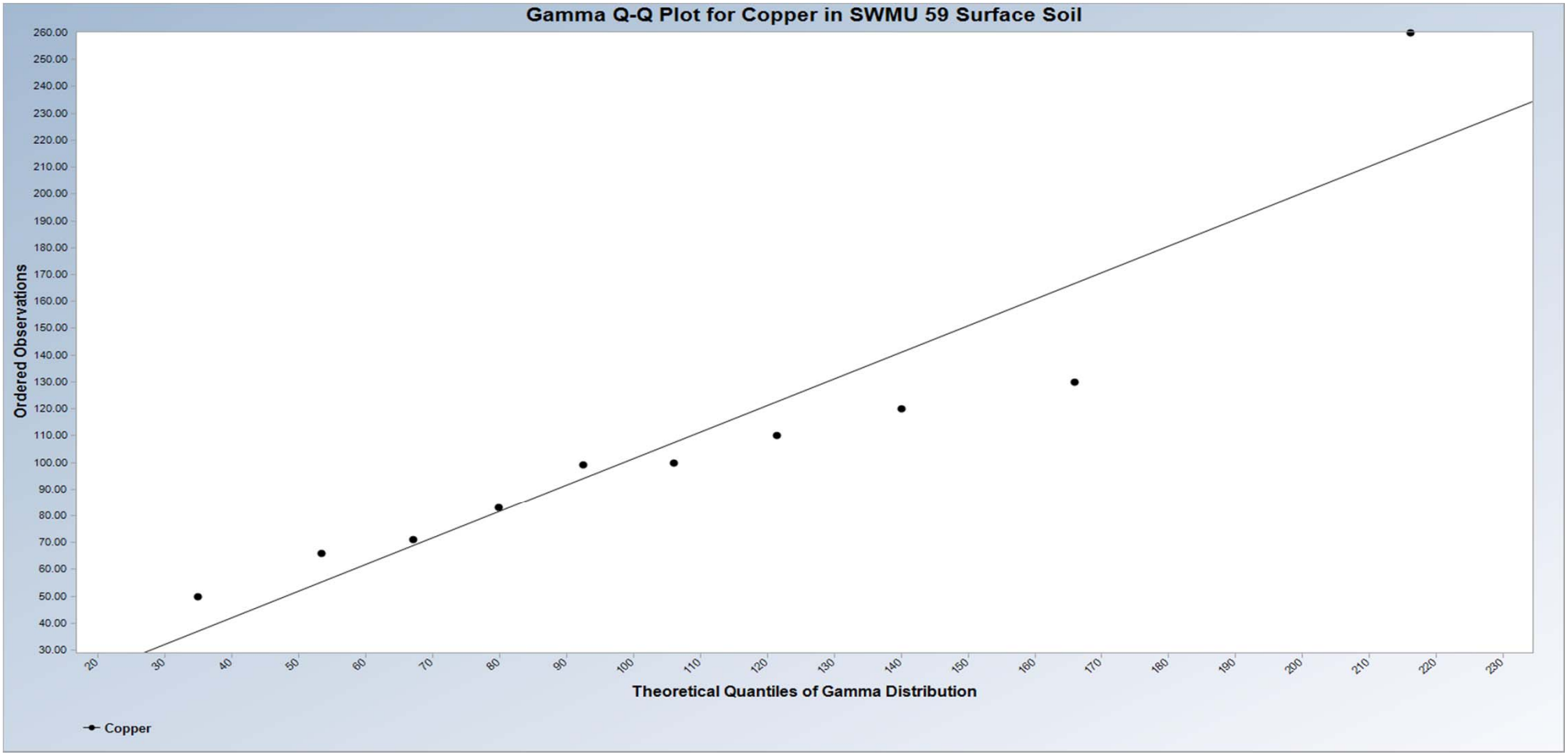
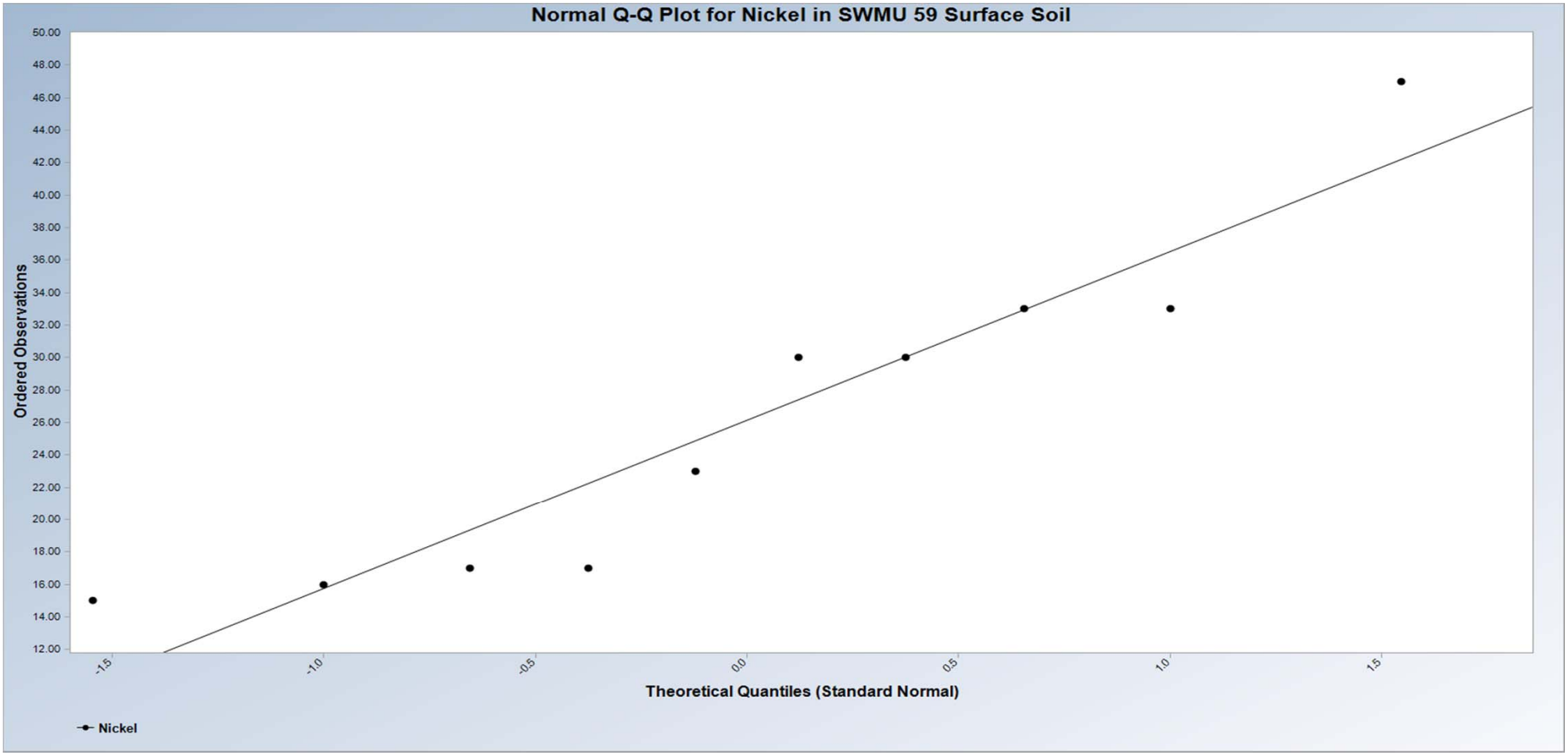
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



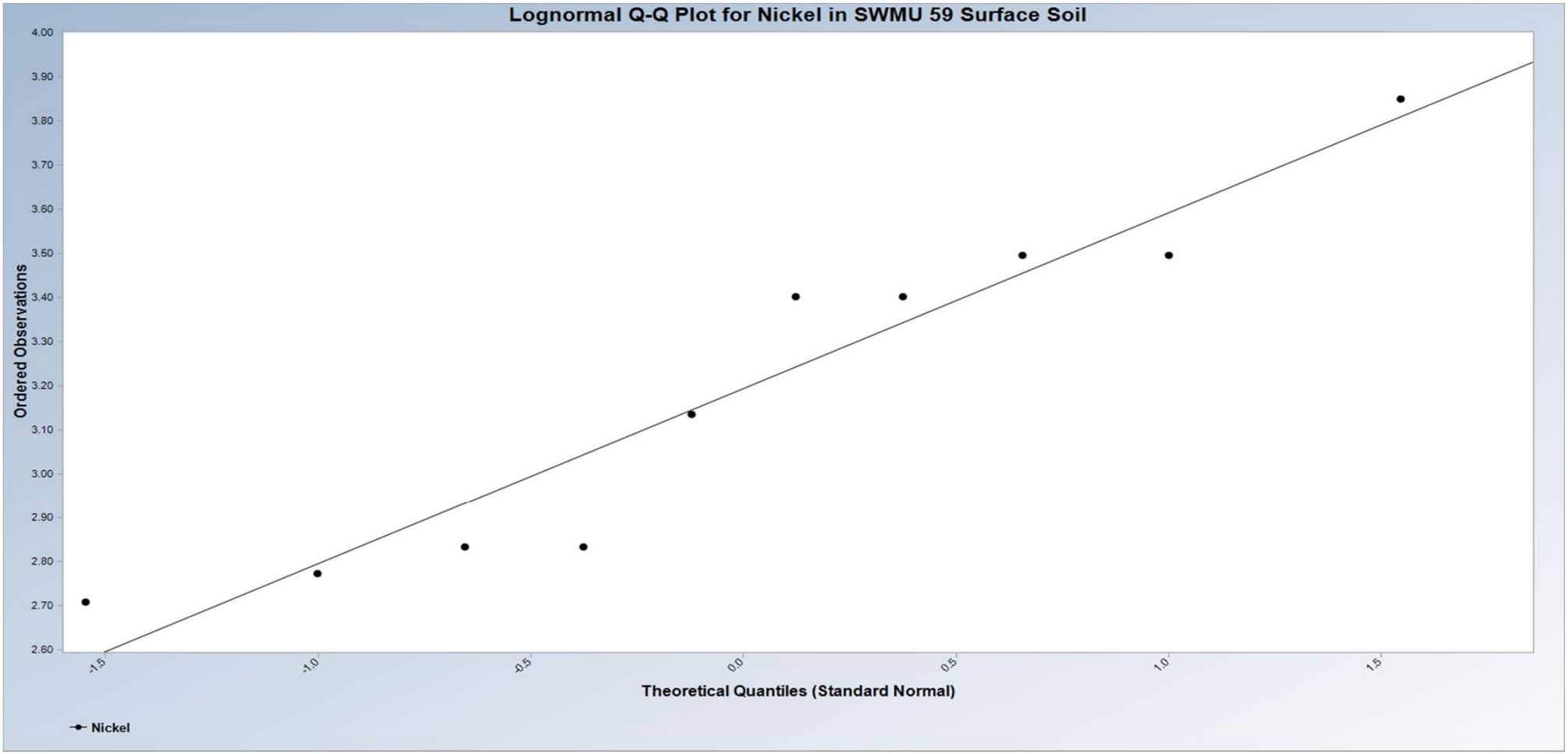
APPENDIX I

PROBABILITY PLOT - NICKEL IN SURFACE SOIL COLLECTED DURING HE 2012 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



APPENDIX I

PROBABILITY PLOT - NICKEL IN SURFACE SOIL COLLECTED DURING HE 2012 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



APPENDIX I

PROBABILITY PLOT - NICKEL IN SURFACE SOIL COLLECTED DURING HE 2012 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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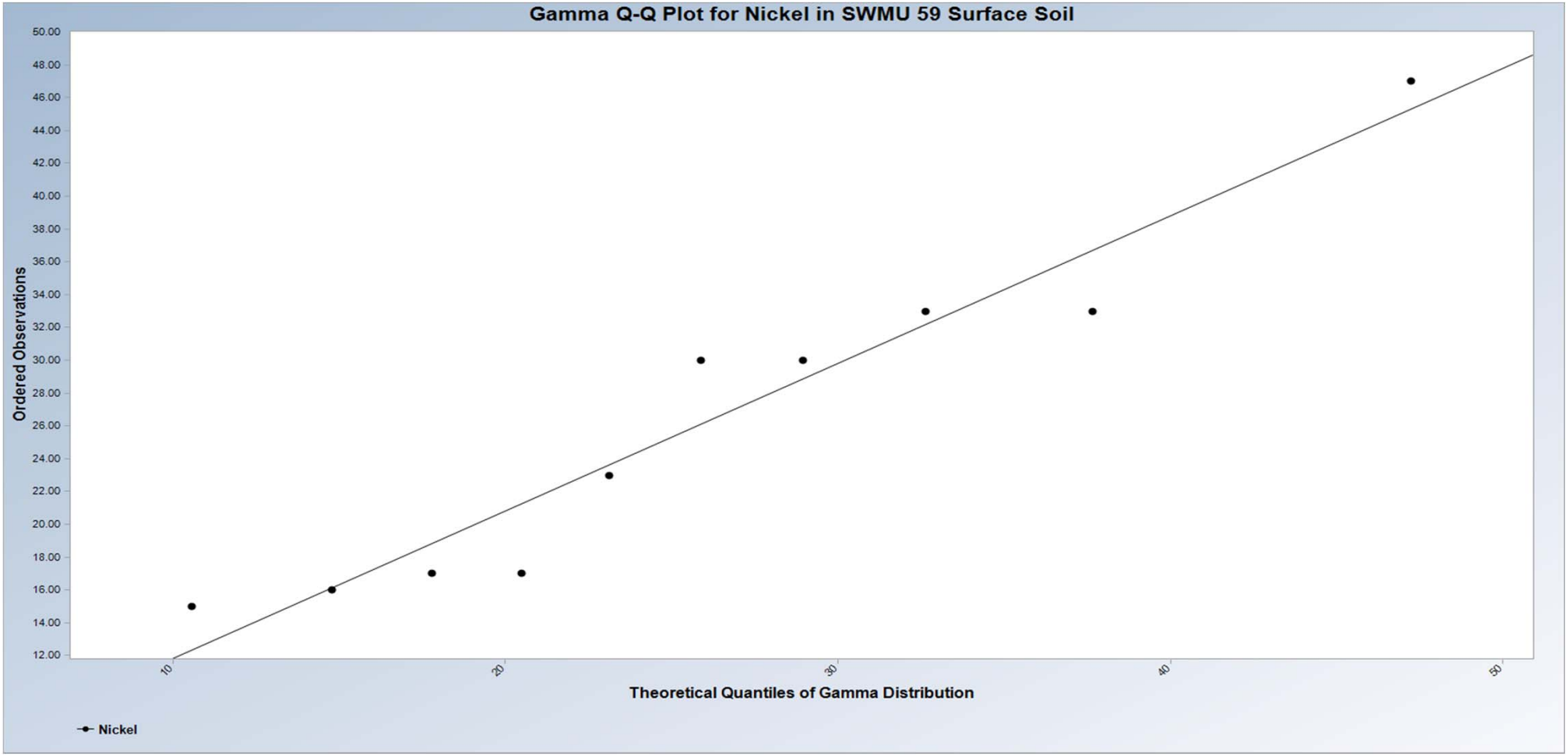
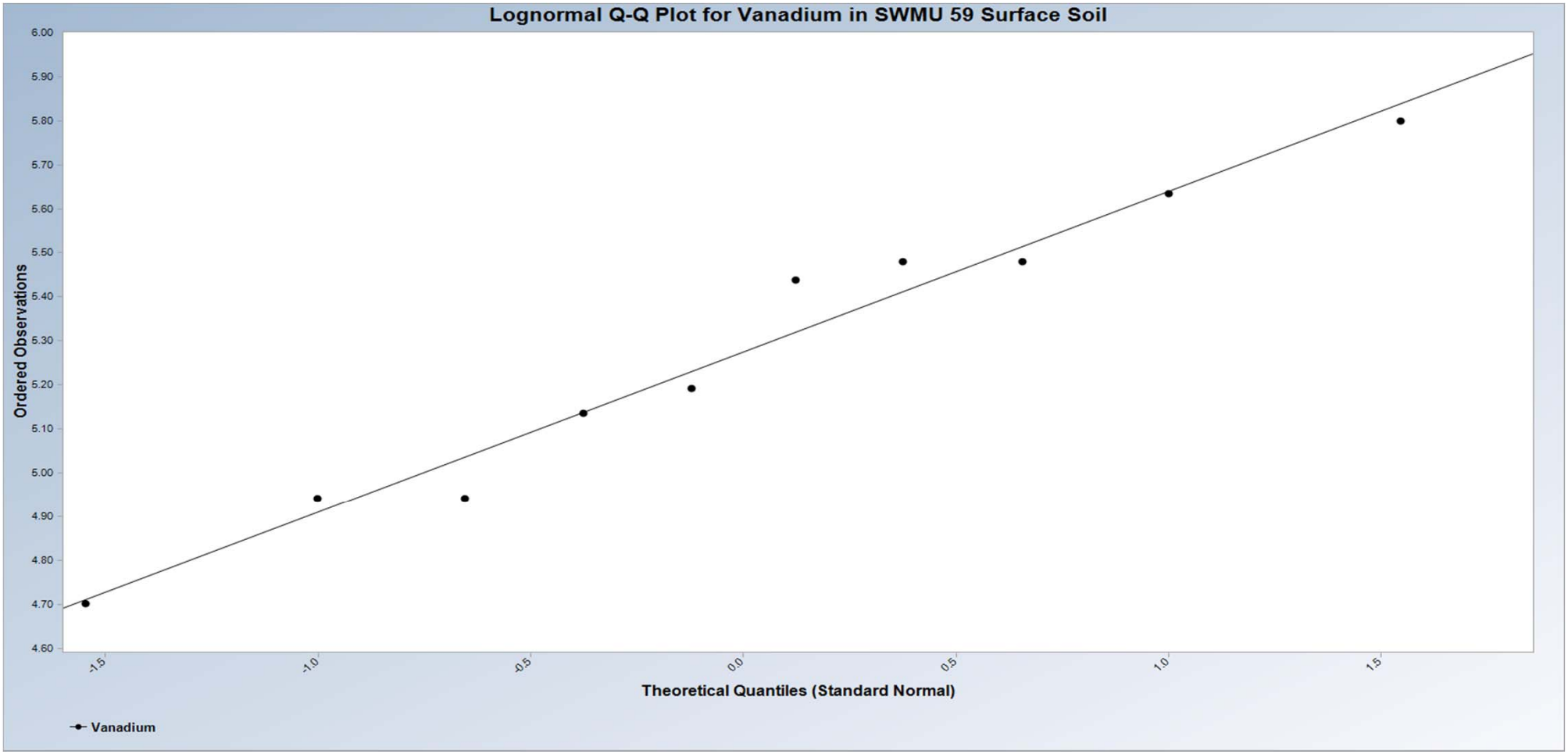


APPENDIX I

PROBABILITY PLOT - VANADIUM IN SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



APPENDIX I

PROBABILITY PLOT - VANADIUM IN SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION
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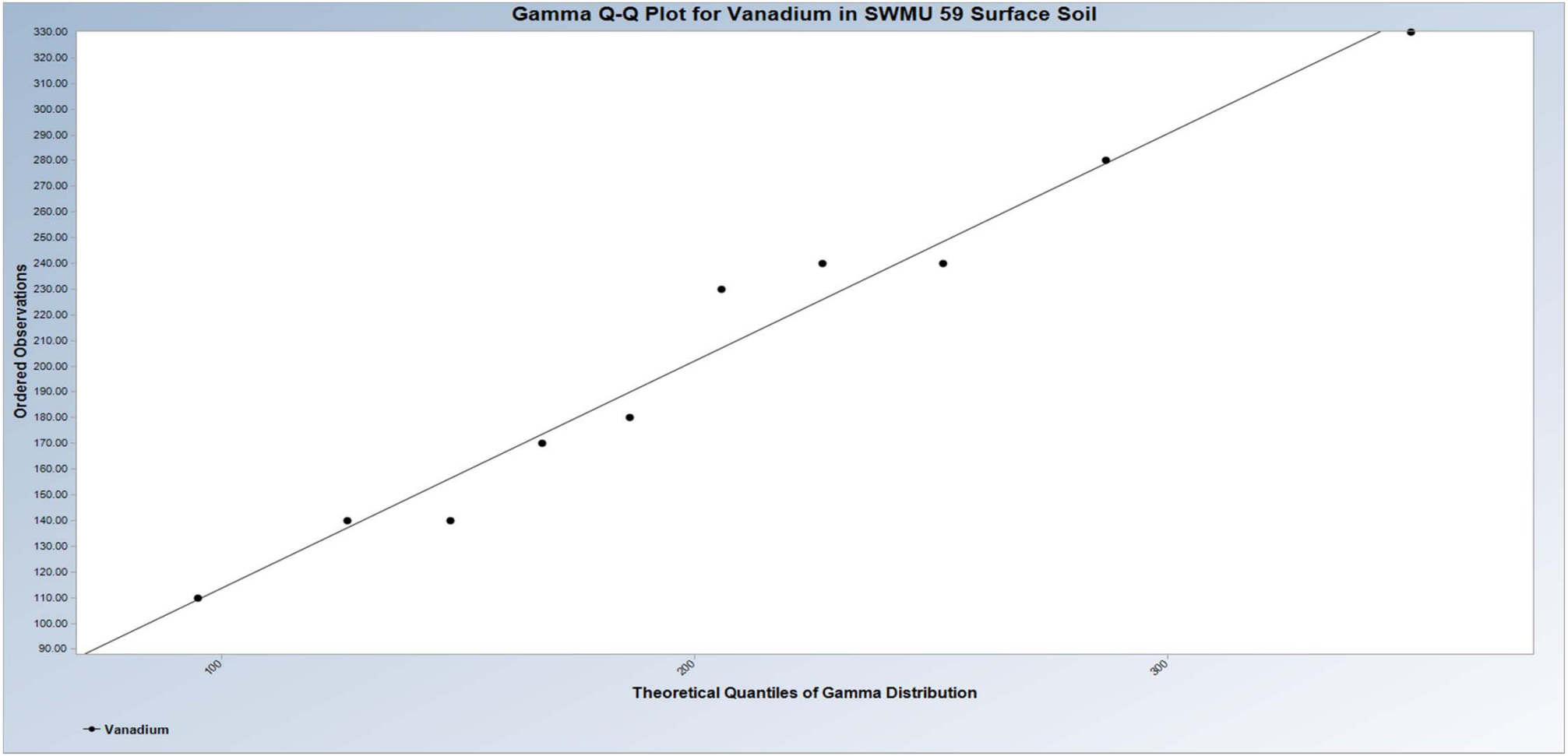

APPENDIX I

PROBABILITY PLOT - ZINC IN SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
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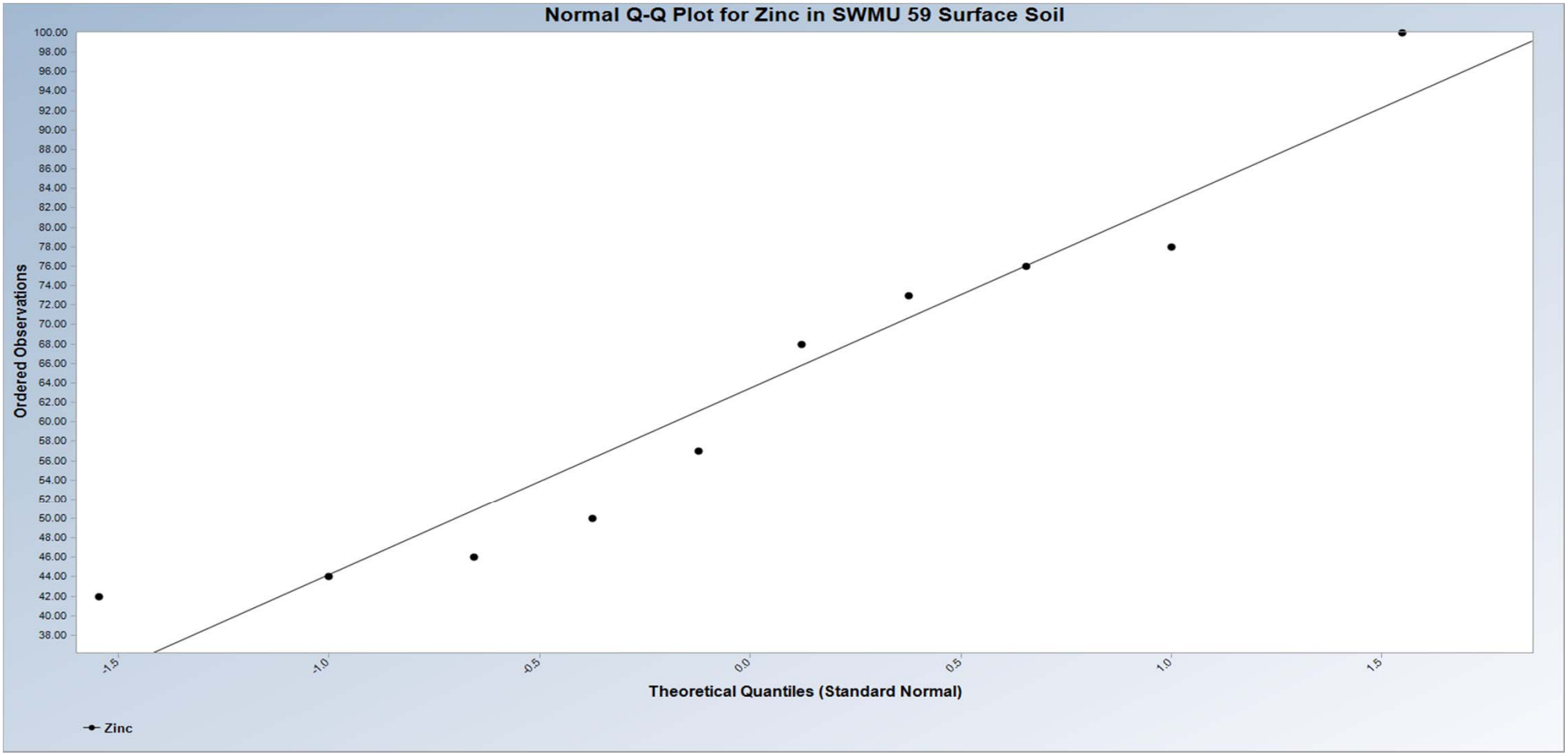

APPENDIX I

PROBABILITY PLOT - ZINC IN SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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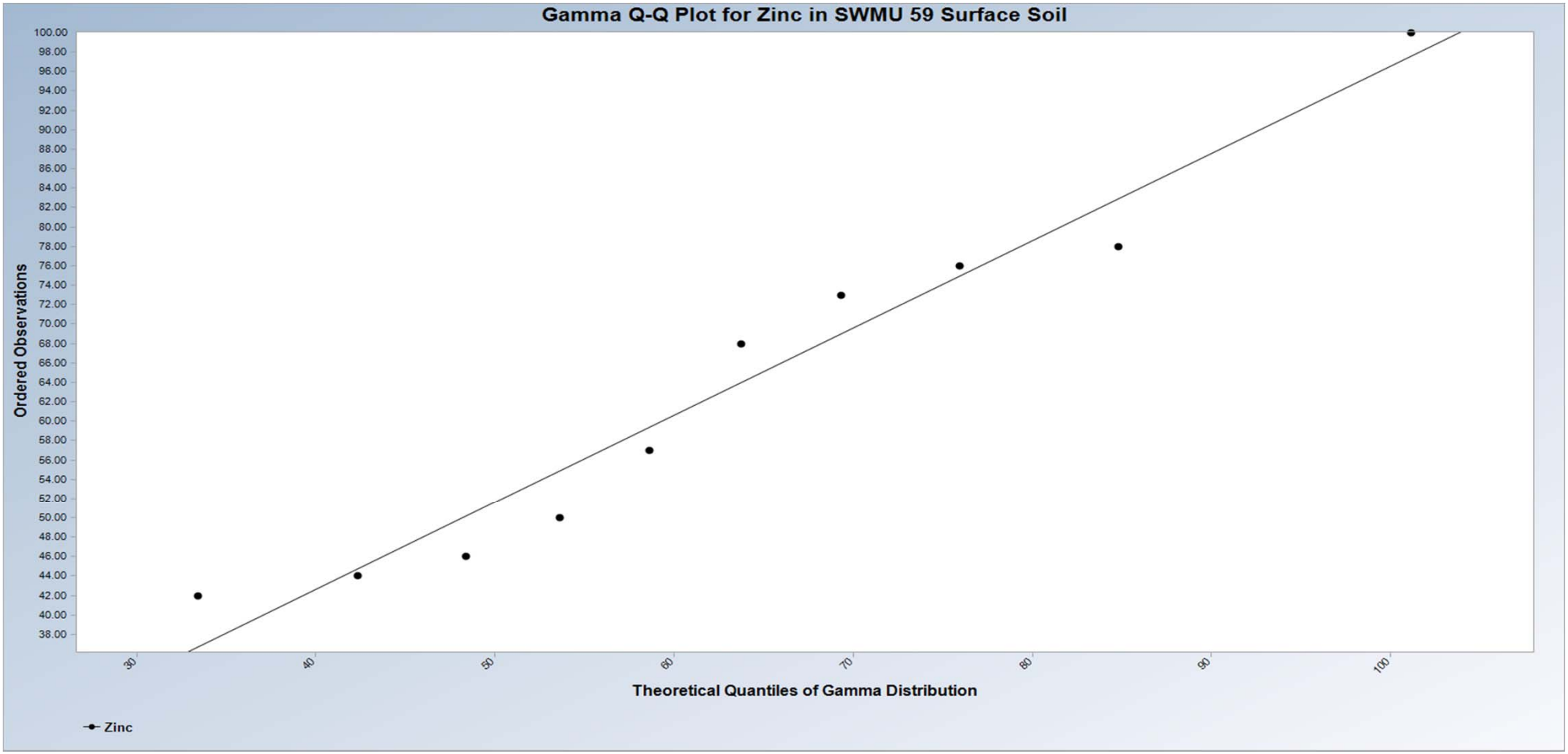

APPENDIX I

PROBABILITY PLOT - ZINC IN SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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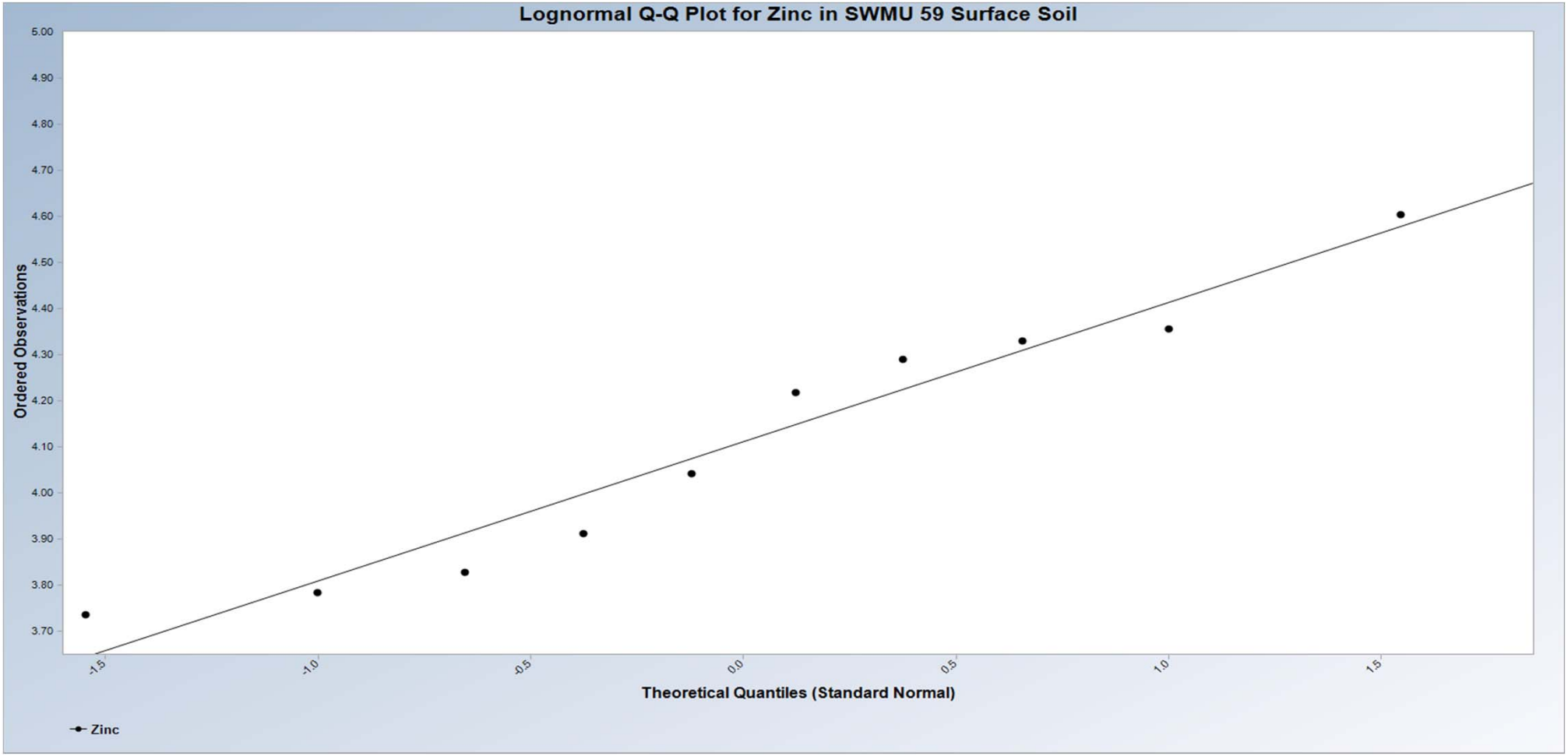
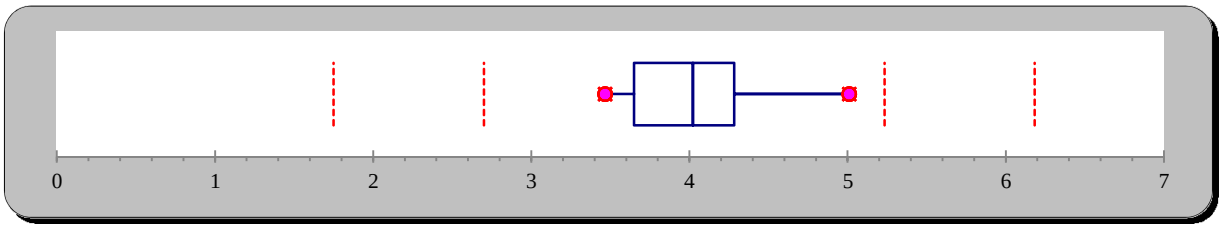


Box and Whisker Plot

Chromium: SWMU 59 Surface Soil, 2012 CMS Investigation
(Log-Transformed Analytical Data)

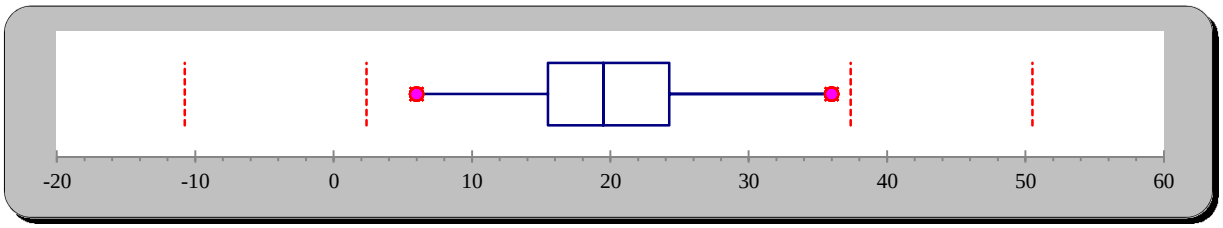
Lower Whisker	Lower Hinge	Median	Upper Hinge	Upper Whisker
3.4657359	3.6501761	4.0213497	4.2835146	5.0106353



Box and Whisker Plot

Cobalt: SWMU 59 Surface Soil, 2012 CMS Investigation
(Non-Transformed Analytical Data)

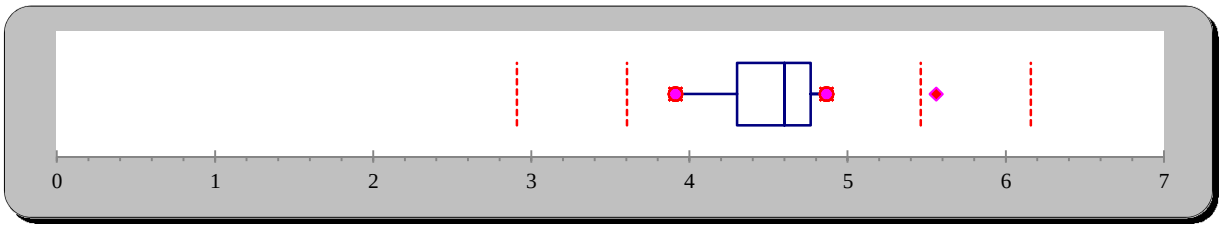
Lower Whisker	Lower Hinge	Median	Upper Hinge	Upper Whisker
6	15.5	19.5	24.25	36



Box and Whisker Plot

Copper: SWMU 59 Surface Soil, 2012 CMS Investigation
(Log-Transformed Analytical Data)

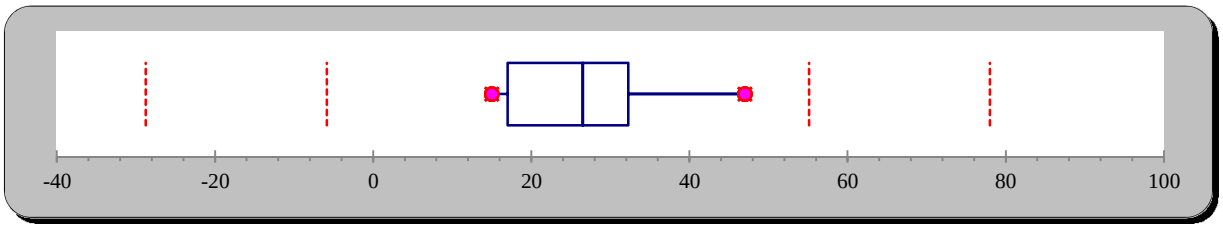
Lower Whisker	Lower Hinge	Median	Upper Hinge	Upper Whisker
3.912023	4.3017201	4.600145	4.7657389	4.8675345



Box and Whisker Plot

Nickel: SWMU 59 Surface Soil, 2012 CMS Investiation
(Non-Transformed Analytical Data)

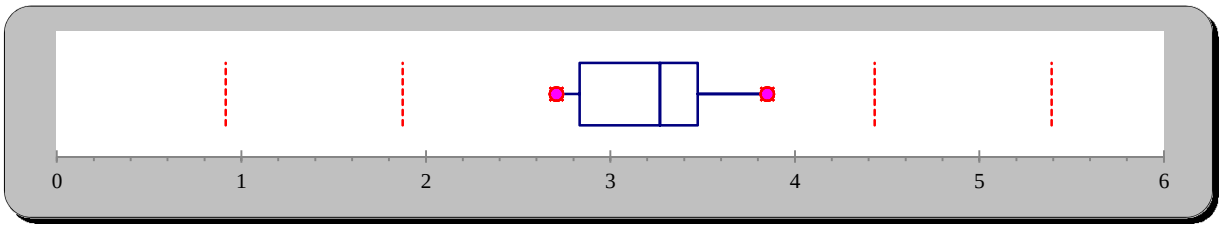
Lower Whisker	Lower Hinge	Median	Upper Hinge	Upper Whisker
15	17	26.5	32.25	47



Box and Whisker Plot

Nickel: SWMU 59 Surface Soil, 2012 CMS Investigation
(Log-Transformed Analytical Data)

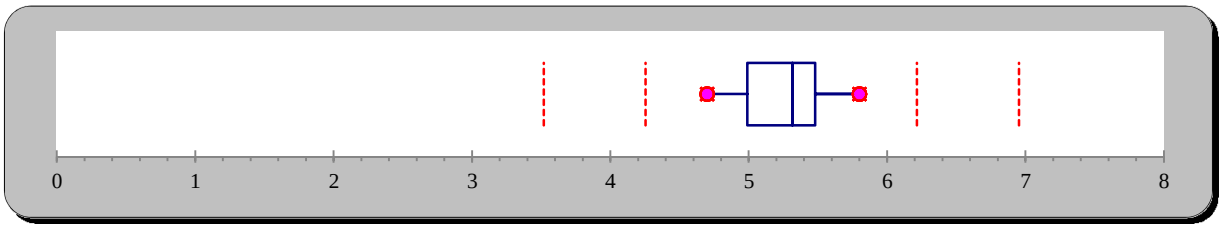
Lower Whisker	Lower Hinge	Median	Upper Hinge	Upper Whisker
2.7080502	2.8332133	3.2683458	3.47268	3.8501476



Box and Whisker Plot

Vanadium: SWMU 59 Surface Soil, 2012 CMS Investigation
(Log-Transformed Analytical Data)

Lower Whisker	Lower Hinge	Median	Upper Hinge	Upper Whisker
4.7004804	4.9901814	5.3155181	5.4806389	5.7990927



APPENDIX J
2010 SUBSURFACE SOIL STATISTICS

General UCL Statistics for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Beryllium: SWMU 59 Subsurface Soil, 2012 CMS Investigation

General Statistics

Number of Valid Data	23	Number of Detected Data	15
Number of Distinct Detected Data	13	Number of Non-Detect Data	8
		Percent Non-Detects	34.78%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.091	Minimum Detected	-2.397
Maximum Detected	0.96	Maximum Detected	-0.0408
Mean of Detected	0.386	Mean of Detected	-1.083
SD of Detected	0.212	SD of Detected	0.547
Minimum Non-Detect	2.6	Minimum Non-Detect	0.956
Maximum Non-Detect	3.5	Maximum Non-Detect	1.253

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	23
Number treated as Detected	0
Single DL Non-Detect Percentage	100.00%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.858	Shapiro Wilk Test Statistic	0.946
5% Shapiro Wilk Critical Value	0.881	5% Shapiro Wilk Critical Value	0.881
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.765	Mean	-0.573
SD	0.564	SD	0.839
95% DL/2 (t) UCL	0.967	95% H-Stat (DL/2) UCL	1.215
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-1.083
		SD in Log Scale	0.457
		Mean in Original Scale	0.372
		SD in Original Scale	0.176
		95% t UCL	0.436
		95% Percentile Bootstrap UCL	0.436
		95% BCA Bootstrap UCL	0.456
		95% H-UCL	0.454

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	3.21	Data appear Gamma Distributed at 5% Significance Level
Theta Star	0.12	
nu star	96.29	
A-D Test Statistic	0.419	
5% A-D Critical Value	0.74	
K-S Test Statistic	0.74	
5% K-S Critical Value	0.223	
Data appear Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution		Nonparametric Statistics	
Gamma ROS Statistics using Extrapolated Data		Kaplan-Meier (KM) Method	
Minimum	0.091	Mean	0.386
Maximum	0.96	SD	0.205
Mean	0.394	SE of Mean	0.0547
Median	0.37	95% KM (t) UCL	0.48
SD	0.176	95% KM (z) UCL	0.476
k star	4.835	95% KM (jackknife) UCL	0.481
Theta star	0.0815	95% KM (bootstrap t) UCL	0.545
Nu star	222.4	95% KM (BCA) UCL	0.49
AppChi2	188.9	95% KM (Percentile Bootstrap) UCL	0.484
95% Gamma Approximate UCL (Use when n >= 40)	0.464	95% KM (Chebyshev) UCL	0.624
95% Adjusted Gamma UCL (Use when n < 40)	0.47	97.5% KM (Chebyshev) UCL	0.728
		99% KM (Chebyshev) UCL	0.93
		Potential UCLs to Use	
		95% KM (Percentile Bootstrap) UCL	0.484

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Beryllium: NAPR Basewide Background, Clay Subsurface Soil

General Statistics

Number of Valid Observations	18	Number of Distinct Observations	17

Raw Statistics		**Log-transformed Statistics**	
Minimum	0.052	Minimum of Log Data	-2.957
Maximum	0.7	Maximum of Log Data	-0.357
Mean	0.259	Mean of log Data	-1.562
Geometric Mean	0.21	SD of log Data	0.699
Median	0.255		
SD	0.169		
Std. Error of Mean	0.0397		
Coefficient of Variation	0.651		
Skewness	1.145		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.907	Shapiro Wilk Test Statistic	0.971
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	0.328	95% H-UCL	0.391
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.464
95% Adjusted-CLT UCL (Chen-1995)	0.336	97.5% Chebyshev (MVUE) UCL	0.551
95% Modified-t UCL (Johnson-1978)	0.33	99% Chebyshev (MVUE) UCL	0.722

Gamma Distribution Test		**Data Distribution**
k star (bias corrected)	2.138	Data appear Normal at 5% Significance Level
Theta Star	0.121	
MLE of Mean	0.259	
MLE of Standard Deviation	0.177	
nu star	76.97	
Approximate Chi Square Value (.05)	57.76	**Nonparametric Statistics**
Adjusted Level of Significance	0.0357	95% CLT UCL 0.324
Adjusted Chi Square Value	56.17	95% Jackknife UCL 0.328
		95% Standard Bootstrap UCL 0.323
Anderson-Darling Test Statistic	0.236	95% Bootstrap-t UCL 0.349
Anderson-Darling 5% Critical Value	0.749	95% Hall's Bootstrap UCL 0.363
Kolmogorov-Smirnov Test Statistic	0.118	95% Percentile Bootstrap UCL 0.326
Kolmogorov-Smirnov 5% Critical Value	0.206	95% BCA Bootstrap UCL 0.337
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 0.432
		97.5% Chebyshev(Mean, Sd) UCL 0.507
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 0.654
95% Approximate Gamma UCL (Use when n >= 40)	0.345	
95% Adjusted Gamma UCL (Use when n < 40)	0.355	

Potential UCL to Use		Use 95% Student's-t UCL	0.328

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Cadmium: SWMU 59 Subsurface Soil, 2010 CMS Investigation

General Statistics

Number of Valid Data	23	Number of Detected Data	20
Number of Distinct Detected Data	18	Number of Non-Detect Data	3
		Percent Non-Detects	13.04%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.12	Minimum Detected	-2.12
Maximum Detected	0.77	Maximum Detected	-0.261
Mean of Detected	0.413	Mean of Detected	-1.005
SD of Detected	0.204	SD of Detected	0.511
Minimum Non-Detect	3.1	Minimum Non-Detect	1.131
Maximum Non-Detect	3.5	Maximum Non-Detect	1.253

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	23
Number treated as Detected	0
Single DL Non-Detect Percentage	100.00%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.903	Shapiro Wilk Test Statistic	0.958
5% Shapiro Wilk Critical Value	0.905	5% Shapiro Wilk Critical Value	0.905
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.57	Mean	-0.811
SD	0.457	SD	0.698
95% DL/2 (t) UCL	0.733	95% H-Stat (DL/2) UCL	0.782
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-1.005
		SD in Log Scale	0.481
		Mean in Original Scale	0.407
		SD in Original Scale	0.192
		95% t UCL	0.476
		95% Percentile Bootstrap UCL	0.472
		95% BCA Bootstrap UCL	0.479
		95% H-UCL	0.502

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	3.733	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	0.11		
nu star	149.3		
A-D Test Statistic	0.379	Nonparametric Statistics	
5% A-D Critical Value	0.745	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.745	Mean	0.413
5% K-S Critical Value	0.195	SD	0.198
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	0.0455
		95% KM (t) UCL	0.491
Assuming Gamma Distribution		95% KM (z) UCL	0.487
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.491
Minimum	0.12	95% KM (bootstrap t) UCL	0.502
Maximum	0.77	95% KM (BCA) UCL	0.491
Mean	0.416	95% KM (Percentile Bootstrap) UCL	0.486
Median	0.36	95% KM (Chebyshev) UCL	0.611
SD	0.192	97.5% KM (Chebyshev) UCL	0.697
k star	4.269	99% KM (Chebyshev) UCL	0.865
Theta star	0.0975		
Nu star	196.4	Potential UCLs to Use	
AppChi2	165	95% KM (BCA) UCL	0.491
95% Gamma Approximate UCL (Use when n >= 40)	0.495		
95% Adjusted Gamma UCL (Use when n < 40)	0.502		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Chromium: SWMU 59 Subsurface Soil, 2010 CMS Investigation

General Statistics

Number of Valid Observations	23	Number of Distinct Observations	23

Raw Statistics		Log-transformed Statistics	
Minimum	8	Minimum of Log Data	2.079
Maximum	79.3	Maximum of Log Data	4.373
Mean	35.36	Mean of log Data	3.407
Geometric Mean	30.17	SD of log Data	0.601
Median	32.1		
SD	19.32		
Std. Error of Mean	4.029		
Coefficient of Variation	0.546		
Skewness	0.574		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.942	Shapiro Wilk Test Statistic	0.967
Shapiro Wilk Critical Value	0.914	Shapiro Wilk Critical Value	0.914
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	42.28	95% H-UCL	47.08
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	56.45
95% Adjusted-CLT UCL (Chen-1995)	42.5	97.5% Chebyshev (MVUE) UCL	65.38
95% Modified-t UCL (Johnson-1978)	42.36	99% Chebyshev (MVUE) UCL	82.91

Gamma Distribution Test		Data Distribution
k star (bias corrected)	2.906	Data appear Normal at 5% Significance Level
Theta Star	12.17	
MLE of Mean	35.36	
MLE of Standard Deviation	20.74	
nu star	133.7	
Approximate Chi Square Value (.05)	108	**Nonparametric Statistics**
Adjusted Level of Significance	0.0389	95% CLT UCL 41.99
Adjusted Chi Square Value	106.3	95% Jackknife UCL 42.28
		95% Standard Bootstrap UCL 41.86
Anderson-Darling Test Statistic	0.285	95% Bootstrap-t UCL 42.88
Anderson-Darling 5% Critical Value	0.75	95% Hall's Bootstrap UCL 42.27
Kolmogorov-Smirnov Test Statistic	0.109	95% Percentile Bootstrap UCL 42.01
Kolmogorov-Smirnov 5% Critical Value	0.183	95% BCA Bootstrap UCL 42.24
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 52.92
		97.5% Chebyshev(Mean, Sd) UCL 60.52
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 75.44
95% Approximate Gamma UCL (Use when n >= 40)	43.78	
95% Adjusted Gamma UCL (Use when n < 40)	44.47	

Potential UCL to Use	Use 95% Student's-t UCL 42.28

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Chromium: NAPR Basewide Background, Clay Subsurface Soil

General Statistics

Number of Valid Observations	18	Number of Distinct Observations	16

Raw Statistics

Minimum	3.9
Maximum	148
Mean	37.31
Geometric Mean	23.93
Median	21.5
SD	38.59
Std. Error of Mean	9.095
Coefficient of Variation	1.034
Skewness	1.818

Log-transformed Statistics

Minimum of Log Data	1.361
Maximum of Log Data	4.997
Mean of log Data	3.175
SD of log Data	0.981

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.774
Shapiro Wilk Critical Value	0.897

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.982
Shapiro Wilk Critical Value	0.897

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	53.13

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	56.43
95% Modified-t UCL (Johnson-1978)	53.78

Assuming Lognormal Distribution

95% H-UCL	72.11
95% Chebyshev (MVUE) UCL	78.98
97.5% Chebyshev (MVUE) UCL	97
99% Chebyshev (MVUE) UCL	132.4

Gamma Distribution Test

k star (bias corrected)	1.093
Theta Star	34.14
MLE of Mean	37.31
MLE of Standard Deviation	35.69
nu star	39.34
Approximate Chi Square Value (.05)	25.97
Adjusted Level of Significance	0.0357
Adjusted Chi Square Value	24.93
Anderson-Darling Test Statistic	0.427
Anderson-Darling 5% Critical Value	0.761
Kolmogorov-Smirnov Test Statistic	0.162
Kolmogorov-Smirnov 5% Critical Value	0.208

Data appear Gamma Distributed at 5% Significance Level

Data Distribution

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	52.27
95% Jackknife UCL	53.13
95% Standard Bootstrap UCL	51.44
95% Bootstrap-t UCL	62.36
95% Hall's Bootstrap UCL	60.99
95% Percentile Bootstrap UCL	52.79
95% BCA Bootstrap UCL	55.72
95% Chebyshev(Mean, Sd) UCL	76.95
97.5% Chebyshev(Mean, Sd) UCL	94.1
99% Chebyshev(Mean, Sd) UCL	127.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (Use when n >= 40)	56.51
95% Adjusted Gamma UCL (Use when n < 40)	58.87

Potential UCL to Use	Use 95% Approximate Gamma UCL 56.51

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Cobalt: SWMU 59 Surface Soil, 2010 CMS Investigation

General Statistics

Number of Valid Observations	23	Number of Distinct Observations	22

Raw Statistics

Minimum	9.6
Maximum	72.1
Mean	28.88
Geometric Mean	25.22
Median	26.9
SD	16.37
Std. Error of Mean	3.413
Coefficient of Variation	0.567
Skewness	1.466

Log-transformed Statistics

Minimum of Log Data	2.262
Maximum of Log Data	4.278
Mean of log Data	3.227
SD of log Data	0.53

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.847
Shapiro Wilk Critical Value	0.914

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.966
Shapiro Wilk Critical Value	0.914

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	34.74

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	35.61
95% Modified-t UCL (Johnson-1978)	34.92

Assuming Lognormal Distribution

95% H-UCL	36.36
95% Chebyshev (MVUE) UCL	43.29
97.5% Chebyshev (MVUE) UCL	49.56
99% Chebyshev (MVUE) UCL	61.86

Gamma Distribution Test

k star (bias corrected)	3.37
Theta Star	8.571
MLE of Mean	28.88
MLE of Standard Deviation	15.73
nu star	155
Approximate Chi Square Value (.05)	127.2
Adjusted Level of Significance	0.0389
Adjusted Chi Square Value	125.4
Anderson-Darling Test Statistic	0.453
Anderson-Darling 5% Critical Value	0.749
Kolmogorov-Smirnov Test Statistic	0.166
Kolmogorov-Smirnov 5% Critical Value	0.182

Data appear Gamma Distributed at 5% Significance Level

Data Distribution

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	34.5
95% Jackknife UCL	34.74
95% Standard Bootstrap UCL	34.23
95% Bootstrap-t UCL	37.26
95% Hall's Bootstrap UCL	39.11
95% Percentile Bootstrap UCL	34.63
95% BCA Bootstrap UCL	35.92
95% Chebyshev(Mean, Sd) UCL	43.76
97.5% Chebyshev(Mean, Sd) UCL	50.2
99% Chebyshev(Mean, Sd) UCL	62.84

Assuming Gamma Distribution

95% Approximate Gamma UCL (Use when n >= 40)	35.19
95% Adjusted Gamma UCL (Use when n < 40)	35.7

Potential UCL to Use	Use 95% Approximate Gamma UCL 35.19

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Cobalt: NAPR Basewide Background, Clay Subsurface Soil

General Statistics

Number of Valid Data	18	Number of Detected Data	17
Number of Distinct Detected Data	17	Number of Non-Detect Data	1
		Percent Non-Detects	5.56%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.83	Minimum Detected	-0.186
Maximum Detected	33.8	Maximum Detected	3.52
Mean of Detected	9.619	Mean of Detected	1.875
SD of Detected	8.907	SD of Detected	0.948
Minimum Non-Detect	1.2	Minimum Non-Detect	0.182
Maximum Non-Detect	1.2	Maximum Non-Detect	0.182

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.821	Shapiro Wilk Test Statistic	0.981
5% Shapiro Wilk Critical Value	0.892	5% Shapiro Wilk Critical Value	0.892
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	9.118	Mean	1.742
SD	8.898	SD	1.078
95% DL/2 (t) UCL	12.77	95% H-Stat (DL/2) UCL	20.98
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	8.575	Mean in Log Scale	1.771
SD	9.407	SD in Log Scale	1.02
95% MLE (t) UCL	12.43	Mean in Original Scale	9.141
95% MLE (Tiku) UCL	12.32	SD in Original Scale	8.876
		95% t UCL	12.78
		95% Percentile Bootstrap UCL	12.8
		95% BCA Bootstrap UCL	13.52
		95% H UCL	19.12

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	1.216	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	7.912		
nu star	41.34		
A-D Test Statistic	0.324	**Nonparametric Statistics**	
5% A-D Critical Value	0.757	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.757	Mean	9.131
5% K-S Critical Value	0.213	SD	8.635
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	2.098
		95% KM (t) UCL	12.78
Assuming Gamma Distribution		95% KM (z) UCL	12.58
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	12.74
Minimum	0.000001	95% KM (bootstrap t) UCL	14.45
Maximum	33.8	95% KM (BCA) UCL	13.02
Mean	9.085	95% KM (Percentile Bootstrap) UCL	12.78
Median	5.95	95% KM (Chebyshev) UCL	18.28
SD	8.933	97.5% KM (Chebyshev) UCL	22.23
k star	0.474	99% KM (Chebyshev) UCL	30.01
Theta star	19.18		
Nu star	17.05	Potential UCLs to Use	
AppChi2	8.709	95% KM (Chebyshev) UCL	18.28
95% Gamma Approximate UCL (Use when n >= 40)	17.79		
95% Adjusted Gamma UCL (Use when n < 40)	19.03		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Copper: SWMU 59 Subsurface Soil, 2010 CMS Investigation

General Statistics

Number of Valid Observations	23	Number of Distinct Observations	23

Raw Statistics

Minimum	5.1
Maximum	270
Mean	88.28
Geometric Mean	72.74
Median	77.6
SD	55.92
Std. Error of Mean	11.66
Coefficient of Variation	0.633
Skewness	2.071

Log-transformed Statistics

Minimum of Log Data	1.629
Maximum of Log Data	5.598
Mean of log Data	4.287
SD of log Data	0.732

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.773
Shapiro Wilk Critical Value	0.914

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.789
Shapiro Wilk Critical Value	0.914

Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	108.3

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	112.8
95% Modified-t UCL (Johnson-1978)	109.1

Assuming Lognormal Distribution

95% H-UCL	134.1
95% Chebyshev (MVUE) UCL	161
97.5% Chebyshev (MVUE) UCL	190.1
99% Chebyshev (MVUE) UCL	247.3

Gamma Distribution Test

k star (bias corrected)	2.41
Theta Star	36.63
MLE of Mean	88.28
MLE of Standard Deviation	56.87
nu star	110.9
Approximate Chi Square Value (.05)	87.55
Adjusted Level of Significance	0.0389
Adjusted Chi Square Value	86.05
Anderson-Darling Test Statistic	1.171
Anderson-Darling 5% Critical Value	0.751
Kolmogorov-Smirnov Test Statistic	0.177
Kolmogorov-Smirnov 5% Critical Value	0.183

Data follow Appr. Gamma Distribution at 5% Significance Level

Data Distribution

Data Follow Appr. Gamma Distribution at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	107.5
95% Jackknife UCL	108.3
95% Standard Bootstrap UCL	107
95% Bootstrap-t UCL	120.2
95% Hall's Bootstrap UCL	233.2
95% Percentile Bootstrap UCL	107.8
95% BCA Bootstrap UCL	113.1
95% Chebyshev(Mean, Sd) UCL	139.1
97.5% Chebyshev(Mean, Sd) UCL	161.1
99% Chebyshev(Mean, Sd) UCL	204.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (Use when n >= 40)	111.8
95% Adjusted Gamma UCL (Use when n < 40)	113.7

Potential UCL to Use

Use 95% Approximate Gamma UCL 111.8

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Copper: NAPR Basewide Background, Clay Subsurface Soil

General Statistics

Number of Valid Observations	17	Number of Distinct Observations	17

Raw Statistics

Minimum	18
Maximum	260
Mean	105
Geometric Mean	82.94
Median	89
SD	70.54
Std. Error of Mean	17.11
Coefficient of Variation	0.672
Skewness	0.809

Log-transformed Statistics

Minimum of Log Data	2.89
Maximum of Log Data	5.561
Mean of log Data	4.418
SD of log Data	0.742

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.917
Shapiro Wilk Critical Value	0.892

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.969
Shapiro Wilk Critical Value	0.892

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	134.8

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	136.7
95% Modified-t UCL (Johnson-1978)	135.4

Assuming Lognormal Distribution

95% H-UCL	167.3
95% Chebyshev (MVUE) UCL	196.5
97.5% Chebyshev (MVUE) UCL	235.3
99% Chebyshev (MVUE) UCL	311.3

Gamma Distribution Test

k star (bias corrected)	1.913
Theta Star	54.88
MLE of Mean	105
MLE of Standard Deviation	75.9
nu star	65.04
Approximate Chi Square Value (.05)	47.48
Adjusted Level of Significance	0.0346
Adjusted Chi Square Value	45.91
Anderson-Darling Test Statistic	0.255
Anderson-Darling 5% Critical Value	0.748
Kolmogorov-Smirnov Test Statistic	0.139
Kolmogorov-Smirnov 5% Critical Value	0.211

Data appear Gamma Distributed at 5% Significance Level

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	133.1
95% Jackknife UCL	134.8
95% Standard Bootstrap UCL	132.6
95% Bootstrap-t UCL	138.9
95% Hall's Bootstrap UCL	139.2
95% Percentile Bootstrap UCL	134.8
95% BCA Bootstrap UCL	134.2
95% Chebyshev(Mean, Sd) UCL	179.5
97.5% Chebyshev(Mean, Sd) UCL	211.8
99% Chebyshev(Mean, Sd) UCL	275.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (Use when n >= 40)	143.8
95% Adjusted Gamma UCL (Use when n < 40)	148.7

Potential UCL to Use

Use 95% Student's-t UCL 134.8

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Mercury: SWMU 59 Subsurface Soil, 2010 CMS Investigation

General Statistics

Number of Valid Data	23	Number of Detected Data	10
Number of Distinct Detected Data	7	Number of Non-Detect Data	13
		Percent Non-Detects	56.52%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.009	Minimum Detected	-4.711
Maximum Detected	0.1	Maximum Detected	-2.303
Mean of Detected	0.0231	Mean of Detected	-4.131
SD of Detected	0.028	SD of Detected	0.774
Minimum Non-Detect	0.036	Minimum Non-Detect	-3.324
Maximum Non-Detect	0.048	Maximum Non-Detect	-3.037

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	22
Number treated as Detected	1
Single DL Non-Detect Percentage	95.65%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.57	Shapiro Wilk Test Statistic	0.788
5% Shapiro Wilk Critical Value	0.842	5% Shapiro Wilk Critical Value	0.842
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.0213	Mean	-4.01
SD	0.018	SD	0.51
95% DL/2 (t) UCL	0.0278	95% H-Stat (DL/2) UCL	0.0256
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-4.211
		SD in Log Scale	0.536
		Mean in Original Scale	0.0182
		SD in Original Scale	0.0187
		95% t UCL	0.0249
		95% Percentile Bootstrap UCL	0.0254
		95% BCA Bootstrap UCL	0.029
		95% H-UCL	0.0215

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	1.133	Data Follow Appr. Gamma Distribution at 5% Significance Level
Theta Star	0.0204	
nu star	22.66	
A-D Test Statistic	1.18	
5% A-D Critical Value	0.739	
K-S Test Statistic	0.739	
5% K-S Critical Value	0.271	
Data follow Appr. Gamma Distribution at 5% Significance Level		

Assuming Gamma Distribution	
Gamma ROS Statistics using Extrapolated Data	
Minimum	0.00385
Maximum	0.1
Mean	0.0214
Median	0.0203
SD	0.0192
k star	2.017
Theta star	0.0106
Nu star	92.77
AppChi2	71.56
95% Gamma Approximate UCL (Use when n >= 40)	0.0278
95% Adjusted Gamma UCL (Use when n < 40)	0.0283

Note: DL/2 is not a recommended method.

Nonparametric Statistics	
Kaplan-Meier (KM) Method	
Mean	0.0183
SD	0.0189
SE of Mean	0.00457
95% KM (t) UCL	0.0261
95% KM (z) UCL	0.0258
95% KM (jackknife) UCL	0.0261
95% KM (bootstrap t) UCL	0.0428
95% KM (BCA) UCL	0.0262
95% KM (Percentile Bootstrap) UCL	0.0265
95% KM (Chebyshev) UCL	0.0382
97.5% KM (Chebyshev) UCL	0.0468
99% KM (Chebyshev) UCL	0.0638
Potential UCLs to Use	
95% KM (t) UCL	0.0261

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Nickel: SMWU 59 Subsurface Soil, 2010 CMS Investigation

General Statistics

Number of Valid Observations	23	Number of Distinct Observations	22

Raw Statistics		Log-transformed Statistics	
Minimum	6.3	Minimum of Log Data	1.841
Maximum	47.3	Maximum of Log Data	3.857
Mean	17.35	Mean of log Data	2.733
Geometric Mean	15.38	SD of log Data	0.495
Median	14.9		
SD	9.33		
Std. Error of Mean	1.946		
Coefficient of Variation	0.538		
Skewness	1.613		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.868	Shapiro Wilk Test Statistic	0.982
Shapiro Wilk Critical Value	0.914	Shapiro Wilk Critical Value	0.914
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	20.69	95% H-UCL	21.4
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	25.37
95% Adjusted-CLT UCL (Chen-1995)	21.25	97.5% Chebyshev (MVUE) UCL	28.86
95% Modified-t UCL (Johnson-1978)	20.8	99% Chebyshev (MVUE) UCL	35.73

Gamma Distribution Test		Data Distribution
k star (bias corrected)	3.782	Data appear Gamma Distributed at 5% Significance Level
Theta Star	4.587	
MLE of Mean	17.35	
MLE of Standard Deviation	8.921	
nu star	174	
Approximate Chi Square Value (.05)	144.5	**Nonparametric Statistics**
Adjusted Level of Significance	0.0389	95% CLT UCL 20.55
Adjusted Chi Square Value	142.5	95% Jackknife UCL 20.69
		95% Standard Bootstrap UCL 20.42
Anderson-Darling Test Statistic	0.272	95% Bootstrap-t UCL 21.69
Anderson-Darling 5% Critical Value	0.748	95% Hall's Bootstrap UCL 22.9
Kolmogorov-Smirnov Test Statistic	0.0809	95% Percentile Bootstrap UCL 20.66
Kolmogorov-Smirnov 5% Critical Value	0.182	95% BCA Bootstrap UCL 21.17
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 25.83
		97.5% Chebyshev(Mean, Sd) UCL 29.5
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 36.71
95% Approximate Gamma UCL (Use when n >= 40)	20.89	
95% Adjusted Gamma UCL (Use when n < 40)	21.18	

Potential UCL to Use	Use 95% Approximate Gamma UCL 20.89

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Nickel: NAPR Basewide Background, Clay Subsurface Soil

General Statistics

Number of Valid Observations	18	Number of Distinct Observations	17
Number of Missing Values	1		

Raw Statistics		Log-transformed Statistics	
Minimum	1.1	Minimum of Log Data	0.0953
Maximum	35.6	Maximum of Log Data	3.572
Mean	7.889	Mean of log Data	1.654
Geometric Mean	5.23	SD of log Data	0.921
Median	5.85		
SD	8.387		
Std. Error of Mean	1.977		
Coefficient of Variation	1.063		
Skewness	2.389		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.728	Shapiro Wilk Test Statistic	0.974
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	11.33	95% H-UCL	14.04
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	15.78
95% Adjusted-CLT UCL (Chen-1995)	12.33	97.5% Chebyshev (MVUE) UCL	19.25
95% Modified-t UCL (Johnson-1978)	11.51	99% Chebyshev (MVUE) UCL	26.08

Gamma Distribution Test		Data Distribution
k star (bias corrected)	1.17	Data appear Gamma Distributed at 5% Significance Level
Theta Star	6.744	
MLE of Mean	7.889	
MLE of Standard Deviation	7.294	
nu star	42.11	
Approximate Chi Square Value (.05)	28.23	**Nonparametric Statistics**
Adjusted Level of Significance	0.0357	95% CLT UCL 11.14
Adjusted Chi Square Value	27.14	95% Jackknife UCL 11.33
		95% Standard Bootstrap UCL 10.97
Anderson-Darling Test Statistic	0.444	95% Bootstrap-t UCL 14.26
Anderson-Darling 5% Critical Value	0.759	95% Hall's Bootstrap UCL 23.67
Kolmogorov-Smirnov Test Statistic	0.148	95% Percentile Bootstrap UCL 11.17
Kolmogorov-Smirnov 5% Critical Value	0.208	95% BCA Bootstrap UCL 12.87
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 16.51
		97.5% Chebyshev(Mean, Sd) UCL 20.23
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 27.56
95% Approximate Gamma UCL (Use when n >= 40)	11.77	
95% Adjusted Gamma UCL (Use when n < 40)	12.24	

Potential UCL to Use	Use 95% Approximate Gamma UCL 11.77

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Selenium: SWMU 59 Subsurface Soil, 2010 CMS Investigation

General Statistics

Number of Valid Data	23	Number of Detected Data	13
Number of Distinct Detected Data	11	Number of Non-Detect Data	10
		Percent Non-Detects	43.48%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.2	Minimum Detected	-1.609
Maximum Detected	2.6	Maximum Detected	0.956
Mean of Detected	0.952	Mean of Detected	-0.373
SD of Detected	0.829	SD of Detected	0.833
Minimum Non-Detect	13.2	Minimum Non-Detect	2.58
Maximum Non-Detect	17.7	Maximum Non-Detect	2.874

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	23
Number treated as Detected	0
Single DL Non-Detect Percentage	100.00%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.784	Shapiro Wilk Test Statistic	0.926
5% Shapiro Wilk Critical Value	0.866	5% Shapiro Wilk Critical Value	0.866
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	3.79	Mean	0.662
SD	3.398	SD	1.356
95% DL/2 (t) UCL	5.007	95% H-Stat (DL/2) UCL	11.67
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-0.373
		SD in Log Scale	0.627
		Mean in Original Scale	0.843
		SD in Original Scale	0.631
		95% t UCL	1.069
		95% Percentile Bootstrap UCL	1.058
		95% BCA Bootstrap UCL	1.106
		95% H-UCL	1.109

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	1.352	Data appear Gamma Distributed at 5% Significance Level
Theta Star	0.704	
nu star	35.15	
A-D Test Statistic	0.647	
5% A-D Critical Value	0.748	
K-S Test Statistic	0.748	
5% K-S Critical Value	0.24	
Data appear Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution	
Gamma ROS Statistics using Extrapolated Data	
Minimum	0.2
Maximum	2.6
Mean	0.971
Median	0.998
SD	0.625
k star	2.43
Theta star	0.4
Nu star	111.8
AppChi2	88.37
95% Gamma Approximate UCL (Use when n >= 40)	1.228
95% Adjusted Gamma UCL (Use when n < 40)	1.249

Note: DL/2 is not a recommended method.

Nonparametric Statistics	
Kaplan-Meier (KM) Method	
Mean	0.952
SD	0.796
SE of Mean	0.23
95% KM (t) UCL	1.347
95% KM (z) UCL	1.33
95% KM (jackknife) UCL	1.354
95% KM (bootstrap t) UCL	1.634
95% KM (BCA) UCL	1.353
95% KM (Percentile Bootstrap) UCL	1.337
95% KM (Chebyshev) UCL	1.954
97.5% KM (Chebyshev) UCL	2.388
99% KM (Chebyshev) UCL	3.239
Potential UCLs to Use	
95% KM (t) UCL	1.347

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Selenium: NAPR Basewide Background, Clay Subsurface Soil

General Statistics

Number of Valid Data	20	Number of Detected Data	6
Number of Distinct Detected Data	6	Number of Non-Detect Data	14
		Percent Non-Detects	70.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.22	Minimum Detected	-1.514
Maximum Detected	3.8	Maximum Detected	1.335
Mean of Detected	1.283	Mean of Detected	-0.262
SD of Detected	1.38	SD of Detected	1.131
Minimum Non-Detect	0.15	Minimum Non-Detect	-1.897
Maximum Non-Detect	1.3	Maximum Non-Detect	0.262

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	18
Number treated as Detected	2
Single DL Non-Detect Percentage	90.00%

Warning: There are only 6 Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.819	Shapiro Wilk Test Statistic	0.922
5% Shapiro Wilk Critical Value	0.788	5% Shapiro Wilk Critical Value	0.788
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.64	Mean	-1.012
SD	0.853	SD	1.083
95% DL/2 (t) UCL	0.97	95% H-Stat (DL/2) UCL	1.295
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-2.095
		SD in Log Scale	1.458
		Mean in Original Scale	0.433
		SD in Original Scale	0.91
		95% t UCL	0.785
		95% Percentile Bootstrap UCL	0.799
		95% BCA Bootstrap UCL	0.956
		95% H-UCL	1.095

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.668	Data appear Normal at 5% Significance Level	
Theta Star	1.921		
nu star	8.017		
A-D Test Statistic	0.365	**Nonparametric Statistics**	
5% A-D Critical Value	0.713	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.713	Mean	0.552
5% K-S Critical Value	0.34	SD	0.842
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	0.207
		95% KM (t) UCL	0.91
Assuming Gamma Distribution		95% KM (z) UCL	0.893
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.855
Minimum	0.000001	95% KM (bootstrap t) UCL	1.287
Maximum	3.8	95% KM (BCA) UCL	1.62
Mean	0.385	95% KM (Percentile Bootstrap) UCL	1.2
Median	0.000001	95% KM (Chebyshev) UCL	1.454
SD	0.93	97.5% KM (Chebyshev) UCL	1.845
k star	0.113	99% KM (Chebyshev) UCL	2.611
Theta star	3.422		
Nu star	4.501	Potential UCLs to Use	
AppChi2	0.929	95% KM (t) UCL	0.91
95% Gamma Approximate UCL (Use when n >= 40)	1.865	95% KM (Percentile Bootstrap) UCL	1.2
95% Adjusted Gamma UCL (Use when n < 40)	2.137		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Tin: SWMU 59 Subsurface Soil, 2010 CMS Investigation

General Statistics

Number of Valid Data	23	Number of Detected Data	11
Number of Distinct Detected Data	8	Number of Non-Detect Data	12
		Percent Non-Detects	52.17%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	1.9	Minimum Detected	0.642
Maximum Detected	26	Maximum Detected	3.258
Mean of Detected	4.6	Mean of Detected	1.107
SD of Detected	7.104	SD of Detected	0.725
Minimum Non-Detect	5.1	Minimum Non-Detect	1.629
Maximum Non-Detect	6.5	Maximum Non-Detect	1.872

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	22
Number treated as Detected	1
Single DL Non-Detect Percentage	95.65%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.385	Shapiro Wilk Test Statistic	0.517
5% Shapiro Wilk Critical Value	0.85	5% Shapiro Wilk Critical Value	0.85
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	3.715	Mean	1.084
SD	4.87	SD	0.493
95% DL/2 (t) UCL	5.459	95% H-Stat (DL/2) UCL	4.106
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	1.056
		SD in Log Scale	0.502
		Mean in Original Scale	3.643
		SD in Original Scale	4.888
		95% t UCL	5.394
		95% Percentile Bootstrap UCL	5.653
		95% BCA Bootstrap UCL	6.675
		95% H-UCL	4.026

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	1.032	Data do not follow a Discernable Distribution (0.05)	
Theta Star	4.459		
nu star	22.69		
A-D Test Statistic	2.876	Nonparametric Statistics	
5% A-D Critical Value	0.745	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.745	Mean	3.483
5% K-S Critical Value	0.261	SD	4.81
Data not Gamma Distributed at 5% Significance Level		SE of Mean	1.054
		95% KM (t) UCL	5.294
Assuming Gamma Distribution		95% KM (z) UCL	5.218
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	5.249
Minimum	1.861	95% KM (bootstrap t) UCL	17.63
Maximum	26	95% KM (BCA) UCL	5.572
Mean	4.286	95% KM (Percentile Bootstrap) UCL	5.542
Median	2.8	95% KM (Chebyshev) UCL	8.079
SD	4.885	97.5% KM (Chebyshev) UCL	10.07
k star	2.035	99% KM (Chebyshev) UCL	13.97
Theta star	2.106		
Nu star	93.61	Potential UCLs to Use	
AppChi2	72.3	95% KM (t) UCL	5.294
95% Gamma Approximate UCL (Use when n >= 40)	5.55	95% KM (% Bootstrap) UCL	5.542
95% Adjusted Gamma UCL (Use when n < 40)	5.656		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Tin: NAPR Basewide Background, Clay Subsurface Soil

General Statistics

Number of Valid Data	19	Number of Detected Data	13
Number of Distinct Detected Data	11	Number of Non-Detect Data	6
		Percent Non-Detects	31.58%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	1.5	Minimum Detected	0.405
Maximum Detected	3.1	Maximum Detected	1.131
Mean of Detected	2.346	Mean of Detected	0.835
SD of Detected	0.443	SD of Detected	0.199
Minimum Non-Detect	0.78	Minimum Non-Detect	-0.248
Maximum Non-Detect	1.9	Maximum Non-Detect	0.642

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	8
Number treated as Detected	11
Single DL Non-Detect Percentage	42.11%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.991	Shapiro Wilk Test Statistic	0.969
5% Shapiro Wilk Critical Value	0.866	5% Shapiro Wilk Critical Value	0.866
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	1.828	Mean	0.451
SD	0.868	SD	0.623
95% DL/2 (t) UCL	2.174	95% H-Stat (DL/2) UCL	2.608
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	2.057	Mean in Log Scale	0.691
SD	0.586	SD in Log Scale	0.274
95% MLE (t) UCL	2.29	Mean in Original Scale	2.068
95% MLE (Tiku) UCL	2.325	SD in Original Scale	0.557
		95% t UCL	2.289
		95% Percentile Bootstrap UCL	2.273
		95% BCA Bootstrap UCL	2.275
		95% H UCL	2.332

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	22.12	Data appear Normal at 5% Significance Level
Theta Star	0.106	
nu star	575	
A-D Test Statistic	0.169	
5% A-D Critical Value	0.733	
K-S Test Statistic	0.733	
5% K-S Critical Value	0.236	
Data appear Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution		Nonparametric Statistics	
Gamma ROS Statistics using Extrapolated Data		Kaplan-Meier (KM) Method	
Minimum	0.285	Mean	2.081
Maximum	3.1	SD	0.526
Mean	1.827	SE of Mean	0.126
Median	2.1	95% KM (t) UCL	2.299
SD	0.884	95% KM (z) UCL	2.288
k star	2.432	95% KM (jackknife) UCL	2.289
Theta star	0.751	95% KM (bootstrap t) UCL	2.297
Nu star	92.43	95% KM (BCA) UCL	2.416
AppChi2	71.26	95% KM (Percentile Bootstrap) UCL	2.363
95% Gamma Approximate UCL (Use when n >= 40)	2.369	95% KM (Chebyshev) UCL	2.629
95% Adjusted Gamma UCL (Use when n < 40)	2.425	97.5% KM (Chebyshev) UCL	2.866
		99% KM (Chebyshev) UCL	3.332
		Potential UCLs to Use	
		95% KM (t) UCL	2.299
		95% KM (Percentile Bootstrap) UCL	2.363

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Vanadium: SWMU 59 Subsurface Soil, 2010 CMS Investigation

General Statistics

Number of Valid Observations	23	Number of Distinct Observations	23

Raw Statistics		Log-transformed Statistics	
Minimum	43.5	Minimum of Log Data	3.773
Maximum	282	Maximum of Log Data	5.642
Mean	134.1	Mean of log Data	4.79
Geometric Mean	120.3	SD of log Data	0.494
Median	136		
SD	61.21		
Std. Error of Mean	12.76		
Coefficient of Variation	0.456		
Skewness	0.592		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.964	Shapiro Wilk Test Statistic	0.969
Shapiro Wilk Critical Value	0.914	Shapiro Wilk Critical Value	0.914
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	156	95% H-UCL	167.3
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	198.2
95% Adjusted-CLT UCL (Chen-1995)	156.8	97.5% Chebyshev (MVUE) UCL	225.5
95% Modified-t UCL (Johnson-1978)	156.3	99% Chebyshev (MVUE) UCL	279.1

Gamma Distribution Test		Data Distribution
k star (bias corrected)	4.177	Data appear Normal at 5% Significance Level
Theta Star	32.1	
MLE of Mean	134.1	
MLE of Standard Deviation	65.6	
nu star	192.1	
Approximate Chi Square Value (.05)	161.1	**Nonparametric Statistics**
Adjusted Level of Significance	0.0389	95% CLT UCL 155.1
Adjusted Chi Square Value	159	95% Jackknife UCL 156
		95% Standard Bootstrap UCL 154.6
Anderson-Darling Test Statistic	0.183	95% Bootstrap-t UCL 157.3
Anderson-Darling 5% Critical Value	0.747	95% Hall's Bootstrap UCL 158.1
Kolmogorov-Smirnov Test Statistic	0.11	95% Percentile Bootstrap UCL 155.7
Kolmogorov-Smirnov 5% Critical Value	0.182	95% BCA Bootstrap UCL 156
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 189.7
		97.5% Chebyshev(Mean, Sd) UCL 213.8
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 261.1
95% Approximate Gamma UCL (Use when n >= 40)	159.9	
95% Adjusted Gamma UCL (Use when n < 40)	162	

Potential UCL to Use		Use 95% Student's-t UCL	156

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Vanadium: NAPR Basewide Background, Clay Subsurface Soil

General Statistics

Number of Valid Observations	19	Number of Distinct Observations	17

Raw Statistics

Minimum	25
Maximum	410
Mean	208.6
Geometric Mean	175.5
Median	200
SD	112.7
Std. Error of Mean	25.87
Coefficient of Variation	0.541
Skewness	0.548

Log-transformed Statistics

Minimum of Log Data	3.219
Maximum of Log Data	6.016
Mean of log Data	5.168
SD of log Data	0.67

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.932
Shapiro Wilk Critical Value	0.901

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.903
Shapiro Wilk Critical Value	0.901

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	253.4

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	254.6
95% Modified-t UCL (Johnson-1978)	254

Assuming Lognormal Distribution

95% H-UCL	310.5
95% Chebyshev (MVUE) UCL	370.7
97.5% Chebyshev (MVUE) UCL	437.4
99% Chebyshev (MVUE) UCL	568.3

Gamma Distribution Test

k star (bias corrected)	2.608
Theta Star	79.97
MLE of Mean	208.6
MLE of Standard Deviation	129.1
nu star	99.12
Approximate Chi Square Value (.05)	77.15
Adjusted Level of Significance	0.0369
Adjusted Chi Square Value	75.46
Anderson-Darling Test Statistic	0.287
Anderson-Darling 5% Critical Value	0.748
Kolmogorov-Smirnov Test Statistic	0.104
Kolmogorov-Smirnov 5% Critical Value	0.2

Data appear Gamma Distributed at 5% Significance Level

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	251.1
95% Jackknife UCL	253.4
95% Standard Bootstrap UCL	250.8
95% Bootstrap-t UCL	260.3
95% Hall's Bootstrap UCL	252.6
95% Percentile Bootstrap UCL	250.5
95% BCA Bootstrap UCL	251.3
95% Chebyshev(Mean, Sd) UCL	321.3
97.5% Chebyshev(Mean, Sd) UCL	370.1
99% Chebyshev(Mean, Sd) UCL	465.9

Assuming Gamma Distribution

95% Approximate Gamma UCL (Use when n >= 40)	268
95% Adjusted Gamma UCL (Use when n < 40)	274

Potential UCL to Use

Use 95% Student's-t UCL 253.4

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Zinc: SWMU 59 Subsurface Soil, 2010 CMS Investigation

General Statistics

Number of Valid Observations	23	Number of Distinct Observations	23

Raw Statistics

Minimum	39.3
Maximum	242
Mean	87.82
Geometric Mean	79.42
Median	75.3
SD	46.06
Std. Error of Mean	9.604
Coefficient of Variation	0.524
Skewness	2.025

Log-transformed Statistics

Minimum of Log Data	3.671
Maximum of Log Data	5.489
Mean of log Data	4.375
SD of log Data	0.436

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.787
Shapiro Wilk Critical Value	0.914

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.938
Shapiro Wilk Critical Value	0.914

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	104.3

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	107.9
95% Modified-t UCL (Johnson-1978)	105

Assuming Lognormal Distribution

95% H-UCL	104.4
95% Chebyshev (MVUE) UCL	122.5
97.5% Chebyshev (MVUE) UCL	137.9
99% Chebyshev (MVUE) UCL	168.1

Gamma Distribution Test

k star (bias corrected)	4.497
Theta Star	19.53
MLE of Mean	87.82
MLE of Standard Deviation	41.41
nu star	206.8
Approximate Chi Square Value (.05)	174.6
Adjusted Level of Significance	0.0389
Adjusted Chi Square Value	172.4
Anderson-Darling Test Statistic	0.927
Anderson-Darling 5% Critical Value	0.746
Kolmogorov-Smirnov Test Statistic	0.235
Kolmogorov-Smirnov 5% Critical Value	0.182

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL (Use when n >= 40)	104.1
95% Adjusted Gamma UCL (Use when n < 40)	105.4

Data Distribution

Data appear Lognormal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	103.6
95% Jackknife UCL	104.3
95% Standard Bootstrap UCL	103.3
95% Bootstrap-t UCL	112.3
95% Hall's Bootstrap UCL	114.8
95% Percentile Bootstrap UCL	105
95% BCA Bootstrap UCL	106.3
95% Chebyshev(Mean, Sd) UCL	129.7
97.5% Chebyshev(Mean, Sd) UCL	147.8
99% Chebyshev(Mean, Sd) UCL	183.4

Potential UCL to Use

Use 95% Student's-t UCL	104.3
or 95% Modified-t UCL	105
or 95% H-UCL	104.4

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Zinc; NAPR Basewide Background, Clay Subsurface Soil

General Statistics

Number of Valid Data	19	Number of Detected Data	18
Number of Distinct Detected Data	18	Number of Non-Detect Data	1
		Percent Non-Detects	5.26%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	3.9	Minimum Detected	1.361
Maximum Detected	98	Maximum Detected	4.585
Mean of Detected	38.68	Mean of Detected	3.394
SD of Detected	25.41	SD of Detected	0.83
Minimum Non-Detect	27	Minimum Non-Detect	3.296
Maximum Non-Detect	27	Maximum Non-Detect	3.296

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.942	Shapiro Wilk Test Statistic	0.938
5% Shapiro Wilk Critical Value	0.897	5% Shapiro Wilk Critical Value	0.897
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	37.35	Mean	3.352
SD	25.36	SD	0.827
95% DL/2 (t) UCL	47.44	95% H-Stat (DL/2) UCL	63.86
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	30.27	Mean in Log Scale	3.359
SD	33.5	SD in Log Scale	0.821
95% MLE (t) UCL	43.6	Mean in Original Scale	37.44
95% MLE (Tiku) UCL	46.25	SD in Original Scale	25.27
		95% t UCL	47.5
		95% Percentile Bootstrap UCL	47.29
		95% BCA Bootstrap UCL	47.83
		95% H UCL	63.68

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	1.758	Data appear Normal at 5% Significance Level
Theta Star	22	
nu star	63.28	
A-D Test Statistic	0.239	
5% A-D Critical Value	0.752	
K-S Test Statistic	0.752	
5% K-S Critical Value	0.206	
Data appear Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution		Nonparametric Statistics	
Gamma ROS Statistics using Extrapolated Data		Kaplan-Meier (KM) Method	
Minimum	3.9	Mean	37.52
Maximum	98	SD	24.58
Mean	37.56	SE of Mean	5.818
Median	27.8	95% KM (t) UCL	47.61
SD	25.17	95% KM (z) UCL	47.09
k star	1.782	95% KM (jackknife) UCL	47.6
Theta star	21.08	95% KM (bootstrap t) UCL	49.6
Nu star	67.72	95% KM (BCA) UCL	47.61
AppChi2	49.78	95% KM (Percentile Bootstrap) UCL	47
95% Gamma Approximate UCL (Use when n >= 40)	51.1	95% KM (Chebyshev) UCL	62.88
95% Adjusted Gamma UCL (Use when n < 40)	52.52	97.5% KM (Chebyshev) UCL	73.86
		99% KM (Chebyshev) UCL	95.41
		Potential UCLs to Use	
		95% KM (t) UCL	47.61
		95% KM (Percentile Bootstrap) UCL	47

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

General Background Statistics for Full Data Sets

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Coverage	90%
Different or Future K Values	1
Number of Bootstrap Operations	2000

Chromium: SWMU 59 Subsurface Soil, 2010 CMS Investigation

General Statistics

Total Number of Observations	23	Number of Distinct Observations	23
Tolerance Factor	1.869		

Raw Statistics

Minimum	8
Maximum	79.3
Second Largest	63.5
First Quartile	19.85
Median	32.1
Third Quartile	50.6
Mean	35.36
Geometric Mean	30.17
SD	19.32
Coefficient of Variation	0.546
Skewness	0.574

Log-Transformed Statistics

Minimum	2.079
Maximum	4.373
Second Largest	4.151
First Quartile	2.979
Median	3.469
Third Quartile	3.924
Mean	3.407
SD	0.601

Background Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.942
Shapiro Wilk Critical Value	0.914

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.967
Shapiro Wilk Critical Value	0.914

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% UTL with 90% Coverage	71.47
95% UPL (t)	69.25
90% Percentile (z)	60.12
95% Percentile (z)	67.14
99% Percentile (z)	80.31

Assuming Lognormal Distribution

95% UTL with 90% Coverage	92.73
95% UPL (t)	86.54
90% Percentile (z)	65.16
95% Percentile (z)	81.05
99% Percentile (z)	122

Gamma Distribution Test

k star	2.906
Theta Star	12.17
MLE of Mean	35.36
MLE of Standard Deviation	20.74
nu star	133.7

A-D Test Statistic	0.285
5% A-D Critical Value	0.75
K-S Test Statistic	0.109
5% K-S Critical Value	0.183

Data appear Gamma Distributed at 5% Significance Level

Data Distribution Test

Data appear Normal at 5% Significance Level

Nonparametric Statistics

90% Percentile	59.06
95% Percentile	63.1
99% Percentile	75.82

Assuming Gamma Distribution

90% Percentile	63.17
95% Percentile	74.89
99% Percentile	100.3
95% WH Approx. Gamma UPL	76.83
95% HW Approx. Gamma UPL	78.64
95% WH Approx. Gamma UTL with 90% Coverage	80.73
95% HW Approx. Gamma UTL with 90% Coverage	82.94

95% UTL with 90% Coverage	63.5
95% Percentile Bootstrap UTL with 90% Coverage	76.14
95% BCA Bootstrap UTL with 90% Coverage	75.34
95% UPL	76.14
95% Chebyshev UPL	121.4
Upper Threshold Limit Based upon IQR	96.73

Chromium: NAPR Basewide Background, Clay Subsurface Soil

General Statistics

Total Number of Observations	18	Number of Distinct Observations	16
Tolerance Factor	1.974		

Raw Statistics		Log-Transformed Statistics	
Minimum	3.9	Minimum	1.361
Maximum	148	Maximum	4.997
Second Largest	101	Second Largest	4.615
First Quartile	12.68	First Quartile	2.514
Median	21.5	Median	3.061
Third Quartile	36.85	Third Quartile	3.607
Mean	37.31	Mean	3.175
Geometric Mean	23.93	SD	0.981
SD	38.59		
Coefficient of Variation	1.034		
Skewness	1.818		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.774	Shapiro Wilk Test Statistic	0.982
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	113.5	95% UTL with 90% Coverage	166.1
95% UPL (t)	106.3	95% UPL (t)	138.3
90% Percentile (z)	86.76	90% Percentile (z)	84.17
95% Percentile (z)	100.8	95% Percentile (z)	120.2
99% Percentile (z)	127.1	99% Percentile (z)	234.7

Gamma Distribution Test		Data Distribution Test
k star	1.093	Data appear Gamma Distributed at 5% Significance Level
Theta Star	34.14	
MLE of Mean	37.31	
MLE of Standard Deviation	35.69	
nu star	39.34	
A-D Test Statistic	0.427	
5% A-D Critical Value	0.761	
K-S Test Statistic	0.162	
5% K-S Critical Value	0.208	
Data appear Gamma Distributed at 5% Significance Level		

Nonparametric Statistics	
90% Percentile	89.17
95% Percentile	108.1
99% Percentile	140
95% UTL with 90% Coverage	148
95% Percentile Bootstrap UTL with 90% Coverage	148
95% BCA Bootstrap UTL with 90% Coverage	148
95% UPL	148
95% Chebyshev UPL	210.1
Upper Threshold Limit Based upon IQR	73.11

Assuming Gamma Distribution	
90% Percentile	84.04
95% Percentile	108.3
99% Percentile	164.4
95% WH Approx. Gamma UPL	113.2
95% HW Approx. Gamma UPL	116.8
95% WH Approx. Gamma UTL with 90% Coverage	127
95% HW Approx. Gamma UTL with 90% Coverage	132.5

Cobalt: SWMU 59 Subsurface Soil, 2010 CMS Investigation

General Statistics

Total Number of Observations	23	Number of Distinct Observations	22
Tolerance Factor	1.869		

Raw Statistics		Log-Transformed Statistics	
Minimum	9.6	Minimum	2.262
Maximum	72.1	Maximum	4.278
Second Largest	67.6	Second Largest	4.214
First Quartile	18.85	First Quartile	2.934
Median	26.9	Median	3.292
Third Quartile	32.1	Third Quartile	3.469
Mean	28.88	Mean	3.227
Geometric Mean	25.22	SD	0.53
SD	16.37		
Coefficient of Variation	0.567		
Skewness	1.466		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.847	Shapiro Wilk Test Statistic	0.966
Shapiro Wilk Critical Value	0.914	Shapiro Wilk Critical Value	0.914
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	59.48	95% UTL with 90% Coverage	67.85
95% UPL (t)	57.59	95% UPL (t)	63.84
90% Percentile (z)	49.86	90% Percentile (z)	49.71
95% Percentile (z)	55.81	95% Percentile (z)	60.25
99% Percentile (z)	66.96	99% Percentile (z)	86.44

Gamma Distribution Test		Data Distribution Test
k star	3.37	Data appear Gamma Distributed at 5% Significance Level
Theta Star	8.571	
MLE of Mean	28.88	
MLE of Standard Deviation	15.73	
nu star	155	
A-D Test Statistic	0.453	
5% A-D Critical Value	0.749	
K-S Test Statistic	0.166	
5% K-S Critical Value	0.182	
Data appear Gamma Distributed at 5% Significance Level		

Nonparametric Statistics	
90% Percentile	51.04
95% Percentile	66.18
99% Percentile	71.11

Assuming Gamma Distribution			
90% Percentile	49.98	95% UTL with 90% Coverage	67.6
95% Percentile	58.65	95% Percentile Bootstrap UTL with 90% Coverage	68.36
99% Percentile	77.34	95% BCA Bootstrap UTL with 90% Coverage	67.6
		95% UPL	71.2
		95% Chebyshev UPL	101.8
95% WH Approx. Gamma UPL	59.86	Upper Threshold Limit Based upon IQR	51.98
95% HW Approx. Gamma UPL	60.58		
95% WH Approx. Gamma UTL with 90% Coverage	62.72		
95% HW Approx. Gamma UTL with 90% Coverage	63.65		

Copper: SWMU 59 Subsurface Soil, 2010 CMS Investigation

General Statistics

Total Number of Observations	23	Number of Distinct Observations	23
Tolerance Factor	1.869		

Raw Statistics

Minimum	5.1
Maximum	270
Second Largest	217
First Quartile	60.4
Median	77.6
Third Quartile	90.75
Mean	88.28
Geometric Mean	72.74
SD	55.92
Coefficient of Variation	0.633
Skewness	2.071

Log-Transformed Statistics

Minimum	1.629
Maximum	5.598
Second Largest	5.38
First Quartile	4.099
Median	4.352
Third Quartile	4.508
Mean	4.287
SD	0.732

Background Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.773
Shapiro Wilk Critical Value	0.914

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.789
Shapiro Wilk Critical Value	0.914

Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

95% UTL with 90% Coverage	192.8
95% UPL (t)	186.4
90% Percentile (z)	159.9
95% Percentile (z)	180.3
99% Percentile (z)	218.4

Assuming Lognormal Distribution

95% UTL with 90% Coverage	285.8
95% UPL (t)	262.7
90% Percentile (z)	185.9
95% Percentile (z)	242.5
99% Percentile (z)	399.4

Gamma Distribution Test

k star	2.41
Theta Star	36.63
MLE of Mean	88.28
MLE of Standard Deviation	56.87
nu star	110.9

A-D Test Statistic	1.171
5% A-D Critical Value	0.751
K-S Test Statistic	0.177
5% K-S Critical Value	0.183

Data follow Appx. Gamma Distribution at 5% Significance Level

Data Distribution Test

Data Follow Appr. Gamma Distribution at 5% Significance Level

Nonparametric Statistics

90% Percentile	123.8
95% Percentile	207.9
99% Percentile	258.3

Assuming Gamma Distribution

90% Percentile	164.4
95% Percentile	197.6
99% Percentile	270.5
95% WH Approx. Gamma UPL	201.1
95% HW Approx. Gamma UPL	209.2
95% WH Approx. Gamma UTL with 90% Coverage	212
95% HW Approx. Gamma UTL with 90% Coverage	221.6

95% UTL with 90% Coverage	217
95% Percentile Bootstrap UTL with 90% Coverage	241.2
95% BCA Bootstrap UTL with 90% Coverage	217
95% UPL	259.4
95% Chebyshev UPL	337.3
Upper Threshold Limit Based upon IQR	136.3

Copper: NAPR Basewide Background, Clay Subsurface Soil

General Statistics

Total Number of Observations	17	Number of Distinct Observations	17
Tolerance Factor	2.002		

Raw Statistics		Log-Transformed Statistics	
Minimum	18	Minimum	2.89
Maximum	260	Maximum	5.561
Second Largest	210	Second Largest	5.347
First Quartile	52.6	First Quartile	3.963
Median	89	Median	4.489
Third Quartile	144	Third Quartile	4.97
Mean	105	Mean	4.418
Geometric Mean	82.94	SD	0.742
SD	70.54		
Coefficient of Variation	0.672		
Skewness	0.809		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.917	Shapiro Wilk Test Statistic	0.969
Shapiro Wilk Critical Value	0.892	Shapiro Wilk Critical Value	0.892
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	246.2	95% UTL with 90% Coverage	366.1
95% UPL (t)	231.7	95% UPL (t)	314.4
90% Percentile (z)	195.4	90% Percentile (z)	214.6
95% Percentile (z)	221	95% Percentile (z)	280.9
99% Percentile (z)	269.1	99% Percentile (z)	465.7

Gamma Distribution Test		Data Distribution Test
k star	1.913	Data appear Normal at 5% Significance Level
Theta Star	54.88	
MLE of Mean	105	
MLE of Standard Deviation	75.9	
nu star	65.04	
A-D Test Statistic	0.255	
5% A-D Critical Value	0.748	
K-S Test Statistic	0.139	
5% K-S Critical Value	0.211	
Data appear Gamma Distributed at 5% Significance Level		

Nonparametric Statistics	
90% Percentile	204
95% Percentile	220
99% Percentile	252

Assuming Gamma Distribution			
90% Percentile	206.3	95% UTL with 90% Coverage	260
95% Percentile	252.5	95% Percentile Bootstrap UTL with 90% Coverage	260
99% Percentile	355.3	95% BCA Bootstrap UTL with 90% Coverage	260
		95% UPL	260
		95% Chebyshev UPL	421.3
95% WH Approx. Gamma UPL	264	Upper Threshold Limit Based upon IQR	281.1
95% HW Approx. Gamma UPL	272.7		
95% WH Approx. Gamma UTL with 90% Coverage	292.2		
95% HW Approx. Gamma UTL with 90% Coverage	304.6		

Nickel: SWMU 59 Subsurface Soil, 2010 CMS Investigation

General Statistics

Total Number of Observations	23	Number of Distinct Observations	22
Tolerance Factor	1.869		

Raw Statistics		Log-Transformed Statistics	
Minimum	6.3	Minimum	1.841
Maximum	47.3	Maximum	3.857
Second Largest	29.6	Second Largest	3.388
First Quartile	10.3	First Quartile	2.331
Median	14.9	Median	2.701
Third Quartile	21.15	Third Quartile	3.051
Mean	17.35	Mean	2.733
Geometric Mean	15.38	SD	0.495
SD	9.33		
Coefficient of Variation	0.538		
Skewness	1.613		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.868	Shapiro Wilk Test Statistic	0.982
Shapiro Wilk Critical Value	0.914	Shapiro Wilk Critical Value	0.914
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	34.79	95% UTL with 90% Coverage	38.81
95% UPL (t)	33.71	95% UPL (t)	36.66
90% Percentile (z)	29.31	90% Percentile (z)	29.01
95% Percentile (z)	32.69	95% Percentile (z)	34.73
99% Percentile (z)	39.05	99% Percentile (z)	48.67

Gamma Distribution Test		Data Distribution Test
k star	3.782	Data appear Gamma Distributed at 5% Significance Level
Theta Star	4.587	
MLE of Mean	17.35	
MLE of Standard Deviation	8.921	
nu star	174	
A-D Test Statistic	0.272	
5% A-D Critical Value	0.748	
K-S Test Statistic	0.0809	
5% K-S Critical Value	0.182	
Data appear Gamma Distributed at 5% Significance Level		

Nonparametric Statistics	
90% Percentile	27.9
95% Percentile	29.43
99% Percentile	43.41

Assuming Gamma Distribution			
90% Percentile	29.31	95% UTL with 90% Coverage	29.6
95% Percentile	34.13	95% Percentile Bootstrap UTL with 90% Coverage	43.42
99% Percentile	44.47	95% BCA Bootstrap UTL with 90% Coverage	29.6
		95% UPL	43.76
		95% Chebyshev UPL	58.89
95% WH Approx. Gamma UPL	34.79	Upper Threshold Limit Based upon IQR	37.43
95% HW Approx. Gamma UPL	35.14		
95% WH Approx. Gamma UTL with 90% Coverage	36.37		
95% HW Approx. Gamma UTL with 90% Coverage	36.83		

Nickel: NAPR Basewide Background, Clay Subsurface Soil

General Statistics

Total Number of Observations	18	Number of Distinct Observations	17
Tolerance Factor	1.974	Number of Missing Values	1

Raw Statistics		Log-Transformed Statistics	
Minimum	1.1	Minimum	0.0953
Maximum	35.6	Maximum	3.572
Second Largest	17	Second Largest	2.833
First Quartile	2.25	First Quartile	0.81
Median	5.85	Median	1.766
Third Quartile	9.45	Third Quartile	2.235
Mean	7.889	Mean	1.654
Geometric Mean	5.23	SD	0.921
SD	8.387		
Coefficient of Variation	1.063		
Skewness	2.389		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.728	Shapiro Wilk Test Statistic	0.974
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	24.44	95% UTL with 90% Coverage	32.2
95% UPL (t)	22.88	95% UPL (t)	27.11
90% Percentile (z)	18.64	90% Percentile (z)	17.02
95% Percentile (z)	21.68	95% Percentile (z)	23.78
99% Percentile (z)	27.4	99% Percentile (z)	44.53

Gamma Distribution Test		Data Distribution Test
k star	1.17	Data appear Gamma Distributed at 5% Significance Level
Theta Star	6.744	
MLE of Mean	7.889	
MLE of Standard Deviation	7.294	
nu star	42.11	
A-D Test Statistic	0.444	
5% A-D Critical Value	0.759	
K-S Test Statistic	0.148	
5% K-S Critical Value	0.208	
Data appear Gamma Distributed at 5% Significance Level		

Nonparametric Statistics	
90% Percentile	16.65
95% Percentile	19.79
99% Percentile	32.44

Assuming Gamma Distribution			
90% Percentile	17.48	95% UTL with 90% Coverage	35.6
95% Percentile	22.37	95% Percentile Bootstrap UTL with 90% Coverage	35.6
99% Percentile	33.61	95% BCA Bootstrap UTL with 90% Coverage	35.6
		95% UPL	35.6
		95% Chebyshev UPL	45.45
95% WH Approx. Gamma UPL	23.27	Upper Threshold Limit Based upon IQR	20.25
95% HW Approx. Gamma UPL	23.81		
95% WH Approx. Gamma UTL with 90% Coverage	26.03		
95% HW Approx. Gamma UTL with 90% Coverage	26.92		

Vanadium: SWMU 59 Subsurface Soil, 2010 CMS Investigation

General Statistics

Total Number of Observations	23	Number of Distinct Observations	23
Tolerance Factor	1.869		

Raw Statistics

Minimum	43.5
Maximum	282
Second Largest	236
First Quartile	86.15
Median	136
Third Quartile	166
Mean	134.1
Geometric Mean	120.3
SD	61.21
Coefficient of Variation	0.456
Skewness	0.592

Log-Transformed Statistics

Minimum	3.773
Maximum	5.642
Second Largest	5.464
First Quartile	4.456
Median	4.913
Third Quartile	5.112
Mean	4.79
SD	0.494

Background Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.964
Shapiro Wilk Critical Value	0.914

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.969
Shapiro Wilk Critical Value	0.914

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% UTL with 90% Coverage	248.5
95% UPL (t)	241.4
90% Percentile (z)	212.5
95% Percentile (z)	234.8
99% Percentile (z)	276.5

Assuming Lognormal Distribution

95% UTL with 90% Coverage	303.1
95% UPL (t)	286.3
90% Percentile (z)	226.7
95% Percentile (z)	271.3
99% Percentile (z)	380

Gamma Distribution Test

k star	4.177
Theta Star	32.1
MLE of Mean	134.1
MLE of Standard Deviation	65.6
nu star	192.1
A-D Test Statistic	0.183
5% A-D Critical Value	0.747
K-S Test Statistic	0.11
5% K-S Critical Value	0.182

Data appear Gamma Distributed at 5% Significance Level

Data Distribution Test

Data appear Normal at 5% Significance Level

Nonparametric Statistics

90% Percentile	209.2
95% Percentile	233.8
99% Percentile	271.9
95% UTL with 90% Coverage	236
95% Percentile Bootstrap UTL with 90% Coverage	268.4
95% BCA Bootstrap UTL with 90% Coverage	268.4
95% UPL	272.8
95% Chebyshev UPL	406.6
Upper Threshold Limit Based upon IQR	285.8

Assuming Gamma Distribution

90% Percentile	222
95% Percentile	257
99% Percentile	331.5
95% WH Approx. Gamma UPL	262.2
95% HW Approx. Gamma UPL	266.9
95% WH Approx. Gamma UTL with 90% Coverage	273.7
95% HW Approx. Gamma UTL with 90% Coverage	279.4

Vanadium: NAPR Basewide Background, Clay Subsurface Soil

General Statistics

Total Number of Observations	19	Number of Distinct Observations	17
Tolerance Factor	1.949		

Raw Statistics

Minimum	25
Maximum	410
Second Largest	410
First Quartile	120
Median	200
Third Quartile	258
Mean	208.6
Geometric Mean	175.5
SD	112.7
Coefficient of Variation	0.541
Skewness	0.548

Log-Transformed Statistics

Minimum	3.219
Maximum	6.016
Second Largest	6.016
First Quartile	4.787
Median	5.298
Third Quartile	5.553
Mean	5.168
SD	0.67

Background Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.932
Shapiro Wilk Critical Value	0.901

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.903
Shapiro Wilk Critical Value	0.901

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% UTL with 90% Coverage	428.3
95% UPL (t)	409.2
90% Percentile (z)	353.1
95% Percentile (z)	394
99% Percentile (z)	470.9

Assuming Lognormal Distribution

95% UTL with 90% Coverage	648.3
95% UPL (t)	578.5
90% Percentile (z)	414.5
95% Percentile (z)	528.7
99% Percentile (z)	835

Gamma Distribution Test

k star	2.608
Theta Star	79.97
MLE of Mean	208.6
MLE of Standard Deviation	129.1
nu star	99.12

A-D Test Statistic	0.287
5% A-D Critical Value	0.748
K-S Test Statistic	0.104
5% K-S Critical Value	0.2

Data appear Gamma Distributed at 5% Significance Level

Data Distribution Test

Data appear Normal at 5% Significance Level

Nonparametric Statistics

90% Percentile	380.4
95% Percentile	410
99% Percentile	410

Assuming Gamma Distribution

90% Percentile	381.6
95% Percentile	456
99% Percentile	618.4
95% WH Approx. Gamma UPL	470.5
95% HW Approx. Gamma UPL	488
95% WH Approx. Gamma UTL with 90% Coverage	507
95% HW Approx. Gamma UTL with 90% Coverage	529.5

95% UTL with 90% Coverage	410
95% Percentile Bootstrap UTL with 90% Coverage	410
95% BCA Bootstrap UTL with 90% Coverage	410
95% UPL	410
95% Chebyshev UPL	712.8
Upper Threshold Limit Based upon IQR	465

Zinc: SWMU 59 Subsurface Soil, 2010 CMS Investigation

General Statistics

Total Number of Observations	23	Number of Distinct Observations	23
Tolerance Factor	1.869		

Raw Statistics		Log-Transformed Statistics	
Minimum	39.3	Minimum	3.671
Maximum	242	Maximum	5.489
Second Largest	160	Second Largest	5.075
First Quartile	65	First Quartile	4.174
Median	75.3	Median	4.321
Third Quartile	91.7	Third Quartile	4.518
Mean	87.82	Mean	4.375
Geometric Mean	79.42	SD	0.436
SD	46.06		
Coefficient of Variation	0.524		
Skewness	2.025		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.787	Shapiro Wilk Test Statistic	0.938
Shapiro Wilk Critical Value	0.914	Shapiro Wilk Critical Value	0.914
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	173.9	95% UTL with 90% Coverage	179.5
95% UPL (t)	168.6	95% UPL (t)	170.7
90% Percentile (z)	146.8	90% Percentile (z)	138.9
95% Percentile (z)	163.6	95% Percentile (z)	162.8
99% Percentile (z)	195	99% Percentile (z)	219.2

Gamma Distribution Test		Data Distribution Test
k star	4.497	Data appear Lognormal at 5% Significance Level
Theta Star	19.53	
MLE of Mean	87.82	
MLE of Standard Deviation	41.41	
nu star	206.8	
A-D Test Statistic	0.927	
5% A-D Critical Value	0.746	
K-S Test Statistic	0.235	
5% K-S Critical Value	0.182	
Data not Gamma Distributed at 5% Significance Level		

Nonparametric Statistics	
90% Percentile	144.8
95% Percentile	158.8
99% Percentile	224

Assuming Gamma Distribution			
90% Percentile	143.3	95% UTL with 90% Coverage	160
95% Percentile	165.1	95% Percentile Bootstrap UTL with 90% Coverage	225.6
99% Percentile	211.5	95% BCA Bootstrap UTL with 90% Coverage	223.2
		95% UPL	225.6
		95% Chebyshev UPL	292.9
95% WH Approx. Gamma UPL	167.7	Upper Threshold Limit Based upon IQR	131.8
95% HW Approx. Gamma UPL	168.1		
95% WH Approx. Gamma UTL with 90% Coverage	174.8		
95% HW Approx. Gamma UTL with 90% Coverage	175.6		

Gehan Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Beryllium, SWMU 59

Background Data: BerylliumBG

Raw Statistics

	Site	Background
Number of Valid Data	23	18
Number of Non-Detect Data	8	0
Number of Detect Data	15	18
Minimum Non-Detect	2.6	N/A
Maximum Non-Detect	3.5	N/A
Percent Non detects	34.78%	0.00%
Minimum Detected	0.091	0.052
Maximum Detected	0.96	0.7
Mean of Detected Data	0.386	0.259
Median of Detected Data	0.34	0.255
SD of Detected Data	0.212	0.169

Site vs Background Gehan Test

H0: Mean/Median of Site or AOC <= Mean/Median of background

Gehan z Test Value	2.074
Critical z (0.95)	1.645
P-Value	0.019

Conclusion with Alpha = 0.05

Reject H0, Conclude Site > Background

P-Value < alpha (0.05)

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Chromium, SWMU 59

Background Data: ChromiumBG

Raw Statistics

	Site	Background
Number of Valid Data	23	18
Number of Non-Detect Data	0	0
Number of Detect Data	23	18
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	8	3.9
Maximum Detected	79.3	148
Mean of Detected Data	35.36	37.31
Median of Detected Data	32.1	21.5
SD of Detected Data	19.32	38.59

Wilcoxon-Mann-Whitney Site vs Background Test

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	512
WMW Test U-Stat	0.749
WMW Critical Value (0.050)	1.645
P-Value	0.227

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Site <= Background

P-Value >= alpha (0.05)

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Cobalt, SWMU 59

Background Data: CobaltBG

Raw Statistics

	Site	Background
Number of Valid Data	23	18
Number of Non-Detect Data	0	1
Number of Detect Data	23	17
Minimum Non-Detect	N/A	1.2
Maximum Non-Detect	N/A	1.2
Percent Non detects	0.00%	5.56%
Minimum Detected	9.6	0.83
Maximum Detected	72.1	33.8
Mean of Detected Data	28.88	9.619
Median of Detected Data	26.9	6.5
SD of Detected Data	16.37	8.907

Wilcoxon-Mann-Whitney Site vs Background Test

All observations <= 1.2 (Max DL) are ranked the same

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	648
WMW Test U-Stat	4.321
WMW Critical Value (0.050)	1.645
P-Value	7.75E-06

Conclusion with Alpha = 0.05

Reject H0, Conclude Site > Background

P-Value < alpha (0.05)

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Copper, SWMU 59

Background Data: CopperBG

Raw Statistics

	Site	Background
Number of Valid Data	23	17
Number of Non-Detect Data	0	0
Number of Detect Data	23	17
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	5.1	18
Maximum Detected	270	260
Mean of Detected Data	88.28	105
Median of Detected Data	77.6	89
SD of Detected Data	55.92	70.54

Wilcoxon-Mann-Whitney Site vs Background Test

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	459
WMW Test U-Stat	-0.356
WMW Critical Value (0.050)	1.645
P-Value	0.639

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Site <= Background

P-Value >= alpha (0.05)

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects

User Selected Options

From File	K:_SOUTHNAVFAC\129344 JM15\SWMU 59\Data\Working Files\Stats\Subsurface Soil\59 SB Data ProUCL.xls
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Nickel, SWMU 59

Background Data: NickelBG

Raw Statistics

	Site	Background
Number of Valid Data	23	18
Number of Non-Detect Data	0	0
Number of Detect Data	23	18
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	6.3	1.1
Maximum Detected	47.3	35.6
Mean of Detected Data	17.35	7.889
Median of Detected Data	14.9	5.85
SD of Detected Data	9.33	8.387

Wilcoxon-Mann-Whitney Site vs Background Test

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	625.5
WMW Test U-Stat	3.73
WMW Critical Value (0.050)	1.645
P-Value	9.559E-05

Conclusion with Alpha = 0.05

Reject H0, Conclude Site > Background

P-Value < alpha (0.05)

t-Test Site vs Background Comparison for Full Data Sets without NDs

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Vanadium, SWMU 59

Background Data: VanadiumBG

Raw Statistics

	Site	Background
Number of Valid Observations	23	19
Number of Distinct Observations	23	17
Minimum	43.5	25
Maximum	282	410
Mean	134.1	208.6
Median	136	200
SD	61.21	112.7
SE of Mean	12.76	25.87

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

Method	DF	t-Test Value	Critical t (0.050)	P-Value
Pooled (Equal Variance)	40	-2.724	1.684	0.995
Welch-Satterthwaite (Unequal Varian	26.5	-2.583	1.703	0.992

Pooled SD 88.206

Conclusion with Alpha = 0.050

* Student t (Pooled) Test: Do Not Reject H0, Conclude Site <= Background
* Welch-Satterthwaite Test: Do Not Reject H0, Conclude Site <= Background

Test of Equality of Variances

Variance of Site	3746
Variance of Background	12711

Numerator DF	Denominator DF	F-Test Value	P-Value
18	22	3.393	0.008

Conclusion with Alpha = 0.05

* Two variances are not equal

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Zinc, SWMU 59

Background Data: ZincBG

Raw Statistics

	Site	Background
Number of Valid Data	23	19
Number of Non-Detect Data	0	1
Number of Detect Data	23	18
Minimum Non-Detect	N/A	27
Maximum Non-Detect	N/A	27
Percent Non detects	0.00%	5.26%
Minimum Detected	39.3	3.9
Maximum Detected	242	98
Mean of Detected Data	87.82	38.68
Median of Detected Data	75.3	32.9
SD of Detected Data	46.06	25.41

Wilcoxon-Mann-Whitney Site vs Background Test

All observations <= 27 (Max DL) are ranked the same

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	659
WMW Test U-Stat	4.144
WMW Critical Value (0.050)	1.645
P-Value	1.704E-05

Conclusion with Alpha = 0.05

Reject H0, Conclude Site > Background

P-Value < alpha (0.05)

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Chromium, SWMU 59

Background Data: ChromiumBG

Raw Statistics

	Site	Background
Number of Valid Data	23	18
Number of Non-Detect Data	0	0
Number of Detect Data	23	18
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	8	3.9
Maximum Detected	79.3	148
Mean of Detected Data	35.36	37.31
Median of Detected Data	32.1	21.5
SD of Detected Data	19.32	38.59

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.043)	5
Approximate K Value (0.043)	5
Number of Site Observations in 'R' Largest	1
Calculated Alpha	0.0449

Conclusion with Alpha = 0.043

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Cobalt, SWMU 59

Background Data: CobaltBG

Raw Statistics

	Site	Background
Number of Valid Data	23	18
Number of Non-Detect Data	0	1
Number of Detect Data	23	17
Minimum Non-Detect	N/A	1.2
Maximum Non-Detect	N/A	1.2
Percent Non detects	0.00%	5.56%
Minimum Detected	9.6	0.83
Maximum Detected	72.1	33.8
Mean of Detected Data	28.88	9.619
Median of Detected Data	26.9	6.5
SD of Detected Data	16.37	8.907

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.043)	5
Approximate K Value (0.043)	5
Number of Site Observations in 'R' Largest	4
Calculated Alpha	0.0449

Conclusion with Alpha = 0.043

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Copper, SWMU 59

Background Data: CopperBG

Raw Statistics

	Site	Background
Number of Valid Data	23	17
Number of Non-Detect Data	0	0
Number of Detect Data	23	17
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	5.1	18
Maximum Detected	270	260
Mean of Detected Data	88.28	105
Median of Detected Data	77.6	89
SD of Detected Data	55.92	70.54

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.046)	6
Approximate K Value (0.046)	6
Number of Site Observations in 'R' Largest	2
Calculated Alpha	0.0263

Conclusion with Alpha = 0.046

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	K:_SOUTHNAVFAC\129344 JM15\SWMU 59\Data\Working Files\Stats\Subsurface Soil\59 SB Data ProUCL.xls
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Nickel, SWMU 59

Background Data: NickelBG

Raw Statistics

	Site	Background
Number of Valid Data	23	18
Number of Non-Detect Data	0	0
Number of Detect Data	23	18
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	6.3	1.1
Maximum Detected	47.3	35.6
Mean of Detected Data	17.35	7.889
Median of Detected Data	14.9	5.85
SD of Detected Data	9.33	8.387

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.043)	5
Approximate K Value (0.043)	5
Number of Site Observations in 'R' Largest	4
Calculated Alpha	0.0449

Conclusion with Alpha = 0.043

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	K:_SOUTHNAVFAC\129344 JM15\SWMU 59\Data\Working Files\Stats\Subsurface Soil\59 SB Data ProUCL.xls.
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Tin, SWMU 59

Background Data: TinBG

Raw Statistics

	Site	Background
Number of Valid Data	23	19
Number of Non-Detect Data	12	6
Number of Detect Data	11	13
Minimum Non-Detect	5.1	0.78
Maximum Non-Detect	6.5	1.9
Percent Non detects	52.17%	31.58%
Minimum Detected	1.9	1.5
Maximum Detected	26	3.1
Mean of Detected Data	4.6	2.346
Median of Detected Data	2.6	2.4
SD of Detected Data	7.104	0.443

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.043)	5
Approximate K Value (0.043)	5
Number of Site Observations in 'R' Largest	5

Non-Detect Values in the 'R' Largest - Cannot complete Quantile Test

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Vanadium, SWMU 59

Background Data: VanadiumBG

Raw Statistics

	Site	Background
Number of Valid Data	23	19
Number of Non-Detect Data	0	0
Number of Detect Data	23	19
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	43.5	25
Maximum Detected	282	410
Mean of Detected Data	134.1	208.6
Median of Detected Data	136	200
SD of Detected Data	61.21	112.7

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.043)	5
Approximate K Value (0.043)	5
Number of Site Observations in 'R' Largest	1
Calculated Alpha	0.0396

Conclusion with Alpha = 0.043

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Zinc, SWMU 59

Background Data: ZincBG

Raw Statistics

	Site	Background
Number of Valid Data	23	19
Number of Non-Detect Data	0	1
Number of Detect Data	23	18
Minimum Non-Detect	N/A	27
Maximum Non-Detect	N/A	27
Percent Non detects	0.00%	5.26%
Minimum Detected	39.3	3.9
Maximum Detected	242	98
Mean of Detected Data	87.82	38.68
Median of Detected Data	75.3	32.9
SD of Detected Data	46.06	25.41

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

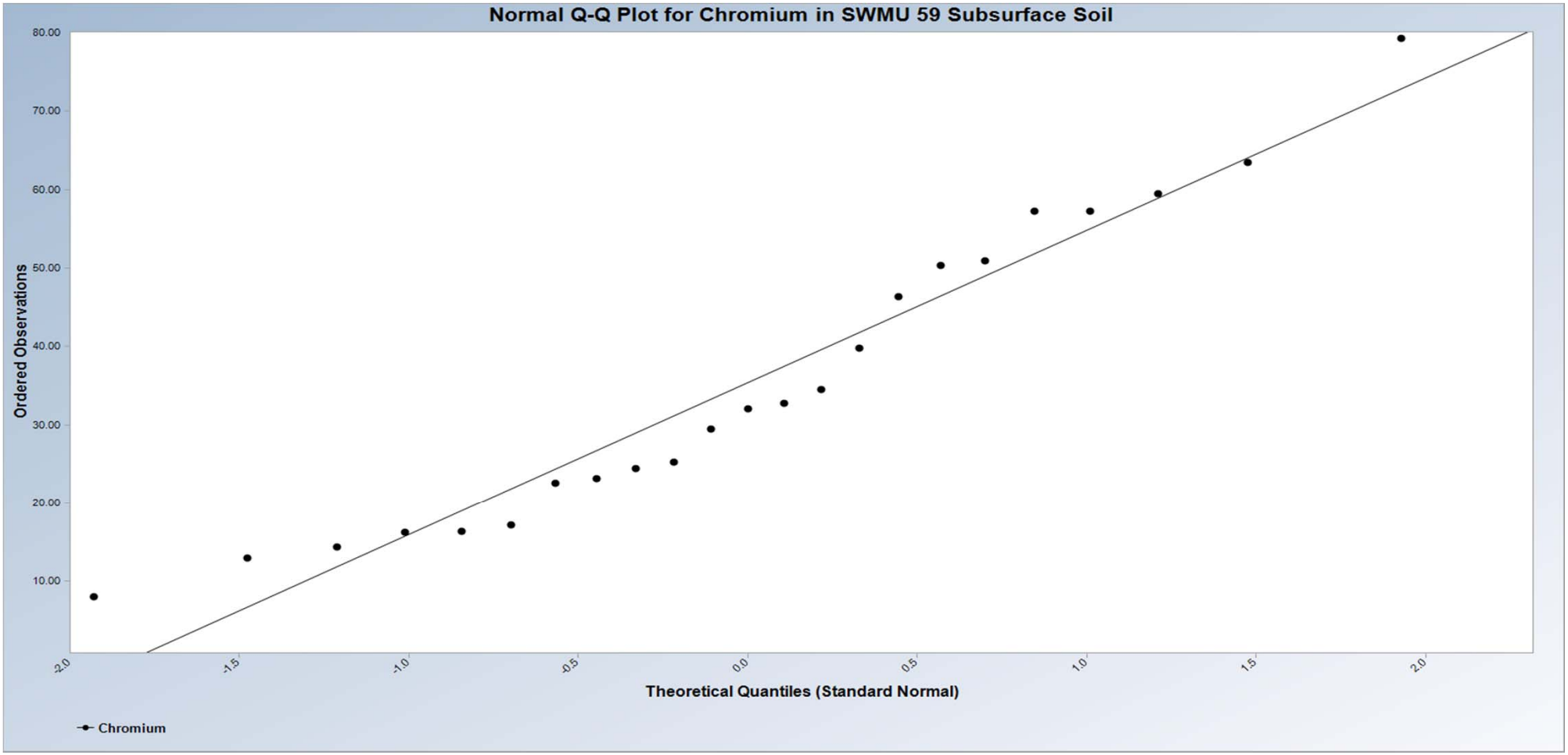
Approximate R Value (0.043)	5
Approximate K Value (0.043)	5
Number of Site Observations in 'R' Largest	5
Calculated Alpha	0.0396

Conclusion with Alpha = 0.043

Reject H0, Conclude Site Concentration > Background Concentration

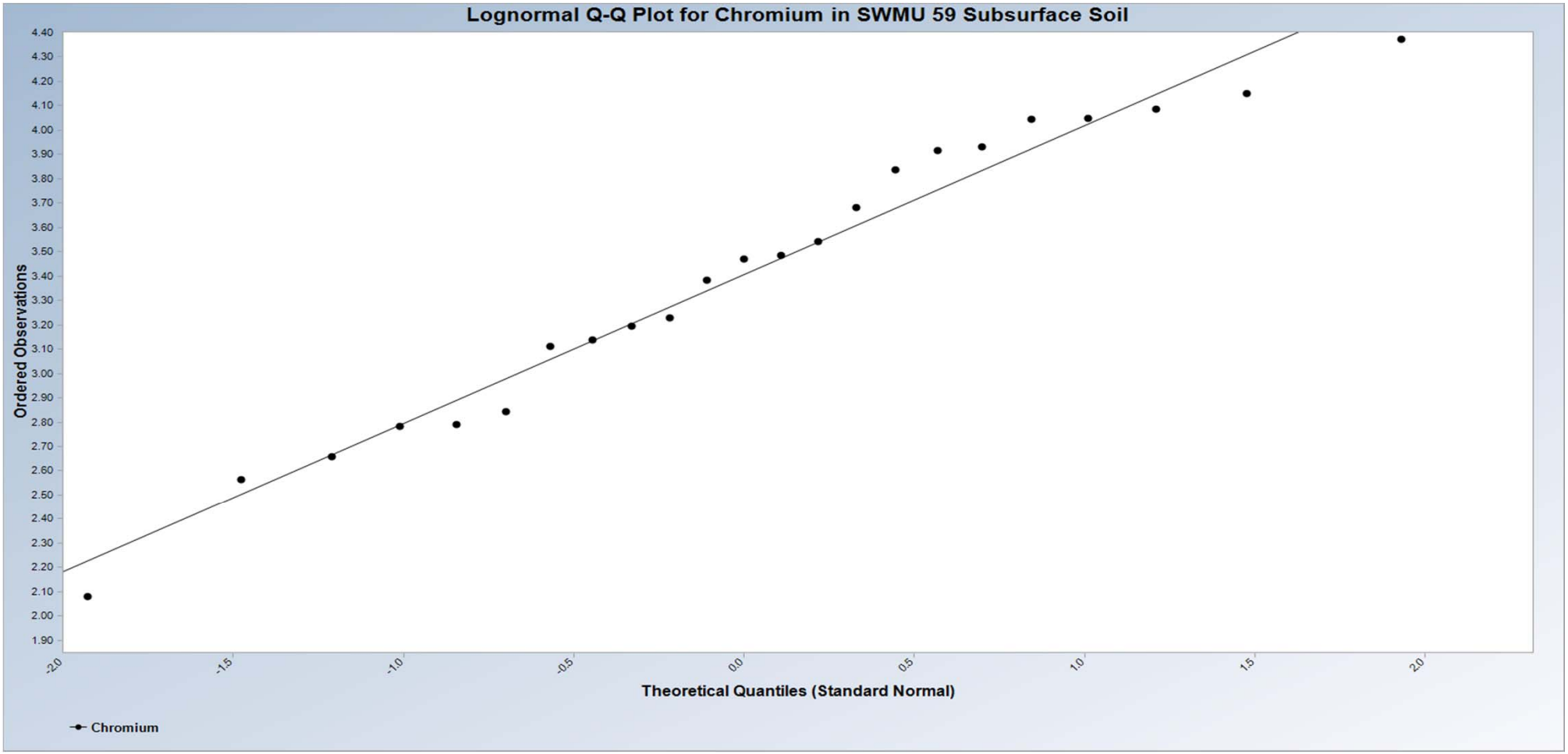
APPENDIX J

PROBABILITY PLOT - CHROMIUM IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



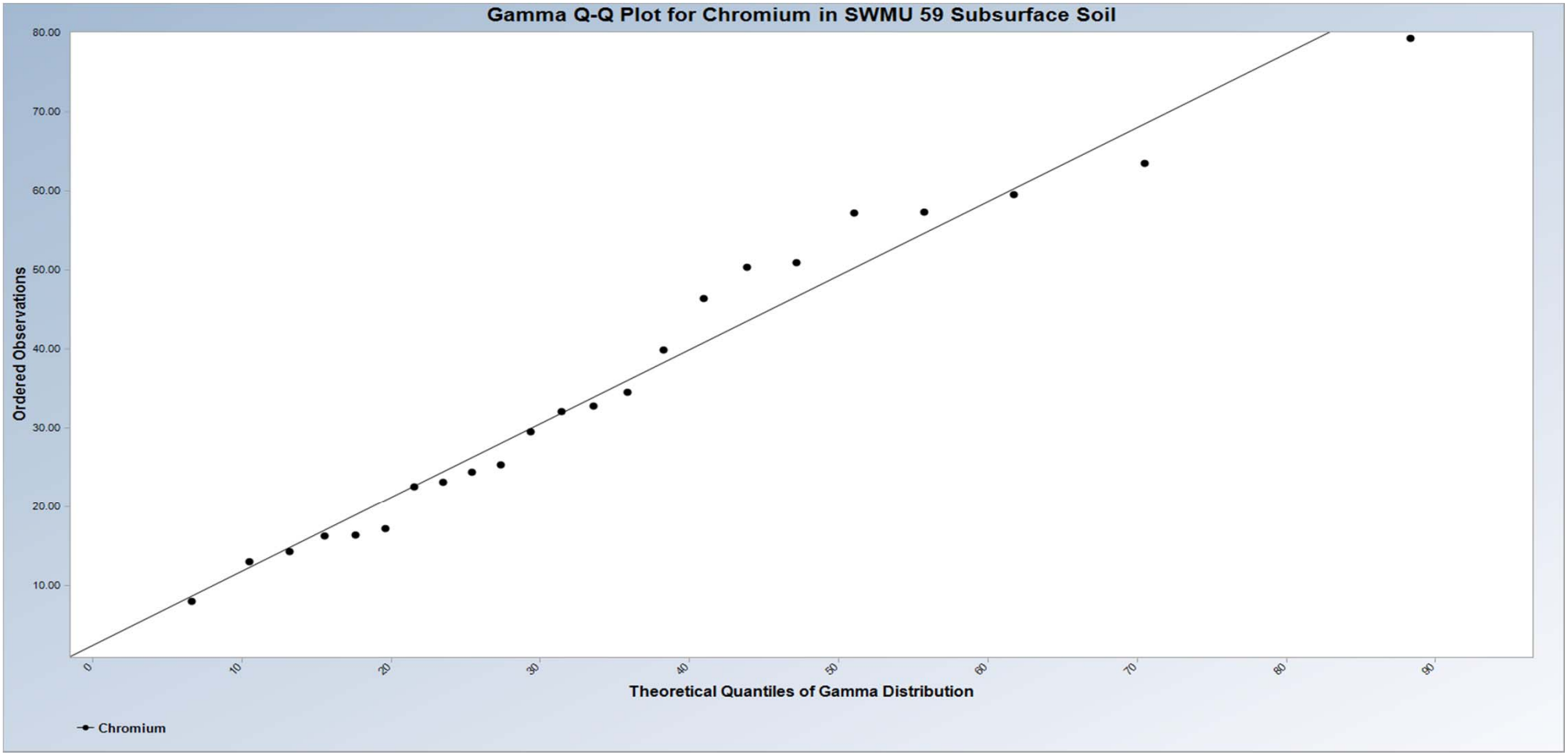
APPENDIX J

PROBABILITY PLOT - CHROMIUM IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



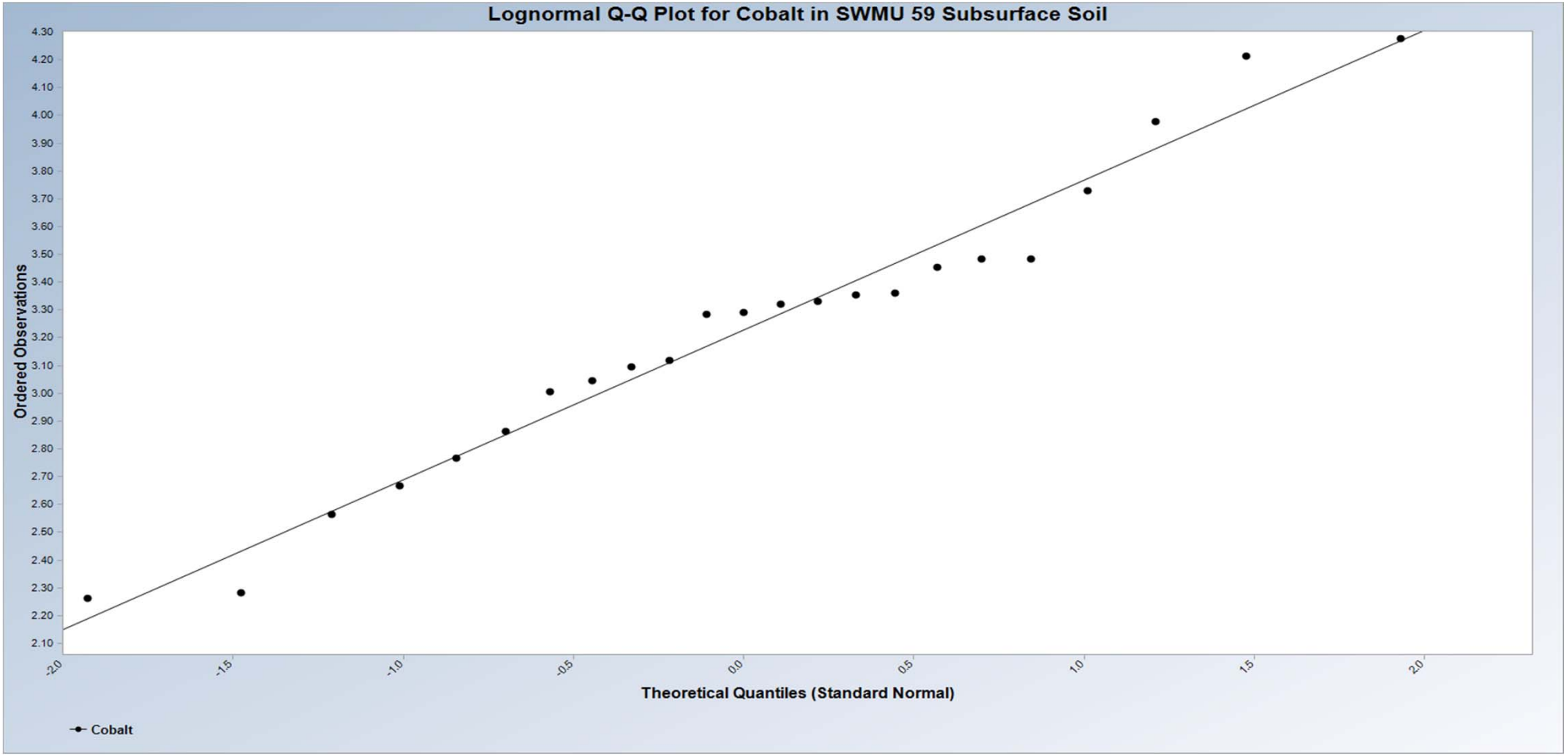
APPENDIX J

PROBABILITY PLOT - CHROMIUM IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



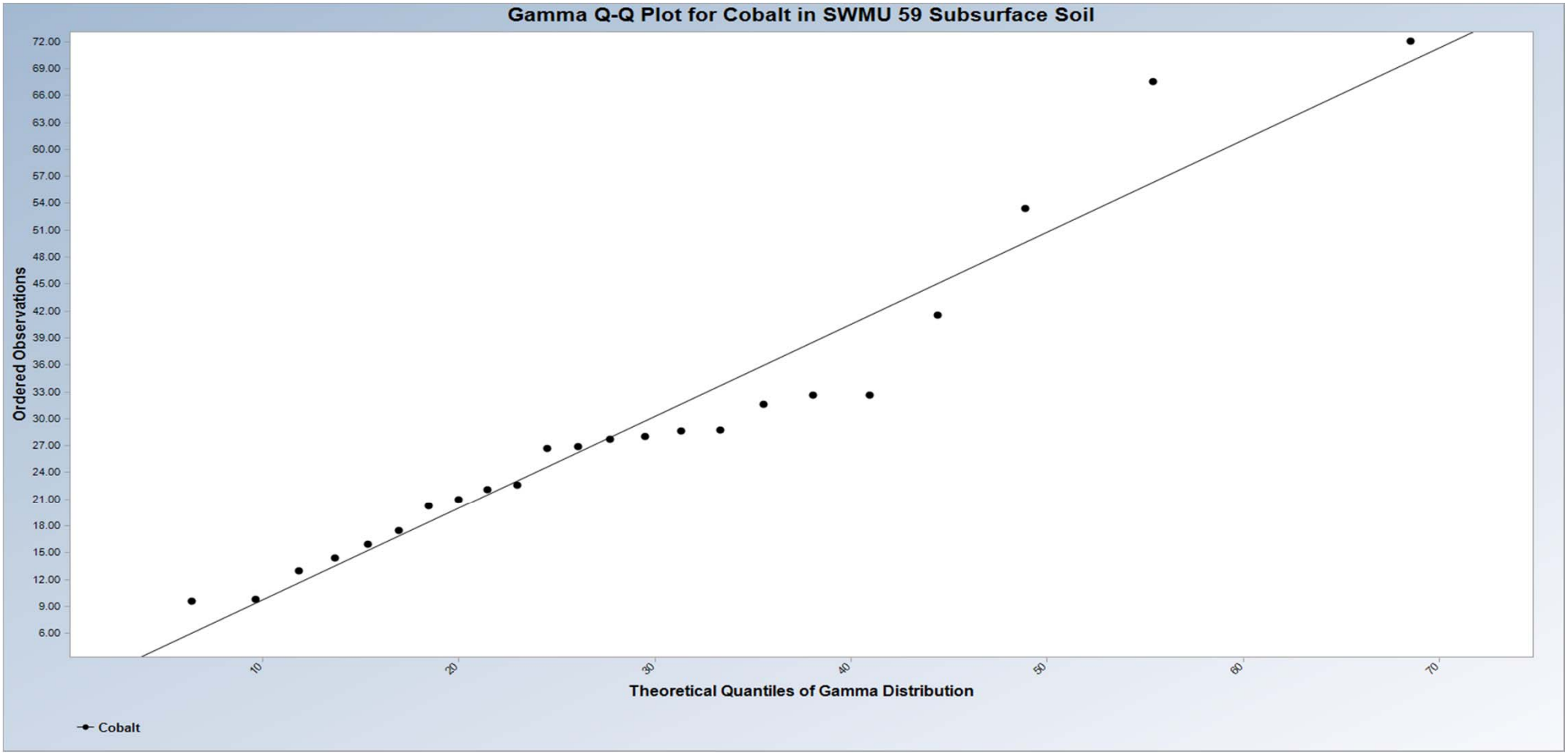
APPENDIX J

PROBABILITY PLOT - COBALT IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



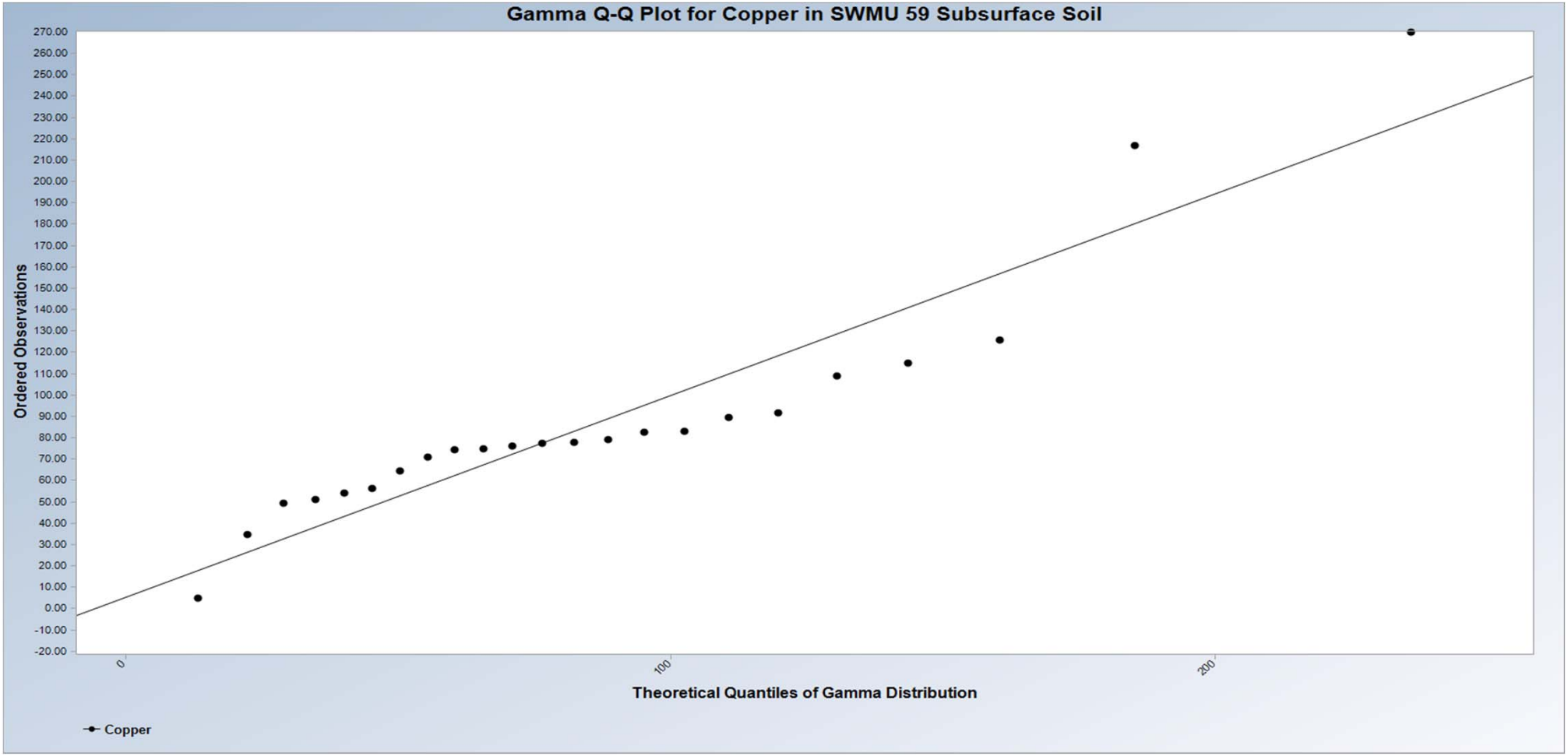
APPENDIX J

PROBABILITY PLOT - COBALT IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



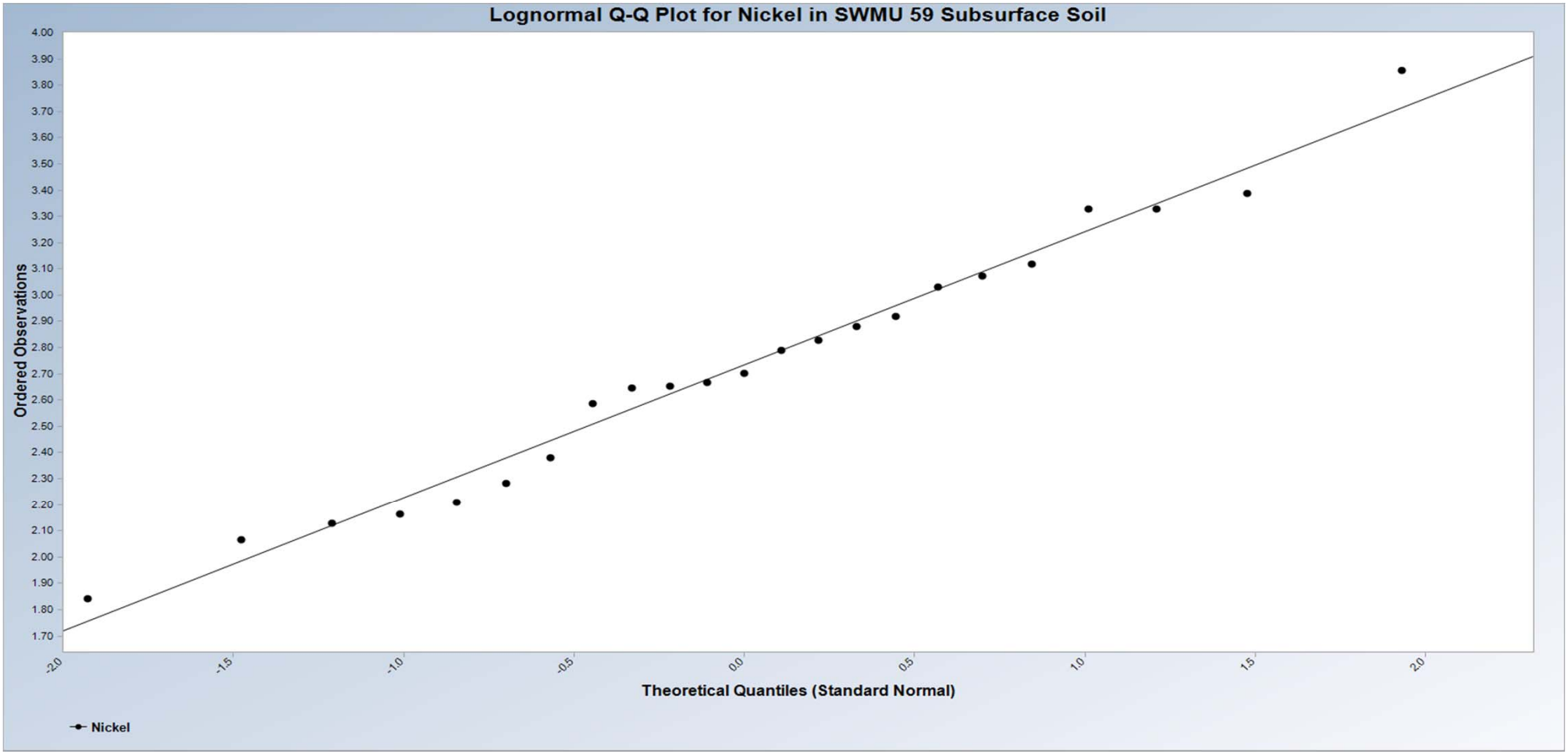
APPENDIX J

PROBABILITY PLOT - COPPER IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



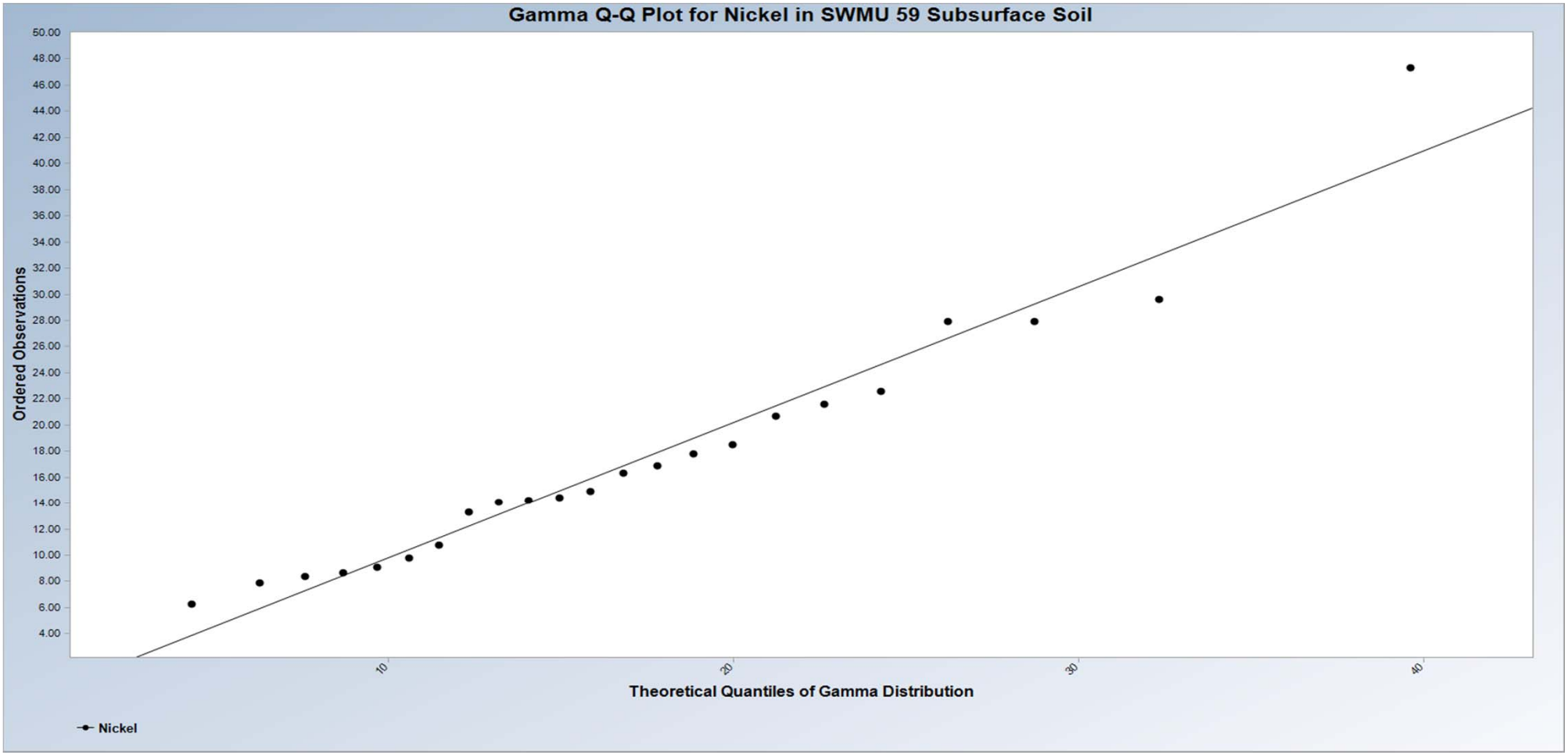
APPENDIX J

PROBABILITY PLOT - NICKEL IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



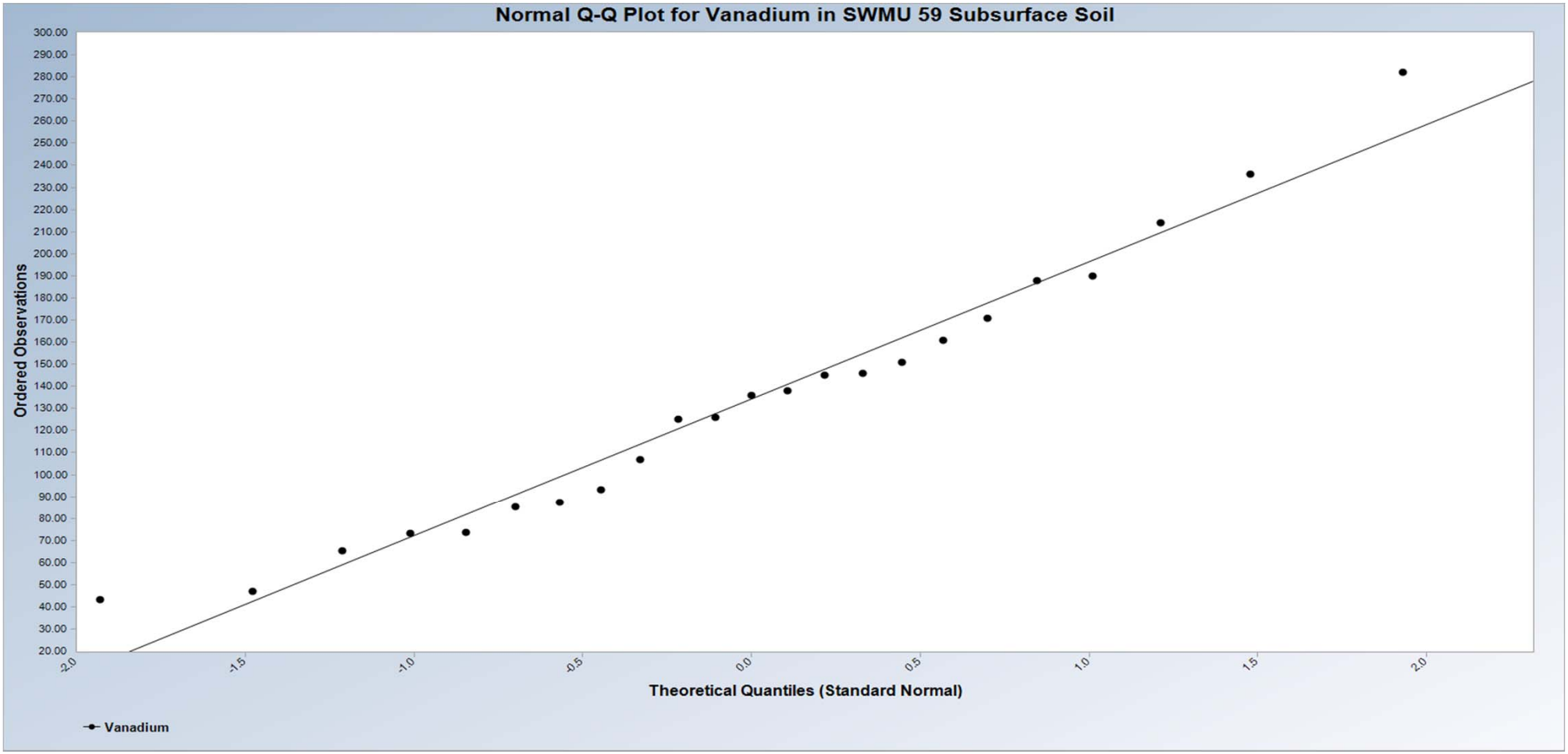
APPENDIX J

PROBABILITY PLOT - NICKEL IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



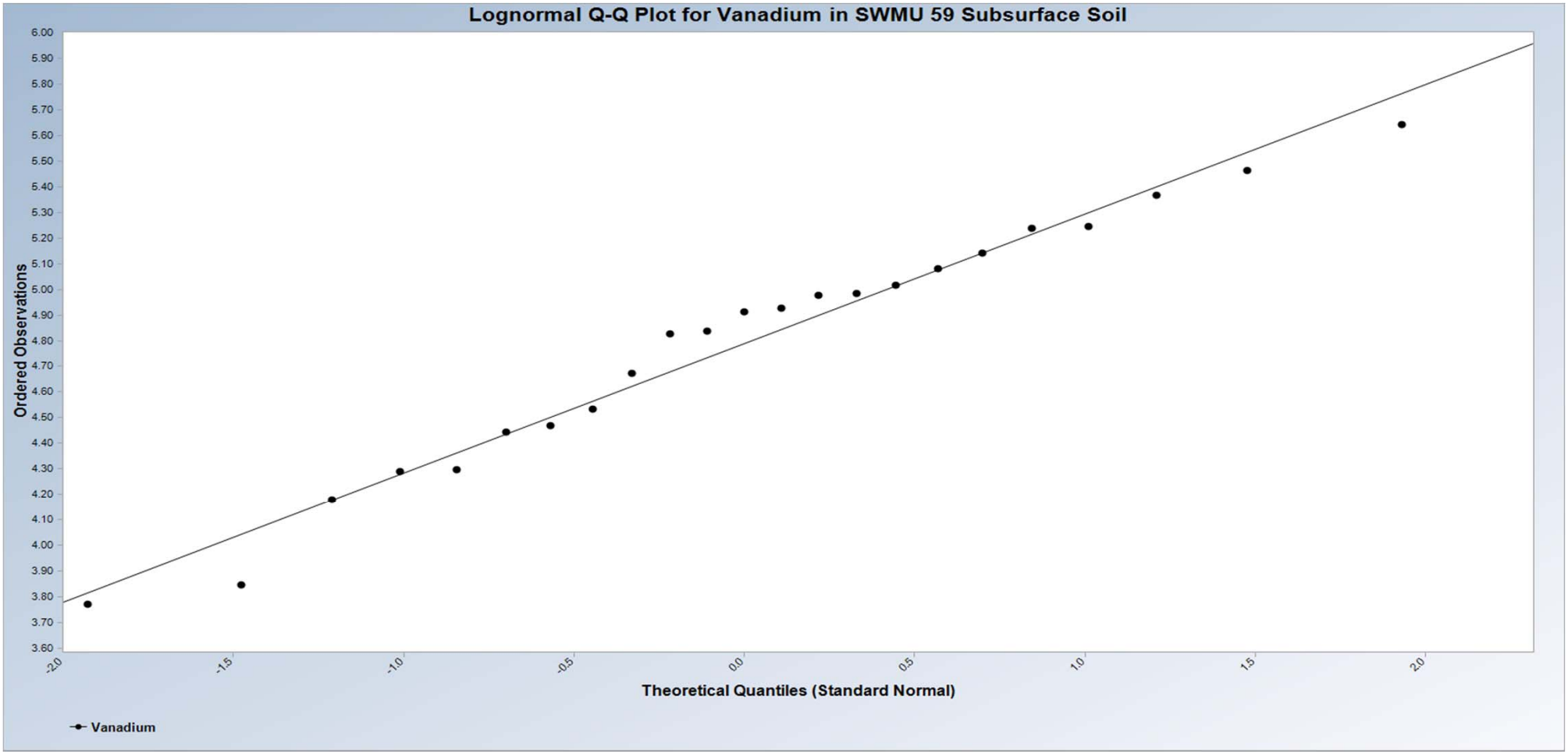
APPENDIX J

PROBABILITY PLOT - VANADIUM IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



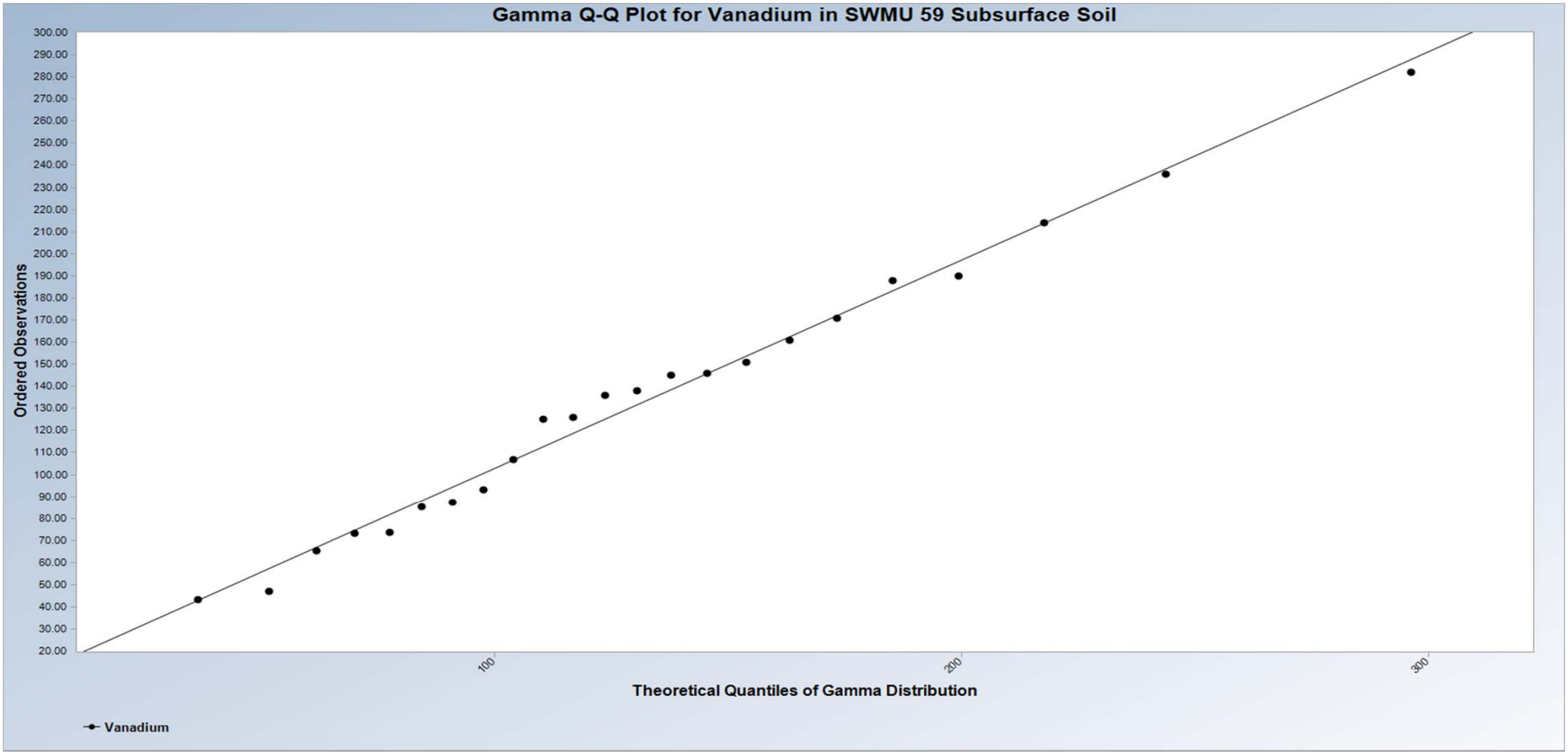
APPENDIX J

PROBABILITY PLOT - VANADIUM IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



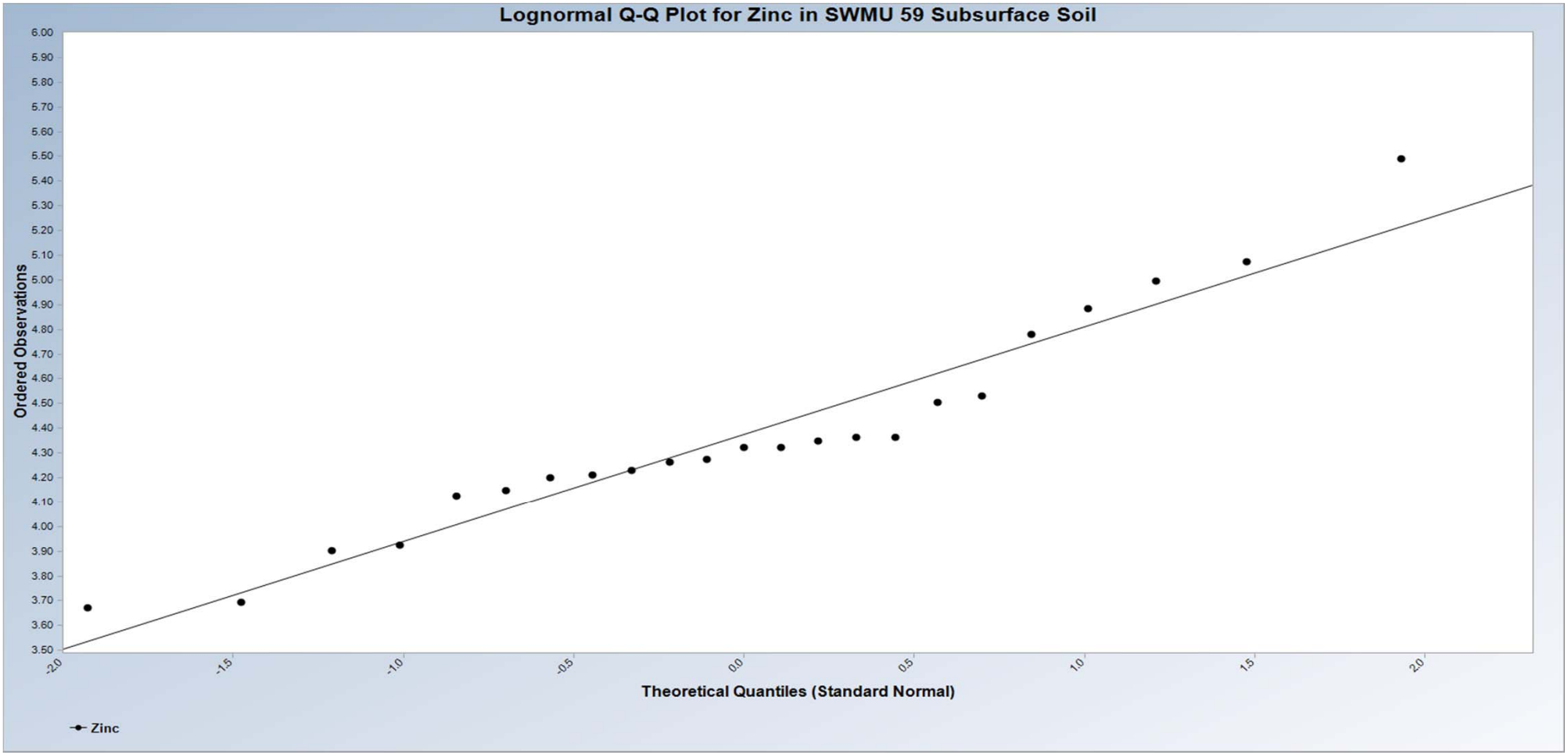
APPENDIX J

PROBABILITY PLOT - VANADIUM IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



APPENDIX J

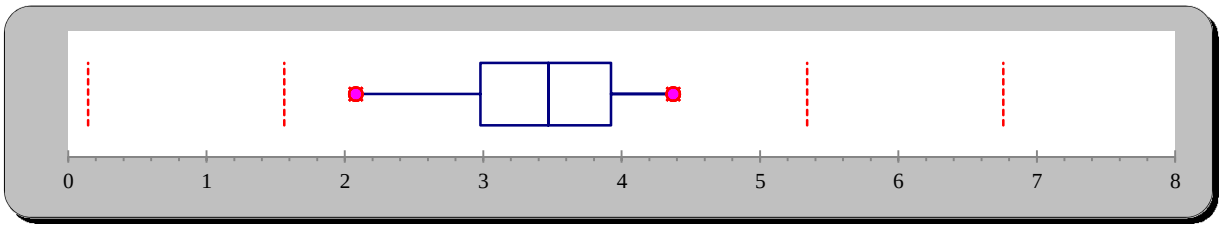
PROBABILITY PLOT - ZINC IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



Box and Whisker Plot

Chromium: SWMU 59 Subsurface Soil, 2010 CMS Investigation
(Log-Transformed Analytical Data)

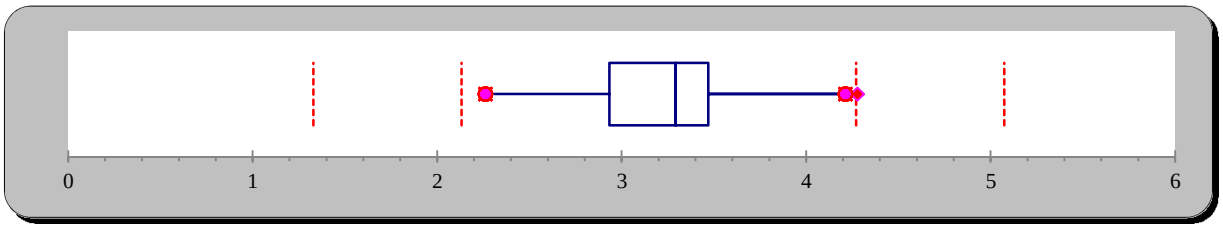
Lower Whisker	Lower Hinge	Median	Upper Hinge	Upper Whisker
2.0794415	2.9792123	3.468856	3.923934	4.3732381



Box and Whisker Plot

Cobalt: SWMU 59 Subsurface Soil, 2010 CMS Investigation
(Log-Transformed Analytical Data)

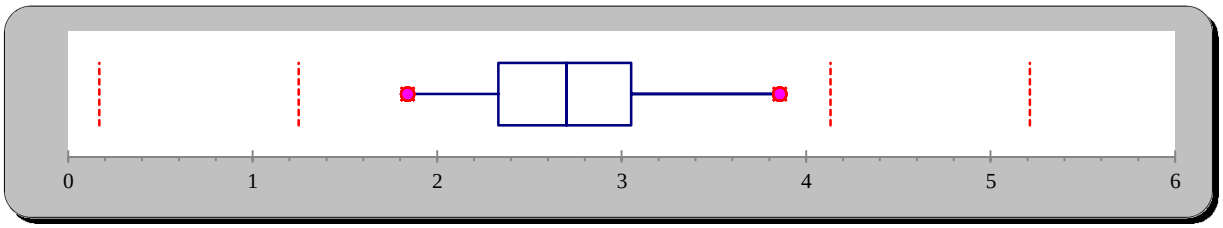
Lower Whisker	Lower Hinge	Median	Upper Hinge	Upper Whisker
2.2617631	2.9339417	3.2921263	3.4687347	4.213608



Box and Whisker Plot

Nickel: SWMU 59 Subsurface Soil, 2010 CMS Investgation
(Log-Transformed Analytical Data)

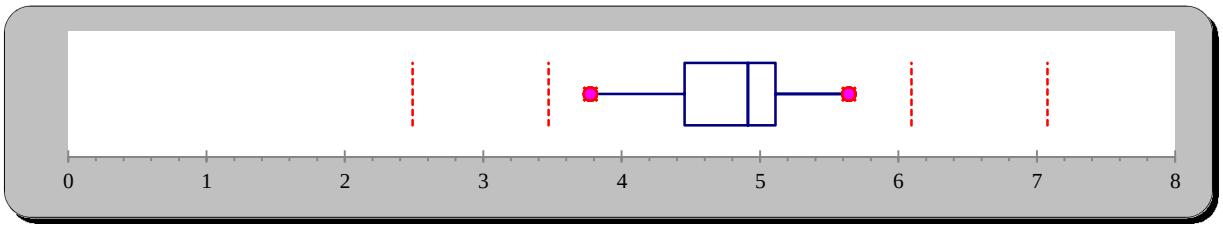
Lower Whisker	Lower Hinge	Median	Upper Hinge	Upper Whisker
1.8405496	2.3309643	2.7013612	3.0514135	3.8565103



Box and Whisker Plot

Vanadium: SWMU 59 Subsurface Soil, 2010 CMS Investigation
(Log-Transformed Analytical Data)

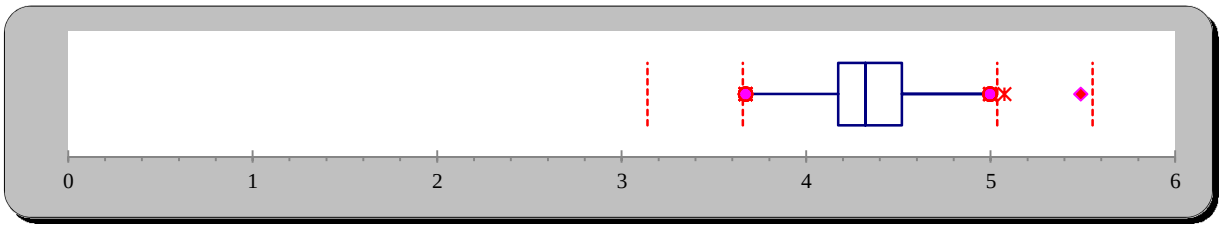
Lower Whisker	Lower Hinge	Median	Upper Hinge	Upper Whisker
3.7727609	4.4560157	4.9126549	5.111534	5.6419071



Box and Whisker Plot

Zinc: SWMU 59 Subsurface Soil, 2010 CMS Investigation
(Log-Transformed Analytical Data)

Lower Whisker	Lower Hinge	Median	Upper Hinge	Upper Whisker
3.6712245	4.1740037	4.3214801	4.5184504	4.9972123



APPENDIX K
2012 SUBSURFACE SOIL STATISTICS

General UCL Statistics for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Beryllium: SWMU 59 Subsurface Soil, 2012 CMS Investigation

General Statistics

Number of Valid Observations	10	Number of Distinct Observations	9

Raw Statistics

Minimum	0.12
Maximum	0.5
Mean	0.259
Geometric Mean	0.234
Median	0.24
SD	0.124
Std. Error of Mean	0.0393
Coefficient of Variation	0.48
Skewness	0.847

Log-transformed Statistics

Minimum of Log Data	-2.12
Maximum of Log Data	-0.693
Mean of log Data	-1.454
SD of log Data	0.481

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.911
Shapiro Wilk Critical Value	0.842

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.943
Shapiro Wilk Critical Value	0.842

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	0.331

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	0.335
95% Modified-t UCL (Johnson-1978)	0.333

Assuming Lognormal Distribution

95% H-UCL	0.373
95% Chebyshev (MVUE) UCL	0.434
97.5% Chebyshev (MVUE) UCL	0.509
99% Chebyshev (MVUE) UCL	0.657

Gamma Distribution Test

k star (bias corrected)	3.588
Theta Star	0.0722
MLE of Mean	0.259
MLE of Standard Deviation	0.137
nu star	71.75
Approximate Chi Square Value (.05)	53.25
Adjusted Level of Significance	0.0267
Adjusted Chi Square Value	50.49
Anderson-Darling Test Statistic	0.299
Anderson-Darling 5% Critical Value	0.729
Kolmogorov-Smirnov Test Statistic	0.163
Kolmogorov-Smirnov 5% Critical Value	0.267

Data appear Gamma Distributed at 5% Significance Level

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	0.324
95% Jackknife UCL	0.331
95% Standard Bootstrap UCL	0.321
95% Bootstrap-t UCL	0.355
95% Hall's Bootstrap UCL	0.392
95% Percentile Bootstrap UCL	0.322
95% BCA Bootstrap UCL	0.33
95% Chebyshev(Mean, Sd) UCL	0.43
97.5% Chebyshev(Mean, Sd) UCL	0.505
99% Chebyshev(Mean, Sd) UCL	0.65

Assuming Gamma Distribution

95% Approximate Gamma UCL (Use when n >= 40)	0.349
95% Adjusted Gamma UCL (Use when n < 40)	0.368

Potential UCL to Use

Use 95% Student's-t UCL 0.331

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Beryllium: NAPR Basewide Background, Clay Subsurface Soil

General Statistics

Number of Valid Observations	18	Number of Distinct Observations	17

Raw Statistics

Minimum	0.052
Maximum	0.7
Mean	0.259
Geometric Mean	0.21
Median	0.255
SD	0.169
Std. Error of Mean	0.0397
Coefficient of Variation	0.651
Skewness	1.145

Log-transformed Statistics

Minimum of Log Data	-2.957
Maximum of Log Data	-0.357
Mean of log Data	-1.562
SD of log Data	0.699

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.907
Shapiro Wilk Critical Value	0.897

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.971
Shapiro Wilk Critical Value	0.897

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	0.328

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	0.336
95% Modified-t UCL (Johnson-1978)	0.33

Assuming Lognormal Distribution

95% H-UCL	0.391
95% Chebyshev (MVUE) UCL	0.464
97.5% Chebyshev (MVUE) UCL	0.551
99% Chebyshev (MVUE) UCL	0.722

Gamma Distribution Test

k star (bias corrected)	2.138
Theta Star	0.121
MLE of Mean	0.259
MLE of Standard Deviation	0.177
nu star	76.97
Approximate Chi Square Value (.05)	57.76
Adjusted Level of Significance	0.0357
Adjusted Chi Square Value	56.17
Anderson-Darling Test Statistic	0.236
Anderson-Darling 5% Critical Value	0.749
Kolmogorov-Smirnov Test Statistic	0.118
Kolmogorov-Smirnov 5% Critical Value	0.206

Data appear Gamma Distributed at 5% Significance Level

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	0.324
95% Jackknife UCL	0.328
95% Standard Bootstrap UCL	0.323
95% Bootstrap-t UCL	0.349
95% Hall's Bootstrap UCL	0.363
95% Percentile Bootstrap UCL	0.326
95% BCA Bootstrap UCL	0.337
95% Chebyshev(Mean, Sd) UCL	0.432
97.5% Chebyshev(Mean, Sd) UCL	0.507
99% Chebyshev(Mean, Sd) UCL	0.654

Assuming Gamma Distribution

95% Approximate Gamma UCL (Use when n >= 40)	0.345
95% Adjusted Gamma UCL (Use when n < 40)	0.355

Potential UCL to Use

Use 95% Student's-t UCL 0.328

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Chromium: SWMU 59 Subsurface Soil, 2012 CMS Investigation

General Statistics

Number of Valid Observations	10	Number of Distinct Observations	10

Raw Statistics		Log-transformed Statistics	
Minimum	16	Minimum of Log Data	2.773
Maximum	120	Maximum of Log Data	4.787
Mean	59.6	Mean of log Data	3.907
Geometric Mean	49.73	SD of log Data	0.67
Median	61.5		
SD	34.93		
Std. Error of Mean	11.04		
Coefficient of Variation	0.586		
Skewness	0.565		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.918	Shapiro Wilk Test Statistic	0.928
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	79.85	95% H-UCL	108.4
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	118.3
95% Adjusted-CLT UCL (Chen-1995)	79.87	97.5% Chebyshev (MVUE) UCL	143.2
95% Modified-t UCL (Johnson-1978)	80.17	99% Chebyshev (MVUE) UCL	192.2

Gamma Distribution Test		Data Distribution
k star (bias corrected)	2.109	Data appear Normal at 5% Significance Level
Theta Star	28.25	
MLE of Mean	59.6	
MLE of Standard Deviation	41.04	
nu star	42.19	
Approximate Chi Square Value (.05)	28.3	**Nonparametric Statistics**
Adjusted Level of Significance	0.0267	95% CLT UCL 77.77
Adjusted Chi Square Value	26.34	95% Jackknife UCL 79.85
		95% Standard Bootstrap UCL 77.02
Anderson-Darling Test Statistic	0.34	95% Bootstrap-t UCL 83.7
Anderson-Darling 5% Critical Value	0.732	95% Hall's Bootstrap UCL 90.24
Kolmogorov-Smirnov Test Statistic	0.182	95% Percentile Bootstrap UCL 77.9
Kolmogorov-Smirnov 5% Critical Value	0.269	95% BCA Bootstrap UCL 79.4
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 107.7
		97.5% Chebyshev(Mean, Sd) UCL 128.6
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 169.5
95% Approximate Gamma UCL (Use when n >= 40)	88.85	
95% Adjusted Gamma UCL (Use when n < 40)	95.48	

Potential UCL to Use	Use 95% Student's-t UCL 79.85

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Chromium: NAPR Basewide Background, Clay Subsurface Soil

General Statistics

Number of Valid Observations	18	Number of Distinct Observations	16

Raw Statistics

Minimum	3.9
Maximum	148
Mean	37.31
Geometric Mean	23.93
Median	21.5
SD	38.59
Std. Error of Mean	9.095
Coefficient of Variation	1.034
Skewness	1.818

Log-transformed Statistics

Minimum of Log Data	1.361
Maximum of Log Data	4.997
Mean of log Data	3.175
SD of log Data	0.981

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.774
Shapiro Wilk Critical Value	0.897

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.982
Shapiro Wilk Critical Value	0.897

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	53.13

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	56.43
95% Modified-t UCL (Johnson-1978)	53.78

Assuming Lognormal Distribution

95% H-UCL	72.11
95% Chebyshev (MVUE) UCL	78.98
97.5% Chebyshev (MVUE) UCL	97
99% Chebyshev (MVUE) UCL	132.4

Gamma Distribution Test

k star (bias corrected)	1.093
Theta Star	34.14
MLE of Mean	37.31
MLE of Standard Deviation	35.69
nu star	39.34
Approximate Chi Square Value (.05)	25.97
Adjusted Level of Significance	0.0357
Adjusted Chi Square Value	24.93
Anderson-Darling Test Statistic	0.427
Anderson-Darling 5% Critical Value	0.761
Kolmogorov-Smirnov Test Statistic	0.162
Kolmogorov-Smirnov 5% Critical Value	0.208

Data appear Gamma Distributed at 5% Significance Level

Data Distribution

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	52.27
95% Jackknife UCL	53.13
95% Standard Bootstrap UCL	51.44
95% Bootstrap-t UCL	62.36
95% Hall's Bootstrap UCL	60.99
95% Percentile Bootstrap UCL	52.79
95% BCA Bootstrap UCL	55.72
95% Chebyshev(Mean, Sd) UCL	76.95
97.5% Chebyshev(Mean, Sd) UCL	94.1
99% Chebyshev(Mean, Sd) UCL	127.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (Use when n >= 40)	56.51
95% Adjusted Gamma UCL (Use when n < 40)	58.87

Potential UCL to Use

Use 95% Approximate Gamma UCL 56.51

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Cobalt: SWMU 59 Subsurface Soil, 2012 CMS Investigation

General Statistics

Number of Valid Observations	10	Number of Distinct Observations	7

Raw Statistics

Minimum	3.5
Maximum	24
Mean	14.02
Geometric Mean	12.32
Median	15
SD	5.97
Std. Error of Mean	1.888
Coefficient of Variation	0.426
Skewness	-0.591

Log-transformed Statistics

Minimum of Log Data	1.253
Maximum of Log Data	3.178
Mean of log Data	2.511
SD of log Data	0.609

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.856
Shapiro Wilk Critical Value	0.842

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.743
Shapiro Wilk Critical Value	0.842

Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	17.48

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	16.75
95% Modified-t UCL (Johnson-1978)	17.42

Assuming Lognormal Distribution

95% H-UCL	24.06
95% Chebyshev (MVUE) UCL	27.03
97.5% Chebyshev (MVUE) UCL	32.44
99% Chebyshev (MVUE) UCL	43.06

Gamma Distribution Test

k star (bias corrected)	2.887
Theta Star	4.857
MLE of Mean	14.02
MLE of Standard Deviation	8.252
nu star	57.73
Approximate Chi Square Value (.05)	41.26
Adjusted Level of Significance	0.0267
Adjusted Chi Square Value	38.86
Anderson-Darling Test Statistic	1.225
Anderson-Darling 5% Critical Value	0.729
Kolmogorov-Smirnov Test Statistic	0.365
Kolmogorov-Smirnov 5% Critical Value	0.268

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL (Use when n >= 40)	19.61
95% Adjusted Gamma UCL (Use when n < 40)	20.83

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	17.13
95% Jackknife UCL	17.48
95% Standard Bootstrap UCL	16.9
95% Bootstrap-t UCL	17.09
95% Hall's Bootstrap UCL	16.94
95% Percentile Bootstrap UCL	17
95% BCA Bootstrap UCL	16.7
95% Chebyshev(Mean, Sd) UCL	22.25
97.5% Chebyshev(Mean, Sd) UCL	25.81
99% Chebyshev(Mean, Sd) UCL	32.8

Potential UCL to Use Use 95% Student's-t UCL 17.48

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Note: For highly negative-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Cobalt: NAPR Basewide Background, Clay Subsurface Soil

General Statistics

Number of Valid Data	18	Number of Detected Data	17
Number of Distinct Detected Data	17	Number of Non-Detect Data	1
		Percent Non-Detects	5.56%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.83	Minimum Detected	-0.186
Maximum Detected	33.8	Maximum Detected	3.52
Mean of Detected	9.619	Mean of Detected	1.875
SD of Detected	8.907	SD of Detected	0.948
Minimum Non-Detect	1.2	Minimum Non-Detect	0.182
Maximum Non-Detect	1.2	Maximum Non-Detect	0.182

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.821	Shapiro Wilk Test Statistic	0.981
5% Shapiro Wilk Critical Value	0.892	5% Shapiro Wilk Critical Value	0.892
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	9.118	Mean	1.742
SD	8.898	SD	1.078
95% DL/2 (t) UCL	12.77	95% H-Stat (DL/2) UCL	20.98
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	8.575	Mean in Log Scale	1.771
SD	9.407	SD in Log Scale	1.02
95% MLE (t) UCL	12.43	Mean in Original Scale	9.141
95% MLE (Tiku) UCL	12.32	SD in Original Scale	8.876
		95% t UCL	12.78
		95% Percentile Bootstrap UCL	12.8
		95% BCA Bootstrap UCL	13.52
		95% H UCL	19.12

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	1.216	Data appear Gamma Distributed at 5% Significance Level
Theta Star	7.912	
nu star	41.34	
A-D Test Statistic	0.324	Nonparametric Statistics
5% A-D Critical Value	0.757	Kaplan-Meier (KM) Method
K-S Test Statistic	0.757	Mean 9.131
5% K-S Critical Value	0.213	SD 8.635
Data appear Gamma Distributed at 5% Significance Level		SE of Mean 2.098
		95% KM (t) UCL 12.78
Assuming Gamma Distribution		95% KM (z) UCL 12.58
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL 12.74
Minimum	0.000001	95% KM (bootstrap t) UCL 14.45
Maximum	33.8	95% KM (BCA) UCL 13.02
Mean	9.085	95% KM (Percentile Bootstrap) UCL 12.78
Median	5.95	95% KM (Chebyshev) UCL 18.28
SD	8.933	97.5% KM (Chebyshev) UCL 22.23
k star	0.474	99% KM (Chebyshev) UCL 30.01
Theta star	19.18	
Nu star	17.05	Potential UCLs to Use
AppChi2	8.709	95% KM (Chebyshev) UCL 18.28
95% Gamma Approximate UCL (Use when n >= 40)	17.79	
95% Adjusted Gamma UCL (Use when n < 40)	19.03	

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Copper: SWMU 59 Subsurface Soil, 2012 CMS Investigation

General Statistics

Number of Valid Observations	10	Number of Distinct Observations	8

Raw Statistics		Log-transformed Statistics	
Minimum	48	Minimum of Log Data	3.871
Maximum	210	Maximum of Log Data	5.347
Mean	102.7	Mean of log Data	4.541
Geometric Mean	93.77	SD of log Data	0.444
Median	99.5		
SD	48.39		
Std. Error of Mean	15.3		
Coefficient of Variation	0.471		
Skewness	1.259		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.893	Shapiro Wilk Test Statistic	0.973
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	130.7	95% H-UCL	142.1
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	166
95% Adjusted-CLT UCL (Chen-1995)	134.4	97.5% Chebyshev (MVUE) UCL	193.5
95% Modified-t UCL (Johnson-1978)	131.8	99% Chebyshev (MVUE) UCL	247.5

Gamma Distribution Test		Data Distribution
k star (bias corrected)	4.027	Data appear Normal at 5% Significance Level
Theta Star	25.5	
MLE of Mean	102.7	
MLE of Standard Deviation	51.17	
nu star	80.55	
Approximate Chi Square Value (.05)	60.87	**Nonparametric Statistics**
Adjusted Level of Significance	0.0267	95% CLT UCL 127.9
Adjusted Chi Square Value	57.9	95% Jackknife UCL 130.7
		95% Standard Bootstrap UCL 127.1
Anderson-Darling Test Statistic	0.266	95% Bootstrap-t UCL 143.6
Anderson-Darling 5% Critical Value	0.729	95% Hall's Bootstrap UCL 198.2
Kolmogorov-Smirnov Test Statistic	0.18	95% Percentile Bootstrap UCL 129.2
Kolmogorov-Smirnov 5% Critical Value	0.267	95% BCA Bootstrap UCL 134.9
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 169.4
		97.5% Chebyshev(Mean, Sd) UCL 198.3
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 254.9
95% Approximate Gamma UCL (Use when n >= 40)	135.9	
95% Adjusted Gamma UCL (Use when n < 40)	142.9	

Potential UCL to Use	Use 95% Student's-t UCL 130.7

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Copper: NAPR Basewide Background, Clay Subsurface Soil

General Statistics

Number of Valid Observations	17	Number of Distinct Observations	17

Raw Statistics

Minimum	18
Maximum	260
Mean	105
Geometric Mean	82.94
Median	89
SD	70.54
Std. Error of Mean	17.11
Coefficient of Variation	0.672
Skewness	0.809

Log-transformed Statistics

Minimum of Log Data	2.89
Maximum of Log Data	5.561
Mean of log Data	4.418
SD of log Data	0.742

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.917
Shapiro Wilk Critical Value	0.892

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.969
Shapiro Wilk Critical Value	0.892

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	134.8

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	136.7
95% Modified-t UCL (Johnson-1978)	135.4

Assuming Lognormal Distribution

95% H-UCL	167.3
95% Chebyshev (MVUE) UCL	196.5
97.5% Chebyshev (MVUE) UCL	235.3
99% Chebyshev (MVUE) UCL	311.3

Gamma Distribution Test

k star (bias corrected)	1.913
Theta Star	54.88
MLE of Mean	105
MLE of Standard Deviation	75.9
nu star	65.04
Approximate Chi Square Value (.05)	47.48
Adjusted Level of Significance	0.0346
Adjusted Chi Square Value	45.91
Anderson-Darling Test Statistic	0.255
Anderson-Darling 5% Critical Value	0.748
Kolmogorov-Smirnov Test Statistic	0.139
Kolmogorov-Smirnov 5% Critical Value	0.211

Data appear Gamma Distributed at 5% Significance Level

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	133.1
95% Jackknife UCL	134.8
95% Standard Bootstrap UCL	132.6
95% Bootstrap-t UCL	138.9
95% Hall's Bootstrap UCL	139.2
95% Percentile Bootstrap UCL	134.8
95% BCA Bootstrap UCL	134.2
95% Chebyshev(Mean, Sd) UCL	179.5
97.5% Chebyshev(Mean, Sd) UCL	211.8
99% Chebyshev(Mean, Sd) UCL	275.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (Use when n >= 40)	143.8
95% Adjusted Gamma UCL (Use when n < 40)	148.7

Potential UCL to Use Use 95% Student's-t UCL 134.8

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Nickel: SWMU 59 Subsurface Soil, 2012 CMS Investigation

General Statistics

Number of Valid Observations	10	Number of Distinct Observations	10

Raw Statistics		Log-transformed Statistics	
Minimum	5.7	Minimum of Log Data	1.74
Maximum	44	Maximum of Log Data	3.784
Mean	25.37	Mean of log Data	3.096
Geometric Mean	22.11	SD of log Data	0.608
Median	25.5		
SD	12.28		
Std. Error of Mean	3.882		
Coefficient of Variation	0.484		
Skewness	0.167		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.962	Shapiro Wilk Test Statistic	0.908
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	32.49	95% H-UCL	43.07
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	48.4
95% Adjusted-CLT UCL (Chen-1995)	31.97	97.5% Chebyshev (MVUE) UCL	58.08
95% Modified-t UCL (Johnson-1978)	32.52	99% Chebyshev (MVUE) UCL	77.09

Gamma Distribution Test		Data Distribution
k star (bias corrected)	2.719	Data appear Normal at 5% Significance Level
Theta Star	9.33	
MLE of Mean	25.37	
MLE of Standard Deviation	15.39	
nu star	54.38	
Approximate Chi Square Value (.05)	38.44	**Nonparametric Statistics**
Adjusted Level of Significance	0.0267	95% CLT UCL 31.75
Adjusted Chi Square Value	36.12	95% Jackknife UCL 32.49
		95% Standard Bootstrap UCL 31.58
Anderson-Darling Test Statistic	0.249	95% Bootstrap-t UCL 33.43
Anderson-Darling 5% Critical Value	0.73	95% Hall's Bootstrap UCL 32.09
Kolmogorov-Smirnov Test Statistic	0.157	95% Percentile Bootstrap UCL 31.6
Kolmogorov-Smirnov 5% Critical Value	0.268	95% BCA Bootstrap UCL 31.97
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 42.29
		97.5% Chebyshev(Mean, Sd) UCL 49.61
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 63.99
95% Approximate Gamma UCL (Use when n >= 40)	35.89	
95% Adjusted Gamma UCL (Use when n < 40)	38.2	

Potential UCL to Use	Use 95% Student's-t UCL 32.49

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Nickel: NAPR Basewide Background, Clay Subsurface Soil

General Statistics

Number of Valid Observations	18	Number of Distinct Observations	17
Number of Missing Values	1		

Raw Statistics		Log-transformed Statistics	
Minimum	1.1	Minimum of Log Data	0.0953
Maximum	35.6	Maximum of Log Data	3.572
Mean	7.889	Mean of log Data	1.654
Geometric Mean	5.23	SD of log Data	0.921
Median	5.85		
SD	8.387		
Std. Error of Mean	1.977		
Coefficient of Variation	1.063		
Skewness	2.389		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.728	Shapiro Wilk Test Statistic	0.974
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	11.33	95% H-UCL	14.04
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	15.78
95% Adjusted-CLT UCL (Chen-1995)	12.33	97.5% Chebyshev (MVUE) UCL	19.25
95% Modified-t UCL (Johnson-1978)	11.51	99% Chebyshev (MVUE) UCL	26.08

Gamma Distribution Test		Data Distribution
k star (bias corrected)	1.17	Data appear Gamma Distributed at 5% Significance Level
Theta Star	6.744	
MLE of Mean	7.889	
MLE of Standard Deviation	7.294	
nu star	42.11	
Approximate Chi Square Value (.05)	28.23	
Adjusted Level of Significance	0.0357	
Adjusted Chi Square Value	27.14	
Anderson-Darling Test Statistic	0.444	
Anderson-Darling 5% Critical Value	0.759	
Kolmogorov-Smirnov Test Statistic	0.148	
Kolmogorov-Smirnov 5% Critical Value	0.208	
Data appear Gamma Distributed at 5% Significance Level		

Nonparametric Statistics	
95% CLT UCL	11.14
95% Jackknife UCL	11.33
95% Standard Bootstrap UCL	10.97
95% Bootstrap-t UCL	14.26
95% Hall's Bootstrap UCL	23.67
95% Percentile Bootstrap UCL	11.17
95% BCA Bootstrap UCL	12.87
95% Chebyshev(Mean, Sd) UCL	16.51
97.5% Chebyshev(Mean, Sd) UCL	20.23
99% Chebyshev(Mean, Sd) UCL	27.56

Assuming Gamma Distribution	
95% Approximate Gamma UCL (Use when n >= 40)	11.77
95% Adjusted Gamma UCL (Use when n < 40)	12.24

Potential UCL to Use	Use 95% Approximate Gamma UCL 11.77

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Selenium: NAPR Basewide Background, Clay Subsurface Soil

General Statistics

Number of Valid Data	20	Number of Detected Data	6
Number of Distinct Detected Data	6	Number of Non-Detect Data	14
		Percent Non-Detects	70.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.22	Minimum Detected	-1.514
Maximum Detected	3.8	Maximum Detected	1.335
Mean of Detected	1.283	Mean of Detected	-0.262
SD of Detected	1.38	SD of Detected	1.131
Minimum Non-Detect	0.15	Minimum Non-Detect	-1.897
Maximum Non-Detect	1.3	Maximum Non-Detect	0.262

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	18
Number treated as Detected	2
Single DL Non-Detect Percentage	90.00%

Warning: There are only 6 Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.819	Shapiro Wilk Test Statistic	0.922
5% Shapiro Wilk Critical Value	0.788	5% Shapiro Wilk Critical Value	0.788
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.64	Mean	-1.012
SD	0.853	SD	1.083
95% DL/2 (t) UCL	0.97	95% H-Stat (DL/2) UCL	1.295
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-2.095
		SD in Log Scale	1.458
		Mean in Original Scale	0.433
		SD in Original Scale	0.91
		95% t UCL	0.785
		95% Percentile Bootstrap UCL	0.799
		95% BCA Bootstrap UCL	0.956
		95% H-UCL	1.095

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	0.668	Data appear Normal at 5% Significance Level
Theta Star	1.921	
nu star	8.017	
A-D Test Statistic	0.365	
5% A-D Critical Value	0.713	
K-S Test Statistic	0.713	
5% K-S Critical Value	0.34	
Data appear Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution		Nonparametric Statistics	
Gamma ROS Statistics using Extrapolated Data		Kaplan-Meier (KM) Method	
Minimum	0.000001	Mean	0.552
Maximum	3.8	SD	0.842
Mean	0.385	SE of Mean	0.207
Median	0.000001	95% KM (t) UCL	0.91
SD	0.93	95% KM (z) UCL	0.893
k star	0.113	95% KM (jackknife) UCL	0.855
Theta star	3.422	95% KM (bootstrap t) UCL	1.287
Nu star	4.501	95% KM (BCA) UCL	1.62
AppChi2	0.929	95% KM (Percentile Bootstrap) UCL	1.2
95% Gamma Approximate UCL (Use when n >= 40)	1.865	95% KM (Chebyshev) UCL	1.454
95% Adjusted Gamma UCL (Use when n < 40)	2.137	97.5% KM (Chebyshev) UCL	1.845
		99% KM (Chebyshev) UCL	2.611
		Potential UCLs to Use	
		95% KM (t) UCL	0.91
		95% KM (Percentile Bootstrap) UCL	1.2

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Vanadium: SWMU 59 Subsurface Soil, 2012 CMS Investigation

General Statistics

Number of Valid Observations	10	Number of Distinct Observations	7

Raw Statistics		Log-transformed Statistics	
Minimum	110	Minimum of Log Data	4.7
Maximum	400	Maximum of Log Data	5.991
Mean	223	Mean of log Data	5.333
Geometric Mean	207	SD of log Data	0.405
Median	180		
SD	92.02		
Std. Error of Mean	29.1		
Coefficient of Variation	0.413		
Skewness	0.777		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.905	Shapiro Wilk Test Statistic	0.945
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	276.3	95% H-UCL	298.2
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	348.6
95% Adjusted-CLT UCL (Chen-1995)	278.5	97.5% Chebyshev (MVUE) UCL	403.1
95% Modified-t UCL (Johnson-1978)	277.5	99% Chebyshev (MVUE) UCL	510.1

Gamma Distribution Test		Data Distribution
k star (bias corrected)	4.893	Data appear Normal at 5% Significance Level
Theta Star	45.58	
MLE of Mean	223	
MLE of Standard Deviation	100.8	
nu star	97.86	
Approximate Chi Square Value (.05)	76.04	**Nonparametric Statistics**
Adjusted Level of Significance	0.0267	95% CLT UCL 270.9
Adjusted Chi Square Value	72.7	95% Jackknife UCL 276.3
		95% Standard Bootstrap UCL 269.3
Anderson-Darling Test Statistic	0.432	95% Bootstrap-t UCL 290.2
Anderson-Darling 5% Critical Value	0.728	95% Hall's Bootstrap UCL 276.1
Kolmogorov-Smirnov Test Statistic	0.26	95% Percentile Bootstrap UCL 270
Kolmogorov-Smirnov 5% Critical Value	0.267	95% BCA Bootstrap UCL 277
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 349.8
		97.5% Chebyshev(Mean, Sd) UCL 404.7
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 512.5
95% Approximate Gamma UCL (Use when n >= 40)	287	
95% Adjusted Gamma UCL (Use when n < 40)	300.2	

Potential UCL to Use	Use 95% Student's-t UCL 276.3

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Vanadium: NAPR Basewide Background, Clay Subsurface Soil

General Statistics

Number of Valid Observations	19	Number of Distinct Observations	17

Raw Statistics

Minimum	25
Maximum	410
Mean	208.6
Geometric Mean	175.5
Median	200
SD	112.7
Std. Error of Mean	25.87
Coefficient of Variation	0.541
Skewness	0.548

Log-transformed Statistics

Minimum of Log Data	3.219
Maximum of Log Data	6.016
Mean of log Data	5.168
SD of log Data	0.67

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.932
Shapiro Wilk Critical Value	0.901

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.903
Shapiro Wilk Critical Value	0.901

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	253.4

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	254.6
95% Modified-t UCL (Johnson-1978)	254

Assuming Lognormal Distribution

95% H-UCL	310.5
95% Chebyshev (MVUE) UCL	370.7
97.5% Chebyshev (MVUE) UCL	437.4
99% Chebyshev (MVUE) UCL	568.3

Gamma Distribution Test

k star (bias corrected)	2.608
Theta Star	79.97
MLE of Mean	208.6
MLE of Standard Deviation	129.1
nu star	99.12
Approximate Chi Square Value (.05)	77.15
Adjusted Level of Significance	0.0369
Adjusted Chi Square Value	75.46
Anderson-Darling Test Statistic	0.287
Anderson-Darling 5% Critical Value	0.748
Kolmogorov-Smirnov Test Statistic	0.104
Kolmogorov-Smirnov 5% Critical Value	0.2

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL (Use when n >= 40)	268
95% Adjusted Gamma UCL (Use when n < 40)	274

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	251.1
95% Jackknife UCL	253.4
95% Standard Bootstrap UCL	250.8
95% Bootstrap-t UCL	260.3
95% Hall's Bootstrap UCL	252.6
95% Percentile Bootstrap UCL	250.5
95% BCA Bootstrap UCL	251.3
95% Chebyshev(Mean, Sd) UCL	321.3
97.5% Chebyshev(Mean, Sd) UCL	370.1
99% Chebyshev(Mean, Sd) UCL	465.9

Potential UCL to Use

Use 95% Student's-t UCL 253.4

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Zinc: SWMU 59 Subsurface Soil, 2012 CMS Investigation

General Statistics

Number of Valid Observations	10	Number of Distinct Observations	9

Raw Statistics		Log-transformed Statistics	
Minimum	35	Minimum of Log Data	3.555
Maximum	77	Maximum of Log Data	4.344
Mean	53.3	Mean of log Data	3.946
Geometric Mean	51.73	SD of log Data	0.259
Median	51.5		
SD	13.7		
Std. Error of Mean	4.333		
Coefficient of Variation	0.257		
Skewness	0.335		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.957	Shapiro Wilk Test Statistic	0.963
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	61.24	95% H-UCL	63.22
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	72.45
95% Adjusted-CLT UCL (Chen-1995)	60.92	97.5% Chebyshev (MVUE) UCL	80.73
95% Modified-t UCL (Johnson-1978)	61.32	99% Chebyshev (MVUE) UCL	96.99

Gamma Distribution Test		Data Distribution
k star (bias corrected)	11.85	Data appear Normal at 5% Significance Level
Theta Star	4.497	
MLE of Mean	53.3	
MLE of Standard Deviation	15.48	
nu star	237	
Approximate Chi Square Value (.05)	202.4	**Nonparametric Statistics**
Adjusted Level of Significance	0.0267	95% CLT UCL 60.43
Adjusted Chi Square Value	196.8	95% Jackknife UCL 61.24
		95% Standard Bootstrap UCL 60.07
Anderson-Darling Test Statistic	0.241	95% Bootstrap-t UCL 61.35
Anderson-Darling 5% Critical Value	0.725	95% Hall's Bootstrap UCL 60.86
Kolmogorov-Smirnov Test Statistic	0.164	95% Percentile Bootstrap UCL 60.5
Kolmogorov-Smirnov 5% Critical Value	0.266	95% BCA Bootstrap UCL 60.8
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 72.19
		97.5% Chebyshev(Mean, Sd) UCL 80.36
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 96.42
95% Approximate Gamma UCL (Use when n >= 40)	62.42	
95% Adjusted Gamma UCL (Use when n < 40)	64.19	

Potential UCL to Use	Use 95% Student's-t UCL 61.24

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Zinc: NAPR Basewide Background, Clay Subsurface Soil

General Statistics

Number of Valid Data	19	Number of Detected Data	18
Number of Distinct Detected Data	18	Number of Non-Detect Data	1
		Percent Non-Detects	5.26%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	3.9	Minimum Detected	1.361
Maximum Detected	98	Maximum Detected	4.585
Mean of Detected	38.68	Mean of Detected	3.394
SD of Detected	25.41	SD of Detected	0.83
Minimum Non-Detect	27	Minimum Non-Detect	3.296
Maximum Non-Detect	27	Maximum Non-Detect	3.296

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.942	Shapiro Wilk Test Statistic	0.938
5% Shapiro Wilk Critical Value	0.897	5% Shapiro Wilk Critical Value	0.897
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	37.35	Mean	3.352
SD	25.36	SD	0.827
95% DL/2 (t) UCL	47.44	95% H-Stat (DL/2) UCL	63.86
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	30.27	Mean in Log Scale	3.359
SD	33.5	SD in Log Scale	0.821
95% MLE (t) UCL	43.6	Mean in Original Scale	37.44
95% MLE (Tiku) UCL	46.25	SD in Original Scale	25.27
		95% t UCL	47.5
		95% Percentile Bootstrap UCL	47.29
		95% BCA Bootstrap UCL	47.83
		95% H UCL	63.68

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	1.758	Data appear Normal at 5% Significance Level	
Theta Star	22		
nu star	63.28		
A-D Test Statistic	0.239	**Nonparametric Statistics**	
5% A-D Critical Value	0.752	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.752	Mean	37.52
5% K-S Critical Value	0.206	SD	24.58
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	5.818
		95% KM (t) UCL	47.61
Assuming Gamma Distribution		95% KM (z) UCL	47.09
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	47.6
Minimum	3.9	95% KM (bootstrap t) UCL	49.6
Maximum	98	95% KM (BCA) UCL	47.61
Mean	37.56	95% KM (Percentile Bootstrap) UCL	47
Median	27.8	95% KM (Chebyshev) UCL	62.88
SD	25.17	97.5% KM (Chebyshev) UCL	73.86
k star	1.782	99% KM (Chebyshev) UCL	95.41
Theta star	21.08		
Nu star	67.72	Potential UCLs to Use	
AppChi2	49.78	95% KM (t) UCL	47.61
95% Gamma Approximate UCL (Use when n >= 40)	51.1	95% KM (Percentile Bootstrap) UCL	47
95% Adjusted Gamma UCL (Use when n < 40)	52.52		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

General Background Statistics for Full Data Sets

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Coverage	90%
Different or Future K Values	1
Number of Bootstrap Operations	2000

Beryllium: SWMU 59 Subsurface Soil, 2012 CMS Investigation

General Statistics

Total Number of Observations	10	Number of Distinct Observations	9
Tolerance Factor	2.355		

Raw Statistics

Minimum	0.12
Maximum	0.5
Second Largest	0.42
First Quartile	0.16
Median	0.24
Third Quartile	0.3
Mean	0.259
Geometric Mean	0.234
SD	0.124
Coefficient of Variation	0.48
Skewness	0.847

Log-Transformed Statistics

Minimum	-2.12
Maximum	-0.693
Second Largest	-0.868
First Quartile	-1.853
Median	-1.427
Third Quartile	-1.206
Mean	-1.454
SD	0.481

Background Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.911
Shapiro Wilk Critical Value	0.842

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.943
Shapiro Wilk Critical Value	0.842

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% UTL with 90% Coverage	0.552
95% UPL (t)	0.498
90% Percentile (z)	0.418
95% Percentile (z)	0.463
99% Percentile (z)	0.548

Assuming Lognormal Distribution

95% UTL with 90% Coverage	0.725
95% UPL (t)	0.589
90% Percentile (z)	0.433
95% Percentile (z)	0.515
99% Percentile (z)	0.715

Gamma Distribution Test

k star	3.588
Theta Star	0.0722
MLE of Mean	0.259
MLE of Standard Deviation	0.137
nu star	71.75
A-D Test Statistic	0.299
5% A-D Critical Value	0.729
K-S Test Statistic	0.163
5% K-S Critical Value	0.267

Data appear Gamma Distributed at 5% Significance Level

Data Distribution Test

Data appear Normal at 5% Significance Level

Nonparametric Statistics

90% Percentile	0.428
95% Percentile	0.464
99% Percentile	0.493
95% UTL with 90% Coverage	0.5
95% Percentile Bootstrap UTL with 90% Coverage	0.5
95% BCA Bootstrap UTL with 90% Coverage	0.5
95% UPL	0.5
95% Chebyshev UPL	0.827
Upper Threshold Limit Based upon IQR	0.51

Assuming Gamma Distribution

90% Percentile	0.442
95% Percentile	0.517
99% Percentile	0.677
95% WH Approx. Gamma UPL	0.542
95% HW Approx. Gamma UPL	0.551
95% WH Approx. Gamma UTL with 90% Coverage	0.633
95% HW Approx. Gamma UTL with 90% Coverage	0.651

Beryllium: NAPR Basewide Background, Clay Subsurface Soil

General Statistics

Total Number of Observations	18	Number of Distinct Observations	17
Tolerance Factor	1.974		

Raw Statistics

Minimum	0.052
Maximum	0.7
Second Largest	0.54
First Quartile	0.133
Median	0.255
Third Quartile	0.323
Mean	0.259
Geometric Mean	0.21
SD	0.169
Coefficient of Variation	0.651
Skewness	1.145

Log-Transformed Statistics

Minimum	-2.957
Maximum	-0.357
Second Largest	-0.616
First Quartile	-2.022
Median	-1.367
Third Quartile	-1.132
Mean	-1.562
SD	0.699

Background Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.907
Shapiro Wilk Critical Value	0.897

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.971
Shapiro Wilk Critical Value	0.897

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% UTL with 90% Coverage	0.592
95% UPL (t)	0.56
90% Percentile (z)	0.475
95% Percentile (z)	0.536
99% Percentile (z)	0.651

Assuming Lognormal Distribution

95% UTL with 90% Coverage	0.833
95% UPL (t)	0.731
90% Percentile (z)	0.514
95% Percentile (z)	0.662
99% Percentile (z)	1.066

Gamma Distribution Test

k star	2.138
Theta Star	0.121
MLE of Mean	0.259
MLE of Standard Deviation	0.177
nu star	76.97

A-D Test Statistic	0.236
5% A-D Critical Value	0.749
K-S Test Statistic	0.118
5% K-S Critical Value	0.206

Data appear Gamma Distributed at 5% Significance Level

Data Distribution Test

Data appear Normal at 5% Significance Level

Nonparametric Statistics

90% Percentile	0.428
95% Percentile	0.564
99% Percentile	0.673

Assuming Gamma Distribution

90% Percentile	0.496
95% Percentile	0.602
99% Percentile	0.835
95% WH Approx. Gamma UPL	0.625
95% HW Approx. Gamma UPL	0.644
95% WH Approx. Gamma UTL with 90% Coverage	0.683
95% HW Approx. Gamma UTL with 90% Coverage	0.709

95% UTL with 90% Coverage	0.7
95% Percentile Bootstrap UTL with 90% Coverage	0.7
95% BCA Bootstrap UTL with 90% Coverage	0.7
95% UPL	0.7
95% Chebyshev UPL	1.014
Upper Threshold Limit Based upon IQR	0.608

Chromium: SWMU 59 Subsurface Soil, 2012 CMS Investigation

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
Tolerance Factor	2.355		

Raw Statistics

Minimum	16
Maximum	120
Second Largest	110
First Quartile	30
Median	61.5
Third Quartile	68.5
Mean	59.6
Geometric Mean	49.73
SD	34.93
Coefficient of Variation	0.586
Skewness	0.565

Log-Transformed Statistics

Minimum	2.773
Maximum	4.787
Second Largest	4.7
First Quartile	3.366
Median	4.119
Third Quartile	4.226
Mean	3.907
SD	0.67

Background Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.918
Shapiro Wilk Critical Value	0.842

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.928
Shapiro Wilk Critical Value	0.842

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% UTL with 90% Coverage	141.9
95% UPL (t)	126.7
90% Percentile (z)	104.4
95% Percentile (z)	117
99% Percentile (z)	140.8

Assuming Lognormal Distribution

95% UTL with 90% Coverage	241
95% UPL (t)	180.4
90% Percentile (z)	117.4
95% Percentile (z)	149.7
99% Percentile (z)	236.4

Gamma Distribution Test

k star	2.109
Theta Star	28.25
MLE of Mean	59.6
MLE of Standard Deviation	41.04
nu star	42.19

A-D Test Statistic	0.34
5% A-D Critical Value	0.732
K-S Test Statistic	0.182
5% K-S Critical Value	0.269

Data appear Gamma Distributed at 5% Significance Level

Data Distribution Test

Data appear Normal at 5% Significance Level

Nonparametric Statistics

90% Percentile	111
95% Percentile	115.5
99% Percentile	119.1

Assuming Gamma Distribution

90% Percentile	114.5
95% Percentile	139
99% Percentile	193.3
95% WH Approx. Gamma UPL	149.2
95% HW Approx. Gamma UPL	154.8
95% WH Approx. Gamma UTL with 90% Coverage	180.5
95% HW Approx. Gamma UTL with 90% Coverage	190.6

95% UTL with 90% Coverage	120
95% Percentile Bootstrap UTL with 90% Coverage	120
95% BCA Bootstrap UTL with 90% Coverage	120
95% UPL	120
95% Chebyshev UPL	219.3
Upper Threshold Limit Based upon IQR	126.3

Chromium: NAPR Basewide Background, Clay Subsurface Soil

General Statistics

Total Number of Observations	18	Number of Distinct Observations	16
Tolerance Factor	1.974		

Raw Statistics

Minimum	3.9
Maximum	148
Second Largest	101
First Quartile	12.68
Median	21.5
Third Quartile	36.85
Mean	37.31
Geometric Mean	23.93
SD	38.59
Coefficient of Variation	1.034
Skewness	1.818

Log-Transformed Statistics

Minimum	1.361
Maximum	4.997
Second Largest	4.615
First Quartile	2.514
Median	3.061
Third Quartile	3.607
Mean	3.175
SD	0.981

Background Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.774
Shapiro Wilk Critical Value	0.897

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.982
Shapiro Wilk Critical Value	0.897

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% UTL with 90% Coverage	113.5
95% UPL (t)	106.3
90% Percentile (z)	86.76
95% Percentile (z)	100.8
99% Percentile (z)	127.1

Assuming Lognormal Distribution

95% UTL with 90% Coverage	166.1
95% UPL (t)	138.3
90% Percentile (z)	84.17
95% Percentile (z)	120.2
99% Percentile (z)	234.7

Gamma Distribution Test

k star	1.093
Theta Star	34.14
MLE of Mean	37.31
MLE of Standard Deviation	35.69
nu star	39.34

A-D Test Statistic	0.427
5% A-D Critical Value	0.761
K-S Test Statistic	0.162
5% K-S Critical Value	0.208

Data appear Gamma Distributed at 5% Significance Level

Data Distribution Test

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

90% Percentile	89.17
95% Percentile	108.1
99% Percentile	140

Assuming Gamma Distribution

90% Percentile	84.04
95% Percentile	108.3
99% Percentile	164.4
95% WH Approx. Gamma UPL	113.2
95% HW Approx. Gamma UPL	116.8
95% WH Approx. Gamma UTL with 90% Coverage	127
95% HW Approx. Gamma UTL with 90% Coverage	132.5

95% UTL with 90% Coverage	148
95% Percentile Bootstrap UTL with 90% Coverage	148
95% BCA Bootstrap UTL with 90% Coverage	148
95% UPL	148
95% Chebyshev UPL	210.1
Upper Threshold Limit Based upon IQR	73.11

Cobalt: SWMU 59 Subsurface Soil, 2012 CMS Investigation

General Statistics

Total Number of Observations	10	Number of Distinct Observations	7
Tolerance Factor	2.355		

Raw Statistics

Minimum	3.5
Maximum	24
Second Largest	18
First Quartile	14.25
Median	15
Third Quartile	15.75
Mean	14.02
Geometric Mean	12.32
SD	5.97
Coefficient of Variation	0.426
Skewness	-0.591

Log-Transformed Statistics

Minimum	1.253
Maximum	3.178
Second Largest	2.89
First Quartile	2.656
Median	2.708
Third Quartile	2.756
Mean	2.511
SD	0.609

Background Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.856
Shapiro Wilk Critical Value	0.842

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.743
Shapiro Wilk Critical Value	0.842

Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

95% UTL with 90% Coverage	28.08
95% UPL (t)	25.5
90% Percentile (z)	21.67
95% Percentile (z)	23.84
99% Percentile (z)	27.91

Assuming Lognormal Distribution

95% UTL with 90% Coverage	51.73
95% UPL (t)	39.75
90% Percentile (z)	26.9
95% Percentile (z)	33.56
99% Percentile (z)	50.83

Gamma Distribution Test

k star	2.887
Theta Star	4.857
MLE of Mean	14.02
MLE of Standard Deviation	8.252
nu star	57.73

A-D Test Statistic	1.225
5% A-D Critical Value	0.729
K-S Test Statistic	0.365
5% K-S Critical Value	0.268

Data not Gamma Distributed at 5% Significance Level

Data Distribution Test

Data appear Normal at 5% Significance Level

Nonparametric Statistics

90% Percentile	18.6
95% Percentile	21.3
99% Percentile	23.46

Assuming Gamma Distribution

90% Percentile	25.08
95% Percentile	29.75
99% Percentile	39.89

95% WH Approx. Gamma UPL	31.5
95% HW Approx. Gamma UPL	32.96
95% WH Approx. Gamma UTL with 90% Coverage	37.26
95% HW Approx. Gamma UTL with 90% Coverage	39.66

95% UTL with 90% Coverage	24
95% Percentile Bootstrap UTL with 90% Coverage	24
95% BCA Bootstrap UTL with 90% Coverage	24
95% UPL	24
95% Chebyshev UPL	41.31
Upper Threshold Limit Based upon IQR	18

Cobalt: NAPR Basewide Background, Clay Subsurface Soil

General Statistics

Total Number of Observations	18	Number of Distinct Observations	18
Tolerance Factor	1.974		

Raw Statistics		Log-Transformed Statistics	
Minimum	0.83	Minimum	-0.186
Maximum	33.8	Maximum	3.52
Second Largest	23	Second Largest	3.135
First Quartile	3.8	First Quartile	1.334
Median	5.95	Median	1.779
Third Quartile	12.73	Third Quartile	2.526
Mean	9.152	Mean	1.781
Geometric Mean	5.934	SD	1.003
SD	8.866		
Coefficient of Variation	0.969		
Skewness	1.61		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.815	Shapiro Wilk Test Statistic	0.981
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	26.65	95% UTL with 90% Coverage	42.95
95% UPL (t)	25	95% UPL (t)	35.61
90% Percentile (z)	20.51	90% Percentile (z)	21.45
95% Percentile (z)	23.73	95% Percentile (z)	30.88
99% Percentile (z)	29.78	99% Percentile (z)	61.15

Gamma Distribution Test		Data Distribution Test
k star	1.116	Data appear Gamma Distributed at 5% Significance Level
Theta Star	8.198	
MLE of Mean	9.152	
MLE of Standard Deviation	8.661	
nu star	40.19	
A-D Test Statistic	0.288	
5% A-D Critical Value	0.76	
K-S Test Statistic	0.146	
5% K-S Critical Value	0.208	
Data appear Gamma Distributed at 5% Significance Level		

Nonparametric Statistics	
90% Percentile	20.83
95% Percentile	24.62
99% Percentile	31.96

Assuming Gamma Distribution			
90% Percentile	20.51	95% UTL with 90% Coverage	33.8
95% Percentile	26.38	95% Percentile Bootstrap UTL with 90% Coverage	33.8
99% Percentile	39.89	95% BCA Bootstrap UTL with 90% Coverage	33.8
		95% UPL	33.8
		95% Chebyshev UPL	48.86
95% WH Approx. Gamma UPL	27.67	Upper Threshold Limit Based upon IQR	26.11
95% HW Approx. Gamma UPL	28.79		
95% WH Approx. Gamma UTL with 90% Coverage	31		
95% HW Approx. Gamma UTL with 90% Coverage	32.65		

Copper, SWMU 59 Subsurface Soil, 2012 CMS Investigation

General Statistics

Total Number of Observations	10	Number of Distinct Observations	8
Tolerance Factor	2.355		

Raw Statistics

Minimum	48
Maximum	210
Second Largest	150
First Quartile	68.5
Median	99.5
Third Quartile	110
Mean	102.7
Geometric Mean	93.77
SD	48.39
Coefficient of Variation	0.471
Skewness	1.259

Log-Transformed Statistics

Minimum	3.871
Maximum	5.347
Second Largest	5.011
First Quartile	4.226
Median	4.595
Third Quartile	4.7
Mean	4.541
SD	0.444

Background Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.893
Shapiro Wilk Critical Value	0.842

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.973
Shapiro Wilk Critical Value	0.842

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% UTL with 90% Coverage	216.6
95% UPL (t)	195.7
90% Percentile (z)	164.7
95% Percentile (z)	182.3
99% Percentile (z)	215.3

Assuming Lognormal Distribution

95% UTL with 90% Coverage	266.7
95% UPL (t)	220.1
90% Percentile (z)	165.6
95% Percentile (z)	194.6
99% Percentile (z)	263.4

Gamma Distribution Test

k star	4.027
Theta Star	25.5
MLE of Mean	102.7
MLE of Standard Deviation	51.17
nu star	80.55

A-D Test Statistic	0.266
5% A-D Critical Value	0.729
K-S Test Statistic	0.18
5% K-S Critical Value	0.267

Data appear Gamma Distributed at 5% Significance Level

Data Distribution Test

Data appear Normal at 5% Significance Level

Nonparametric Statistics

90% Percentile	156
95% Percentile	183
99% Percentile	204.6

Assuming Gamma Distribution

90% Percentile	171.3
95% Percentile	198.7
99% Percentile	257.3
95% WH Approx. Gamma UPL	207.4
95% HW Approx. Gamma UPL	209.9
95% WH Approx. Gamma UTL with 90% Coverage	240.5
95% HW Approx. Gamma UTL with 90% Coverage	245.6

95% UTL with 90% Coverage	210
95% Percentile Bootstrap UTL with 90% Coverage	210
95% BCA Bootstrap UTL with 90% Coverage	210
95% UPL	210
95% Chebyshev UPL	323.9
Upper Threshold Limit Based upon IQR	172.3

Copper: NAPR Basewide Background, Clay Subsurface Soil

General Statistics

Total Number of Observations	17	Number of Distinct Observations	17
Tolerance Factor	2.002		

Raw Statistics

Minimum	18
Maximum	260
Second Largest	210
First Quartile	52.6
Median	89
Third Quartile	144
Mean	105
Geometric Mean	82.94
SD	70.54
Coefficient of Variation	0.672
Skewness	0.809

Log-Transformed Statistics

Minimum	2.89
Maximum	5.561
Second Largest	5.347
First Quartile	3.963
Median	4.489
Third Quartile	4.97
Mean	4.418
SD	0.742

Background Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.917
Shapiro Wilk Critical Value	0.892

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.969
Shapiro Wilk Critical Value	0.892

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% UTL with 90% Coverage	246.2
95% UPL (t)	231.7
90% Percentile (z)	195.4
95% Percentile (z)	221
99% Percentile (z)	269.1

Assuming Lognormal Distribution

95% UTL with 90% Coverage	366.1
95% UPL (t)	314.4
90% Percentile (z)	214.6
95% Percentile (z)	280.9
99% Percentile (z)	465.7

Gamma Distribution Test

k star	1.913
Theta Star	54.88
MLE of Mean	105
MLE of Standard Deviation	75.9
nu star	65.04

A-D Test Statistic	0.255
5% A-D Critical Value	0.748
K-S Test Statistic	0.139
5% K-S Critical Value	0.211

Data appear Gamma Distributed at 5% Significance Level

Data Distribution Test

Data appear Normal at 5% Significance Level

Nonparametric Statistics

90% Percentile	204
95% Percentile	220
99% Percentile	252

Assuming Gamma Distribution

90% Percentile	206.3
95% Percentile	252.5
99% Percentile	355.3

95% WH Approx. Gamma UPL	264
95% HW Approx. Gamma UPL	272.7
95% WH Approx. Gamma UTL with 90% Coverage	292.2
95% HW Approx. Gamma UTL with 90% Coverage	304.6

95% UTL with 90% Coverage	260
95% Percentile Bootstrap UTL with 90% Coverage	260
95% BCA Bootstrap UTL with 90% Coverage	260
95% UPL	260
95% Chebyshev UPL	421.3
Upper Threshold Limit Based upon IQR	281.1

Nickel: SWMU 59 Subsurface Soil, 2012 CMS Investigation

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
Tolerance Factor	2.355		

Raw Statistics

Minimum	5.7
Maximum	44
Second Largest	43
First Quartile	17.25
Median	25.5
Third Quartile	31.25
Mean	25.37
Geometric Mean	22.11
SD	12.28
Coefficient of Variation	0.484
Skewness	0.167

Log-Transformed Statistics

Minimum	1.74
Maximum	3.784
Second Largest	3.761
First Quartile	2.848
Median	3.238
Third Quartile	3.441
Mean	3.096
SD	0.608

Background Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.962
Shapiro Wilk Critical Value	0.842

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.908
Shapiro Wilk Critical Value	0.842

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% UTL with 90% Coverage	54.28
95% UPL (t)	48.97
90% Percentile (z)	41.1
95% Percentile (z)	45.56
99% Percentile (z)	53.93

Assuming Lognormal Distribution

95% UTL with 90% Coverage	92.51
95% UPL (t)	71.13
90% Percentile (z)	48.18
95% Percentile (z)	60.08
99% Percentile (z)	90.92

Gamma Distribution Test

k star	2.719
Theta Star	9.33
MLE of Mean	25.37
MLE of Standard Deviation	15.39
nu star	54.38

A-D Test Statistic	0.249
5% A-D Critical Value	0.73
K-S Test Statistic	0.157
5% K-S Critical Value	0.268

Data appear Gamma Distributed at 5% Significance Level

Data Distribution Test

Data appear Normal at 5% Significance Level

Nonparametric Statistics

90% Percentile	43.1
95% Percentile	43.55
99% Percentile	43.91

Assuming Gamma Distribution

90% Percentile	45.99
95% Percentile	54.78
99% Percentile	73.95
95% WH Approx. Gamma UPL	58.07
95% HW Approx. Gamma UPL	60.36
95% WH Approx. Gamma UTL with 90% Coverage	68.98
95% HW Approx. Gamma UTL with 90% Coverage	72.87

95% UTL with 90% Coverage	44
95% Percentile Bootstrap UTL with 90% Coverage	44
95% BCA Bootstrap UTL with 90% Coverage	44
95% UPL	44
95% Chebyshev UPL	81.49
Upper Threshold Limit Based upon IQR	52.25

Nickel: NAPR Basewide Background, Clay Subsurface Soil

General Statistics

Total Number of Observations	18	Number of Distinct Observations	17
Tolerance Factor	1.974		

Raw Statistics		Log-Transformed Statistics	
Minimum	1.1	Minimum	0.0953
Maximum	35.6	Maximum	3.572
Second Largest	17	Second Largest	2.833
First Quartile	2.25	First Quartile	0.81
Median	5.85	Median	1.766
Third Quartile	9.45	Third Quartile	2.235
Mean	7.889	Mean	1.654
Geometric Mean	5.23	SD	0.921
SD	8.387		
Coefficient of Variation	1.063		
Skewness	2.389		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.728	Shapiro Wilk Test Statistic	0.974
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	24.44	95% UTL with 90% Coverage	32.2
95% UPL (t)	22.88	95% UPL (t)	27.11
90% Percentile (z)	18.64	90% Percentile (z)	17.02
95% Percentile (z)	21.68	95% Percentile (z)	23.78
99% Percentile (z)	27.4	99% Percentile (z)	44.53

Gamma Distribution Test		Data Distribution Test
k star	1.17	Data appear Gamma Distributed at 5% Significance Level
Theta Star	6.744	
MLE of Mean	7.889	
MLE of Standard Deviation	7.294	
nu star	42.11	
A-D Test Statistic	0.444	
5% A-D Critical Value	0.759	
K-S Test Statistic	0.148	
5% K-S Critical Value	0.208	
Data appear Gamma Distributed at 5% Significance Level		

Nonparametric Statistics	
90% Percentile	16.65
95% Percentile	19.79
99% Percentile	32.44

Assuming Gamma Distribution			
90% Percentile	17.48	95% UTL with 90% Coverage	35.6
95% Percentile	22.37	95% Percentile Bootstrap UTL with 90% Coverage	35.6
99% Percentile	33.61	95% BCA Bootstrap UTL with 90% Coverage	22.58
		95% UPL	35.6
		95% Chebyshev UPL	45.45
95% WH Approx. Gamma UPL	23.27	Upper Threshold Limit Based upon IQR	20.25
95% HW Approx. Gamma UPL	23.81		
95% WH Approx. Gamma UTL with 90% Coverage	26.03		
95% HW Approx. Gamma UTL with 90% Coverage	26.92		

Vanadium: SWMU 59 Subsurface Soil, 2012 CMS Investigation

General Statistics

Total Number of Observations	10	Number of Distinct Observations	7
Tolerance Factor	2.355		

Raw Statistics

Minimum	110
Maximum	400
Second Largest	320
First Quartile	170
Median	180
Third Quartile	280
Mean	223
Geometric Mean	207
SD	92.02
Coefficient of Variation	0.413
Skewness	0.777

Log-Transformed Statistics

Minimum	4.7
Maximum	5.991
Second Largest	5.768
First Quartile	5.136
Median	5.193
Third Quartile	5.635
Mean	5.333
SD	0.405

Background Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.905
Shapiro Wilk Critical Value	0.842

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.945
Shapiro Wilk Critical Value	0.842

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% UTL with 90% Coverage	439.7
95% UPL (t)	399.9
90% Percentile (z)	340.9
95% Percentile (z)	374.4
99% Percentile (z)	437.1

Assuming Lognormal Distribution

95% UTL with 90% Coverage	537.2
95% UPL (t)	450.9
90% Percentile (z)	347.9
95% Percentile (z)	403
99% Percentile (z)	531

Gamma Distribution Test

k star	4.893
Theta Star	45.58
MLE of Mean	223
MLE of Standard Deviation	100.8
nu star	97.86

A-D Test Statistic	0.432
5% A-D Critical Value	0.728
K-S Test Statistic	0.26
5% K-S Critical Value	0.267

Data appear Gamma Distributed at 5% Significance Level

Data Distribution Test

Data appear Normal at 5% Significance Level

Nonparametric Statistics

90% Percentile	328
95% Percentile	364
99% Percentile	392.8

Assuming Gamma Distribution

90% Percentile	358
95% Percentile	410.5
99% Percentile	521.4
95% WH Approx. Gamma UPL	426.4
95% HW Approx. Gamma UPL	431.5
95% WH Approx. Gamma UTL with 90% Coverage	488.9
95% HW Approx. Gamma UTL with 90% Coverage	498.7

95% UTL with 90% Coverage	400
95% Percentile Bootstrap UTL with 90% Coverage	400
95% BCA Bootstrap UTL with 90% Coverage	400
95% UPL	400
95% Chebyshev UPL	643.7
Upper Threshold Limit Based upon IQR	445

Vanadium: NAPR Basewide Background, Clay Subsurface Soil

General Statistics

Total Number of Observations	19	Number of Distinct Observations	17
Tolerance Factor	1.949		

Raw Statistics

Minimum	25
Maximum	410
Second Largest	410
First Quartile	120
Median	200
Third Quartile	258
Mean	208.6
Geometric Mean	175.5
SD	112.7
Coefficient of Variation	0.541
Skewness	0.548

Log-Transformed Statistics

Minimum	3.219
Maximum	6.016
Second Largest	6.016
First Quartile	4.787
Median	5.298
Third Quartile	5.553
Mean	5.168
SD	0.67

Background Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.932
Shapiro Wilk Critical Value	0.901

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.903
Shapiro Wilk Critical Value	0.901

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% UTL with 90% Coverage	428.3
95% UPL (t)	409.2
90% Percentile (z)	353.1
95% Percentile (z)	394
99% Percentile (z)	470.9

Assuming Lognormal Distribution

95% UTL with 90% Coverage	648.3
95% UPL (t)	578.5
90% Percentile (z)	414.5
95% Percentile (z)	528.7
99% Percentile (z)	835

Gamma Distribution Test

k star	2.608
Theta Star	79.97
MLE of Mean	208.6
MLE of Standard Deviation	129.1
nu star	99.12

A-D Test Statistic	0.287
5% A-D Critical Value	0.748
K-S Test Statistic	0.104
5% K-S Critical Value	0.2

Data appear Gamma Distributed at 5% Significance Level

Data Distribution Test

Data appear Normal at 5% Significance Level

Nonparametric Statistics

90% Percentile	380.4
95% Percentile	410
99% Percentile	410

Assuming Gamma Distribution

90% Percentile	381.6
95% Percentile	456
99% Percentile	618.4
95% WH Approx. Gamma UPL	470.5
95% HW Approx. Gamma UPL	488
95% WH Approx. Gamma UTL with 90% Coverage	507
95% HW Approx. Gamma UTL with 90% Coverage	529.5

95% UTL with 90% Coverage	410
95% Percentile Bootstrap UTL with 90% Coverage	410
95% BCA Bootstrap UTL with 90% Coverage	410
95% UPL	410
95% Chebyshev UPL	712.8
Upper Threshold Limit Based upon IQR	465

Zinc: SWMU 59 Subsurface Soil, 2012 CMS Investigation

General Statistics

Total Number of Observations	10	Number of Distinct Observations	9
Tolerance Factor	2.355		

Raw Statistics

Minimum	35
Maximum	77
Second Largest	68
First Quartile	42.5
Median	51.5
Third Quartile	61.75
Mean	53.3
Geometric Mean	51.73
SD	13.7
Coefficient of Variation	0.257
Skewness	0.335

Log-Transformed Statistics

Minimum	3.555
Maximum	4.344
Second Largest	4.22
First Quartile	3.748
Median	3.938
Third Quartile	4.123
Mean	3.946
SD	0.259

Background Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.957
Shapiro Wilk Critical Value	0.842

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.963
Shapiro Wilk Critical Value	0.842

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% UTL with 90% Coverage	85.57
95% UPL (t)	79.65
90% Percentile (z)	70.86
95% Percentile (z)	75.84
99% Percentile (z)	85.18

Assuming Lognormal Distribution

95% UTL with 90% Coverage	95.21
95% UPL (t)	85.12
90% Percentile (z)	72.09
95% Percentile (z)	79.21
99% Percentile (z)	94.51

Gamma Distribution Test

k star	11.85
Theta Star	4.497
MLE of Mean	53.3
MLE of Standard Deviation	15.48
nu star	237

A-D Test Statistic	0.241
5% A-D Critical Value	0.725
K-S Test Statistic	0.164
5% K-S Critical Value	0.266

Data appear Gamma Distributed at 5% Significance Level

Data Distribution Test

Data appear Normal at 5% Significance Level

Nonparametric Statistics

90% Percentile	68.9
95% Percentile	72.95
99% Percentile	76.19

Assuming Gamma Distribution

90% Percentile	73.85
95% Percentile	81.06
99% Percentile	95.75
95% WH Approx. Gamma UPL	82.79
95% HW Approx. Gamma UPL	83.31
95% WH Approx. Gamma UTL with 90% Coverage	90.99
95% HW Approx. Gamma UTL with 90% Coverage	91.92

95% UTL with 90% Coverage	77
95% Percentile Bootstrap UTL with 90% Coverage	77
95% BCA Bootstrap UTL with 90% Coverage	77
95% UPL	77
95% Chebyshev UPL	115.9
Upper Threshold Limit Based upon IQR	90.63

Zinc: NAPR Basewide Background, Clay Subsurface Soil

General Statistics

Total Number of Observations	19	Number of Distinct Observations	19
Tolerance Factor	1.949		

Raw Statistics

Minimum	3.9
Maximum	98
Second Largest	76
First Quartile	21
Median	27.8
Third Quartile	54.85
Mean	38.06
Geometric Mean	29.63
SD	24.84
Coefficient of Variation	0.653
Skewness	0.805

Log-Transformed Statistics

Minimum	1.361
Maximum	4.585
Second Largest	4.331
First Quartile	3.04
Median	3.325
Third Quartile	4.004
Mean	3.389
SD	0.807

Background Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.937
Shapiro Wilk Critical Value	0.901

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.94
Shapiro Wilk Critical Value	0.901

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% UTL with 90% Coverage	86.47
95% UPL (t)	82.25
90% Percentile (z)	69.9
95% Percentile (z)	78.92
99% Percentile (z)	95.85

Assuming Lognormal Distribution

95% UTL with 90% Coverage	142.7
95% UPL (t)	124.5
90% Percentile (z)	83.31
95% Percentile (z)	111.7
99% Percentile (z)	193.5

Gamma Distribution Test

k star	1.844
Theta Star	20.64
MLE of Mean	38.06
MLE of Standard Deviation	28.03
nu star	70.09

A-D Test Statistic	0.234
5% A-D Critical Value	0.751
K-S Test Statistic	0.128
5% K-S Critical Value	0.201

Data appear Gamma Distributed at 5% Significance Level

Data Distribution Test

Data appear Normal at 5% Significance Level

Nonparametric Statistics

90% Percentile	66.88
95% Percentile	78.2
99% Percentile	94.04

Assuming Gamma Distribution

90% Percentile	75.46
95% Percentile	92.65
99% Percentile	131
95% WH Approx. Gamma UPL	96.4
95% HW Approx. Gamma UPL	100.8
95% WH Approx. Gamma UTL with 90% Coverage	105
95% HW Approx. Gamma UTL with 90% Coverage	110.7

95% UTL with 90% Coverage	98
95% Percentile Bootstrap UTL with 90% Coverage	98
95% BCA Bootstrap UTL with 90% Coverage	98
95% UPL	98
95% Chebyshev UPL	149.1
Upper Threshold Limit Based upon IQR	105.6

t-Test Site vs Background Comparison for Full Data Sets without NDs

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Beryllium, SWMU 59

Background Data: BerylliumBG

Raw Statistics

	Site	Background
Number of Valid Observations	10	18
Number of Distinct Observations	9	17
Minimum	0.12	0.052
Maximum	0.5	0.7
Mean	0.259	0.259
Median	0.24	0.255
SD	0.124	0.169
SE of Mean	0.0393	0.0397

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

Method	DF	t-Test Value	Critical t (0.050)	P-Value
Pooled (Equal Variance)	26	0	1.706	0.5
Welch-Satterthwaite (Unequal Varianc	23.7	0	1.711	0.5

Pooled SD 0.155

Conclusion with Alpha = 0.050

* Student t (Pooled) Test: Do Not Reject H0, Conclude Site <= Background
* Welch-Satterthwaite Test: Do Not Reject H0, Conclude Site <= Background

Test of Equality of Variances

Variance of Site	0.0155
Variance of Background	0.0284

Numerator DF	Denominator DF	F-Test Value	P-Value
17	9	1.839	0.354

Conclusion with Alpha = 0.05

* Two variances appear to be equal

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Chromium, SWMU 59

Background Data: ChromiumBG

Raw Statistics

	Site	Background
Number of Valid Data	10	18
Number of Non-Detect Data	0	0
Number of Detect Data	10	18
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	16	3.9
Maximum Detected	120	148
Mean of Detected Data	59.6	37.31
Median of Detected Data	61.5	21.5
SD of Detected Data	34.93	38.59

Wilcoxon-Mann-Whitney Site vs Background Test

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	184
WMW Test U-Stat	129
WMW Critical Value (0.050)	124
Approximate P-Value	0.0325

Conclusion with Alpha = 0.05

Reject H0, Conclude Site > Background

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Cobalt, SWMU 59

Background Data: CobaltBG

Raw Statistics

	Site	Background
Number of Valid Data	10	18
Number of Non-Detect Data	0	1
Number of Detect Data	10	17
Minimum Non-Detect	N/A	1.2
Maximum Non-Detect	N/A	1.2
Percent Non detects	0.00%	5.56%
Minimum Detected	3.5	0.83
Maximum Detected	24	33.8
Mean of Detected Data	14.02	9.619
Median of Detected Data	15	6.5
SD of Detected Data	5.97	8.907

Wilcoxon-Mann-Whitney Site vs Background Test

All observations <= 1.2 (Max DL) are ranked the same

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	182.5
WMW Test U-Stat	127.5
WMW Critical Value (0.050)	124
Approximate P-Value	0.038

Conclusion with Alpha = 0.05

Reject H0, Conclude Site > Background

t-Test Site vs Background Comparison for Full Data Sets without NDs

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Copper, SWMU 59

Background Data: CopperBG

Raw Statistics

	Site	Background
Number of Valid Observations	10	17
Number of Distinct Observations	8	17
Minimum	48	18
Maximum	210	260
Mean	102.7	105
Median	99.5	89
SD	48.39	70.54
SE of Mean	15.3	17.11

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

Method	DF	t-Test Value	Critical t (0.050)	P-Value
Pooled (Equal Variance)	25	-0.09	1.708	0.535
Welch-Satterthwaite (Unequal Varianc	24.2	-0.099	1.711	0.539

Pooled SD 63.459

Conclusion with Alpha = 0.050

* Student t (Pooled) Test: Do Not Reject H0, Conclude Site <= Background
* Welch-Satterthwaite Test: Do Not Reject H0, Conclude Site <= Background

Test of Equality of Variances

Variance of Site	2341
Variance of Background	4975

Numerator DF	Denominator DF	F-Test Value	P-Value
16	9	2.125	0.253

Conclusion with Alpha = 0.05

* Two variances appear to be equal

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Nickel, SWMU 59

Background Data: NickelBG

Raw Statistics

	Site	Background
Number of Valid Data	10	18
Number of Non-Detect Data	0	0
Number of Detect Data	10	18
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	5.7	1.1
Maximum Detected	44	35.6
Mean of Detected Data	25.37	7.889
Median of Detected Data	25.5	5.85
SD of Detected Data	12.28	8.387

Wilcoxon-Mann-Whitney Site vs Background Test

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	215.5
WMW Test U-Stat	160.5
WMW Critical Value (0.050)	124
Approximate P-Value	0.0003951

Conclusion with Alpha = 0.05

Reject H0, Conclude Site > Background

t-Test Site vs Background Comparison for Full Data Sets without NDs

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Vanadium, SWMU 59

Background Data: VanadiumBG

Raw Statistics

	Site	Background
Number of Valid Observations	10	19
Number of Distinct Observations	7	17
Minimum	110	25
Maximum	400	410
Mean	223	208.6
Median	180	200
SD	92.02	112.7
SE of Mean	29.1	25.87

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

Method	DF	t-Test Value	Critical t (0.050)	P-Value
Pooled (Equal Variance)	27	0.347	1.703	0.365
Welch-Satterthwaite (Unequal Varian	22	0.371	1.717	0.357

Pooled SD 106.286

Conclusion with Alpha = 0.050

* Student t (Pooled) Test: Do Not Reject H0, Conclude Site <= Background
* Welch-Satterthwaite Test: Do Not Reject H0, Conclude Site <= Background

Test of Equality of Variances

Variance of Site	8468
Variance of Background	12711

Numerator DF	Denominator DF	F-Test Value	P-Value
18	9	1.501	0.543

Conclusion with Alpha = 0.05

* Two variances appear to be equal

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Zinc, SWMU 59

Background Data: ZincBG

Raw Statistics

	Site	Background
Number of Valid Data	10	19
Number of Non-Detect Data	0	1
Number of Detect Data	10	18
Minimum Non-Detect	N/A	27
Maximum Non-Detect	N/A	27
Percent Non detects	0.00%	5.26%
Minimum Detected	35	3.9
Maximum Detected	77	98
Mean of Detected Data	53.3	38.68
Median of Detected Data	51.5	32.9
SD of Detected Data	13.7	25.41

Wilcoxon-Mann-Whitney Site vs Background Test

All observations <= 27 (Max DL) are ranked the same

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	194
WMW Test U-Stat	139
WMW Critical Value (0.050)	131
Approximate P-Value	0.023

Conclusion with Alpha = 0.05

Reject H0, Conclude Site > Background

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Beryllium, SWMU 59

Background Data: BerylliumBG

Raw Statistics

	Site	Background
Number of Valid Data	10	18
Number of Non-Detect Data	0	0
Number of Detect Data	10	18
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	0.12	0.052
Maximum Detected	0.5	0.7
Mean of Detected Data	0.259	0.259
Median of Detected Data	0.24	0.255
SD of Detected Data	0.124	0.169

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.056)	8
Approximate K Value (0.056)	5
Number of Site Observations in 'R' Largest	3
Calculated Alpha	0.0772

Conclusion with Alpha = 0.056

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Chromium, SWMU 59

Background Data: ChromiumBG

Raw Statistics

	Site	Background
Number of Valid Data	10	18
Number of Non-Detect Data	0	0
Number of Detect Data	10	18
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	16	3.9
Maximum Detected	120	148
Mean of Detected Data	59.6	37.31
Median of Detected Data	61.5	21.5
SD of Detected Data	34.93	38.59

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.056)	8
Approximate K Value (0.056)	5
Number of Site Observations in 'R' Largest	4
Calculated Alpha	0.0772

Conclusion with Alpha = 0.056

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Cobalt, SWMU 59

Background Data: CobaltBG

Raw Statistics

	Site	Background
Number of Valid Data	10	18
Number of Non-Detect Data	0	1
Number of Detect Data	10	17
Minimum Non-Detect	N/A	1.2
Maximum Non-Detect	N/A	1.2
Percent Non detects	0.00%	5.56%
Minimum Detected	3.5	0.83
Maximum Detected	24	33.8
Mean of Detected Data	14.02	9.619
Median of Detected Data	15	6.5
SD of Detected Data	5.97	8.907

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.056)	8
Approximate K Value (0.056)	5
R Value Adjusted for Ties in Data	11
K Value Adjusted for Ties in Data	8
Number of Site Observations in 'R' Largest	7
Calculated Alpha	0.0772

Conclusion with Alpha = 0.056

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Copper, SWMU 59

Background Data: CopperBG

Raw Statistics

	Site	Background
Number of Valid Data	10	17
Number of Non-Detect Data	0	0
Number of Detect Data	10	17
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	48	18
Maximum Detected	210	260
Mean of Detected Data	102.7	105
Median of Detected Data	99.5	89
SD of Detected Data	48.39	70.54

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.052)	3
Approximate K Value (0.052)	3
Number of Site Observations in 'R' Largest	1
Calculated Alpha	0.041

Conclusion with Alpha = 0.052

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Nickel, SWMU 59

Background Data: NickelBG

Raw Statistics

	Site	Background
Number of Valid Data	10	18
Number of Non-Detect Data	0	0
Number of Detect Data	10	18
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	5.7	1.1
Maximum Detected	44	35.6
Mean of Detected Data	25.37	7.889
Median of Detected Data	25.5	5.85
SD of Detected Data	12.28	8.387

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.056)	8
Approximate K Value (0.056)	5
Number of Site Observations in 'R' Largest	7
Calculated Alpha	0.0772

Conclusion with Alpha = 0.056

Reject H0, Conclude Site Concentration > Background Concentration

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Vanadium, SWMU 59

Background Data: VanadiumBG

Raw Statistics

	Site	Background
Number of Valid Data	10	19
Number of Non-Detect Data	0	0
Number of Detect Data	10	19
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	110	25
Maximum Detected	400	410
Mean of Detected Data	223	208.6
Median of Detected Data	180	200
SD of Detected Data	92.02	112.7

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.056)	8
Approximate K Value (0.056)	5
Number of Site Observations in 'R' Largest	4
Calculated Alpha	0.0658

Conclusion with Alpha = 0.056

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Zinc, SWMU 59

Background Data: ZincBG

Raw Statistics

	Site	Background
Number of Valid Data	10	19
Number of Non-Detect Data	0	1
Number of Detect Data	10	18
Minimum Non-Detect	N/A	27
Maximum Non-Detect	N/A	27
Percent Non detects	0.00%	5.26%
Minimum Detected	35	3.9
Maximum Detected	77	98
Mean of Detected Data	53.3	38.68
Median of Detected Data	51.5	32.9
SD of Detected Data	13.7	25.41

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

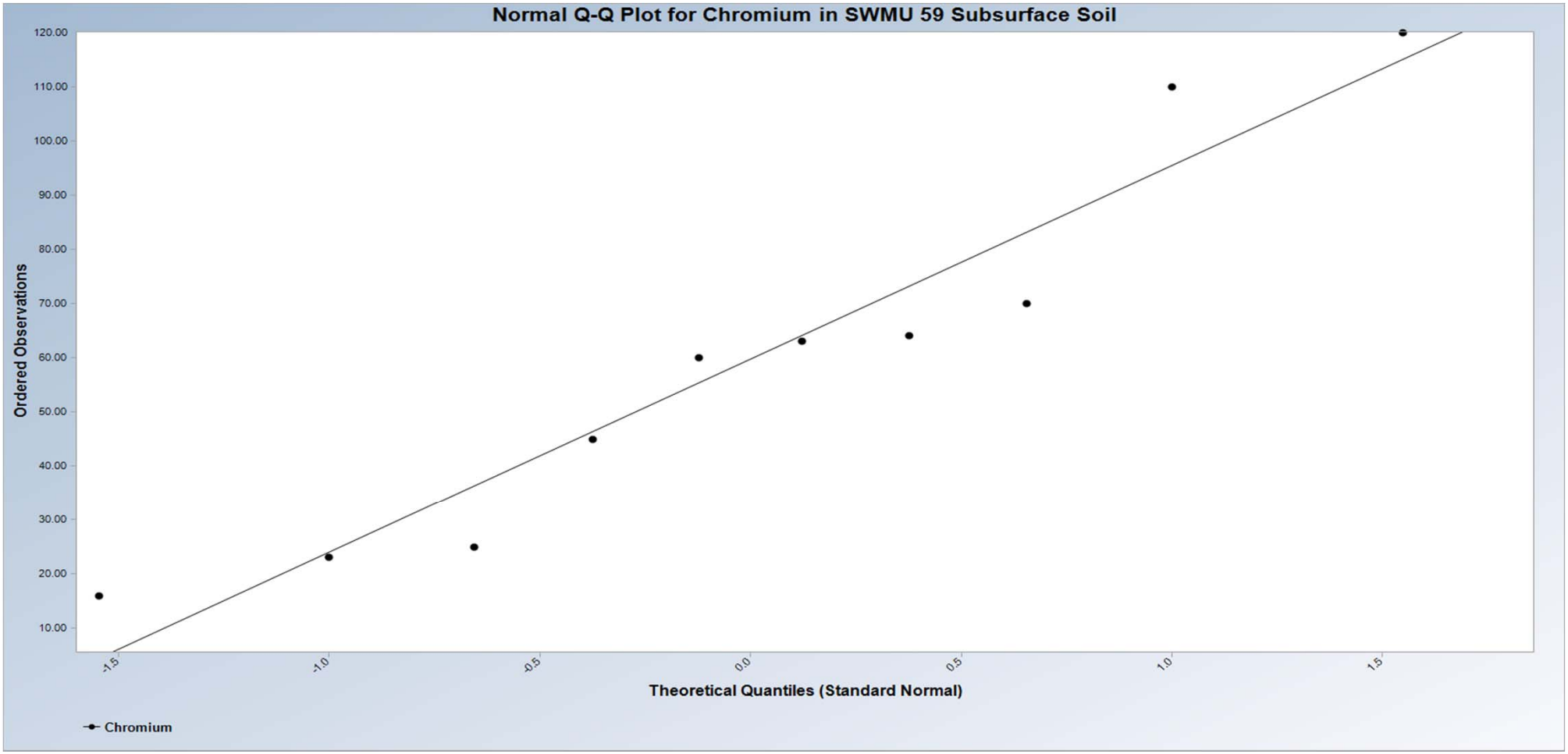
Approximate R Value (0.056)	8
Approximate K Value (0.056)	5
Number of Site Observations in 'R' Largest	4
Calculated Alpha	0.0658

Conclusion with Alpha = 0.056

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

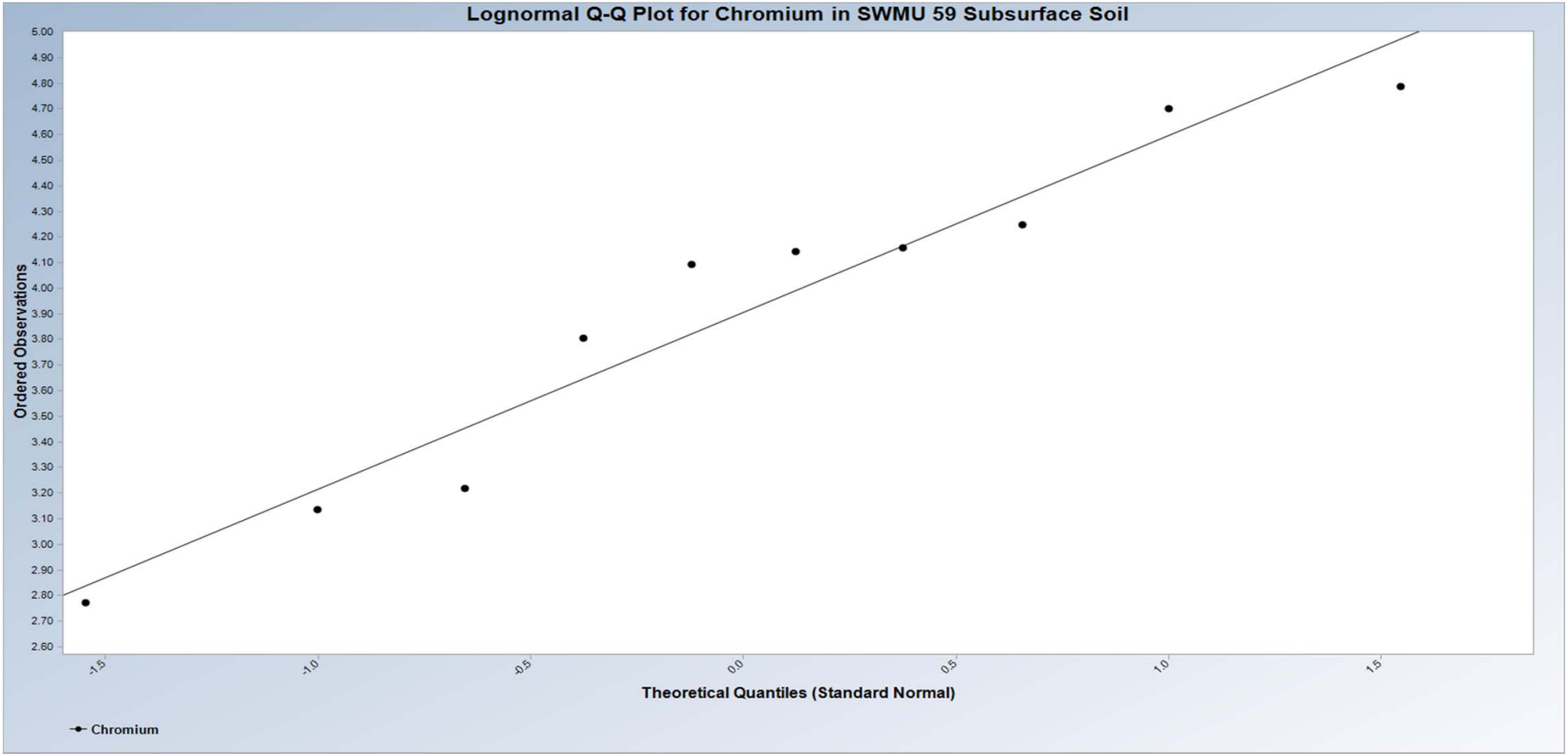
APPENDIX K

PROBABILITY PLOT - CHROMIUM IN SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



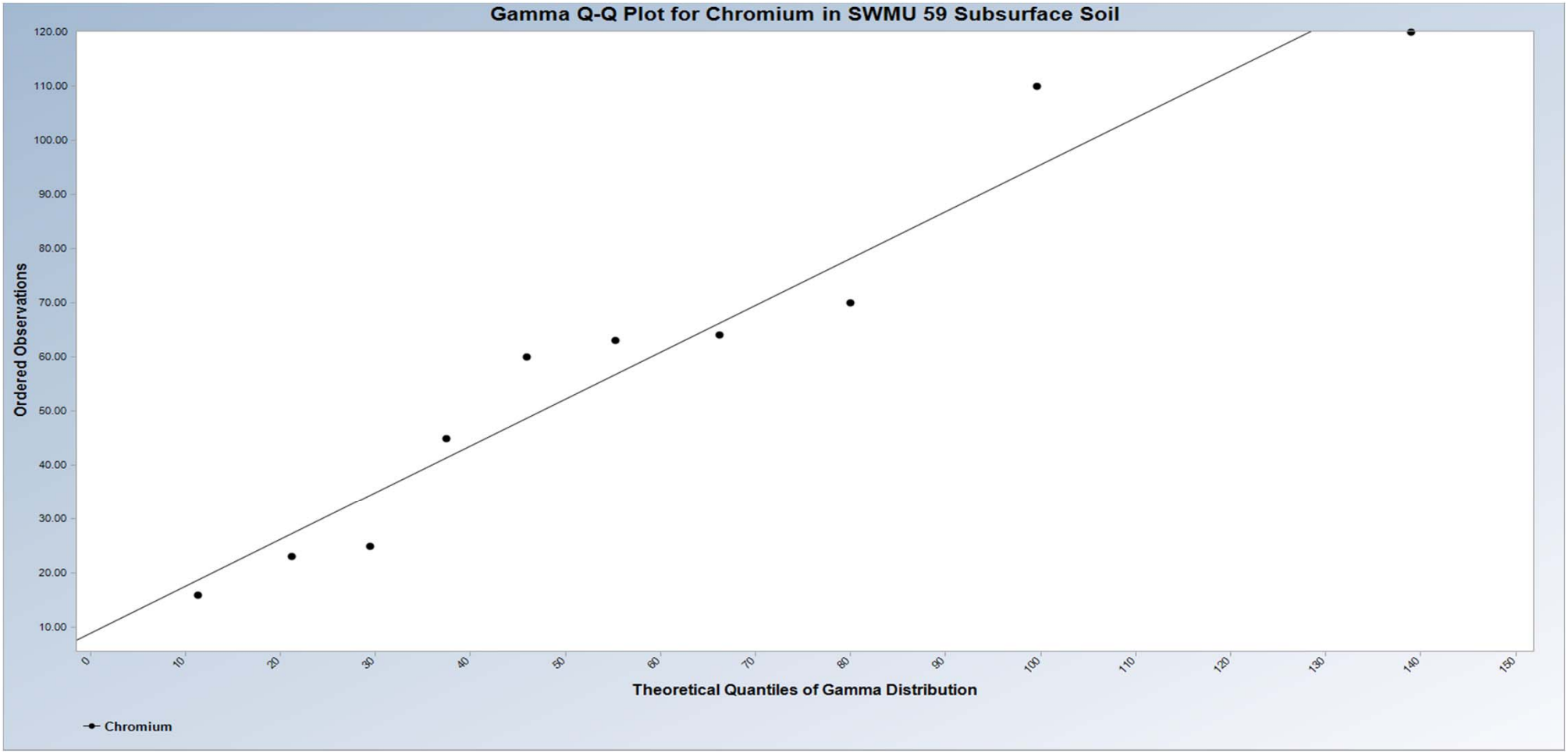
APPENDIX K

PROBABILITY PLOT - CHROMIUM IN SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



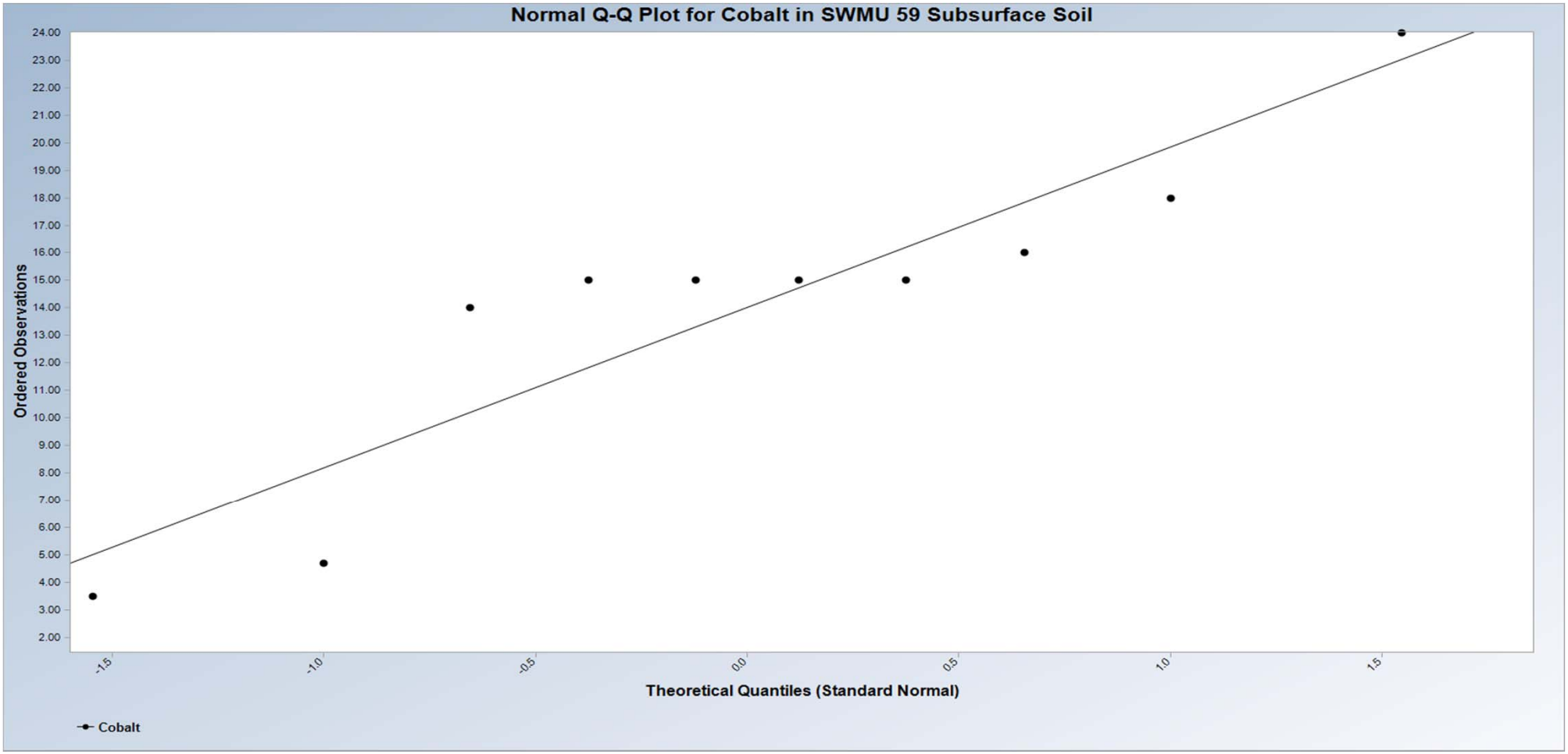
APPENDIX K

PROBABILITY PLOT - CHROMIUM IN SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



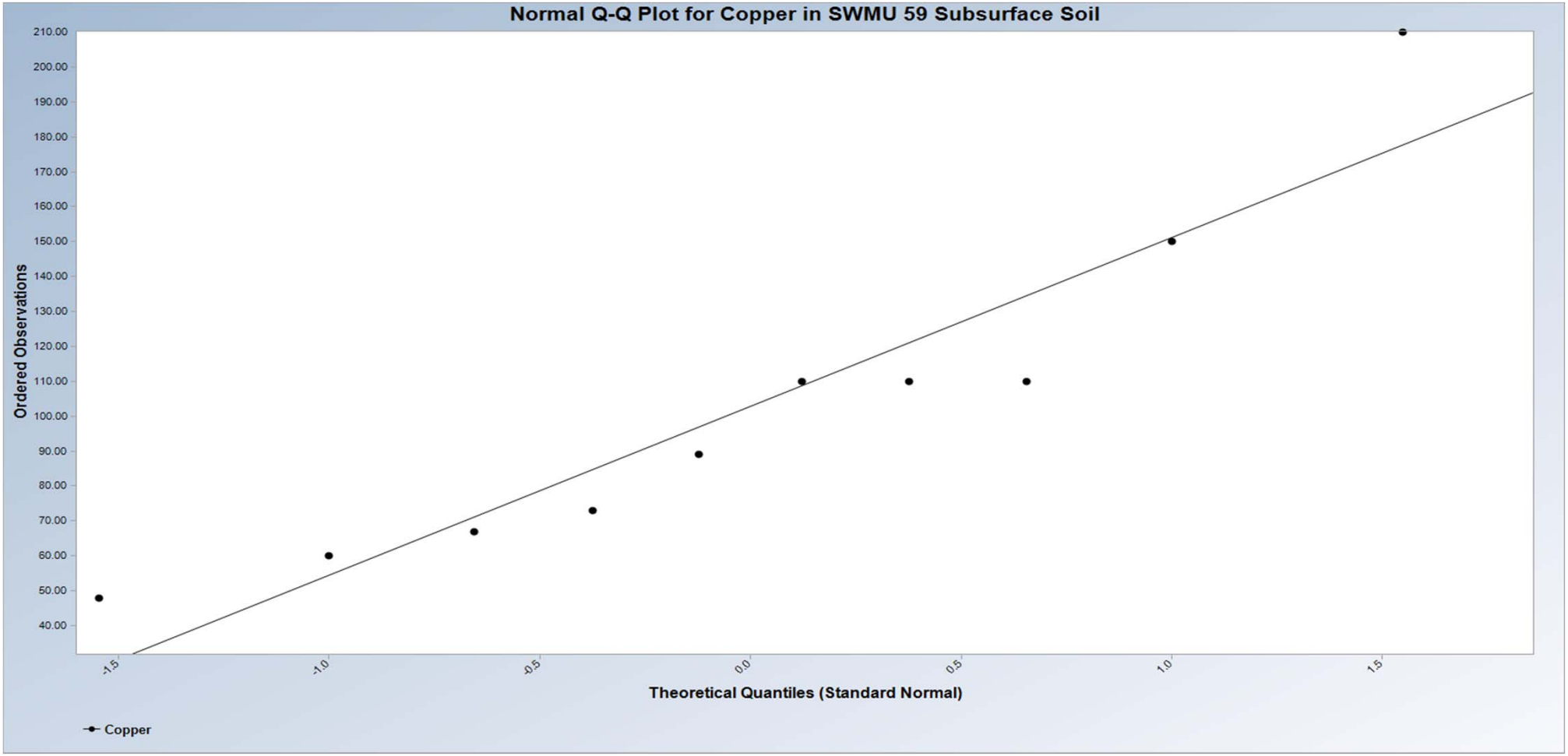
APPENDIX K

PROBABILITY PLOT - COBALT IN SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



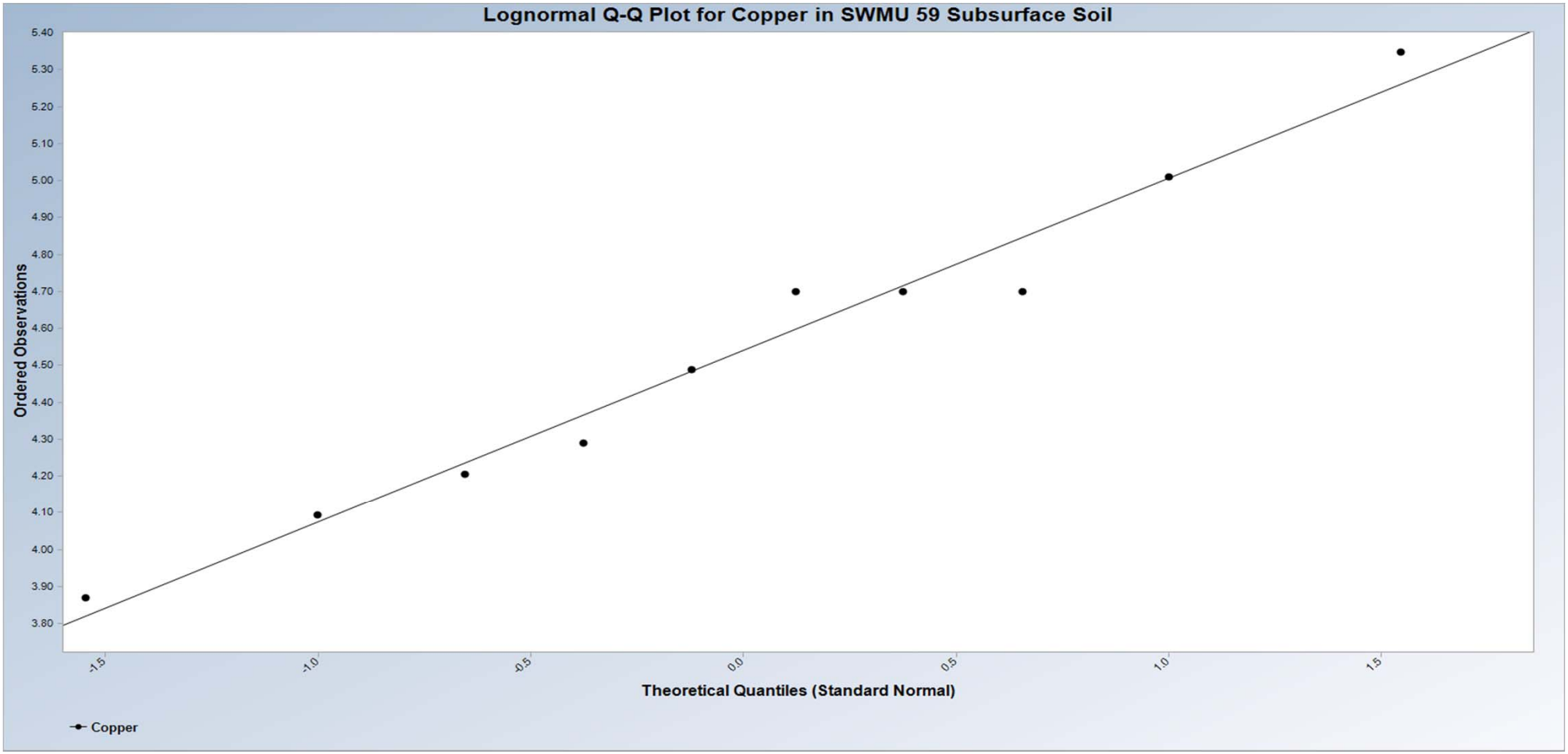
APPENDIX K

PROBABILITY PLOT - COPPER IN SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



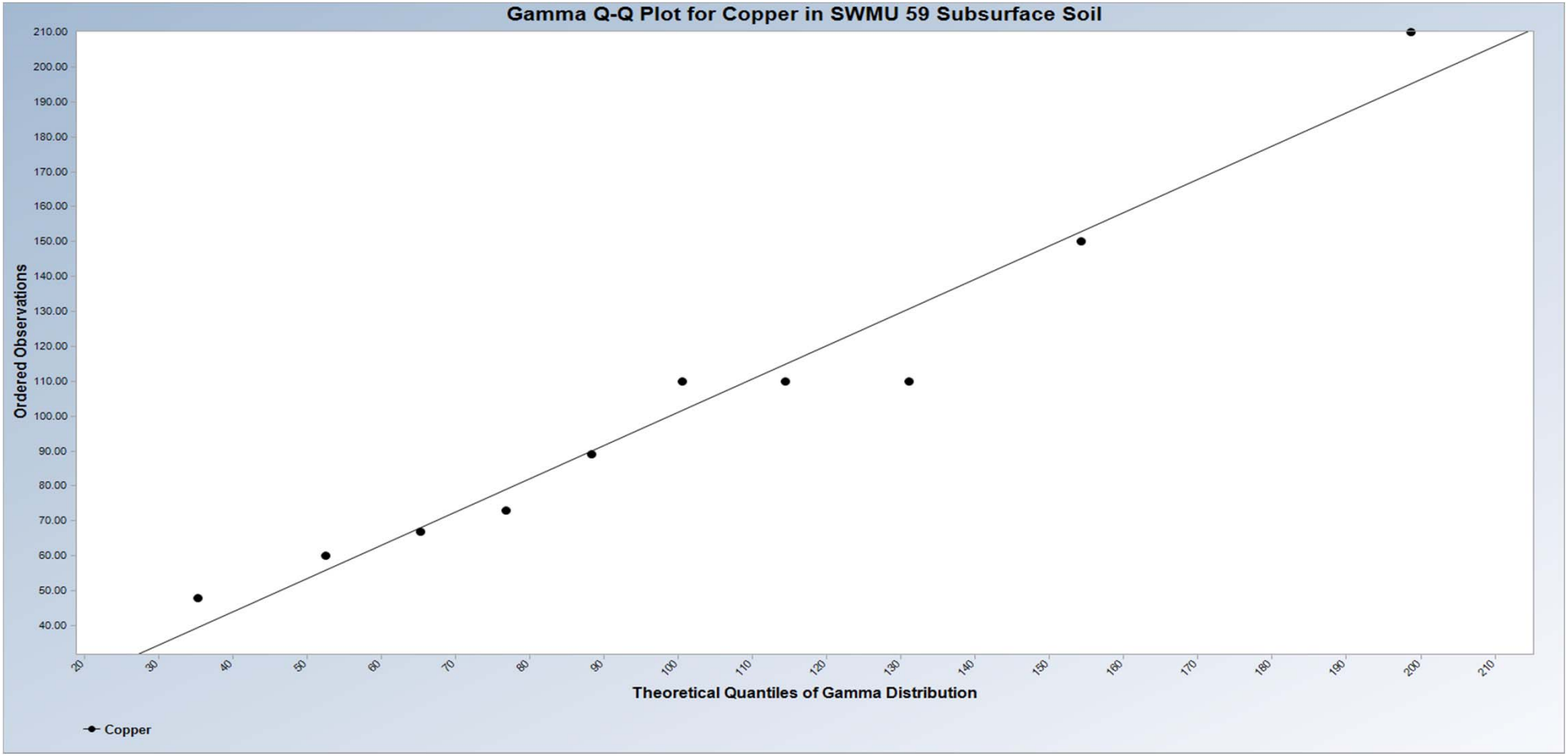
APPENDIX K

PROBABILITY PLOT - COPPER IN SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



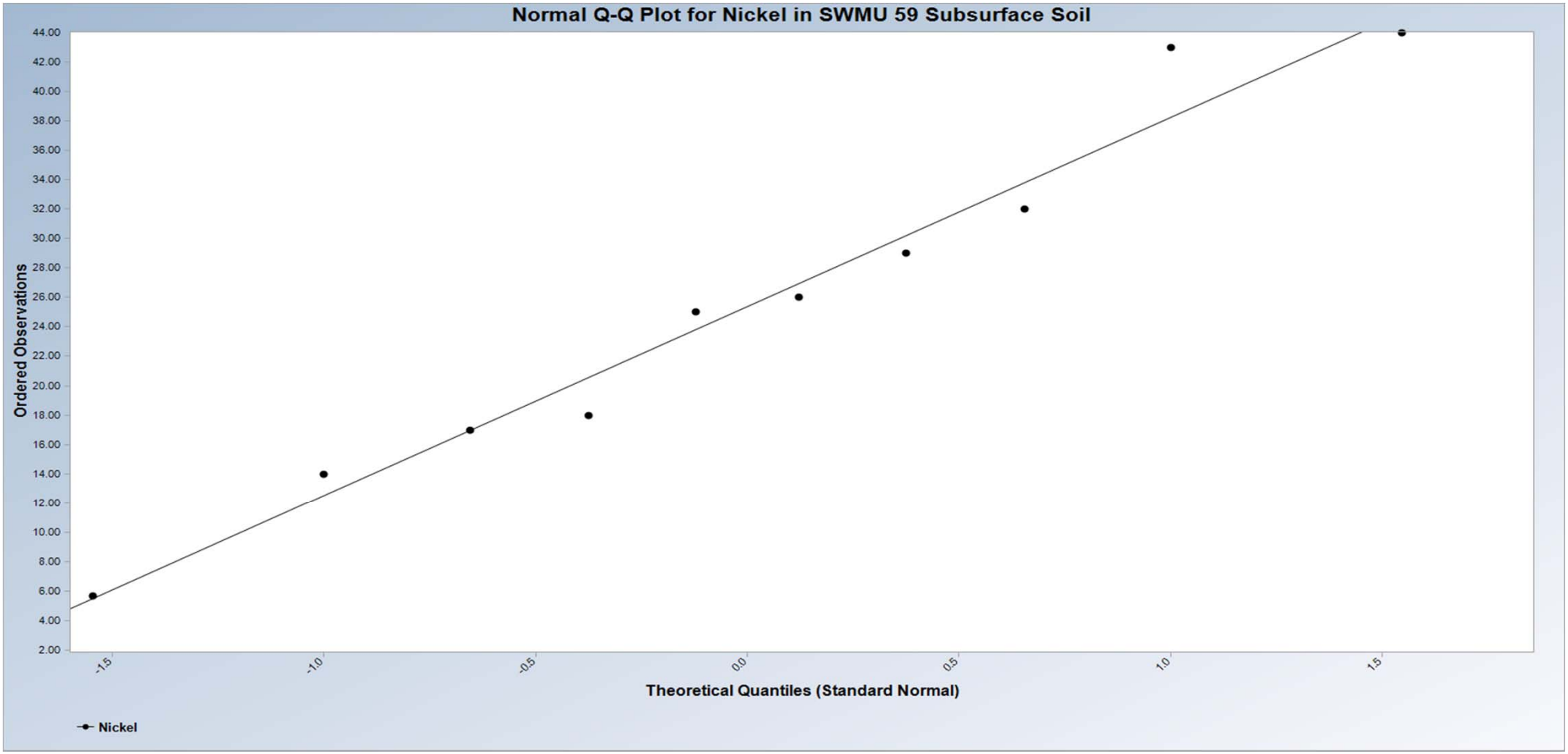
APPENDIX K

PROBABILITY PLOT - COPPER IN SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



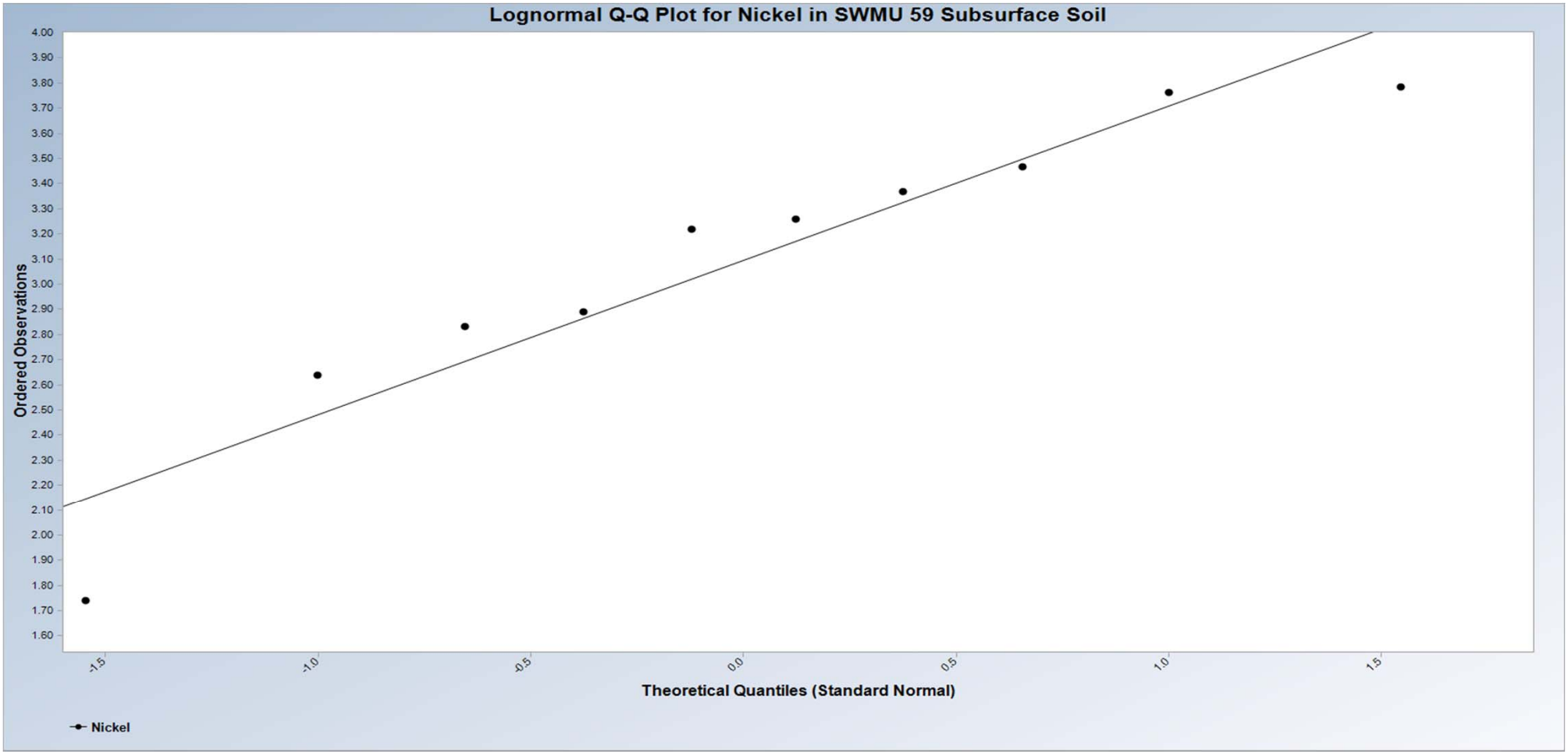
APPENDIX K

PROBABILITY PLOT - NICKEL IN SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



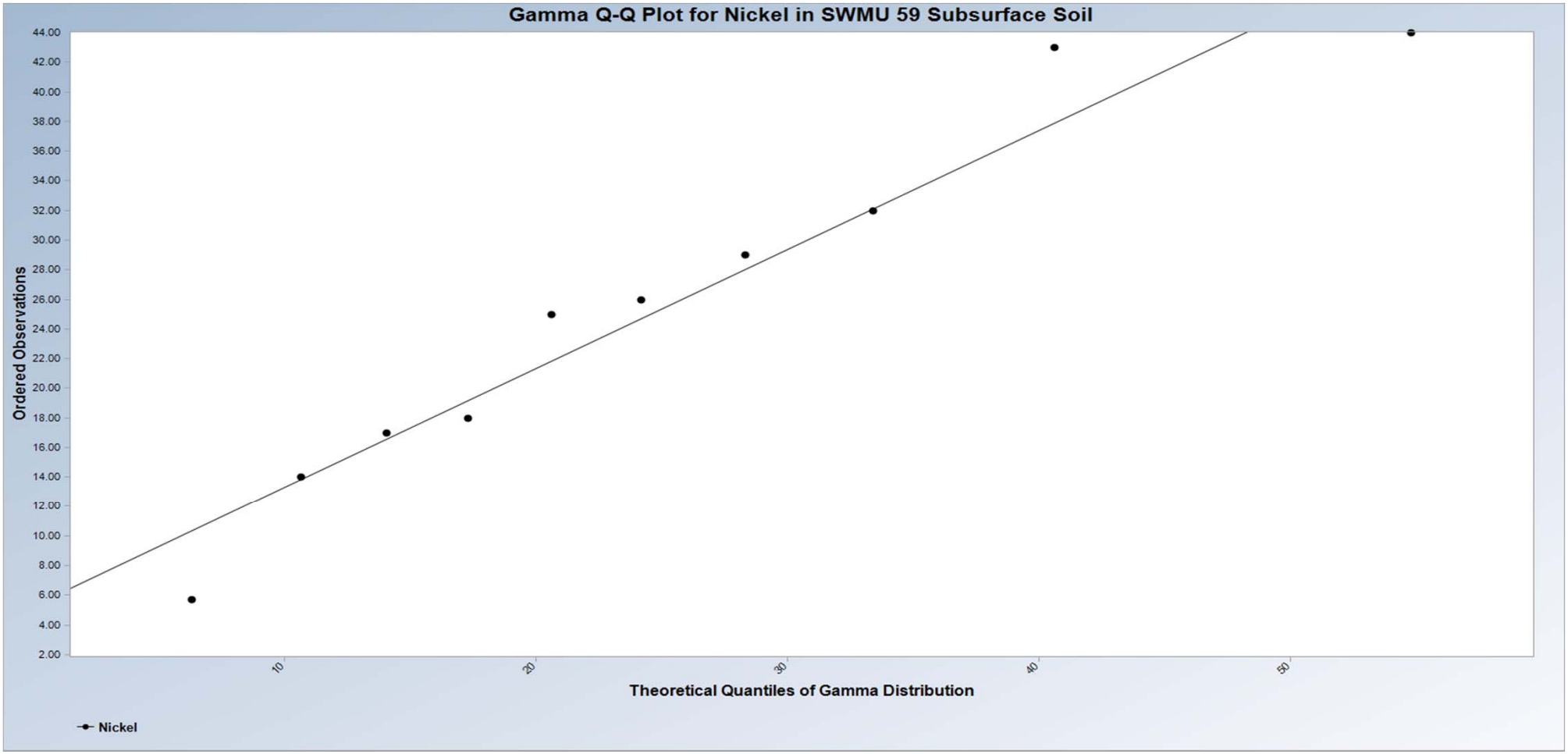
APPENDIX K

PROBABILITY PLOT - NICKEL IN SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



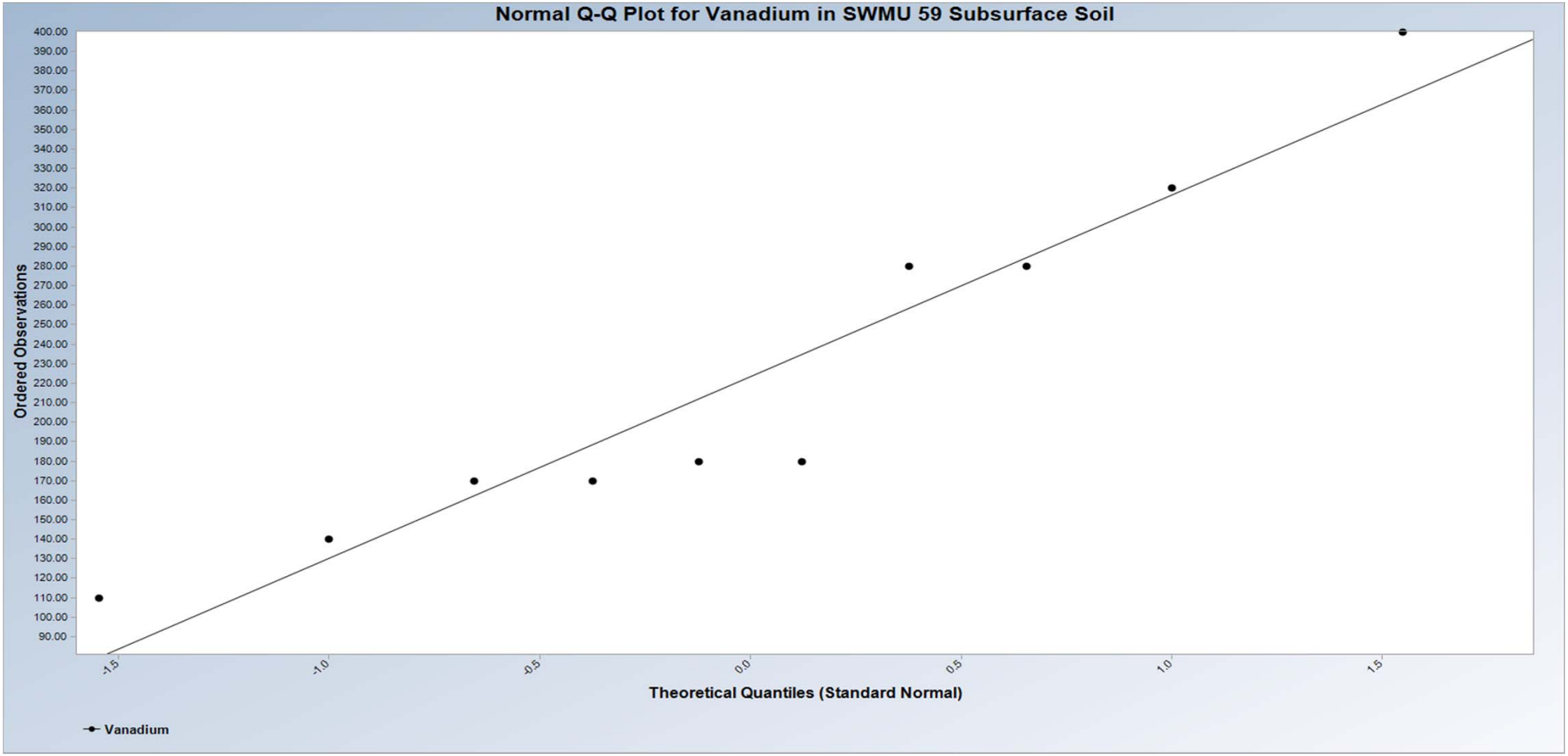
APPENDIX K

PROBABILITY PLOT - NICKEL IN SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



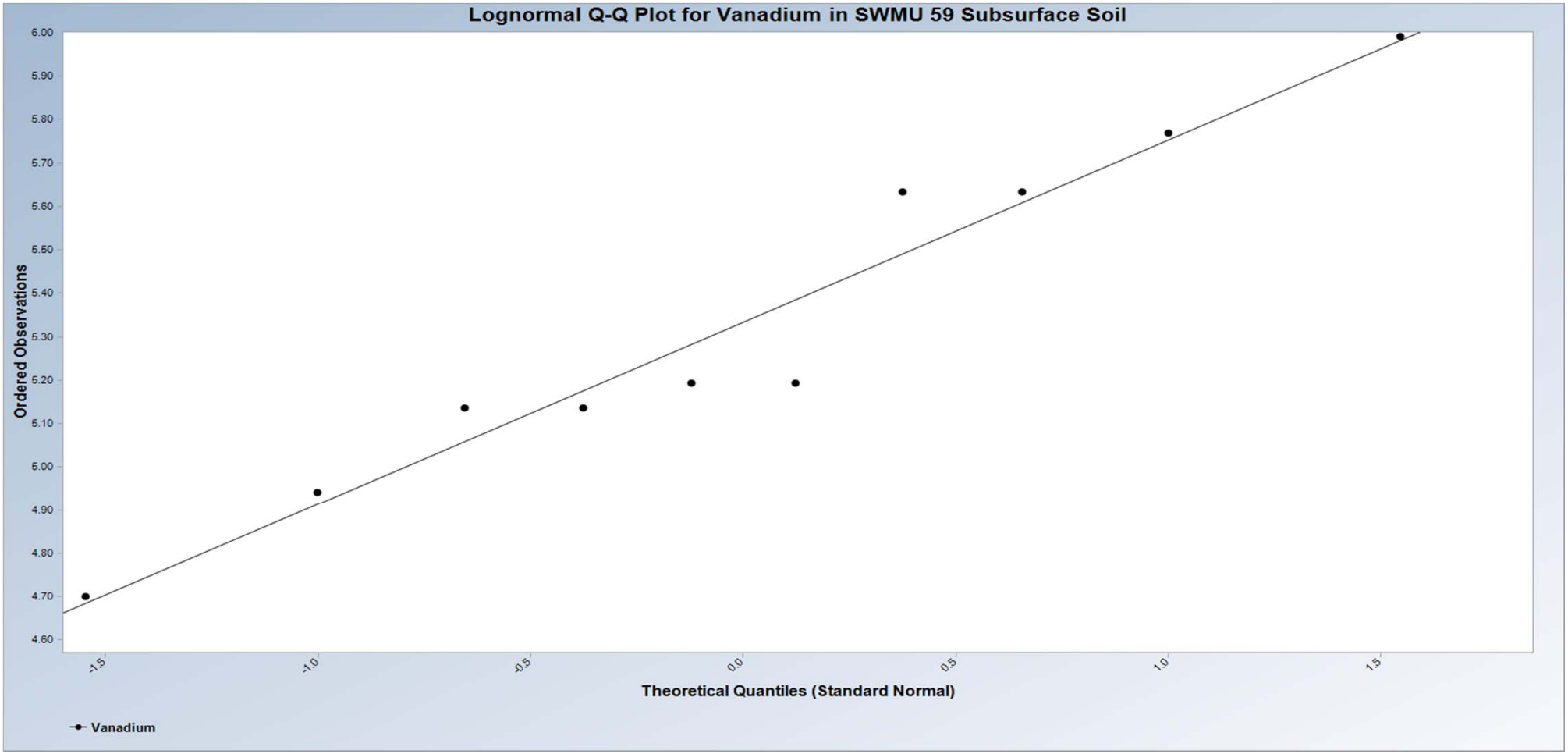
APPENDIX K

PROBABILITY PLOT - VANADIUM IN SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



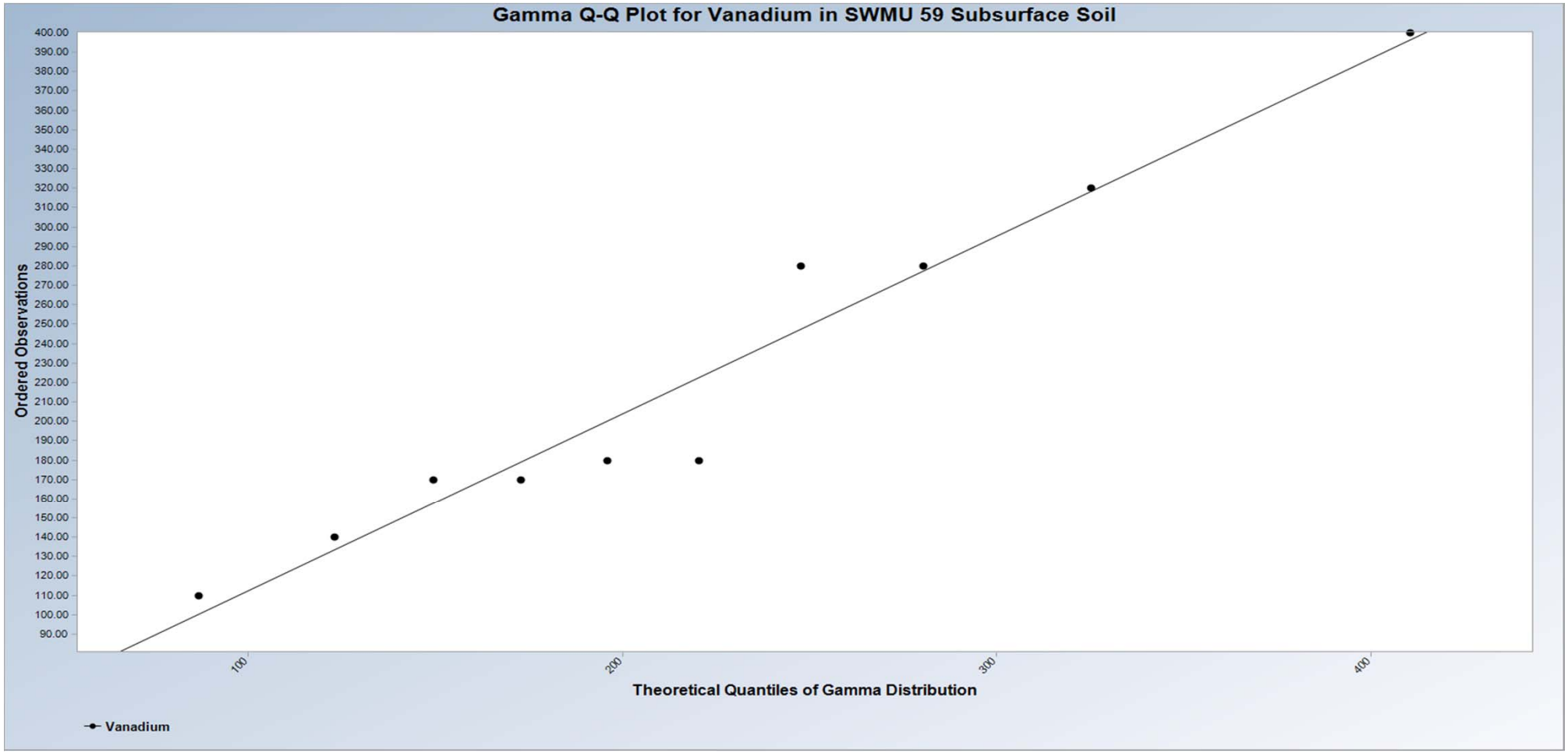
APPENDIX K

PROBABILITY PLOT - VANADIUM IN SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



APPENDIX K

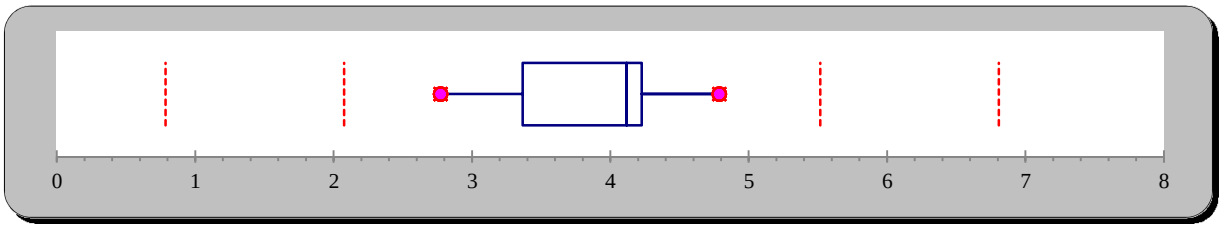
PROBABILITY PLOT - VANADIUM IN SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



Box and Whisker Plot

Chromium: SWMU 59 Subsurface Soil, 2012 CMS Investigation
(Log-Transformed Analytical Data)

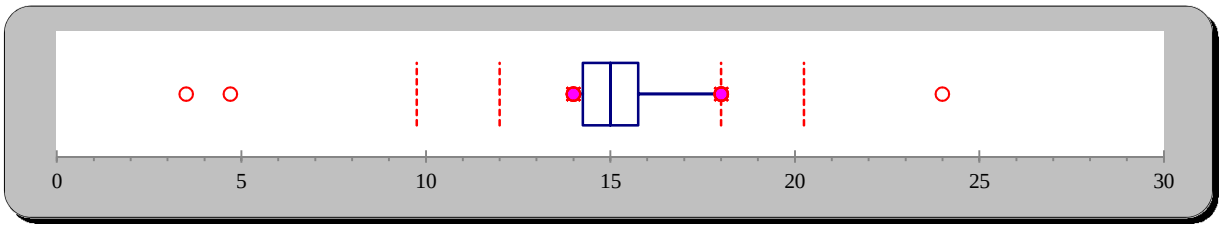
Lower Whisker	Lower Hinge	Median	Upper Hinge	Upper Whisker
2.7725887	3.3658225	4.1187396	4.2260922	4.7874917



Box and Whisker Plot

Cobalt: SWMU 59 Subsurface Soil, 2012 CMS Investigation
(Non-Transformed Analytical Data)

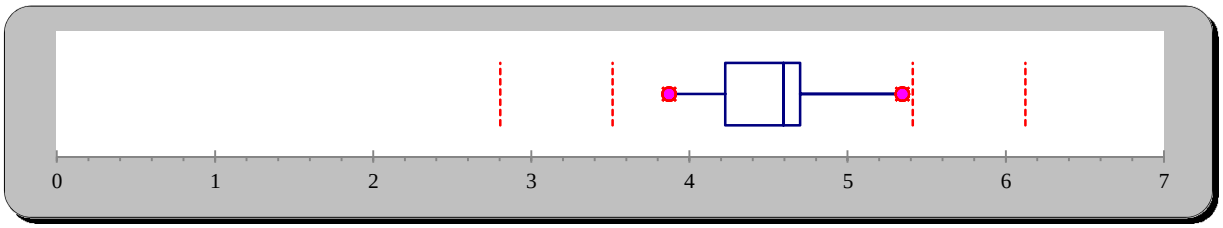
Lower Whisker	Lower Hinge	Median	Upper Hinge	Upper Whisker
14	14.25	15	15.75	18



Box and Whisker Plot

Copper: SWMU 59 Subsurface Soil, 2012 CMS Investigation
(Log-Transformed Analytical Data)

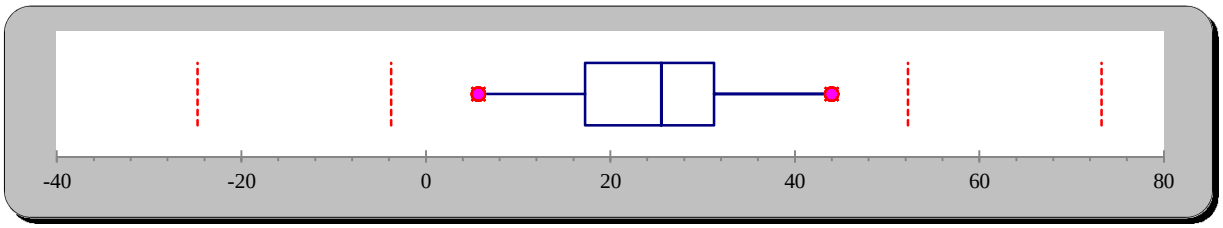
Lower Whisker	Lower Hinge	Median	Upper Hinge	Upper Whisker
3.871201	4.2261343	4.5945584	4.7004804	5.3471075



Box and Whisker Plot

Nickel: SWMU 59 Subsurface Soil, 2012 CMS Investigation
(Non-Transformed Analytical Data)

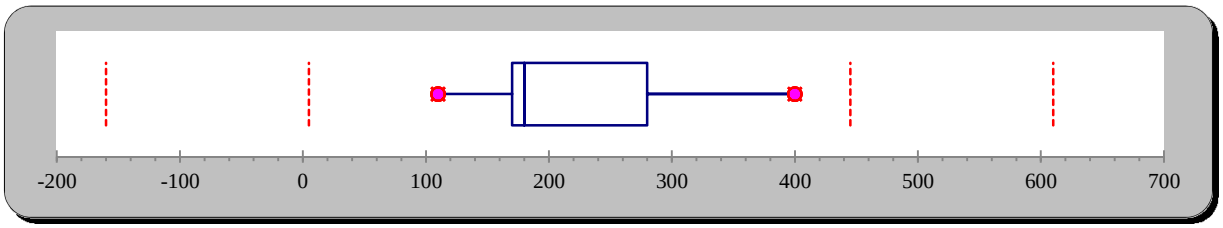
Lower Whisker	Lower Hinge	Median	Upper Hinge	Upper Whisker
5.7	17.25	25.5	31.25	44



Box and Whisker Plot

Vanadium: SWMU 59 Subsurface Soil, 2012 CMS Investigation
(Non-Transformed Analytical Data)

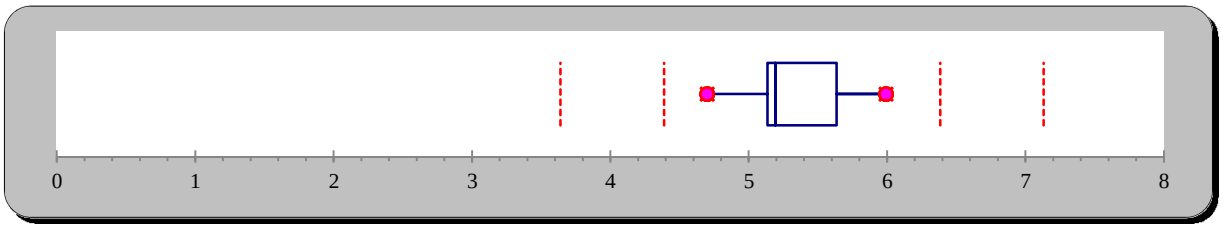
Lower Whisker	Lower Hinge	Median	Upper Hinge	Upper Whisker
110	170	180	280	400



Box and Whisker Plot

Vanadium: SWMU 59 Subsurface Soil, 2012 CMS Investigation
(Log-Transformed Analytical Data)

Lower Whisker	Lower Hinge	Median	Upper Hinge	Upper Whisker
4.7004804	5.1357984	5.1929569	5.6347896	5.9914645



APPENDIX L
GROUNDWATER STATISTICS

General UCL Statistics for Data Sets with Non-Detects

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Copper (Total): SWMU 59 Groundwater

General Statistics

Number of Valid Observations	10	Number of Distinct Observations	10

Raw Statistics		Log-transformed Statistics	
Minimum	3.9	Minimum of Log Data	1.361
Maximum	21.3	Maximum of Log Data	3.059
Mean	9.51	Mean of log Data	2.077
Geometric Mean	7.982	SD of log Data	0.607
Median	8.1		
SD	6.323		
Std. Error of Mean	2		
Coefficient of Variation	0.665		
Skewness	1.265		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.801	Shapiro Wilk Test Statistic	0.903
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	13.18	95% H-UCL	15.53
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	17.46
95% Adjusted-CLT UCL (Chen-1995)	13.65	97.5% Chebyshev (MVUE) UCL	20.95
95% Modified-t UCL (Johnson-1978)	13.31	99% Chebyshev (MVUE) UCL	27.8

Gamma Distribution Test		Data Distribution
k star (bias corrected)	2.174	Data appear Gamma Distributed at 5% Significance Level
Theta Star	4.374	
MLE of Mean	9.51	
MLE of Standard Deviation	6.45	
nu star	43.48	
Approximate Chi Square Value (.05)	29.36	**Nonparametric Statistics**
Adjusted Level of Significance	0.0267	95% CLT UCL 12.8
Adjusted Chi Square Value	27.36	95% Jackknife UCL 13.18
		95% Standard Bootstrap UCL 12.55
Anderson-Darling Test Statistic	0.551	95% Bootstrap-t UCL 17.1
Anderson-Darling 5% Critical Value	0.732	95% Hall's Bootstrap UCL 32.81
Kolmogorov-Smirnov Test Statistic	0.19	95% Percentile Bootstrap UCL 12.84
Kolmogorov-Smirnov 5% Critical Value	0.268	95% BCA Bootstrap UCL 13.55
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 18.23
		97.5% Chebyshev(Mean, Sd) UCL 22
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 29.41
95% Approximate Gamma UCL (Use when n >= 40)	14.08	
95% Adjusted Gamma UCL (Use when n < 40)	15.11	

Potential UCL to Use	Use 95% Approximate Gamma UCL 14.08

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Copper (Total): NAPR Basewide Background, Groundwater

General Statistics

Number of Valid Data	12	Number of Detected Data	11
Number of Distinct Detected Data	11	Number of Non-Detect Data	1
		Percent Non-Detects	8.33%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	8.5	Minimum Detected	2.14
Maximum Detected	352	Maximum Detected	5.864
Mean of Detected	124.8	Mean of Detected	4.295
SD of Detected	108.1	SD of Detected	1.27
Minimum Non-Detect	0.5	Minimum Non-Detect	-0.693
Maximum Non-Detect	0.5	Maximum Non-Detect	-0.693

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.911	Shapiro Wilk Test Statistic	0.904
5% Shapiro Wilk Critical Value	0.85	5% Shapiro Wilk Critical Value	0.85
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	114.4	Mean	3.821
SD	109.2	SD	2.038
95% DL/2 (t) UCL	171	95% H-Stat (DL/2) UCL	8099
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	109.5	Mean in Log Scale	4.044
SD	112	SD in Log Scale	1.49
95% MLE (t) UCL	167.5	Mean in Original Scale	114.7
95% MLE (Tiku) UCL	166.1	SD in Original Scale	108.9
		95% t UCL	171.1
		95% Percentile Bootstrap UCL	165.2
		95% BCA Bootstrap UCL	167.7
		95% H UCL	986.5

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.843	Data appear Normal at 5% Significance Level	
Theta Star	148		
nu star	18.55		
A-D Test Statistic	0.286	Nonparametric Statistics	
5% A-D Critical Value	0.75	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.75	Mean	115.1
5% K-S Critical Value	0.262	SD	103.8
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	31.43
		95% KM (t) UCL	171.5
Assuming Gamma Distribution		95% KM (z) UCL	166.8
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	171.3
Minimum	0.000001	95% KM (bootstrap t) UCL	187.6
Maximum	352	95% KM (BCA) UCL	171.4
Mean	114.4	95% KM (Percentile Bootstrap) UCL	167.2
Median	91.95	95% KM (Chebyshev) UCL	252.1
SD	109.2	97.5% KM (Chebyshev) UCL	311.4
k star	0.314	99% KM (Chebyshev) UCL	427.9
Theta star	364		
Nu star	7.542	Potential UCLs to Use	
AppChi2	2.473	95% KM (t) UCL	171.5
95% Gamma Approximate UCL (Use when n >= 40)	348.9	95% KM (Percentile Bootstrap) UCL	167.2
95% Adjusted Gamma UCL (Use when n < 40)	420.2		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Vanadium (Total): SWMU 59 Groundwater

General Statistics

Number of Valid Observations	10	Number of Distinct Observations	10

Raw Statistics		Log-transformed Statistics	
Minimum	9.2	Minimum of Log Data	2.219
Maximum	171	Maximum of Log Data	5.142
Mean	63.29	Mean of log Data	3.797
Geometric Mean	44.57	SD of log Data	0.934
Median	48.15		
SD	51.83		
Std. Error of Mean	16.39		
Coefficient of Variation	0.819		
Skewness	0.979		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.885	Shapiro Wilk Test Statistic	0.945
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	93.34	95% H-UCL	173.7
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	152.8
95% Adjusted-CLT UCL (Chen-1995)	95.67	97.5% Chebyshev (MVUE) UCL	190.7
95% Modified-t UCL (Johnson-1978)	94.18	99% Chebyshev (MVUE) UCL	265.2

Gamma Distribution Test		Data Distribution
k star (bias corrected)	1.167	Data appear Normal at 5% Significance Level
Theta Star	54.24	
MLE of Mean	63.29	
MLE of Standard Deviation	58.59	
nu star	23.34	
Approximate Chi Square Value (.05)	13.34	**Nonparametric Statistics**
Adjusted Level of Significance	0.0267	95% CLT UCL 90.25
Adjusted Chi Square Value	12.05	95% Jackknife UCL 93.34
		95% Standard Bootstrap UCL 89.55
Anderson-Darling Test Statistic	0.364	95% Bootstrap-t UCL 103.9
Anderson-Darling 5% Critical Value	0.739	95% Hall's Bootstrap UCL 96.3
Kolmogorov-Smirnov Test Statistic	0.208	95% Percentile Bootstrap UCL 91.69
Kolmogorov-Smirnov 5% Critical Value	0.271	95% BCA Bootstrap UCL 94.55
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 134.7
		97.5% Chebyshev(Mean, Sd) UCL 165.6
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 226.4
95% Approximate Gamma UCL (Use when n >= 40)	110.7	
95% Adjusted Gamma UCL (Use when n < 40)	122.6	

Potential UCL to Use	Use 95% Student's-t UCL 93.34

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Vanadium (Total): NAPR Basewide Background, Groundwater

General Statistics

Number of Valid Data	12	Number of Detected Data	11
Number of Distinct Detected Data	11	Number of Non-Detect Data	1
		Percent Non-Detects	8.33%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	1.7	Minimum Detected	0.531
Maximum Detected	549	Maximum Detected	6.308
Mean of Detected	175.1	Mean of Detected	4.484
SD of Detected	169.8	SD of Detected	1.598
Minimum Non-Detect	8.5	Minimum Non-Detect	2.14
Maximum Non-Detect	8.5	Maximum Non-Detect	2.14

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.873	Shapiro Wilk Test Statistic	0.873
5% Shapiro Wilk Critical Value	0.85	5% Shapiro Wilk Critical Value	0.85
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	160.9	Mean	4.231
SD	169.3	SD	1.758
95% DL/2 (t) UCL	248.6	95% H-Stat (DL/2) UCL	3393
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	143.7	Mean in Log Scale	4.252
SD	185.8	SD in Log Scale	1.723
95% MLE (t) UCL	240	Mean in Original Scale	161
95% MLE (Tiku) UCL	239.8	SD in Original Scale	169.2
		95% t UCL	248.7
		95% Percentile Bootstrap UCL	237.6
		95% BCA Bootstrap UCL	256.4
		95% H UCL	2990

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	0.688	Data appear Normal at 5% Significance Level
Theta Star	254.3	
nu star	15.14	
A-D Test Statistic	0.19	
5% A-D Critical Value	0.758	
K-S Test Statistic	0.758	
5% K-S Critical Value	0.264	
Data appear Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution		Nonparametric Statistics	
Gamma ROS Statistics using Extrapolated Data		Kaplan-Meier (KM) Method	
Minimum	0.000001	Mean	160.6
Maximum	549	SD	162.3
Mean	160.5	SE of Mean	49.13
Median	88.15	95% KM (t) UCL	248.9
SD	169.6	95% KM (z) UCL	241.5
k star	0.297	95% KM (jackknife) UCL	247.6
Theta star	540.6	95% KM (bootstrap t) UCL	281.2
Nu star	7.125	95% KM (BCA) UCL	248.9
AppChi2	2.239	95% KM (Percentile Bootstrap) UCL	241.7
95% Gamma Approximate UCL (Use when n >= 40)	510.7	95% KM (Chebyshev) UCL	374.8
95% Adjusted Gamma UCL (Use when n < 40)	619.7	97.5% KM (Chebyshev) UCL	467.5
		99% KM (Chebyshev) UCL	649.5
		Potential UCLs to Use	
		95% KM (t) UCL	248.9
		95% KM (Percentile Bootstrap) UCL	241.7

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

Copper (Dissolved): SWMU 59 Groundwater

General Statistics

Number of Valid Observations	10	Number of Distinct Observations	10

Raw Statistics		Log-transformed Statistics	
Minimum	2.3	Minimum of Log Data	0.833
Maximum	19	Maximum of Log Data	2.944
Mean	7.33	Mean of log Data	1.82
Geometric Mean	6.171	SD of log Data	0.615
Median	7		
SD	4.815		
Std. Error of Mean	1.523		
Coefficient of Variation	0.657		
Skewness	1.674		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.836	Shapiro Wilk Test Statistic	0.967
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	10.12	95% H-UCL	12.18
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	13.65
95% Adjusted-CLT UCL (Chen-1995)	10.7	97.5% Chebyshev (MVUE) UCL	16.39
95% Modified-t UCL (Johnson-1978)	10.26	99% Chebyshev (MVUE) UCL	21.79

Gamma Distribution Test		Data Distribution
k star (bias corrected)	2.211	Data appear Gamma Distributed at 5% Significance Level
Theta Star	3.316	
MLE of Mean	7.33	
MLE of Standard Deviation	4.93	
nu star	44.21	
Approximate Chi Square Value (.05)	29.96	**Nonparametric Statistics**
Adjusted Level of Significance	0.0267	95% CLT UCL 9.835
Adjusted Chi Square Value	27.94	95% Jackknife UCL 10.12
		95% Standard Bootstrap UCL 9.724
Anderson-Darling Test Statistic	0.315	95% Bootstrap-t UCL 11.51
Anderson-Darling 5% Critical Value	0.732	95% Hall's Bootstrap UCL 20.81
Kolmogorov-Smirnov Test Statistic	0.152	95% Percentile Bootstrap UCL 9.9
Kolmogorov-Smirnov 5% Critical Value	0.268	95% BCA Bootstrap UCL 10.25
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 13.97
		97.5% Chebyshev(Mean, Sd) UCL 16.84
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 22.48
95% Approximate Gamma UCL (Use when n >= 40)	10.82	
95% Adjusted Gamma UCL (Use when n < 40)	11.6	

Potential UCL to Use	Use 95% Approximate Gamma UCL 10.82

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Vanadium (Dissolved): SWMU 59 Groundwater

General Statistics

Number of Valid Observations	10	Number of Distinct Observations	10

Raw Statistics		Log-transformed Statistics	
Minimum	9.5	Minimum of Log Data	2.251
Maximum	179	Maximum of Log Data	5.187
Mean	65.61	Mean of log Data	3.783
Geometric Mean	43.95	SD of log Data	0.995
Median	43.6		
SD	56.65		
Std. Error of Mean	17.91		
Coefficient of Variation	0.863		
Skewness	0.889		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.867	Shapiro Wilk Test Statistic	0.931
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	98.45	95% H-UCL	201.2
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	164.6
95% Adjusted-CLT UCL (Chen-1995)	100.5	97.5% Chebyshev (MVUE) UCL	206.6
95% Modified-t UCL (Johnson-1978)	99.29	99% Chebyshev (MVUE) UCL	289.1

Gamma Distribution Test		Data Distribution
k star (bias corrected)	1.04	Data appear Normal at 5% Significance Level
Theta Star	63.08	
MLE of Mean	65.61	
MLE of Standard Deviation	64.33	
nu star	20.8	
Approximate Chi Square Value (.05)	11.45	**Nonparametric Statistics**
Adjusted Level of Significance	0.0267	95% CLT UCL 95.08
Adjusted Chi Square Value	10.26	95% Jackknife UCL 98.45
		95% Standard Bootstrap UCL 93.88
Anderson-Darling Test Statistic	0.439	95% Bootstrap-t UCL 106.7
Anderson-Darling 5% Critical Value	0.741	95% Hall's Bootstrap UCL 97.47
Kolmogorov-Smirnov Test Statistic	0.202	95% Percentile Bootstrap UCL 95.19
Kolmogorov-Smirnov 5% Critical Value	0.272	95% BCA Bootstrap UCL 100.2
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 143.7
		97.5% Chebyshev(Mean, Sd) UCL 177.5
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 243.9
95% Approximate Gamma UCL (Use when n >= 40)	119.3	
95% Adjusted Gamma UCL (Use when n < 40)	133	

Potential UCL to Use	Use 95% Student's-t UCL 98.45

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Zinc (Dissolved): NAPR Basewide Background, Groundwater

General Statistics

Number of Valid Data	11	Number of Detected Data	10
Number of Distinct Detected Data	10	Number of Non-Detect Data	1
		Percent Non-Detects	9.09%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	1.6	Minimum Detected	0.47
Maximum Detected	492	Maximum Detected	6.198
Mean of Detected	68.66	Mean of Detected	2.592
SD of Detected	151.4	SD of Detected	1.829
Minimum Non-Detect	2.4	Minimum Non-Detect	0.875
Maximum Non-Detect	2.4	Maximum Non-Detect	0.875

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.505	Shapiro Wilk Test Statistic	0.906
5% Shapiro Wilk Critical Value	0.842	5% Shapiro Wilk Critical Value	0.842
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	62.53	Mean	2.373
SD	145	SD	1.881
95% DL/2 (t) UCL	141.8	95% H-Stat (DL/2) UCL	1151
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	42.28	Mean in Log Scale	2.309
SD	157.7	SD in Log Scale	1.973
95% MLE (t) UCL	128.4	Mean in Original Scale	62.47
95% MLE (Tiku) UCL	125.5	SD in Original Scale	145.1
		95% t UCL	141.8
		95% Percentile Bootstrap UCL	142.7
		95% BCA Bootstrap UCL	195.6
		95% H UCL	1688

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.348	Data appear Lognormal at 5% Significance Level	
Theta Star	197.4		
nu star	6.956		
A-D Test Statistic	0.921	Nonparametric Statistics	
5% A-D Critical Value	0.795	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.795	Mean	62.56
5% K-S Critical Value	0.284	SD	138.3
Data not Gamma Distributed at 5% Significance Level		SE of Mean	43.95
		95% KM (t) UCL	142.2
Assuming Gamma Distribution		95% KM (z) UCL	134.9
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	141.7
Minimum	0.000001	95% KM (bootstrap t) UCL	483.7
Maximum	492	95% KM (BCA) UCL	148.1
Mean	62.42	95% KM (Percentile Bootstrap) UCL	149.4
Median	5.4	95% KM (Chebyshev) UCL	254.1
SD	145.1	97.5% KM (Chebyshev) UCL	337
k star	0.232	99% KM (Chebyshev) UCL	499.8
Theta star	268.5		
Nu star	5.114	Potential UCLs to Use	
AppChi2	1.205	99% KM (Chebyshev) UCL	499.8
95% Gamma Approximate UCL (Use when n >= 40)	264.9		
95% Adjusted Gamma UCL (Use when n < 40)	344.3		

Warning: Recommended UCL exceeds the maximum observation

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Copper (Total), SWMU 59

Background Data: CopperTBG

Raw Statistics

	Site	Background
Number of Valid Data	10	12
Number of Non-Detect Data	0	1
Number of Detect Data	10	11
Minimum Non-Detect	N/A	0.5
Maximum Non-Detect	N/A	0.5
Percent Non detects	0.00%	8.33%
Minimum Detected	3.9	8.5
Maximum Detected	21.3	352
Mean of Detected Data	9.51	124.8
Median of Detected Data	8.1	102
SD of Detected Data	6.323	108.1

Wilcoxon-Mann-Whitney Site vs Background Test

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	72
WMW Test U-Stat	17
WMW Critical Value (0.050)	85
Approximate P-Value	0.998

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Site <= Background

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Vanadium (Total), SWMU 59

Background Data: VanadiumTBG

Raw Statistics

	Site	Background
Number of Valid Data	10	12
Number of Non-Detect Data	0	1
Number of Detect Data	10	11
Minimum Non-Detect	N/A	8.5
Maximum Non-Detect	N/A	8.5
Percent Non detects	0.00%	8.33%
Minimum Detected	9.2	1.7
Maximum Detected	171	549
Mean of Detected Data	63.29	175.1
Median of Detected Data	48.15	103
SD of Detected Data	51.83	169.8

Wilcoxon-Mann-Whitney Site vs Background Test

All observations <= 8.5 (Max DL) are ranked the same

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	97
WMW Test U-Stat	42
WMW Critical Value (0.050)	85
Approximate P-Value	0.889

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Site <= Background

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Copper (Total), SWMU 59

Background Data: CopperTBG

Raw Statistics

	Site	Background
Number of Valid Data	10	12
Number of Non-Detect Data	0	1
Number of Detect Data	10	11
Minimum Non-Detect	N/A	0.5
Maximum Non-Detect	N/A	0.5
Percent Non detects	0.00%	8.33%
Minimum Detected	3.9	8.5
Maximum Detected	21.3	352
Mean of Detected Data	9.51	124.8
Median of Detected Data	8.1	102
SD of Detected Data	6.323	108.1

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.043)	4
Approximate K Value (0.043)	4
Number of Site Observations in 'R' Largest	0
Calculated Alpha	0.0287

Conclusion with Alpha = 0.043

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Vanadium (Total), SWMU 59

Background Data: VanadiumTBG

Raw Statistics

	Site	Background
Number of Valid Data	10	12
Number of Non-Detect Data	0	1
Number of Detect Data	10	11
Minimum Non-Detect	N/A	8.5
Maximum Non-Detect	N/A	8.5
Percent Non detects	0.00%	8.33%
Minimum Detected	9.2	1.7
Maximum Detected	171	549
Mean of Detected Data	63.29	175.1
Median of Detected Data	48.15	103
SD of Detected Data	51.83	169.8

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.043)	4
Approximate K Value (0.043)	4
Number of Site Observations in 'R' Largest	0
Calculated Alpha	0.0287

Conclusion with Alpha = 0.043

Do Not Reject H0, Perform Wilcoxon-Mann-Whitney or Gehan Test

APPENDIX M
SEDIMENT STATISTICS

General UCL Statistics for Data Sets with Non-Detects

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Barium: NAPR Basewide Background, Freshwater Drainage Ditch Sediment

General Statistics

Number of Valid Observations	12	Number of Distinct Observations	12

Raw Statistics		**Log-transformed Statistics**	
Minimum	37.1	Minimum of Log Data	3.614
Maximum	210	Maximum of Log Data	5.347
Mean	113.7	Mean of log Data	4.6
Geometric Mean	99.48	SD of log Data	0.559
Median	107.5		
SD	57.96		
Std. Error of Mean	16.73		
Coefficient of Variation	0.51		
Skewness	0.387		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.938	Shapiro Wilk Test Statistic	0.954
Shapiro Wilk Critical Value	0.859	Shapiro Wilk Critical Value	0.859
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	143.7	95% H-UCL	168.9
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	197.5
95% Adjusted-CLT UCL (Chen-1995)	143.2	97.5% Chebyshev (MVUE) UCL	233.3
95% Modified-t UCL (Johnson-1978)	144	99% Chebyshev (MVUE) UCL	303.8

Gamma Distribution Test		**Data Distribution**
k star (bias corrected)	2.989	Data appear Normal at 5% Significance Level
Theta Star	38.03	
MLE of Mean	113.7	
MLE of Standard Deviation	65.74	
nu star	71.73	
Approximate Chi Square Value (.05)	53.23	**Nonparametric Statistics**
Adjusted Level of Significance	0.029	95% CLT UCL 141.2
Adjusted Chi Square Value	50.8	95% Jackknife UCL 143.7
		95% Standard Bootstrap UCL 139.4
Anderson-Darling Test Statistic	0.243	95% Bootstrap-t UCL 143.4
Anderson-Darling 5% Critical Value	0.736	95% Hall's Bootstrap UCL 141.6
Kolmogorov-Smirnov Test Statistic	0.146	95% Percentile Bootstrap UCL 140.2
Kolmogorov-Smirnov 5% Critical Value	0.246	95% BCA Bootstrap UCL 140.8
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 186.6
		97.5% Chebyshev(Mean, Sd) UCL 218.1
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 280.1
95% Approximate Gamma UCL (Use when n >= 40)	153.2	
95% Adjusted Gamma UCL (Use when n < 40)	160.5	

Potential UCL to Use		Use 95% Student's-t UCL	143.7

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Copper: SWMU 59 Freshwater Drainage Ditch Sediment

General Statistics

Number of Valid Observations	12	Number of Distinct Observations	12

Raw Statistics

Minimum	36.2
Maximum	187
Mean	113.6
Geometric Mean	103.2
Median	116
SD	46.2
Std. Error of Mean	13.34
Coefficient of Variation	0.407
Skewness	-0.14

Log-transformed Statistics

Minimum of Log Data	3.589
Maximum of Log Data	5.231
Mean of log Data	4.637
SD of log Data	0.49

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.975
Shapiro Wilk Critical Value	0.859

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.922
Shapiro Wilk Critical Value	0.859

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	137.6

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	135
95% Modified-t UCL (Johnson-1978)	137.5

Assuming Lognormal Distribution

95% H-UCL	159.4
95% Chebyshev (MVUE) UCL	187.7
97.5% Chebyshev (MVUE) UCL	219.1
99% Chebyshev (MVUE) UCL	280.8

Gamma Distribution Test

k star (bias corrected)	4.1
Theta Star	27.71
MLE of Mean	113.6
MLE of Standard Deviation	56.1
nu star	98.4
Approximate Chi Square Value (.05)	76.52
Adjusted Level of Significance	0.029
Adjusted Chi Square Value	73.58
Anderson-Darling Test Statistic	0.282
Anderson-Darling 5% Critical Value	0.732
Kolmogorov-Smirnov Test Statistic	0.144
Kolmogorov-Smirnov 5% Critical Value	0.246

Data appear Gamma Distributed at 5% Significance Level

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	135.5
95% Jackknife UCL	137.6
95% Standard Bootstrap UCL	134.2
95% Bootstrap-t UCL	138.5
95% Hall's Bootstrap UCL	133.9
95% Percentile Bootstrap UCL	133.6
95% BCA Bootstrap UCL	134.3
95% Chebyshev(Mean, Sd) UCL	171.7
97.5% Chebyshev(Mean, Sd) UCL	196.9
99% Chebyshev(Mean, Sd) UCL	246.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (Use when n >= 40)	146.1
95% Adjusted Gamma UCL (Use when n < 40)	151.9

Potential UCL to Use — Use 95% Student's-t UCL 137.6

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Note: For highly negative-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Copper: NAPR Basewide Background, Freshwater Drainage Ditch Sediment

General Statistics

Number of Valid Observations	12	Number of Distinct Observations	11

Raw Statistics

Minimum	45.1
Maximum	111
Mean	80.99
Geometric Mean	77.18
Median	85
SD	24.99
Std. Error of Mean	7.215
Coefficient of Variation	0.309
Skewness	-0.188

Log-transformed Statistics

Minimum of Log Data	3.809
Maximum of Log Data	4.71
Mean of log Data	4.346
SD of log Data	0.332

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.88
Shapiro Wilk Critical Value	0.859

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.876
Shapiro Wilk Critical Value	0.859

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	93.95

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	92.44
95% Modified-t UCL (Johnson-1978)	93.88

Assuming Lognormal Distribution

95% H-UCL	99.25
95% Chebyshev (MVUE) UCL	115.5
97.5% Chebyshev (MVUE) UCL	130.4
99% Chebyshev (MVUE) UCL	159.6

Gamma Distribution Test

k star (bias corrected)	7.951
Theta Star	10.19
MLE of Mean	80.99
MLE of Standard Deviation	28.72
nu star	190.8
Approximate Chi Square Value (.05)	159.9
Adjusted Level of Significance	0.029
Adjusted Chi Square Value	155.5
Anderson-Darling Test Statistic	0.67
Anderson-Darling 5% Critical Value	0.73
Kolmogorov-Smirnov Test Statistic	0.225
Kolmogorov-Smirnov 5% Critical Value	0.245

Data appear Gamma Distributed at 5% Significance Level

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	92.86
95% Jackknife UCL	93.95
95% Standard Bootstrap UCL	92.3
95% Bootstrap-t UCL	93.81
95% Hall's Bootstrap UCL	91.51
95% Percentile Bootstrap UCL	92.42
95% BCA Bootstrap UCL	92.08
95% Chebyshev(Mean, Sd) UCL	112.4
97.5% Chebyshev(Mean, Sd) UCL	126.1
99% Chebyshev(Mean, Sd) UCL	152.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (Use when n >= 40)	96.67
95% Adjusted Gamma UCL (Use when n < 40)	99.36

Potential UCL to Use

Use 95% Student's-t UCL 93.95

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Note: For highly negative-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Lead: SWMU 59 Freshwater Drainage Ditch Sediment

General Statistics

Number of Valid Observations	10	Number of Distinct Observations	10

Raw Statistics

Minimum	4.92
Maximum	71.2
Mean	32.84
Geometric Mean	22.61
Median	22.85
SD	25.59
Std. Error of Mean	8.092
Coefficient of Variation	0.779
Skewness	0.52

Log-transformed Statistics

Minimum of Log Data	1.593
Maximum of Log Data	4.265
Mean of log Data	3.119
SD of log Data	1.003

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.879
Shapiro Wilk Critical Value	0.842

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.898
Shapiro Wilk Critical Value	0.842

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	47.67

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	47.57
95% Modified-t UCL (Johnson-1978)	47.89

Assuming Lognormal Distribution

95% H-UCL	105.8
95% Chebyshev (MVUE) UCL	85.65
97.5% Chebyshev (MVUE) UCL	107.6
99% Chebyshev (MVUE) UCL	150.7

Gamma Distribution Test

k star (bias corrected)	1.106
Theta Star	29.68
MLE of Mean	32.84
MLE of Standard Deviation	31.22
nu star	22.13
Approximate Chi Square Value (.05)	12.43
Adjusted Level of Significance	0.0267
Adjusted Chi Square Value	11.19
Anderson-Darling Test Statistic	0.368
Anderson-Darling 5% Critical Value	0.739
Kolmogorov-Smirnov Test Statistic	0.153
Kolmogorov-Smirnov 5% Critical Value	0.271

Data appear Gamma Distributed at 5% Significance Level

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	46.14
95% Jackknife UCL	47.67
95% Standard Bootstrap UCL	45.61
95% Bootstrap-t UCL	50.89
95% Hall's Bootstrap UCL	46.27
95% Percentile Bootstrap UCL	46.24
95% BCA Bootstrap UCL	47.96
95% Chebyshev(Mean, Sd) UCL	68.11
97.5% Chebyshev(Mean, Sd) UCL	83.37
99% Chebyshev(Mean, Sd) UCL	113.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (Use when n >= 40)	58.43
95% Adjusted Gamma UCL (Use when n < 40)	64.93

Potential UCL to Use

Use 95% Student's-t UCL 47.67

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Lead: NAPR Basewide Background, Freshwater Drainage Ditch Sediment

General Statistics

Number of Valid Observations	12	Number of Distinct Observations	12

Raw Statistics		Log-transformed Statistics	
Minimum	7.6	Minimum of Log Data	2.028
Maximum	27	Maximum of Log Data	3.296
Mean	13.98	Mean of log Data	2.541
Geometric Mean	12.7	SD of log Data	0.449
Median	10.4		
SD	6.679		
Std. Error of Mean	1.928		
Coefficient of Variation	0.478		
Skewness	0.89		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.849	Shapiro Wilk Test Statistic	0.885
Shapiro Wilk Critical Value	0.859	Shapiro Wilk Critical Value	0.859
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	17.45	95% H-UCL	18.61
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	21.93
95% Adjusted-CLT UCL (Chen-1995)	17.68	97.5% Chebyshev (MVUE) UCL	25.4
95% Modified-t UCL (Johnson-1978)	17.53	99% Chebyshev (MVUE) UCL	32.21

Gamma Distribution Test		Data Distribution
k star (bias corrected)	4.066	Data appear Gamma Distributed at 5% Significance Level
Theta Star	3.439	
MLE of Mean	13.98	
MLE of Standard Deviation	6.935	
nu star	97.58	
Approximate Chi Square Value (.05)	75.79	**Nonparametric Statistics**
Adjusted Level of Significance	0.029	95% CLT UCL 17.15
Adjusted Chi Square Value	72.87	95% Jackknife UCL 17.45
		95% Standard Bootstrap UCL 17.02
Anderson-Darling Test Statistic	0.715	95% Bootstrap-t UCL 18.39
Anderson-Darling 5% Critical Value	0.732	95% Hall's Bootstrap UCL 17.03
Kolmogorov-Smirnov Test Statistic	0.235	95% Percentile Bootstrap UCL 17.09
Kolmogorov-Smirnov 5% Critical Value	0.246	95% BCA Bootstrap UCL 17.42
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 22.39
		97.5% Chebyshev(Mean, Sd) UCL 26.02
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 33.17
95% Approximate Gamma UCL (Use when n >= 40)	18	
95% Adjusted Gamma UCL (Use when n < 40)	18.73	

Potential UCL to Use		Use 95% Approximate Gamma UCL	18

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Mercury: NAPR Basewide Background, Freshwater Drainage Ditch Sediment

General Statistics

Number of Valid Data	12	Number of Detected Data	11
Number of Distinct Detected Data	9	Number of Non-Detect Data	1
		Percent Non-Detects	8.33%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.029	Minimum Detected	-3.54
Maximum Detected	0.16	Maximum Detected	-1.833
Mean of Detected	0.0886	Mean of Detected	-2.493
SD of Detected	0.0319	SD of Detected	0.419
Minimum Non-Detect	0.14	Minimum Non-Detect	-1.966
Maximum Non-Detect	0.14	Maximum Non-Detect	-1.966

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.912	Shapiro Wilk Test Statistic	0.852
5% Shapiro Wilk Critical Value	0.85	5% Shapiro Wilk Critical Value	0.85
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.0871	Mean	-2.506
SD	0.0309	SD	0.403
95% DL/2 (t) UCL	0.103	95% H-Stat (DL/2) UCL	0.113
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-2.497
		SD in Log Scale	0.4
		Mean in Original Scale	0.0878
		SD in Original Scale	0.0306
		95% t UCL	0.104
		95% Percentile Bootstrap UCL	0.102
		95% BCA Bootstrap UCL	0.103
		95% H-UCL	0.114

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	5.424	Data appear Normal at 5% Significance Level
Theta Star	0.0163	
nu star	119.3	
A-D Test Statistic	0.598	
5% A-D Critical Value	0.73	
K-S Test Statistic	0.73	
5% K-S Critical Value	0.256	
Data appear Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution		Nonparametric Statistics	
Gamma ROS Statistics using Extrapolated Data		Kaplan-Meier (KM) Method	
Minimum	0.029	Mean	0.088
Maximum	0.16	SD	0.0299
Mean	0.0887	SE of Mean	0.00925
Median	0.0908	95% KM (t) UCL	0.105
SD	0.0305	95% KM (z) UCL	0.103
k star	6.078	95% KM (jackknife) UCL	0.105
Theta star	0.0146	95% KM (bootstrap t) UCL	0.106
Nu star	145.9	95% KM (BCA) UCL	0.103
AppChi2	119	95% KM (Percentile Bootstrap) UCL	0.104
95% Gamma Approximate UCL (Use when n >= 40)	0.109	95% KM (Chebyshev) UCL	0.128
95% Adjusted Gamma UCL (Use when n < 40)	0.112	97.5% KM (Chebyshev) UCL	0.146
		99% KM (Chebyshev) UCL	0.18
		Potential UCLs to Use	
		95% KM (t) UCL	0.105
		95% KM (Percentile Bootstrap) UCL	0.104

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Nickel: NAPR Basewide Background, Freshwater Drainage Ditch Sediment

General Statistics

Number of Valid Observations	12	Number of Distinct Observations	9

Raw Statistics		Log-transformed Statistics	
Minimum	7	Minimum of Log Data	1.946
Maximum	17.7	Maximum of Log Data	2.874
Mean	12.9	Mean of log Data	2.532
Geometric Mean	12.58	SD of log Data	0.242
Median	13.2		
SD	2.854		
Std. Error of Mean	0.824		
Coefficient of Variation	0.221		
Skewness	-0.206		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.945	Shapiro Wilk Test Statistic	0.901
Shapiro Wilk Critical Value	0.859	Shapiro Wilk Critical Value	0.859
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	14.38	95% H-UCL	14.85
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	16.88
95% Adjusted-CLT UCL (Chen-1995)	14.2	97.5% Chebyshev (MVUE) UCL	18.59
95% Modified-t UCL (Johnson-1978)	14.37	99% Chebyshev (MVUE) UCL	21.95

Gamma Distribution Test		Data Distribution
k star (bias corrected)	15.19	Data appear Normal at 5% Significance Level
Theta Star	0.849	
MLE of Mean	12.9	
MLE of Standard Deviation	3.31	
nu star	364.6	
Approximate Chi Square Value (.05)	321.4	**Nonparametric Statistics**
Adjusted Level of Significance	0.029	95% CLT UCL 14.26
Adjusted Chi Square Value	315.2	95% Jackknife UCL 14.38
		95% Standard Bootstrap UCL 14.2
Anderson-Darling Test Statistic	0.425	95% Bootstrap-t UCL 14.45
Anderson-Darling 5% Critical Value	0.732	95% Hall's Bootstrap UCL 14.5
Kolmogorov-Smirnov Test Statistic	0.184	95% Percentile Bootstrap UCL 14.26
Kolmogorov-Smirnov 5% Critical Value	0.245	95% BCA Bootstrap UCL 14.21
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 16.49
		97.5% Chebyshev(Mean, Sd) UCL 18.05
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 21.1
95% Approximate Gamma UCL (Use when n >= 40)	14.64	
95% Adjusted Gamma UCL (Use when n < 40)	14.92	

Potential UCL to Use	Use 95% Student's-t UCL 14.38

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Note: For highly negative-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Vanadium: NAPR Basewide Background, Freshwater Drainage Ditch Sediment

General Statistics

Number of Valid Observations	12	Number of Distinct Observations	11

Raw Statistics		Log-transformed Statistics	
Minimum	100	Minimum of Log Data	4.605
Maximum	260	Maximum of Log Data	5.561
Mean	189.9	Mean of log Data	5.216
Geometric Mean	184.2	SD of log Data	0.269
Median	203		
SD	45.8		
Std. Error of Mean	13.22		
Coefficient of Variation	0.241		
Skewness	-0.486		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.952	Shapiro Wilk Test Statistic	0.91
Shapiro Wilk Critical Value	0.859	Shapiro Wilk Critical Value	0.859
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	213.7	95% H-UCL	222.8
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	255.3
95% Adjusted-CLT UCL (Chen-1995)	209.7	97.5% Chebyshev (MVUE) UCL	283.4
95% Modified-t UCL (Johnson-1978)	213.3	99% Chebyshev (MVUE) UCL	338.5

Gamma Distribution Test		Data Distribution
k star (bias corrected)	12.42	Data appear Normal at 5% Significance Level
Theta Star	15.29	
MLE of Mean	189.9	
MLE of Standard Deviation	53.89	
nu star	298.1	
Approximate Chi Square Value (.05)	259.1	**Nonparametric Statistics**
Adjusted Level of Significance	0.029	95% CLT UCL 211.7
Adjusted Chi Square Value	253.5	95% Jackknife UCL 213.7
		95% Standard Bootstrap UCL 210.6
Anderson-Darling Test Statistic	0.435	95% Bootstrap-t UCL 211.3
Anderson-Darling 5% Critical Value	0.731	95% Hall's Bootstrap UCL 210.3
Kolmogorov-Smirnov Test Statistic	0.19	95% Percentile Bootstrap UCL 209.4
Kolmogorov-Smirnov 5% Critical Value	0.245	95% BCA Bootstrap UCL 208.6
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 247.5
		97.5% Chebyshev(Mean, Sd) UCL 272.5
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 321.5
95% Approximate Gamma UCL (Use when n >= 40)	218.5	
95% Adjusted Gamma UCL (Use when n < 40)	223.3	

Potential UCL to Use	Use 95% Student's-t UCL 213.7

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Note: For highly negative-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Zinc: SWMU 59 Freshwater Drainage Ditch Sediment

General Statistics

Number of Valid Observations	12	Number of Distinct Observations	12

Raw Statistics		Log-transformed Statistics	
Minimum	71.7	Minimum of Log Data	4.272
Maximum	357	Maximum of Log Data	5.878
Mean	193.7	Mean of log Data	5.173
Geometric Mean	176.4	SD of log Data	0.463
Median	183.5		
SD	85.68		
Std. Error of Mean	24.73		
Coefficient of Variation	0.442		
Skewness	0.632		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.957	Shapiro Wilk Test Statistic	0.984
Shapiro Wilk Critical Value	0.859	Shapiro Wilk Critical Value	0.859
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	238.1	95% H-UCL	263.1
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	310.1
95% Adjusted-CLT UCL (Chen-1995)	239.2	97.5% Chebyshev (MVUE) UCL	360.1
95% Modified-t UCL (Johnson-1978)	238.9	99% Chebyshev (MVUE) UCL	458.3

Gamma Distribution Test		Data Distribution
k star (bias corrected)	4.181	Data appear Normal at 5% Significance Level
Theta Star	46.34	
MLE of Mean	193.7	
MLE of Standard Deviation	94.74	
nu star	100.3	
Approximate Chi Square Value (.05)	78.23	**Nonparametric Statistics**
Adjusted Level of Significance	0.029	95% CLT UCL 234.4
Adjusted Chi Square Value	75.26	95% Jackknife UCL 238.1
		95% Standard Bootstrap UCL 233.1
Anderson-Darling Test Statistic	0.124	95% Bootstrap-t UCL 249.1
Anderson-Darling 5% Critical Value	0.732	95% Hall's Bootstrap UCL 242.1
Kolmogorov-Smirnov Test Statistic	0.113	95% Percentile Bootstrap UCL 232.6
Kolmogorov-Smirnov 5% Critical Value	0.246	95% BCA Bootstrap UCL 238
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 301.5
		97.5% Chebyshev(Mean, Sd) UCL 348.2
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 439.8
95% Approximate Gamma UCL (Use when n >= 40)	248.5	
95% Adjusted Gamma UCL (Use when n < 40)	258.3	

Potential UCL to Use	Use 95% Student's-t UCL 238.1

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

General Background Statistics for Full Data Sets

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Coverage	90%
Different or Future K Values	1
Number of Bootstrap Operations	2000

Copper: SWMU 59 Freshwater Drainage Ditch Sediment

General Statistics

Total Number of Observations	12	Number of Distinct Observations	12
Tolerance Factor	2.21		

Raw Statistics

Minimum	36.2
Maximum	187
Second Largest	161
First Quartile	85.28
Median	116
Third Quartile	148
Mean	113.6
Geometric Mean	103.2
SD	46.2
Coefficient of Variation	0.407
Skewness	-0.14

Log-Transformed Statistics

Minimum	3.589
Maximum	5.231
Second Largest	5.081
First Quartile	4.445
Median	4.751
Third Quartile	4.996
Mean	4.637
SD	0.49

Background Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.975
Shapiro Wilk Critical Value	0.859

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.922
Shapiro Wilk Critical Value	0.859

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% UTL with 90% Coverage	215.7
95% UPL (t)	200
90% Percentile (z)	172.8
95% Percentile (z)	189.6
99% Percentile (z)	221.1

Assuming Lognormal Distribution

95% UTL with 90% Coverage	304.7
95% UPL (t)	257.8
90% Percentile (z)	193.4
95% Percentile (z)	231
99% Percentile (z)	322.5

Gamma Distribution Test

k star	4.1
Theta Star	27.71
MLE of Mean	113.6
MLE of Standard Deviation	56.1
nu star	98.4

A-D Test Statistic	0.282
5% A-D Critical Value	0.732
K-S Test Statistic	0.144
5% K-S Critical Value	0.246

Data appear Gamma Distributed at 5% Significance Level

Data Distribution Test

Data appear Normal at 5% Significance Level

Nonparametric Statistics

90% Percentile	160.9
95% Percentile	172.7
99% Percentile	184.1

Assuming Gamma Distribution

90% Percentile	188.8
95% Percentile	218.8
99% Percentile	282.7
95% WH Approx. Gamma UPL	227.3
95% HW Approx. Gamma UPL	233.2
95% WH Approx. Gamma UTL with 90% Coverage	256.1
95% HW Approx. Gamma UTL with 90% Coverage	265.2

95% UTL with 90% Coverage	187
95% Percentile Bootstrap UTL with 90% Coverage	187
95% BCA Bootstrap UTL with 90% Coverage	184.4
95% UPL	187
95% Chebyshev UPL	323.2
Upper Threshold Limit Based upon IQR	242.1

Copper: NAPR Basewide Background, Freshwater Drainage Ditch Sediment

General Statistics

Total Number of Observations	12	Number of Distinct Observations	11
Tolerance Factor	2.21		

Raw Statistics

Minimum	45.1
Maximum	111
Second Largest	110
First Quartile	55.45
Median	85
Third Quartile	101.3
Mean	80.99
Geometric Mean	77.18
SD	24.99
Coefficient of Variation	0.309
Skewness	-0.188

Log-Transformed Statistics

Minimum	3.809
Maximum	4.71
Second Largest	4.7
First Quartile	4.015
Median	4.437
Third Quartile	4.617
Mean	4.346
SD	0.332

Background Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.88
Shapiro Wilk Critical Value	0.859

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.876
Shapiro Wilk Critical Value	0.859

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% UTL with 90% Coverage	136.2
95% UPL (t)	127.7
90% Percentile (z)	113
95% Percentile (z)	122.1
99% Percentile (z)	139.1

Assuming Lognormal Distribution

95% UTL with 90% Coverage	160.9
95% UPL (t)	143.7
90% Percentile (z)	118.2
95% Percentile (z)	133.3
99% Percentile (z)	167.3

Gamma Distribution Test

k star	7.951
Theta Star	10.19
MLE of Mean	80.99
MLE of Standard Deviation	28.72
nu star	190.8

A-D Test Statistic	0.67
5% A-D Critical Value	0.73
K-S Test Statistic	0.225
5% K-S Critical Value	0.245

Data appear Gamma Distributed at 5% Significance Level

Data Distribution Test

Data appear Normal at 5% Significance Level

Nonparametric Statistics

90% Percentile	109.5
95% Percentile	110.5
99% Percentile	110.9

Assuming Gamma Distribution

90% Percentile	119.3
95% Percentile	133.3
99% Percentile	162.3
95% WH Approx. Gamma UPL	136.6
95% HW Approx. Gamma UPL	138.1
95% WH Approx. Gamma UTL with 90% Coverage	149.6
95% HW Approx. Gamma UTL with 90% Coverage	152

95% UTL with 90% Coverage	111
95% Percentile Bootstrap UTL with 90% Coverage	111
95% BCA Bootstrap UTL with 90% Coverage	111
95% UPL	111
95% Chebyshev UPL	194.4
Upper Threshold Limit Based upon IQR	170

Lead: SWMU 59 Freshwater Drainage Ditch Sediment

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
Tolerance Factor	2.355		

Raw Statistics		Log-Transformed Statistics	
Minimum	4.92	Minimum	1.593
Maximum	71.2	Maximum	4.265
Second Largest	70	Second Largest	4.248
First Quartile	13.28	First Quartile	2.545
Median	22.85	Median	3.129
Third Quartile	52.58	Third Quartile	3.959
Mean	32.84	Mean	3.119
Geometric Mean	22.61	SD	1.003
SD	25.59		
Coefficient of Variation	0.779		
Skewness	0.52		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.879	Shapiro Wilk Test Statistic	0.898
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	93.1	95% UTL with 90% Coverage	240
95% UPL (t)	82.03	95% UPL (t)	155.6
90% Percentile (z)	65.63	90% Percentile (z)	81.78
95% Percentile (z)	74.92	95% Percentile (z)	117.7
99% Percentile (z)	92.36	99% Percentile (z)	233.2

Gamma Distribution Test		Data Distribution Test
k star	1.106	Data appear Normal at 5% Significance Level
Theta Star	29.68	
MLE of Mean	32.84	
MLE of Standard Deviation	31.22	
nu star	22.13	
A-D Test Statistic	0.368	**Nonparametric Statistics**
5% A-D Critical Value	0.739	90% Percentile 70.12
K-S Test Statistic	0.153	95% Percentile 70.66
5% K-S Critical Value	0.271	99% Percentile 71.09
Data appear Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution			
90% Percentile	73.74	95% UTL with 90% Coverage	71.2
95% Percentile	94.93	95% Percentile Bootstrap UTL with 90% Coverage	71.2
99% Percentile	143.8	95% BCA Bootstrap UTL with 90% Coverage	71.2
		95% UPL	71.2
		95% Chebyshev UPL	149.8
95% WH Approx. Gamma UPL	106.3	Upper Threshold Limit Based upon IQR	111.5
95% HW Approx. Gamma UPL	113.6		
95% WH Approx. Gamma UTL with 90% Coverage	135.4		
95% HW Approx. Gamma UTL with 90% Coverage	149.1		

Lead: NAPR Basewide Background, Freshwater Drainage Ditch Sediment

General Statistics

Total Number of Observations	12	Number of Distinct Observations	12
Tolerance Factor	2.21		

Raw Statistics		Log-Transformed Statistics	
Minimum	7.6	Minimum	2.028
Maximum	27	Maximum	3.296
Second Largest	23	Second Largest	3.135
First Quartile	9.125	First Quartile	2.211
Median	10.4	Median	2.34
Third Quartile	18.75	Third Quartile	2.929
Mean	13.98	Mean	2.541
Geometric Mean	12.7	SD	0.449
SD	6.679		
Coefficient of Variation	0.478		
Skewness	0.89		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.849	Shapiro Wilk Test Statistic	0.885
Shapiro Wilk Critical Value	0.859	Shapiro Wilk Critical Value	0.859
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	28.74	95% UTL with 90% Coverage	34.24
95% UPL (t)	26.47	95% UPL (t)	29.39
90% Percentile (z)	22.54	90% Percentile (z)	22.57
95% Percentile (z)	24.97	95% Percentile (z)	26.57
99% Percentile (z)	29.52	99% Percentile (z)	36.08

Gamma Distribution Test		Data Distribution Test
k star	4.066	Data appear Gamma Distributed at 5% Significance Level
Theta Star	3.439	
MLE of Mean	13.98	
MLE of Standard Deviation	6.935	
nu star	97.58	
A-D Test Statistic	0.715	
5% A-D Critical Value	0.732	
K-S Test Statistic	0.235	
5% K-S Critical Value	0.246	
Data appear Gamma Distributed at 5% Significance Level		

Nonparametric Statistics	
90% Percentile	22.8
95% Percentile	24.8
99% Percentile	26.56

Assuming Gamma Distribution			
90% Percentile	23.28	95% UTL with 90% Coverage	27
95% Percentile	26.99	95% Percentile Bootstrap UTL with 90% Coverage	27
99% Percentile	34.91	95% BCA Bootstrap UTL with 90% Coverage	27
		95% UPL	27
		95% Chebyshev UPL	44.29
95% WH Approx. Gamma UPL	28.01	Upper Threshold Limit Based upon IQR	33.19
95% HW Approx. Gamma UPL	28.3		
95% WH Approx. Gamma UTL with 90% Coverage	31.57		
95% HW Approx. Gamma UTL with 90% Coverage	32.12		

Zinc: SWMU 59 Freshwater Drainage Ditch Sediment

General Statistics

Total Number of Observations	12	Number of Distinct Observations	12
Tolerance Factor	2.21		

Raw Statistics		Log-Transformed Statistics	
Minimum	71.7	Minimum	4.272
Maximum	357	Maximum	5.878
Second Largest	319	Second Largest	5.765
First Quartile	134.8	First Quartile	4.902
Median	183.5	Median	5.211
Third Quartile	239.5	Third Quartile	5.477
Mean	193.7	Mean	5.173
Geometric Mean	176.4	SD	0.463
SD	85.68		
Coefficient of Variation	0.442		
Skewness	0.632		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.957	Shapiro Wilk Test Statistic	0.984
Shapiro Wilk Critical Value	0.859	Shapiro Wilk Critical Value	0.859
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	383.1	95% UTL with 90% Coverage	490.6
95% UPL (t)	353.9	95% UPL (t)	419
90% Percentile (z)	303.5	90% Percentile (z)	319.2
95% Percentile (z)	334.7	95% Percentile (z)	377.7
99% Percentile (z)	393.1	99% Percentile (z)	517.8

Gamma Distribution Test		Data Distribution Test
k star	4.181	Data appear Normal at 5% Significance Level
Theta Star	46.34	
MLE of Mean	193.7	
MLE of Standard Deviation	94.74	
nu star	100.3	
A-D Test Statistic	0.124	Nonparametric Statistics
5% A-D Critical Value	0.732	90% Percentile 313.3
K-S Test Statistic	0.113	95% Percentile 336.1
5% K-S Critical Value	0.246	99% Percentile 352.8
Data appear Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution			
90% Percentile	320.7	95% UTL with 90% Coverage	357
95% Percentile	371.2	95% Percentile Bootstrap UTL with 90% Coverage	357
99% Percentile	478.7	95% BCA Bootstrap UTL with 90% Coverage	353.2
		95% UPL	357
		95% Chebyshev UPL	582.5
95% WH Approx. Gamma UPL	385.1	Upper Threshold Limit Based upon IQR	396.6
95% HW Approx. Gamma UPL	391.8		
95% WH Approx. Gamma UTL with 90% Coverage	433.5		
95% HW Approx. Gamma UTL with 90% Coverage	444.5		

Zinc: NAPR Basewide Background, Freshwater Drainage Ditch Sediment

General Statistics

Total Number of Observations	12	Number of Distinct Observations	11
Tolerance Factor	2.21		

Raw Statistics		Log-Transformed Statistics	
Minimum	41.2	Minimum	3.718
Maximum	99	Maximum	4.595
Second Largest	88.9	Second Largest	4.488
First Quartile	59.28	First Quartile	4.08
Median	72	Median	4.276
Third Quartile	83.75	Third Quartile	4.428
Mean	70.83	Mean	4.229
Geometric Mean	68.67	SD	0.267
SD	17.5		
Coefficient of Variation	0.247		
Skewness	-0.236		

Background Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.974	Shapiro Wilk Test Statistic	0.946
Shapiro Wilk Critical Value	0.859	Shapiro Wilk Critical Value	0.859
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% UTL with 90% Coverage	109.5	95% UTL with 90% Coverage	123.8
95% UPL (t)	103.5	95% UPL (t)	113
90% Percentile (z)	93.26	90% Percentile (z)	96.64
95% Percentile (z)	99.61	95% Percentile (z)	106.5
99% Percentile (z)	111.5	99% Percentile (z)	127.7

Gamma Distribution Test		Data Distribution Test
k star	12.34	Data appear Normal at 5% Significance Level
Theta Star	5.741	
MLE of Mean	70.83	
MLE of Standard Deviation	20.16	
nu star	296.1	
A-D Test Statistic	0.275	Nonparametric Statistics
5% A-D Critical Value	0.731	90% Percentile 88.61
K-S Test Statistic	0.181	95% Percentile 93.45
5% K-S Critical Value	0.245	99% Percentile 97.89
Data appear Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution			
90% Percentile	97.58	95% UTL with 90% Coverage	99
95% Percentile	106.9	95% Percentile Bootstrap UTL with 90% Coverage	99
99% Percentile	126	95% BCA Bootstrap UTL with 90% Coverage	99
		95% UPL	99
		95% Chebyshev UPL	150.2
95% WH Approx. Gamma UPL	108.9	Upper Threshold Limit Based upon IQR	120.5
95% HW Approx. Gamma UPL	109.8		
95% WH Approx. Gamma UTL with 90% Coverage	117.4		
95% HW Approx. Gamma UTL with 90% Coverage	118.8		

t-Test Site vs Background Comparison for Full Data Sets without NDs

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Copper, SWMU 59

Background Data: CopperBG

Raw Statistics

	Site	Background
Number of Valid Observations	12	12
Number of Distinct Observations	12	11
Minimum	36.2	45.1
Maximum	187	111
Mean	113.6	80.99
Median	116	85
SD	46.2	24.99
SE of Mean	13.34	7.215

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

Method	DF	t-Test Value	Critical t (0.050)	P-Value
Pooled (Equal Variance)	22	2.15	1.717	0.021
Welch-Satterthwaite (Unequal Varian	16.9	2.15	1.74	0.023

Pooled SD 37.146

Conclusion with Alpha = 0.050

* Student t (Pooled) Test: Reject H0, Conclude Site > Background
* Welch-Satterthwaite Test: Reject H0, Conclude Site > Background

Test of Equality of Variances

Variance of Site	2135
Variance of Background	624.7

Numerator DF	Denominator DF	F-Test Value	P-Value
11	11	3.417	0.053

Conclusion with Alpha = 0.05

* Two variances appear to be equal

Wilcoxon-Mann-Whitney Site vs Background Comparison Test for Data Sets with Non-Detects

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean/Median Less Than or Equal to Background Mean/Median (Form 1)
Alternative Hypothesis	Site or AOC Mean/Median Greater Than Background Mean/Median

Area of Concern Data: Lead, SWMU 59

Background Data: LeadBG

Raw Statistics

	Site	Background
Number of Valid Data	10	12
Number of Non-Detect Data	0	0
Number of Detect Data	10	12
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	4.92	7.6
Maximum Detected	71.2	27
Mean of Detected Data	32.84	13.98
Median of Detected Data	22.85	10.4
SD of Detected Data	25.59	6.679

Wilcoxon-Mann-Whitney Site vs Background Test

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Site or AOC <= Mean/Median of Background

Site Rank Sum W-Stat	139
WMW Test U-Stat	84
WMW Critical Value (0.050)	85
Approximate P-Value	0.0606

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Site <= Background

t-Test Site vs Background Comparison for Full Data Sets without NDs

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0
Selected Null Hypothesis	Site or AOC Mean Less Than or Equal to Background Mean (Form 1)
Alternative Hypothesis	Site or AOC Mean Greater Than the Background Mean

Area of Concern Data: Zinc, SWMU 59

Background Data: ZincBG

Raw Statistics

	Site	Background
Number of Valid Observations	12	12
Number of Distinct Observations	12	11
Minimum	71.7	41.2
Maximum	357	99
Mean	193.7	70.83
Median	183.5	72
SD	85.68	17.5
SE of Mean	24.73	5.053

Site vs Background Two-Sample t-Test

H0: Mu of Site - Mu of Background <= 0

Method	DF	t-Test Value	Critical t (0.050)	P-Value
Pooled (Equal Variance)	22	4.868	1.717	0
Welch-Satterthwaite (Unequal Varian	11.9	4.868	1.782	0

Pooled SD 61.838

Conclusion with Alpha = 0.050

* Student t (Pooled) Test: Reject H0, Conclude Site > Background
* Welch-Satterthwaite Test: Reject H0, Conclude Site > Background

Test of Equality of Variances

Variance of Site	7342
Variance of Background	306.3

Numerator DF	Denominator DF	F-Test Value	P-Value
11	11	23.966	0

Conclusion with Alpha = 0.05

* Two variances are not equal

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Copper, SWMU 59

Background Data: CopperBG

Raw Statistics

	Site	Background
Number of Valid Data	12	12
Number of Non-Detect Data	0	0
Number of Detect Data	12	12
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	36.2	45.1
Maximum Detected	187	111
Mean of Detected Data	113.6	80.99
Median of Detected Data	116	85
SD of Detected Data	46.2	24.99

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.043)	4
Approximate K Value (0.043)	4
Number of Site Observations in 'R' Largest	4
Calculated Alpha	0.0466

Conclusion with Alpha = 0.043

Reject H0, Conclude Site Concentration > Background Concentration

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Lead, SWMU 59

Background Data: LeadBG

Raw Statistics

	Site	Background
Number of Valid Data	10	12
Number of Non-Detect Data	0	0
Number of Detect Data	10	12
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	4.92	7.6
Maximum Detected	71.2	27
Mean of Detected Data	32.84	13.98
Median of Detected Data	22.85	10.4
SD of Detected Data	25.59	6.679

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

Approximate R Value (0.043)	4
Approximate K Value (0.043)	4
Number of Site Observations in 'R' Largest	4
Calculated Alpha	0.0287

Conclusion with Alpha = 0.043

Reject H0, Conclude Site Concentration > Background Concentration

Quantile Site vs Background Comparison Hypothesis Test for Data Sets with Non-Detects

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Null Hypothesis	Site or AOC Concentration Less Than or Equal to Background Concentration (Form 1)
Alternative Hypothesis	Site or AOC Concentration Greater Than Background Concentration

Area of Concern Data: Zinc, SWMU 59

Background Data: ZincBG

Raw Statistics

	Site	Background
Number of Valid Data	12	12
Number of Non-Detect Data	0	0
Number of Detect Data	12	12
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non detects	0.00%	0.00%
Minimum Detected	71.7	41.2
Maximum Detected	357	99
Mean of Detected Data	193.7	70.83
Median of Detected Data	183.5	72
SD of Detected Data	85.68	17.5

Quantile Test

H0: Site Concentration <= Background Concentration (Form 1)

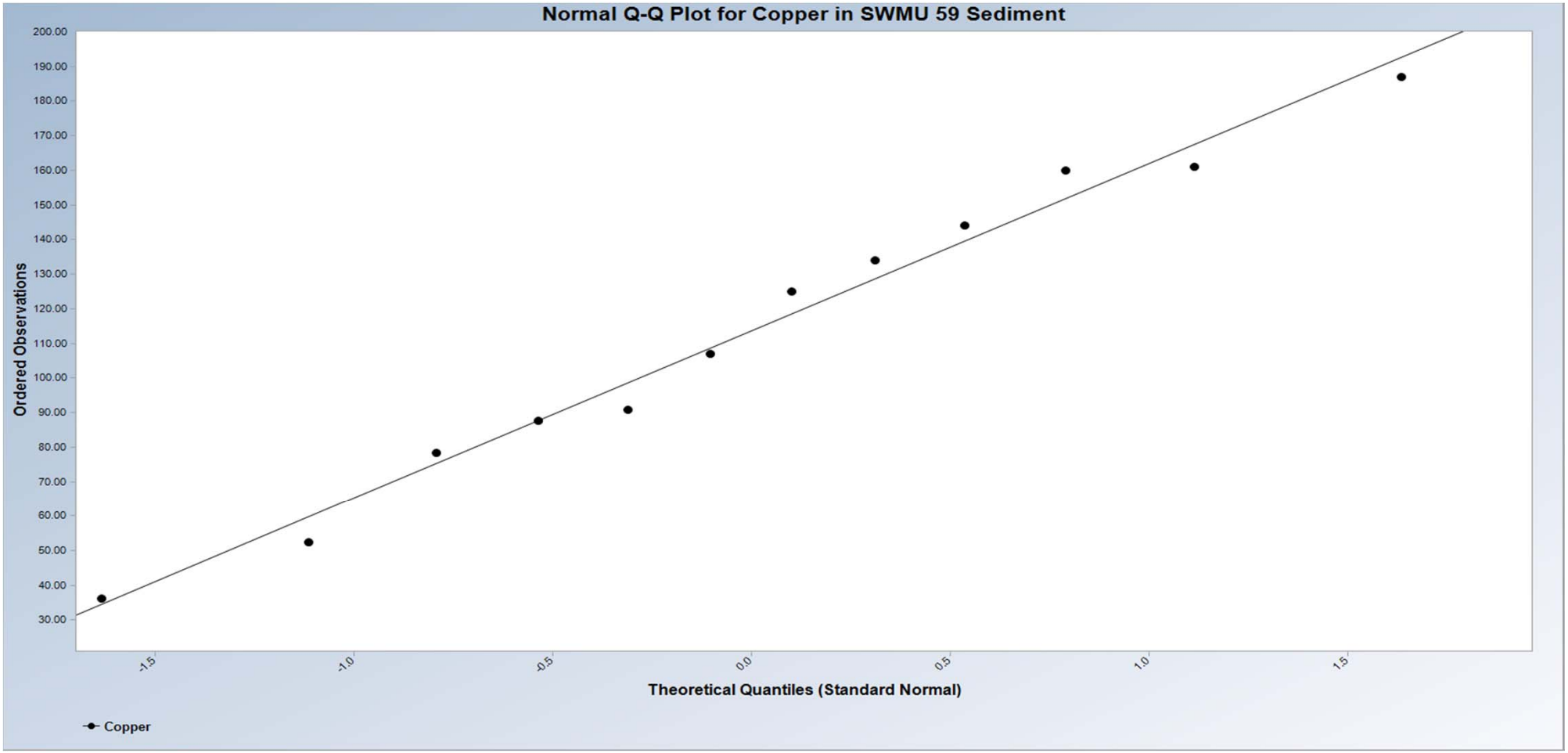
Approximate R Value (0.043)	4
Approximate K Value (0.043)	4
Number of Site Observations in 'R' Largest	4
Calculated Alpha	0.0466

Conclusion with Alpha = 0.043

Reject H0, Conclude Site Concentration > Background Concentration

APPENDIX M

PROBABILITY PLOT - COPPER IN SEDIMENT
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



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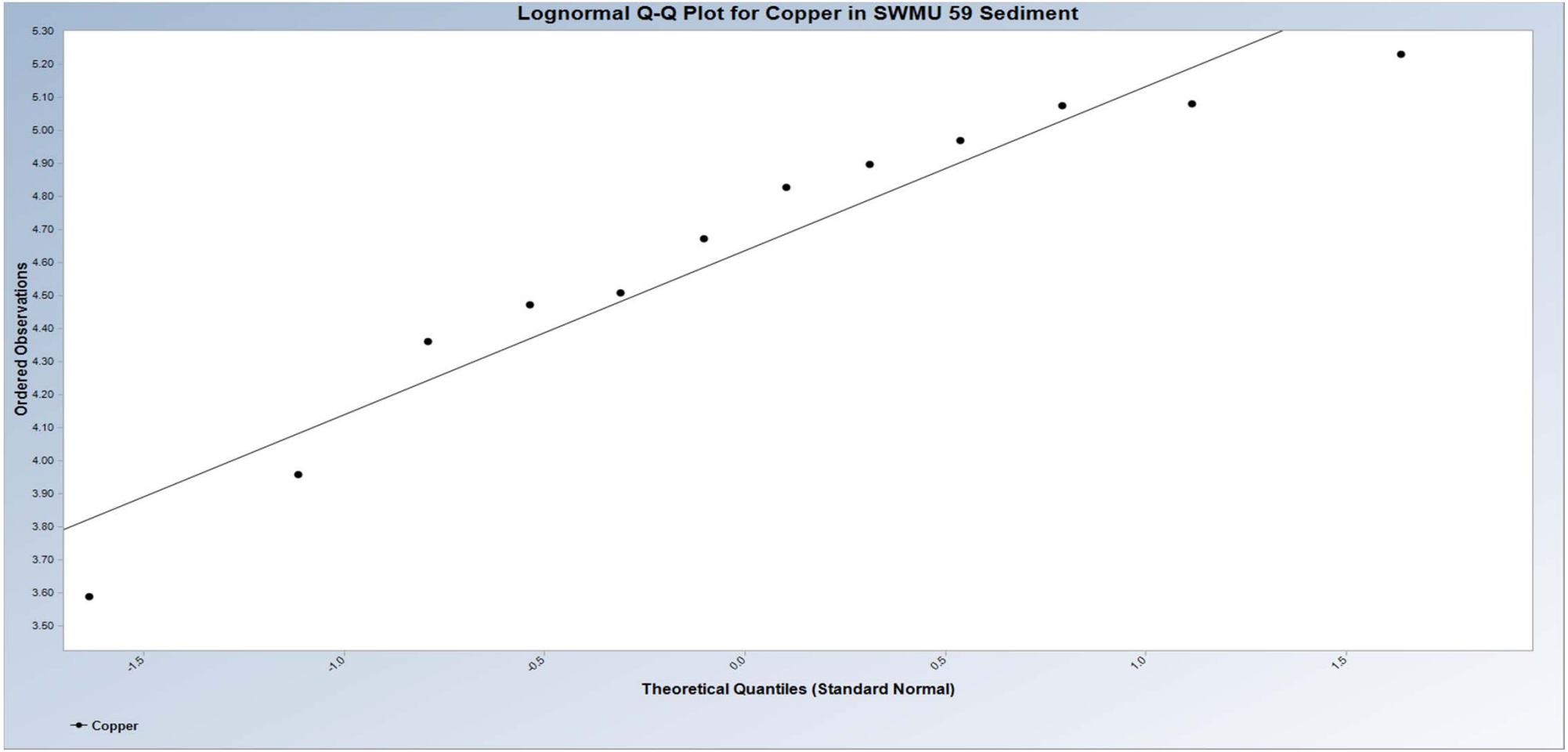

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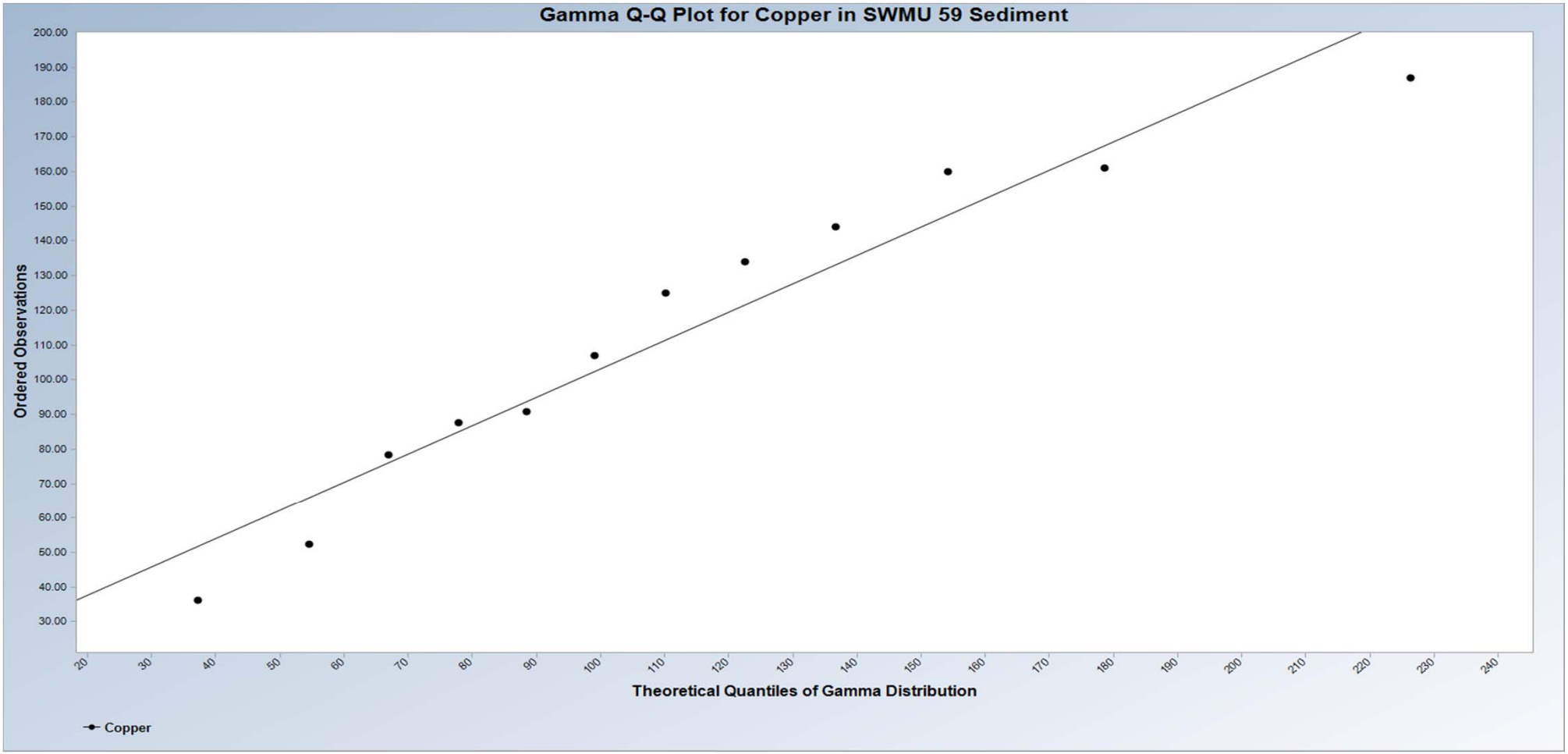

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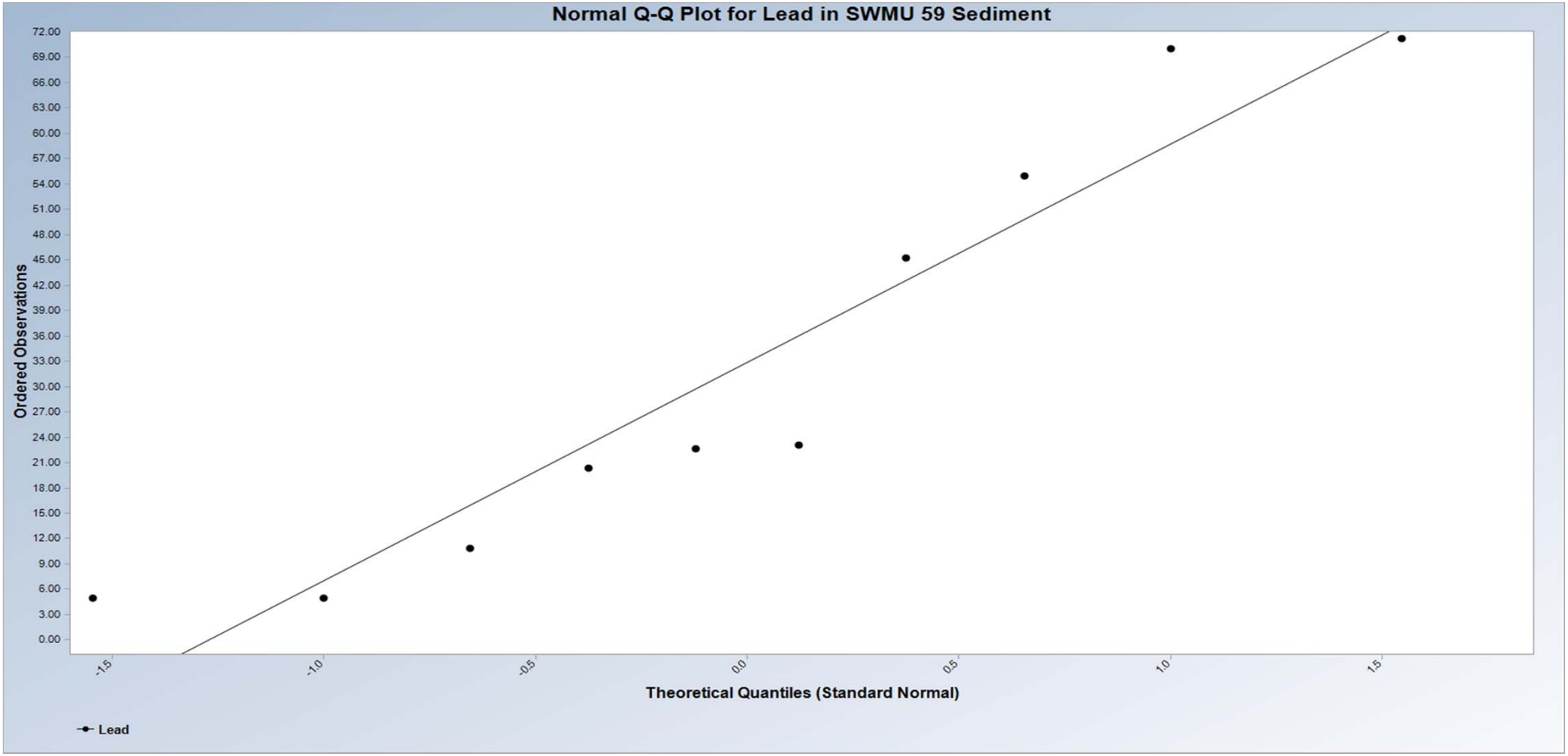

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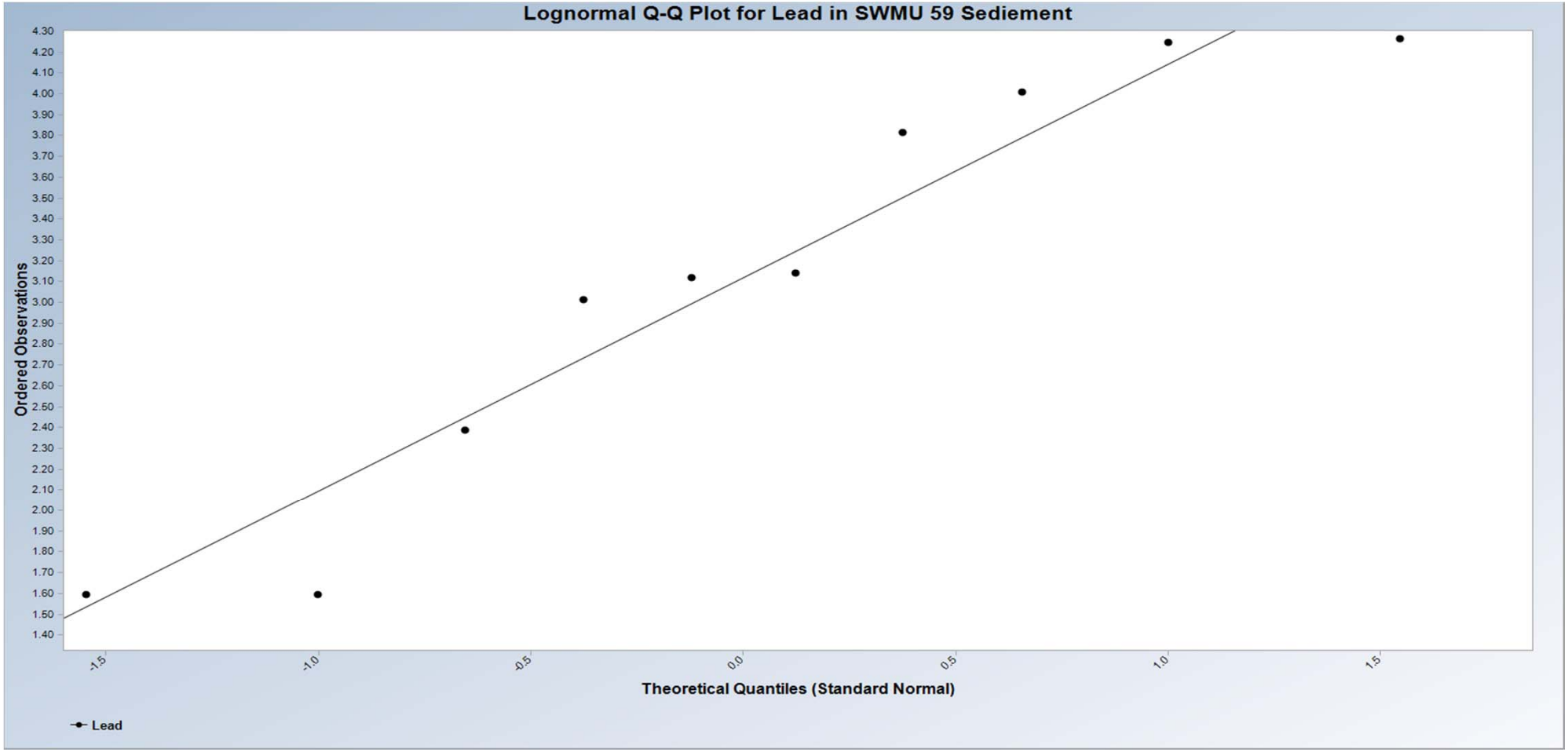

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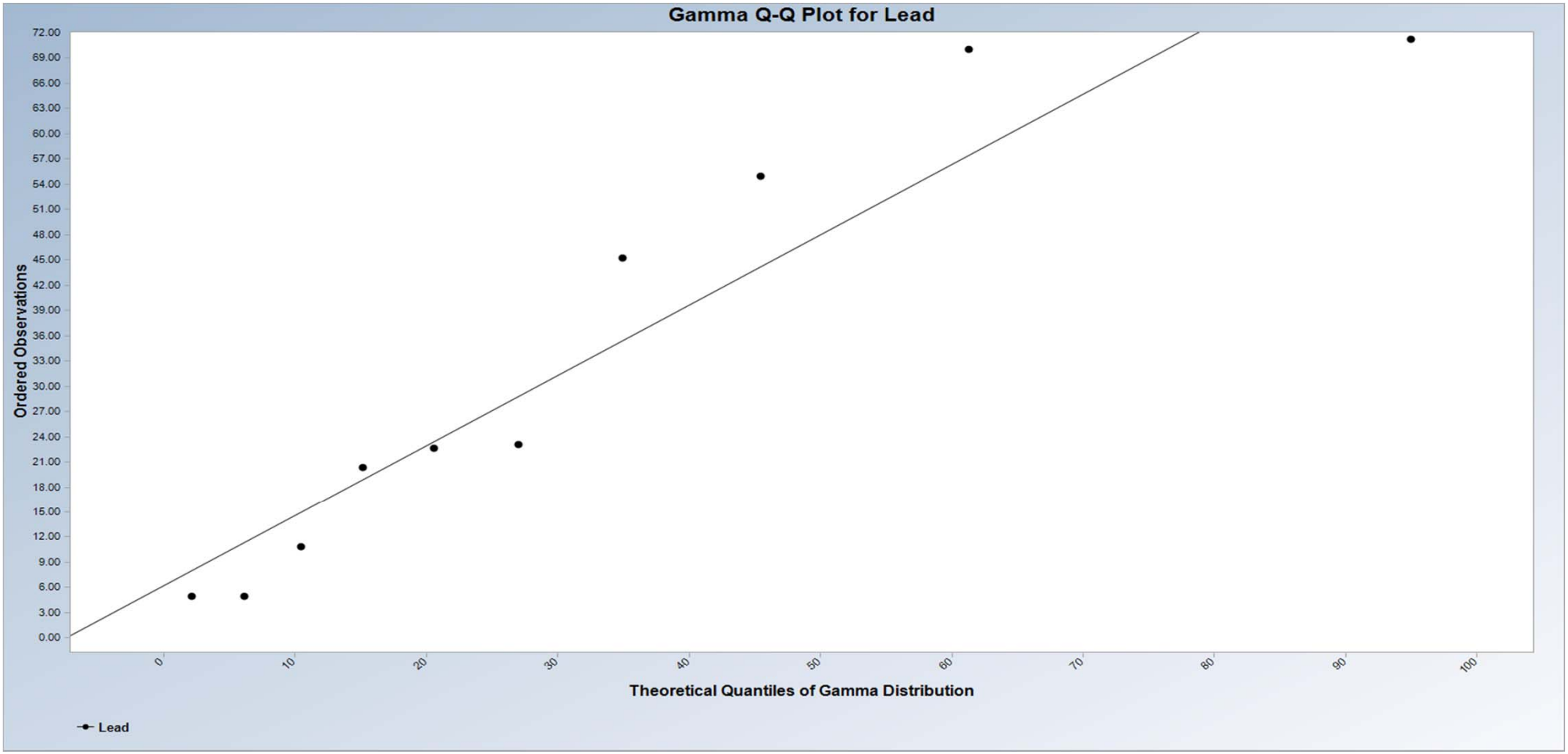

APPENDIX M

PROBABILITY PLOT - ZINC IN SEDIMENT
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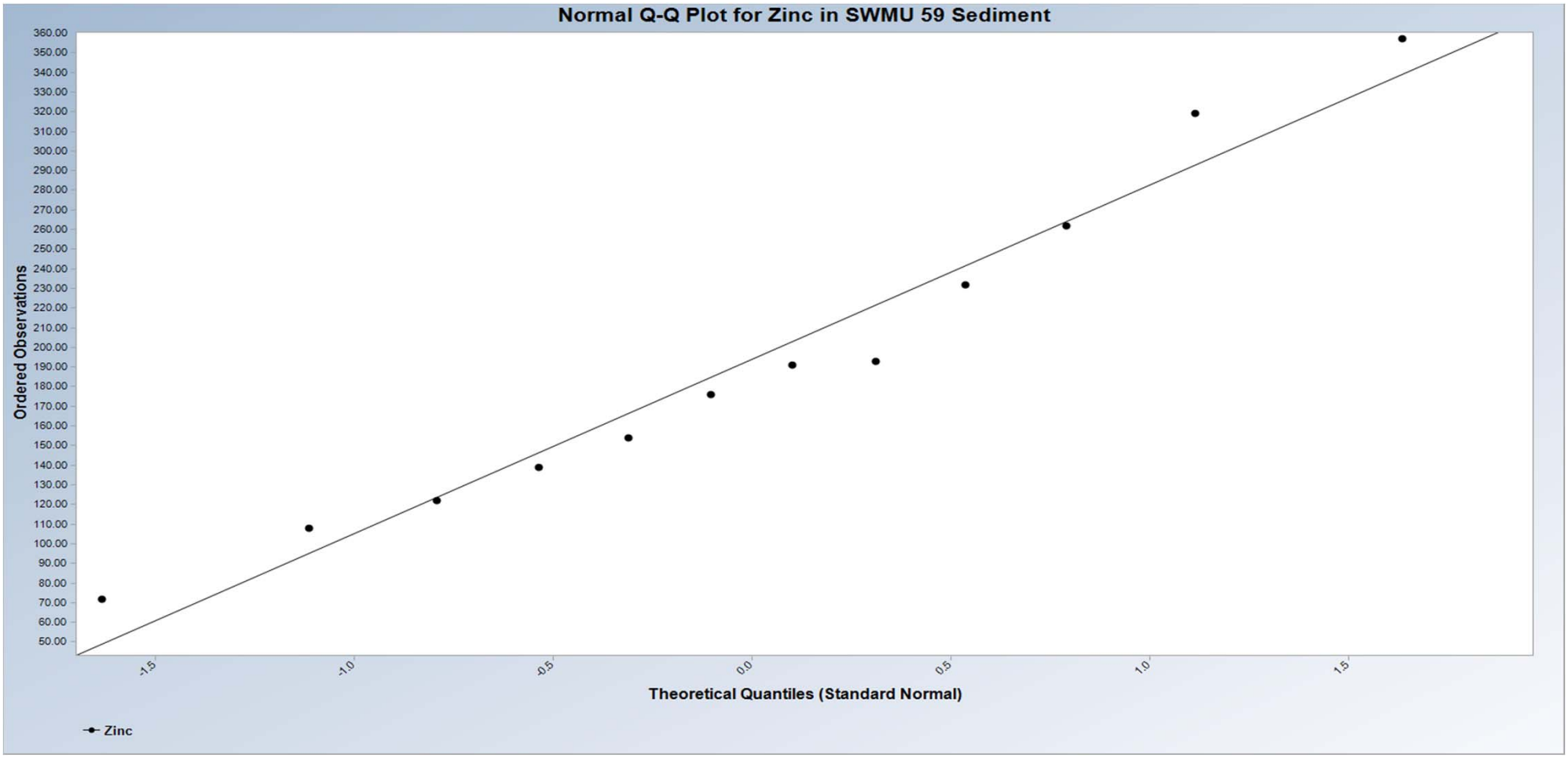

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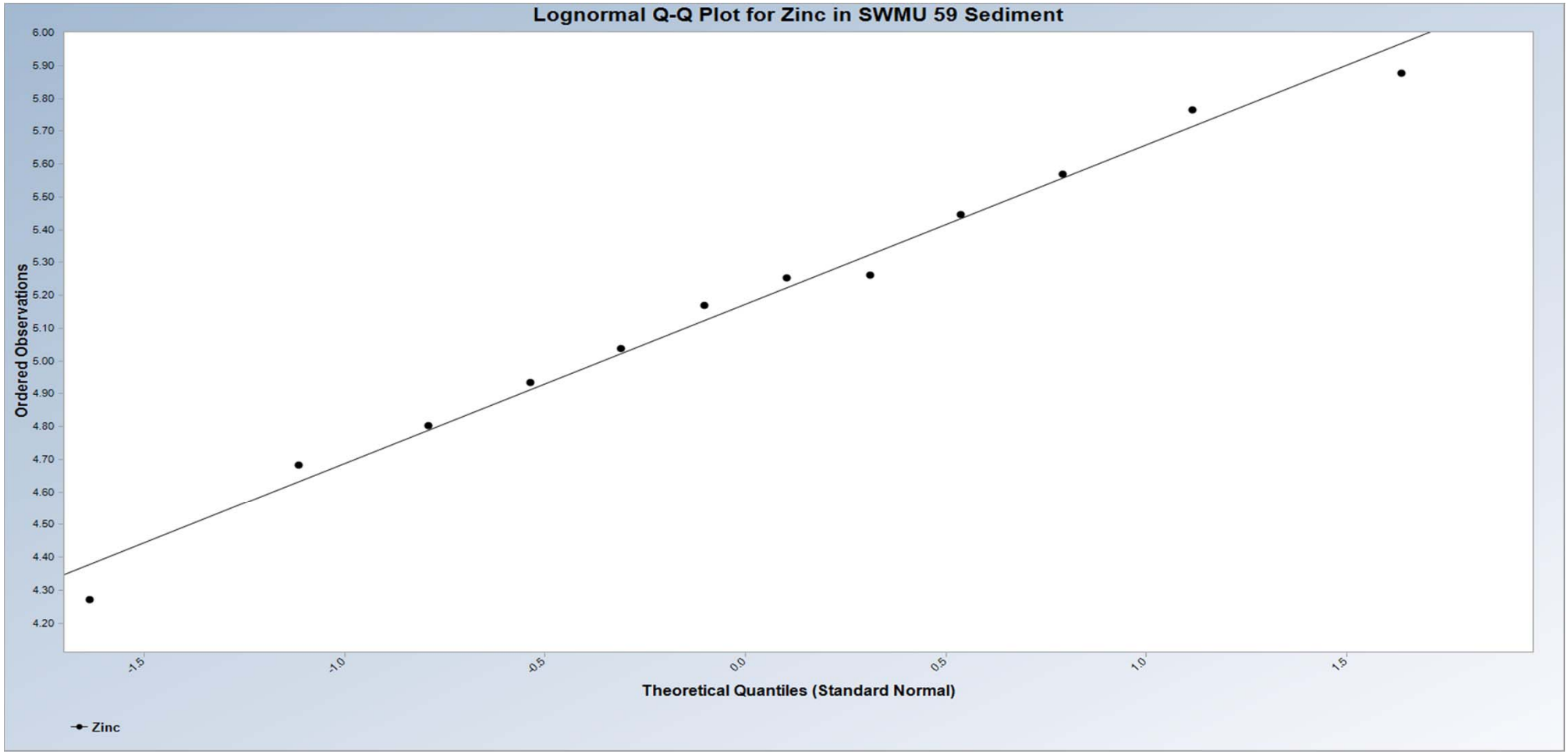
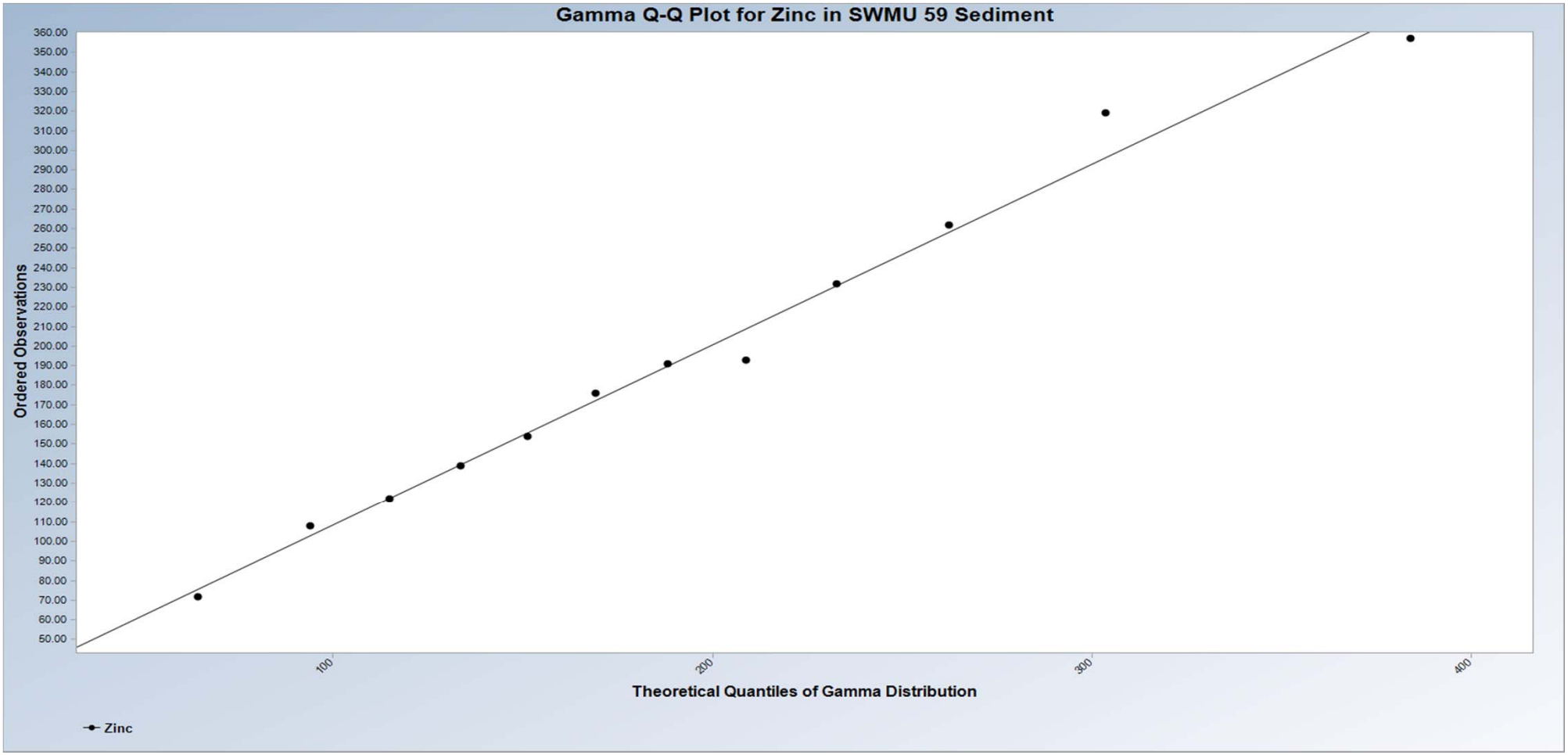
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



APPENDIX M

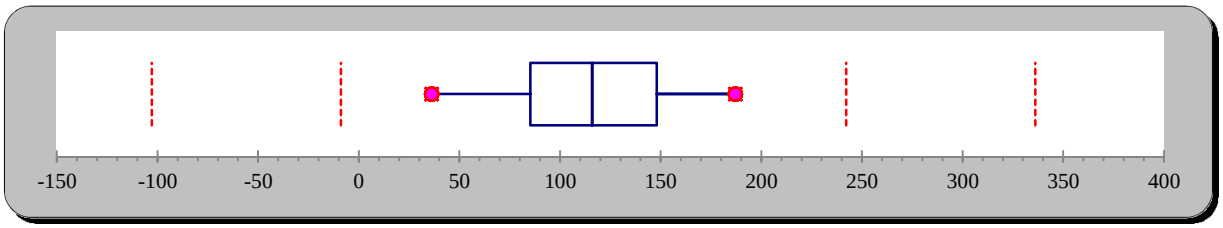
PROBABILITY PLOT - ZINC IN SEDIMENT
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



Box and Whisker Plot

Copper: SWMU 59 Sediment
(Non-Transformed Analytical Data)

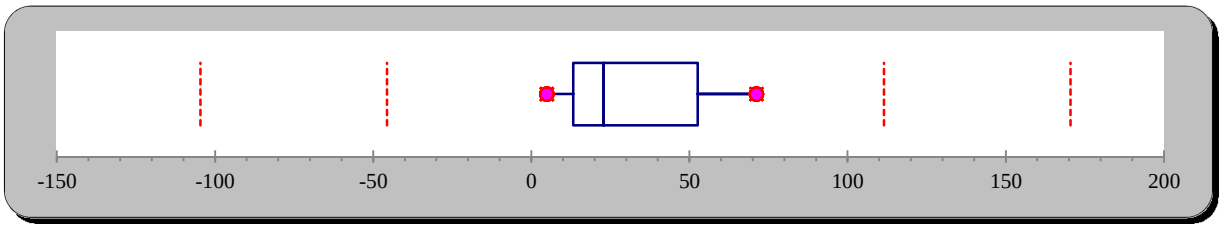
Lower Whisker	Lower Hinge	Median	Upper Hinge	Upper Whisker
36.2	85.275	116	148	187



Box and Whisker Plot

Lead: SWMU 59 Sediment
(Non-Transformed Analytical Data)

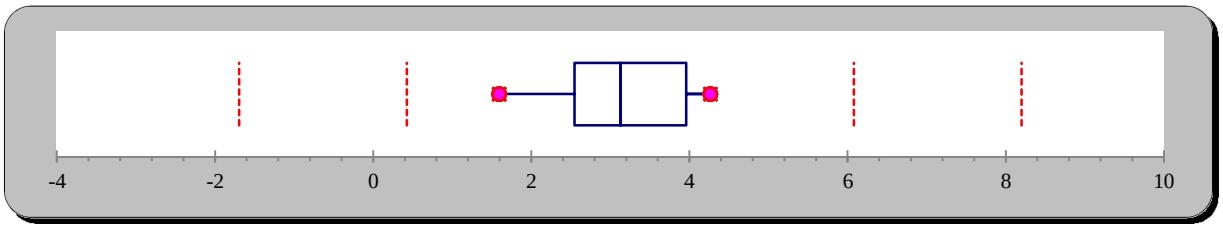
Lower Whisker	Lower Hinge	Median	Upper Hinge	Upper Whisker
4.92	13.275	22.85	52.575	71.2



Box and Whisker Plot

Lead: SWMU 59 Sediment
(Log-Transformed Analytical Data)

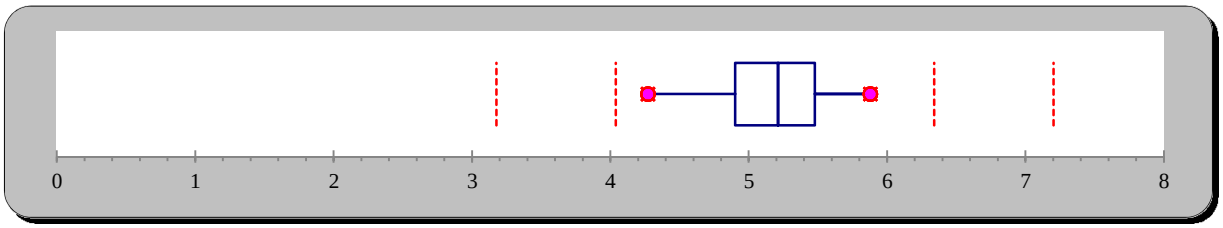
Lower Whisker	Lower Hinge	Median	Upper Hinge	Upper Whisker
1.5933085	2.5454558	3.1288913	3.9588266	4.2654928



Box and Whisker Plot

Zinc: SWMU 59 Sediment
(Log-Transformed Analytical Data)

Lower Whisker	Lower Hinge	Median	Upper Hinge	Upper Whisker
4.2724907	4.9018607	5.2113787	5.4771392	5.8777358



APPENDIX N
BERA DIETARY DOSE TABLES

TABLE N-1
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR MOURNING DOVE DIETARY EXPOSURES
TO ECOLOGICAL CHEMICALS OF POTETNIAL CONCERN IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 3A REFINED RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical [1]	Surface Water Concentration [2] (mg/L)	Surface Soil Concentration [3] (mg/kg)	Soil-to-Plant BAF/Uptake Equation (unitless)	Plant Tissue Concentration [4] (mg/kg)	Dietary Intake [5] (mg/kg-BW/day)	Toxicity Reference Values			Step 3a Refined Risk Estimates [7]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [6] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Semi-Volatile Organics:											
Butyl benzyl phthalate	0.0051	0.1700	0.65677	0.1117	0.01701	NA	NA	NA	---	---	---
Dibenzofuran	0.0051	0.7500	1.28681	0.9651	0.13720	NA	NA	NA	---	---	---
Metals:											
Beryllium	0.0010	0.0328	$\ln(C_p) = 0.7345[\ln(C_s)] - 0.5361$	0.0475	0.00682	NA	NA	NA	---	---	---
Copper	0.0040	136.0000	$\ln(C_p) = 0.394[\ln(C_s)] + 0.668$	13.5121	2.81086	4.05000	12.10000	7.00036	0.69	0.23	0.40
Lead	0.0010	537.1000	$\ln(C_p) = 0.561[\ln(C_s)] - 1.328$	9.0119	5.06891	1.63000	3.26000	2.30517	3.11	1.55	2.20
Vanadium	0.0076	167.0000	0.00485	0.8100	1.30609	0.34400	0.68800	0.48649	3.80	1.90	2.68

Notes:

HQ = Hazard Quotient
BAF = Bioaccumulation Factor
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
mg/L = milligram per liter
mg/kg = milligram per kilogram
mg/kg-BW/day = milligram per kilogram-body weight per day
ln = natural logarithm
C_p = Concentration in plant tissue (mg/kg - dry weight)
C_s = Maximum or 95 percent upper confidence limit of the mean concentration in surface soil (mg/kg - dry weight; see Footnote 3 below)
NA = Not Available
--- = Step 3a refined risk estimate could not be calculated due to the lack of a toxicity reference value

[1] The chemicals listed are those identified as ecological chemicals of potential concern in the Step 2 screening level risk estimate becasue maximum mourning dove exposure doses exceed NOAEL-based toxicity reference values. Detected chemicals lacking avian toxicity reference values are also listed.
[2] Maximum surface water concentration.
[3] Maximum or 95 percent upper confidence limit of the mean surface soil concentration (95 percent upper confidence limit of the mean concentration used for those ecological COPCs with a minimum of eight detected values and less than seventy percent non-detected results).
[4] Plant tissue concentrations were derived by (a) multiplying maximum 95 percent upper confidence limit of the mean surface soil concentrations by soil-to-plant bioaccumulation factors, or (b) soil-to-plant uptake equations.
[5] The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FIR_{dove})(FC_{plant})(PDF_{plant})] + [(FIR_{dove})(SC_x)(PDS)]+[(WIR_{dove})(WC_x)]\}/BW_{dove}$$

Where:

DI_x = Dietary intake of chemical x by the mourning dove (mg/kg-body weight/day)
FIR_{dove} = Mean food ingestion rate for the mourning dove (0.01646 kg/day - dry weight; see Table 7-30)
FC_{plant} = Concentration of chemical x in plant tissue (chemical specific - dry weight; see Table N-1 above)
PDF_{plant} = Proportion of diet composed of plants (0.95 - dry weight basis [unitless]; see Table 7-31)
SC_x = Maximum or 95 percent upper confidence limit of the mean concentration in surface soil (chemical specific - dry weight; see Table N-1 above)
PDS = Proportion of diet composed of surface soil (0.05 - dry weight basis [unitless]; see Table 7-30)
WIR_{dove} = Mean water ingestion rate for the mourning dove (0.01385 L/day; see Table 7-30)
WC_x = Maximum or 95 percent upper confidence limit of the mean concentration in surface water (chemical specific; see Table N-1 above)
BW_{dove} = Mean body weight for the mourning dove (0.115 kg; see Table 7-30)

[6] MATC values were derived by calculating the geometric mean of the NOAEL and LOAEL values.
[7] Refined (Step 3a) NOAEL-, LOAEL-, and MATC-based risk estimates (i.e., HQs) were derived by dividing dietary intakes by NOAEL-, LOAEL-, and MATC-based toxicity reference values, respectively.

TABLE N-2
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR AMERICAN ROBIN DIETARY EXPOSURES
TO ECOLOGICAL CHEMICALS OF POTETNIAL CONCERN IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 3A REFINED RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical [1]	Surface Water Concentration [2] (mg/L)	Surface Soil Concentration [3] (mg/kg)	Soil-to-Plant BAF/Uptake Equation (unitless)	Plant Tissue Concentration [4] (mg/kg)	Soil-to-Terrestrial Invertebrate BAF/Uptake Equation (unitless)	Invertebrate Tissue Concentration [5] (mg/kg)	Dietary Intake [6] (mg/kg-BW/day)	Toxicity Reference Values			Step 3a Refined Risk Estimates [8]		
								NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [7] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Semivolatile Organics:													
Butyl benzyl phthalate	0.1117	0.01701	0.65677	0.1117	1.77288	0.3014	0.03679	NA	NA	NA	---	---	---
Dibenzofuran	0.9651	0.13720	1.28681	0.9651	2.13816	1.6036	0.19500	NA	NA	NA	---	---	---
Pentachlorophenol	2.7278	0.37538	5.93000	2.7278	16.15000	7.4290	0.84795	6.73000	67.30000	21.28213	0.13	0.01	0.04
Organochlorine Pesticides:													
4,4'-DDE	0.0040	0.00076	0.13600	0.0040	$\ln(C_e) = 0.8804[\ln(C_s)] + 2.4771$	0.5374	0.05909	0.22700	2.27000	0.71784	0.26	0.03	0.08
4,4'-DDT	0.0024	0.00079	0.03700	0.0024	$\ln(C_e) = 0.8689[\ln(C_s)] + 2.1247$	0.7737	0.08528	0.22700	2.27000	0.71784	0.38	0.04	0.12
Endrin	0.0198	0.00297	0.53476	0.0198	3.60000	0.1332	0.01520	0.02100	0.10400	0.04673	0.72	0.15	0.33
Metals:													
Beryllium	0.0475	0.00682	$\ln(C_p) = 0.7345[\ln(C_s)] - 0.5361$	0.0475	0.04500	0.0015	0.00119	NA	NA	NA	---	---	---
Cadmium	0.5984	0.08815	$\ln(C_p) = 0.546[\ln(C_s)] - 0.475$	0.5984	$\ln(C_e) = 0.795[\ln(C_s)] + 2.114$	7.8304	0.87271	1.47000	6.36000	3.05765	0.59	0.14	0.29
Chromium, total	1.5027	0.46667	0.04100	1.5027	0.30600	11.2149	1.66124	2.66000	15.60000	6.44174	0.62	0.11	0.26
Copper	13.5121	2.81086	$\ln(C_p) = 0.394[\ln(C_s)] + 0.668$	13.5121	$\ln(C_e) = 0.264[\ln(C_s)] + 1.675$	19.5298	3.83871	4.05000	12.10000	7.00036	0.95	0.32	0.55
Lead	9.0119	5.06891	$\ln(C_p) = 0.561[\ln(C_s)] - 1.328$	9.0119	$\ln(C_e) = 0.807[\ln(C_s)] - 2.18$	18.0465	8.21973	1.63000	3.26000	2.30517	5.04	2.52	3.57
Mercury	0.0611	0.00859	$\ln(C_p) = 0.544[\ln(C_s)] - 0.996$	0.0611	1.69300	0.0620	0.00788	0.02600	0.07800	0.04503	0.30	0.10	0.18
Nickel	0.9348	0.25510	$\ln(C_p) = 0.748[\ln(C_s)] - 2.224$	0.9348	1.05900	18.9243	2.28218	6.71000	18.60000	11.17166	0.34	0.12	0.20
Selenium	0.4752	0.07145	$\ln(C_p) = 1.104[\ln(C_s)] - 0.678$	0.4752	$\ln(C_e) = 0.733[\ln(C_s)] - 0.075$	0.8880	0.11308	0.29000	0.57900	0.40977	0.39	0.20	0.28
Silver	0.0364	0.02368	0.01400	0.0364	2.04500	5.3170	0.61111	2.02000	20.20000	6.38780	0.30	0.03	0.10
Tin	1.0950	0.41248	0.03000	1.0950	1.00000	36.5000	4.41974	6.80000	16.90000	10.72007	0.65	0.26	0.41
Vanadium	0.8100	1.30609	0.00485	0.8100	0.04200	7.0140	2.68823	0.34400	0.68800	0.48649	7.81	3.91	5.53
Zinc	117.3818	18.22912	$\ln(C_p) = 0.554[\ln(C_s)] + 1.575$	117.3818	$\ln(C_e) = 0.328[\ln(C_s)] + 4.449$	565.6185	66.69898	66.10000	171.00000	106.31604	1.01	0.39	0.63

Notes:

HQ = Hazard Quotient
BAF = Bioaccumulation Factor
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
mg/kg = milligram per kilogram
mg/kg-BW/day = milligram per kilogram-body weight per day

mg/L - milligram per liter
ln = natural logarithm
C_e = Concentration in earthworm tissue (mg/kg - dry weight)
C_p = Concentration in plant tissue (mg/kg - dry weight)
C_s = Maximum or 95 percent upper confidence limit of the mean concentration in surface soil (mg/kg - dry weight; see Footnote 3 below)
NA = Not Available
--- = Step 3a refined risk estimate could not be calculated due to the lack of a toxicity reference value

(1) The chemicals listed are those identified as ecological chemicals of potential concern in the Step 2 screening level risk estimate becasue maximum American robin exposure doses exceed NOAEL-based toxicity reference values. Detected chemicals lacking avian toxicity reference values are also listed
(2) Maximum surface water concentration.
(3) Maximum or 95 percent upper confidence limit of the mean surface soil concentration (95 percent upper confidence limit of the mean concentration used for those ecological COPCs with a minimum of eight detected values and less than seventy percent non-detected results).
(4) Plant tissue concentrations were derived by (a) multiplying maximum or 95 percent upper confidence limit of the mean surface soil concentrations by soil-to-plant bioaccumulation factors or (b) soil-to-plant uptake equations.
(5) Soil invertebrate tissue concentrations were derived by (a) multiplying the maximum or 95 percent upper confidence limit of the mean surface soil concentrations by soil-to-invertebrate bioaccumulation factors or (b) soil-to-invertebrate uptake equations.
(6) The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FIR_{robin})(FC_{plant})(PDF_{plant})] + [(FIR_{robin})(FC_{invert})(PDF_{invert})] + [(FIR_{robin})(SC_x)(PDS)]+[(WIR_{robin})(WC_x)]\}/Bw_{robin}$$

Where:

DI_x = Dietary intake of chemical x by the American robin (mg/kg-body weight/day)
FIR_{robin} = Mean food ingestion rate for the American robin (0.01033 kg/day - dry weight; see Table 7-30)
FC_{plant} = Concentration of chemical x in plant tissue (chemical specific - dry weight; see Table N-2 above)
FC_{invert} = Concentration of chemical x in soil invertebrate tissue (chemical specific - dry weight; see Table N-2 above)
PDF_{plant} = Proportion of diet composed of plants (0.083 - dry weight basis [unitless]; see Table 7-31)
PDF_{invert} = Proportion of diet composed of soil invertebrates (0.83 - dry weight basis [unitless]; see Table 7-31)
SC_x = Maximum or 95 percent upper confidence limit of the mean concentration in surface soil (chemical specific - dry weight; see Table N-2 above)
PDS = Proportion of diet composed of surface soil (0.087 - dry weight basis [unitless]; see Table 7-31)
WIR_{robin} = Mean water ingestion rate for the American robin (0.01073 L/day; see Table 7-30)
WC_x = Maximum concentration of chemical x in surface water (chemical specific; see Table N-2 above)
BW_{robin} = Mean body weight for the American robin (0.0785 kg; see Table 7-30)

(7) MATC values were derived by calculating the geometric mean of the NOAEL and LOAEL values
(8) Refined (Step 3a) NOAEL-, LOAEL-, and MATC-based risk estimates (i.e., HQs) were derived by dividing dietary intakes by NOAEL-, LOAEL-, and MATC-based toxicity reference values, respectively

TABLE N-3
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR RED-TAILED HAWK DIETARY EXPOSURES
TO ECOLOGICAL CHEMICALS OF POTETNIAL CONCERN IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 3A REFINED RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical [1]	Surface Water Concentration [2] (mg/L)	Surface Soil Concentration [3] (mg/kg)	Soil-to-Small Mammal BAF/Uptake Equation (unitless)	Small Mammal Concentration [4] (mg/kg)	Dietary Intake [5] (mg/kg-BW/day)	Toxicity Reference Values			Step 3a Refined Risk Estimates [7]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [6] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Semivolatile Organics:											
Butyl benzyl phthalate	0.1117	0.01701	$C_m = [(BAF_d)(DI)]/0.32$	0.0586	0.00499	NA	NA	NA	---	---	---
Dibenzofuran	0.9651	0.13720	$C_m = [(BAF_d)(DI)]/0.32$	0.3534	0.02867	NA	NA	NA	---	---	---
Metals:											
Beryllium	0.0475	0.00682	$C_m = [(BAF_d)(DI)]/0.32$	0.0072	0.00063	NA	NA	NA	---	---	---
Lead	9.0119	5.06891	0.0659	35.3949	2.84211	3.85000	38.50000	12.17477	0.74	0.07	0.23
Vanadium	0.8100	1.30609	0.01037	1.7318	0.13949	0.34400	0.68800	0.48649	0.41	0.20	0.29

Notes:

HQ = Hazard Quotient
BAF = Bioaccumulation Factor
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
mg/kg = milligram per kilogram
mg/kg-BW/day = milligram per kilogram-body weight per day
mg/L = milligram per liter
C_m = Concentration in small mammal tissue (mg/kg - dry weight)
BAF_d = small mammal diet-to-whole body bioaccumulation factor (wet weight basis; assumed to be 1.0)
DI_m = Small mammal dietary intake (mg/kg-BW/day)
NA = Not Available
--- = Step 3a refined risk estimate could not be calculated due to the lack of a toxicity reference value

(1) The chemicals listed are those identified as ecological chemicals of potential concern in the Step 2 screening level risk estimate becasue maximum red-tailed hawk exposure doses exceed NOAEL-based toxicity reference values. Detected chemicals lacking avian toxicity reference values are also listed.
(2) Maximum surface water concentration.
(3) Maximum or 95 percent upper confidence limit of the mean surface soil concentration (95 percent upper confidence limit of the mean concentration used for those ecological COPCs with a minimum of eight detected values and less than seventy percent non-detected results).
(4) The small mammal (i.e., Norway rat) tissue concentrations were derived by (a) multiplying maximum surface soil concentrations by soil-to-small mammal bioaccumulation factors, or (b) multiplying small mammal dietary intakes (see Table N-5 for small mammal dietary intake values) by small mammal diet-to-whole body BAF values (BAF_d assumed to be 1.0 for all chemicals [wet weight basis]) and dividing the products by 0.32 (solids content of small mammals).
(5) The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FIR_{hawk})(FC_{sm})(PDF_{sm})] + [(FIR_{hawk})(SC_x)(PDS)]+[(WIR_{hawk})(WC_x)]\}/BW_{hawk}$$

Where:

DI_x = Dietary intake of chemical x by the red-tailed hawk (mg/kg-body weight/day)
FIR_{hawk} = Mean food ingestion rate for the red-tailed hawk (0.08788 kg/day - dry weight; see Table 7-30)
FC_{sm}= Concentration of chemical x in small mammal tissue (chemical specific - dry weight; see Table N-3 above)
PDF_{sm} = Proportion of diet composed of small mammals (1.0 - dry weight basis [unitless]; see Table 7-31)
SC_x = Maximum or 95 percent UCL of the mean concentration in surface soil (chemical specific - dry weight; see Table N-3 above)
PDS = Proportion of diet composed of surface soil (0.0 - dry weight basis [unitless]; see Table 7-31)
WIR_{hawk} = Mean water ingestion rate for the mourning dove (0.06268 L/day; see Table 7-30)
WC_x = Maximum or 95 percent upper confidence limit of the mean concentration in surface water (chemical specific; see Table N-3 above)
BW_{hawk} = Mean body weight for the red-tailed hawk (1.0945 kg; see Table 7-30)

(6) MATC values were derived by calculating the geometric mean of the NOAEL and LOAEL values.
(7) Refined (Step 3a) NOAEL-, LOAEL-, and MATC-based risk estimates (i.e., HQs) were derived by dividing dietary intakes by NOAEL-, LOAEL-, and MATC-based toxicity reference values, respectively.

TABLE N-4
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR BROWN FLOWER BAT DIETARY
TO ECOLOGICAL CHEMICALS OF POTETNIAL CONCERN IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 3A REFINED RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical [1]	Surface Water Concentration [2] (mg/L)	Surface Soil Concentration [3] (mg/kg)	Soil-to-Plant BAF/Uptake Equation (unitless)	Plant Tissue Concentration [4] (mg/kg)	Dietary Intake [5] (mg/kg-BW/day)	Toxicity Reference Values			Step 3a Refined Risk Estimates [7]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [6] (mg/kg-BW/day)	NOAEL-Based HQ (mg/kg-BW/day)	LOAEL-Based HQ (mg/kg-BW/day)	MATC-Based HQ (mg/kg-BW/day)
Semivolatile Organics:											
Dibenzofuran	0.9651	0.13720	1.28681	0.9651	0.13612	NA	NA	NA	---	---	---
LLPAHs:											
Pyrene	1.2636	0.18437	0.72000	1.2636	0.17724	0.61500	3.01000	1.36057	0.29	0.06	0.13
Metals:											
Selenium	0.4752	0.07145	ln(Cp) = 1.104[ln(Cs)] - 0.678	0.4752	0.06677	0.14300	0.21500	0.17534	0.47	0.31	0.38

Notes:

HQ = Hazard Quotient
BAF = Bioaccumulation Factor
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
mg/kg = milligram per kilogram
ln = natural logarithm
mg/kg-BW/day = milligram per kilogram-body weight per day
mg/L = milligram per liter
C_p = Concentration in plant tissue (mg/kg - dry weight)
C_s = Maximum or 95 percent upper confidence limit of the mean concentration in surface soil (mg/kg - dry weight; see Footnote 3 below).

[1] The chemicals listed are those identified as ecological chemicals of potential concern in the Step 2 screening level risk estimate becasue maximum brown flower bat exposure doses exceed NOAEL-based toxicity reference values. Detected chemicals lacking mammalian toxicity reference values are also listed.
[2] Maximum surface water concentration.
[3] Maximum or 95 percent upper confidence limit of the mean surface soil concentration (95 percent upper confidence limit of the mean concentration used for those ecological COPCs with a minimum of eight detected values and less than seventy percent non-detected results).
[4] Plant tissue concentrations were derived by (a) multiplying maximum 95 percent upper confidence limit of the mean surface soil concentrations by soil-to-plant bioaccumulation factors, or (b) soil-to-plant uptake equations.
[5] Soil invertebrate tissue concentrations were derived by (a) multiplying the maximum or 95 percent upper confidence limit of the mean surface soil concentrations by soil-to-invertebrate bioaccumulation factors or (b) soil-to-invertebrate uptake equations.

$$DI_x = \{[(FI_{bat})(FC_{plant})(PDF_{plant})] + [(FIR_{bat})(SC_x)(PDS)]+[(WIR_{bat})(WC_x)]\}/BW_{bat}$$

Where:

DI_x = Dietary intake of chemical by the brown flower bat (mg/kg-body weight/day)
FIR_{bat} = Mean food ingestion rate for the brown flower bat (0.00257 kg/day - dry weight; see Table 7-30)
FC_{plant} = Concentration of chemical x in plant tissue (chemical-specific; see Table N-4 above)
PDF_{plant} = Proportion of diet composed of plants (1.0 - dry weight basis [unitless]; see Table 7-31)
SC_x = Maximum or 95 percent upper confidence limit of the mean concentration in surface soil (chemical-specific; see Table N-4 above)
PDS = Proportion of diet composed of surface soil (0.0 - dry weight basis [unitless]; see Table 7-31)
WIR_{bat} = Mean water ingestion rate for the brown flower bat (0.00270 L/day; see Table 7-30)
WC_x = Maximum or 95 percent upper confidence limit of the mean concentration in surface water (chemical-specific; see Table N-4 above)
BW_{bat} = Mean body weight for the brown flower bat (0.0183 kg; see Table 7-30)

[6] MATC value was derived by calculating the geometric mean of the NOAEL and LOAEL values.
[7] Refined (Step 3a) NOAEL-, LOAEL-, and MATC-based risk estimates (i.e., HQs) were derived by dividing dietary intakes by NOAEL-, LOAEL-, and MATC-based toxicity reference values, respectively. differences in body weights between the test species [pig] and receptor species [brown flower bat]).

TABLE N-5
FOOD ITEM CONCENTRATIONS AND DIETARY INTAKES FOR NORWAY RAT DIETARY EXPOSURES TO ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 3A REFINED RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical [1]	Surface Water Concentration [2] (mg/L)	Surface Soil Concentration [3] (mg/kg)	Soil-to-Plant BAF/Uptake Equation (unitless)	Plant Tissue Concentration [4] (mg/kg)	Soil-to-Terrestrial Invertebrate BAF/Uptake Equation (unitless)	Invertebrate Tissue Concentration [5] (mg/kg)	Dietary Intake [6] (mg/kg-BW/day)
Semivolatile Organics:							
Butyl benzyl phthalate	0.1117	0.01701	0.65677	0.1117	1.77288	0.3014	0.01874
Dibenzofuran	0.9651	0.13720	1.28681	0.9651	2.13816	1.6036	0.11308
Metals:							
Beryllium	0.0475	0.00682	$\ln(C_p) = 0.7345[\ln(C_s)] - 0.5361$	0.0475	0.04500	0.0015	0.00229

Notes:

BAF = Bioaccumulation Factor
mg/kg = milligram per kilogram
mg/kg-BW/day = milligram per kilogram-body weight per day
mg/L = milligram per liter
ln = natural logarithm
C_p = Concentration in plant tissue (mg/kg - dry weight)
C_s =Maximum or 95 percent upper confidence limit of the mean concentration in surface soil (mg/kg - dry weight; see Footnote 3 below).

(1) The chemicals listed are limited to those identified as ecological chemicals of potential concern for red-tailed hawk dietary exposures chemicals with Norway rat tissue concentrations estimated using dietary intakes and diet-to-whole body BAF values (i.e., beryllium; see Table N-3).
(2) Maximum surface water concentration.
(3) Maximum or 95 percent upper confidence limit of the mean surface soil concentration (95 percent upper confidence limit of the mean concentration used for those ecological COPCs with a minimum of eight detected values and less than seventy percent non-detected results).
(4) Plant tissue concentrations were derived by (a) multiplying maximum 95 percent upper confidence limit of the mean surface soil concentrations by soil-to-plant bioaccumulation factors, or (b) soil-to-plant uptake equations.
(5) Soil invertebrate tissue concentrations were derived by multiplying the maximum or 95 percent upper confidence limit of the mean surface soil concentrations by soil-to-invertebrate bioaccumulation factors.
(6) The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FIR_{rat})(FC_{plant})(PDF_{plant})] + [(FIR_{rat})(FC_{invert})(PDF_{invert})] + [(FIR_{rat})(SC_x)(PDS)]+[(WIR_{rat})(WC_x)]\}/BW_{rat}$$

Where:

DI_x = Dietary intake of beryllium by the Norway rat (mg/kg-body weight/day)
FIR_{rat} = Food ingestion rate for the Norway rat (0.03092 kg/day - dry weight; see Table 7-30)
FC_{plant} = Concentration of chemical x in plant tissue (chemical specific - dry weight; see Table N-5 above)
FC_{invert} = Concentration of chemical x in soil invertebrate tissue (chemical specific - dry weight; see Table N-5 above)
PDF_{plant} = Proportion of diet composed of plants (0.49 - dry weight basis [unitless]; see Table 7-31)
PDF_{invert} = Proportion of diet composed of soil invertebrates (0.49 - dry weight basis [unitless]; see Table 7-31)
SC_x = Maximum or 95 percent upper confidence limit of the mean concentration in surface soil (chemical-specific; see Table N-5 above)
PDS = Proportion of diet composed of surface soil (0.02 - dry weight basis [unitless]; see Table 7-31)
WIR_{rat} = Mean water ingestion rate for the Norway rat (0.03849 L/day; see Table 7-30)
WC_x = Maximum or 95 percent upper confidence limit of the mean concentration in surface water (chemical-specific; see Table N-5 above)
BW_{rat} = Midpoint body weight for the Norway rat (0.350 kg; see Table 7-30)

TABLE N-6
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR MOURNING DOVE DIETARY EXPOSURES
TO ECOLOGICAL CHEMICALS OF POTETNIAL CONCERN IN SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 3A REFINED RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical [1]	Surface Water Concentration [2] (mg/L)	Surface Soil Concentration [3] (mg/kg)	Soil-to-Plant BAF/Uptake Equation (unitless)	Plant Tissue Concentration [4] (mg/kg)	Dietary Intake [5] (mg/kg-BW/day)	Toxicity Reference Values			Step 3a Refined Risk Estimates [7]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [6] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Metals:											
Beryllium	0.0000	0.3760	$\ln(C_p) = 0.7345[\ln(C_s)] - 0.5361$	0.2852	0.04147	NA	NA	NA	---	---	---
Chromium, total	0.0008	88.5300	0.04100	3.6297	1.12713	2.66000	15.60000	6.44174	0.42	0.07	0.17
Copper	0.0040	146.3000	$\ln(C_p) = 0.394[\ln(C_s)] + 0.668$	13.9064	2.93818	4.05000	12.10000	7.00036	0.73	0.24	0.42
Vanadium	0.0076	246.4000	0.00485	1.1950	1.92664	0.34400	0.68800	0.48649	5.60	2.80	3.96

Notes:

HQ = Hazard Quotient
BAF = Bioaccumulation Factor
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
mg/L = milligram per liter
mg/kg = milligram per kilogram
mg/kg-BW/day = milligram per kilogram-body weight per day
ln = natural logarithm
C_p = Concentration in plant tissue (mg/kg - dry weight)
C_s =Maximum or 95 percent upper confidence limit of the mean concentration in surface soil (mg/kg - dry weight; see Footnote 3 below).
NA = Not Available
--- = Step 3a refined risk estimate could not be calculated due to the lack of a toxicity reference value

(1) The chemicals listed are those identified as ecological chemicals of potential concern in the Step 2 screening level risk estimate becasue maximum mourning dove exposure doses exceed NOAEL-based toxicity reference values. Detected chemicals lacking avian toxicity reference values are also listed.

(2) Maximum surface water concentration.

(3) Maximum or 95 percent upper confidence limit of the mean surface soil concentration (95 percent upper confidence limit of the mean concentration used for those ecological COPCs with a minimum of eight detected values and less than seventy percent non-detected results).

(4) Plant tissue concentrations were derived by (a) multiplying maximum 95 percent upper confidence limit of the mean surface soil concentrations by soil-to-plant bioaccumulation factors, or (b) soil-to-plant uptake equations.

(5) The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FIR_{dove})(FC_{plant})(PDF_{plant})] + [(FIR_{dove})(SC_x)(PDS)]+[(WIR_{dove})(WC_x)]\}/BW_{dove}$$

Where:

DI_x = Dietary intake of chemical x by the mourning dove (mg/kg-body weight/day)
FIR_{dove} = Mean food ingestion rate for the mourning dove (0.01646 kg/day - dry weight; see Table 7-30)
FC_{plant} = Concentration of chemical x in plant tissue (chemical specific - dry weight; see Table N-6 above)
PDF_{plant} = Proportion of diet composed of plants (0.95 - dry weight basis [unitless]; see Table 7-31)
SC_x = Maximum or 95 percent upper confidence limit of the mean concentration in surface soil (chemical specific - dry weight; see Table N-6 above)
PDS = Proportion of diet composed of surface soil (0.05 - dry weight basis [unitless]; see Table 7-30)
WIR_{dove} = Mean water ingestion rate for the mourning dove (0.01385 L/day; see Table 7-30)
WC_x = Maximum or 95 percent upper confidence limit of the mean concentration in surface water (chemical specific; see Table N-6 above)
BW_{dove} = Mean body weight for the mourning dove (0.115 kg; see Table 7-30)

(6) MATC values were derived by calculating the geometric mean of the NOAEL and LOAEL values.

(7) Refined (Step 3a) NOAEL-, LOAEL-, and MATC-based risk estimates (i.e., HQs) were derived by dividing dietary intakes by NOAEL-, LOAEL-, and MATC-based toxicity reference values, respectively.

TABLE N-7
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR AMERICAN ROBIN DIETARY EXPOSURES
TO ECOLOGICAL CHEMICALS OF POTETNIAL CONCERN IN SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 3A REFINED RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical [1]	Surface Water Concentration [2] (mg/L)	Surface Soil Concentration [3] (mg/kg)	Soil-to-Plant BAF/Uptake Equation (unitless)	Plant Tissue Concentration [4] (mg/kg)	Soil-to-Terrestrial Invertebrate BAF/Uptake Equation (unitless)	Invertebrate Tissue Concentration [5] (mg/kg)	Dietary Intake [6] (mg/kg-BW/day)	Toxicity Reference Values			Step 3a Refined Risk Estimates [8]		
								NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [7] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Metals:													
Beryllium	0.2852	0.04147	$In(C_p) = 0.7345[ln(C_s)] - 0.5361$	0.2852	0.04500	0.0169	0.00889	NA	NA	NA	---	---	---
Chromium, total	3.6297	1.12713	0.04100	3.6297	0.30600	27.0902	4.00788	2.66000	15.60000	6.44174	1.51	0.26	0.62
Copper	13.9064	2.93818	$ln(C_p) = 0.394[ln(C_s)] + 0.668$	13.9064	$ln(C_e) = 0.264[ln(C_s)] + 1.675$	19.9098	3.98417	4.05000	12.10000	7.00036	0.98	0.33	0.57
Mercury	0.0863	0.01225	$In(C_p) = 0.544[ln[C_s]) - 0.996$	0.0863	1.69300	0.1168	0.01441	0.02600	0.07800	0.04503	0.36	0.12	0.21
Nickel	1.4488	0.42681	$ln(C_p) = 0.748[ln(C_s)] - 2.224$	1.4488	1.05900	33.9939	4.09497	6.71000	18.60000	11.17166	0.61	0.22	0.37
Tin	0.2490	2.50233	0.03000	0.2490	1.00000	8.3000	3.73668	6.80000	16.90000	10.72007	0.55	0.22	0.35
Vanadium	1.1950	1.92664	0.00485	1.1950	0.04200	10.3488	3.96428	0.34400	0.68800	0.48649	11.52	5.76	8.15
Zinc	50.3306	7.37580	$ln(C_p) = 0.554[ln(C_s)] + 1.575$	50.3306	$ln(C_e) = 0.328[ln(C_s)] + 4.449$	351.4475	39.72616	66.10000	171.00000	106.31604	0.60	0.23	0.37

Notes:

HQ = Hazard Quotient
BAF = Bioaccumulation Factor
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
mg/kg = milligram per kilogram
mg/kg-BW/day = milligram per kilogram-body weight per day
mg/L = milligram per liter
ln = natural logarithm
C_e = Concentration in earthworm tissue (mg/kg - dry weight)
C_p = Concentration in plant tissue (mg/kg - dry weight)
C_s =Maximum or 95 percent upper confidence limit of the mean concentration in surface soil (mg/kg - dry weight; see Footnote 3 below).
NA = Not Available
--- = Step 3a refined risk estimate could not be calculated due to the lack of a toxicity reference value

(1) The chemicals listed are those identified as ecological chemicals of potential concern in the Step 2 screening level risk estimate becasue maximum American robin exposure doses exceed NOAEL-based toxicity reference values. Detected chemicals lacking avian toxicity reference values are also listed.
(2) Maximum surface water concentration.
(3) Maximum or 95 percent upper confidence limit of the mean surface soil concentration (95 percent upper confidence limit of the mean concentration used for those ecological COPCs with a minimum of eight detected values and less than seventy percent non-detected results).
(4) Plant tissue concentrations were derived by (a) multiplying maximum or 95 percent upper confidence limit of the mean surface soil concentrations by soil-to-plant bioaccumulation factors or (b) soil-to-plant uptake equations.
(5) Soil invertebrate tissue concentrations were derived by (a) multiplying the maximum or 95 percent upper confidence limit of the mean surface soil concentrations by soil-to-invertebrate bioaccumulation factors or (b) soil-to-invertebrate uptake equations.
(6) The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FIR_{robin})(FC_{plant})(PDF_{plant})] + [(FIR_{robin})(FC_{invert})(PDF_{invert})] + [(FIR_{robin})(SC_x)(PDS)]+[(WIR_{robin})(WC_x)]\}/Bw_{robin}$$

Where:

DI_x = Dietary intake of chemical x by the American robin (mg/kg-body weight/day)
FIR_{robin} = Mean food ingestion rate for the American robin (0.01033 kg/day - dry weight; see Table 7-30)
FC_{plant} = Concentration of chemical x in plant tissue (chemical specific - dry weight; see Table N-7 above)
FC_{invert} = Concentration of chemical x in soil invertebrate tissue (chemical specific - dry weight; see Table N-7 above)
PDF_{plant} = Proportion of diet composed of plants (0.083 - dry weight basis [unitless]; see Table 7-31)
PDF_{invert} = Proportion of diet composed of soil invertebrates (0.83 - dry weight basis [unitless]; see Table 7-31)
SC_x = Maximum or 95 percent upper confidence limit of the mean concentration in surface soil (chemical specific - dry weight; see Table N-7 above)
PDS = Proportion of diet composed of surface soil (0.087 - dry weight basis [unitless]; see Table 7-31)
WIR_{robin} = Mean water ingestion rate for the American robin (0.01073 L/day; see Table 7-30)
WC_x = Maximum concentration of chemical x in surface water (chemical specific; see Table N-7 above)
BW_{robin} = Mean body weight for the American robin (0.0785 kg; see Table 7-30)

(7) MATC values were derived by calculating the geometric mean of the NOAEL and LOAEL values.
(8) Refined (Step 3a) NOAEL-, LOAEL-, and MATC-based risk estimates (i.e., HQs) were derived by dividing dietary intakes by NOAEL-, LOAEL-, and MATC-based toxicity reference values, respectively.

TABLE N-8
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR RED-TAILED HAWK DIETARY EXPOSURES
TO ECOLOGICAL CHEMICALS OF POTETNIAL CONCERN IN SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 3A REFINED RISK CALCULATION
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Chemical [1]	Surface Water Concentration [2] (mg/L)	Surface Soil Concentration [3] (mg/kg)	Soil-to-Small Mammal BAF/Uptake Equation (unitless)	Small Mammal Concentration [4] (mg/kg)	Dietary Intake [5] (mg/kg-BW/day)	Toxicity Reference Values			Step 3a Refined Risk Estimates [7]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [6] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Metals:											
Beryllium	0.2852	0.04147	$C_m = [(BAF_d)(DI)]/0.32$	0.0429	0.00345	NA	NA	NA	---	---	---
Vanadium	1.1950	1.92664	$C_m = [(BAF_d)(DI)]/0.32$	2.5552	0.20560	0.34400	0.68800	0.48649	0.60	0.30	0.42

Notes:

HQ = Hazard Quotient
BAF = Bioaccumulation Factor
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
mg/kg = milligram per kilogram
mg/kg-BW/day = milligram per kilogram-body weight per day
mg/L = milligram per liter
C_m = Concentration in small mammal tissue (mg/kg - dry weight)
BAF_d = small mammal diet-to-whole body bioaccumulation factor (wet weight basis; assumed to be 1.0)
DI_m = Small mammal dietary intake (mg/kg-BW/day)
NA = Not Available
--- = Step 3a refined risk estimate could not be calculated due to the lack of a toxicity reference value

[1] The chemicals listed are those identified as ecological chemicals of potential concern in the Step 2 screening level risk estimate becasue maximum red-tailed hawk exposure doses exceed NOAEL-based toxicity reference values. Detected chemicals lacking avian toxicity reference values are also listed.

[2] Maximum surface water concentration.

[3] Maximum or 95 percent upper confidence limit of the mean surface soil concentration (95 percent upper confidence limit of the mean concentration used for those ecological COPCs with a minimum of eight detected values and less than seventy percent non-detected results).

[4] The small mammal (i.e., Norway rat) tissue concentrations were derived by multiplying small mammal dietary intakes (see Table N-9 for small mammal dietary intake values) by small mammal diet-to-whole body BAF values (BAF_d assumed to be 1.0 for all chemicals [wet weight basis]) and dividing the products by 0.32 (solids content of small mammals).

[5] The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FIR_{hawk})(FC_{sm})(PDF_{sm})] + [(FIR_{hawk})(SC_x)(PDS)]+[(WIR_{hawk})(WC_x)]\}/BW_{hawk}$$

Where:

DI_x = Dietary intake of chemical x by the red-tailed hawk (mg/kg-body weight/day)
FIR_{hawk} = Mean food ingestion rate for the red-tailed hawk (0.08788 kg/day - dry weight; see Table 7-30)
FC_{sm}= Concentration of chemical x in small mammal tissue (chemical specific - dry weight; see Table N-3 above)
PDF_{sm} = Proportion of diet composed of small mammals (1.0 - dry weight basis [unitless]; see Table 7-31)
SC_x = Maximum or 95 percent UCL of the mean concentration in surface soil (chemical specific - dry weight; see Table N-3 above)
PDS = Proportion of diet composed of surface soil (0.0 - dry weight basis [unitless]; see Table 7-31)
WIR_{hawk} = Mean water ingestion rate for the mourning dove (0.06268 L/day; see Table 7-30)
WC_x = Maximum or 95 percent upper confidence limit of the mean concentration in surface water (chemical specific; see Table N-3 above)
BW_{hawk} = Mean body weight for the red-tailed hawk (1.0945 kg; see Table 7-30)

[6] MATC values were derived by calculating the geometric mean of the NOAEL and LOAEL values.

[7] Refined (Step 3a) NOAEL-, LOAEL-, and MATC-based risk estimates (i.e., HQs) were derived by dividing dietary intakes by NOAEL-, LOAEL-, and MATC-based toxicity reference values, respectively.

TABLE N-9
FOOD ITEM CONCENTRATIONS AND DIETARY INTAKES FOR NORWAY RAT DIETARY EXPOSURES TO ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 3A REFINED RISK CALCULATION
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical [1]	Surface Water Concentration [2] (mg/L)	Surface Soil Concentration [3] (mg/kg)	Soil-to-Plant BAF/Uptake Equation (unitless)	Plant Tissue Concentration [4] (mg/kg)	Soil-to-Terrestrial Invertebrate BAF/Uptake Equation (unitless)	Invertebrate Tissue Concentration [5] (mg/kg)	Dietary Intake [6] (mg/kg-BW/day)
Metals:							
Beryllium	0.2852	0.04147	$In(C_p) = 0.7345[ln(C_s)] - 0.5361$	0.2852	0.04500	0.0169	0.01374
Vanadium	1.1950	1.92664	0.00485	1.1950	0.04200	10.3488	0.93591

Notes:

BAF = Bioaccumulation Factor
mg/kg = milligram per kilogram
mg/kg-BW/day = milligram per kilogram-body weight per day
ln = natural logarithm
C_p = Concentration in plant tissue (mg/kg - dry weight)
C_s =Maximum or 95 percent upper confidence limit of the mean concentration in surface soil (mg/kg - dry weight; see Footnote 3 below).

(1) The chemicals listed are limited to those identified as ecological chemicals of potential concern for red-tailed hawk dietary exposures chemicals with Norway rat tissue concentrations estimated using dietary intakes and diet-to-whole body BAF values (i.e., beryllium; see Table I-8).
(2) Maximum surface water concentration.
(3) Maximum or 95 percent upper confidence limit of the mean surface soil concentration (95 percent upper confidence limit of the mean concentration used for those ecological COPCs with a minimum of eight detected values and less than seventy percent non-detected results).
(4) Plant tissue concentrations were derived by (a) multiplying maximum 95 percent upper confidence limit of the mean surface soil concentrations by soil-to-plant bioaccumulation factors, or (b) soil-to-plant uptake equations.
(5) Soil invertebrate tissue concentrations were derived by (a) multiplying the maximum or 95 percent upper confidence limit of the mean surface soil concentrations by soil-to-invertebrate bioaccumulation factors or (b) soil-to-invertebrate uptake equations.
(6) The dietary intake for beryllium was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FIR_{rat})(FC_{plant})(PDF_{plant})] + [(FIR_{rat})(FC_{invert})(PDF_{invert})] + [(FIR_{rat})(SC_x)(PDS)]+[(WIR_{rat})(WC_x)]\}/BW_{rat}$$

Where:

DI_x = Dietary intake of beryllium by the Norway rat (mg/kg-body weight/day)
FIR_{rat} = Food ingestion rate for the Norway rat (0.03092 kg/day - dry weight; see Table 7-30)
FC_{plant} = Concentration of chemical x in plant tissue (chemical specific - dry weight; see Table N-5 above)
FC_{invert} = Concentration of chemical x in soil invertebrate tissue (chemical specific - dry weight; see Table N-5 above)
PDF_{plant} = Proportion of diet composed of plants (0.49 - dry weight basis [unitless]; see Table 7-31)
PDF_{invert} = Proportion of diet composed of soil invertebrates (0.49 - dry weight basis [unitless]; see Table 7-31)
SC_x = Maximum or 95 percent upper confidence limit of the mean concentration in surface soil (chemical-specific; see Table N-5 above)
PDS = Proportion of diet composed of surface soil (0.02 - dry weight basis [unitless]; see Table 7-31)
WIR_{rat} = Mean water ingestion rate for the Norway rat (0.03849 L/day; see Table 7-30)
WC_x = Maximum or 95 percent upper confidence limit of the mean concentration in surface water (chemical-specific; see Table N-5 above)
BW_{rat} = Midpoint body weight for the Norway rat (0.350 kg; see Table 7-30)

TABLE N-10
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR MOURNING DOVE DIETARY EXPOSURES
TO ECOLOGICAL CHEMICALS OF POTETNIAL CONCERN IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 3A REFINED RISK CALCULATION
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Chemical [1]	Surface Water Concentration [2] (mg/L)	Subsurface Soil Concentration [3] (mg/kg)	Soil-to-Plant BAF/Uptake Equation (unitless)	Plant Tissue Concentration [4] (mg/kg)	Dietary Intake [5] (mg/kg-BW/day)	Toxicity Reference Values			Step 3a Refined Risk Estimates [7]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [6] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Metals:											
Beryllium	0.0010	0.4840	$\ln(C_p) = 0.7345[\ln(C_s)] - 0.5361$	0.3433	0.05026	NA	NA	NA	---	---	---
Copper	0.0040	111.8000	$\ln(C_p) = 0.394[\ln(C_s)] + 0.668$	12.5082	2.50119	4.05000	12.10000	7.00036	0.62	0.21	0.36
Vanadium	0.0076	156.0000	0.00485	0.7566	1.22012	0.34400	0.68800	0.48649	3.55	1.77	2.51

Notes:

HQ = Hazard Quotient
BAF = Bioaccumulation Factor
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
mg/kg = milligram per kilogram
mg/kg-BW/day = milligram per kilogram-body weight per day
mg/L = milligram per liter
ln = natural logarithm
C_p = Concentration in plant tissue (mg/kg - dry weight)
C_s = Maximum or 95 percent upper confidence limit of the mean concentration in subsurface soil (mg/kg - dry weight; see Footnote 3 below)
NA = Not Available
--- = Step 3a refined risk estimate could not be calculated due to the lack of a toxicity reference value

(1) The chemicals listed are those identified as ecological chemicals of potential concern in the Step 2 screening level risk estimate becasue maximum mourning dove exposure doses exceed NOAEL-based toxicity reference values. Detected chemicals lacking avian toxicity reference values are also listed.

(2) Maximum surface water concentration.

(3) Maximum or 95 percent upper confidence limit of the mean subsurface soil concentration (95 percent upper confidence limit of the mean concentration used for those ecological COPCs with a minimum of eight detected values and less than seventy percent non-detected results).

(4) Plant tissue concentrations were derived by (a) multiplying maximum 95 percent upper confidence limit of the mean subsurface soil concentrations by soil-to-plant bioaccumulation factors, or (b) soil-to-plant uptake equations.

(5) The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FIR_{dove})(FC_{plant})(PDF_{plant})] + [(FIR_{dove})(SC_x)(PDS)]+[(WIR_{dove})(WC_x)]\}/BW_{dove}$$

Where:

DI_x = Dietary intake of chemical x by the mourning dove (mg/kg-body weight/day)
FIR_{dove} = Mean food ingestion rate for the mourning dove (0.01646 kg/day - dry weight; see Table 7-30)
FC_{plant} = Concentration of chemical x in plant tissue (chemical specific - dry weight; see Table N-10 above)
PDF_{plant} = Proportion of diet composed of plants (0.95 - dry weight basis [unitless]; see Table 7-31)
SC_x = Maximum or 95 percent upper confidence limit of the mean concentration in subsurface soil (chemical specific - dry weight; see Table N-10 above)
PDS = Proportion of diet composed of subsurface soil (0.05 - dry weight basis [unitless]; see Table 7-30)
WIR_{dove} = Mean water ingestion rate for the mourning dove (0.01385 L/day; see Table 7-30)
WC_x = Maximum or 95 percent upper confidence limit of the mean concentration in surface water (chemical specific; see Table N-10 above)
BW_{dove} = Mean body weight for the mourning dove (0.115 kg; see Table 7-30)

(6) MATC values were derived by calculating the geometric mean of the NOAEL and LOAEL values.

(7) Refined (Step 3a) NOAEL-, LOAEL-, and MATC-based risk estimates (i.e., HQs) were derived by dividing dietary intakes by NOAEL-, LOAEL-, and MATC-based toxicity reference values, respectively.

TABLE N-11
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR AMERICAN ROBIN DIETARY EXPOSURES
TO ECOLOGICAL CHEMICALS OF POTETNIAL CONCERN IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 3A REFINED RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical [1]	Surface Water Concentration [2] (mg/L)	Subsurface Soil Concentration [3] (mg/kg)	Soil-to-Plant BAF/Uptake Equation (unitless)	Plant Tissue Concentration [4] (mg/kg)	Soil-to-Terrestrial Invertebrate BAF/Uptake Equation (unitless)	Invertebrate Tissue Concentration [5] (mg/kg)	Dietary Intake [6] (mg/kg-BW/day)	Toxicity Reference Values			Step 3a Refined Risk Estimates [8]		
								NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [7] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Semivolatile Organics:													
Pentachlorophenol	0.0100	0.4800	5.93000	2.8464	16.15000	7.7520	0.88101	6.73000	67.30000	21.28213	0.13	0.01	0.04
Metals:													
Beryllium	0.0010	0.4840	$\ln(C_p) = 0.7345[\ln(C_s)] - 0.5361$	0.3433	0.04500	0.0218	0.01136	NA	NA	NA	---	---	---
Cadmium	0.0010	0.4910	$\ln(C_p) = 0.546[\ln(C_s)] - 0.475$	0.4217	$\ln(C_e) = 0.795[\ln(C_s)] + 2.114$	4.7044	0.52371	1.47000	6.36000	3.05765	0.36	0.08	0.17
Chromium, total	0.0008	42.2800	0.04100	1.7335	0.30600	12.9377	1.91413	2.66000	15.60000	6.44174	0.72	0.12	0.30
Copper	0.0040	111.8000	$\ln(C_p) = 0.394[\ln(C_s)] + 0.668$	12.5082	$\ln(C_e) = 0.264[\ln(C_s)] + 1.675$	18.5452	3.42664	4.05000	12.10000	7.00036	0.85	0.28	0.49
Mercury	0.0002	0.0261	$\ln(C_p) = 0.544[\ln(C_s)] - 0.996$	0.0508	1.69300	0.0442	0.00564	0.02600	0.07800	0.04503	0.22	0.07	0.13
Nickel	0.0010	20.8900	$\ln(C_p) = 0.748[\ln(C_s)] - 2.224$	1.0506	1.05900	22.1225	2.66600	6.71000	18.60000	11.17166	0.40	0.14	0.24
Selenium	0.0008	1.3470	$\ln(C_p) = 1.104[\ln(C_s)] - 0.678$	0.7053	$\ln(C_e) = 0.733[\ln(C_s)] - 0.075$	1.1541	0.14837	0.29000	0.57900	0.40977	0.51	0.26	0.36
Silver	0.0010	0.5700	0.01400	0.0080	2.04500	1.1657	0.13407	2.02000	20.20000	6.38780	0.07	<0.01	0.02
Tin	0.0200	5.5420	0.03000	0.1663	1.00000	5.5420	0.67317	6.80000	16.90000	10.72007	0.10	0.04	0.06
Vanadium	0.0076	156.0000	0.00485	0.7566	0.04200	6.5520	2.51023	0.34400	0.68800	0.48649	7.30	3.65	5.16
Zinc	0.0079	105.0000	$\ln(C_p) = 0.554[\ln(C_s)] + 1.575$	63.6433	$\ln(C_e) = 0.328[\ln(C_s)] + 4.449$	393.6645	44.81720	66.10000	171.00000	106.31604	0.68	0.26	0.42

Notes:

HQ = Hazard Quotient
BAF = Bioaccumulation Factor
NOAEL = No Observed Adverse Effect Leve
LOAEL = Lowest Observed Adverse Effect Leve
MATC = Maximum Acceptable Toxicant Concentration
mg/kg = milligram per kilogram
mg/kg-BW/day = milligram per kilogram-body weight per day
mg/L - milligram per liter
ln = natural logarithm
C_e = Concentration in earthworm tissue (mg/kg - dry weight)
C_p = Concentration in plant tissue (mg/kg - dry weight)
C_s = Maximum or 95 percent upper confidence limit of the mean concentration in subsurface soil (mg/kg - dry weight; see Footnote 3 below)
NA = Not Available
--- = Step 3a refined risk estimate could not be calculated due to the lack of a toxicity reference value

[1] The chemicals listed are those identified as ecological chemicals of potential concern in the Step 2 screening level risk estimate becasue maximum American robin exposure doses exceed NOAEL-based toxicity reference values. Detected chemicals lacking avian toxicity reference values are also listed.
[2] Maximum surface water concentration.
[3] Maximum or 95 percent upper confidence limit of the mean subsurface soil concentration (95 percent upper confidence limit of the mean concentration used for those ecological COPCs with a minimum of eight detected values and less than seventy percent non-detected results).
[4] Plant tissue concentrations were derived by (a) multiplying maximum or 95 percent upper confidence limit of the mean subsurface soil concentrations by soil-to-plant bioaccumulation factors or (b) soil-to-plant uptake equations.
[5] Soil invertebrate tissue concentrations were derived by (a) multiplying the maximum or 95 percent upper confidence limit of the mean subsurface soil concentrations by soil-to-invertebrate bioaccumulation factors or (b) soil-to-invertebrate uptake equations.
[6] The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FIR_{robin})(FC_{plant})(PDF_{plant})] + [(FIR_{robin})(FC_{invert})(PDF_{invert})] + [(FIR_{robin})(SC_x)(PDS)]+[(WIR_{robin})(WC_x)]\}/Bw_{robin}$$

Where:

DI_x = Dietary intake of chemical x by the American robin (mg/kg-body weight/day)
FIR_{robin} = Mean food ingestion rate for the American robin (0.01033 kg/day - dry weight; see Table 7-30)
FC_{plant} = Concentration of chemical x in plant tissue (chemical specific - dry weight; see Table N-11 above)
FC_{invert} = Concentration of chemical x in soil invertebrate tissue (chemical specific - dry weight; see Table N-11 above)
PDF_{plant} = Proportion of diet composed of plants (0.083 - dry weight basis [unitless]; see Table 7-31)
PDF_{invert} = Proportion of diet composed of soil invertebrates (0.83 - dry weight basis [unitless]; see Table 7-31)
SC_x = Maximum or 95 percent upper confidence limit of the mean concentration in surface soil (chemical specific - dry weight; see Table N-11 above)
PDS = Proportion of diet composed of surface soil (0.087 - dry weight basis [unitless]; see Table 7-31)
WIR_{robin} = Mean water ingestion rate for the American robin (0.01073 L/day; see Table 7-30)
WC_x = Maximum concentration of chemical x in surface water (chemical specific; see Table N-11 above)
BW_{robin} = Mean body weight for the American robin (0.0785 kg; see Table 7-30)

[7] MATC values were derived by calculating the geometric mean of the NOAEL and LOAEL values.
[8] Refined (Step 3a) NOAEL-, LOAEL-, and MATC-based risk estimates (i.e., HQs) were derived by dividing dietary intakes by NOAEL-, LOAEL-, and MATC-based toxicity reference values, respectively.

TABLE N-12
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR RED-TAILED HAWK DIETARY EXPOSURES
TO ECOLOGICAL CHEMICALS OF POTETNIAL CONCERN IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 3A REFINED RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical [1]	Surface Water Concentration [2] (mg/L)	Subsurface Soil Concentration [3] (mg/kg)	Soil-to-Small Mammal BAF/Uptake Equation (unitless)	Small Mammal Concentration [4] (mg/kg)	Dietary Intake [5] (mg/kg-BW/day)	Toxicity Reference Values			Step 3a Refined Risk Estimates [7]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [6] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Metals:											
Beryllium	0.0010	0.4840	$C_m = [(BAF_d)(DI)]/0.32$	0.0524	0.00427	NA	NA	NA	---	---	---
Vanadium	0.0076	156.0000	0.01037	1.6177	0.13033	0.34400	0.68800	0.48649	0.38	0.19	0.27

Notes:

HQ = Hazard Quotient
BAF = Bioaccumulation Factor
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
mg/kg = milligram per kilogram
mg/kg-BW/day = milligram per kilogram-body weight per day
mg/L = milligram per liter
C_m = Concentration in small mammal tissue (mg/kg - dry weight)
BAF_d = small mammal diet-to-whole body bioaccumulation factor (wet weight basis; assumed to be 1.0)
DI_m = Small mammal dietary intake (mg/kg-BW/day)
NA = Not Available
--- = Step 3a refined risk estimate could not be calculated due to the lack of a toxicity reference value

[1] The chemicals listed are those identified as ecological chemicals of potential concern in the Step 2 screening level risk estimate becasue maximum red-tailed hawk exposure doses exceed NOAEL-based toxicity reference values. Detected chemicals lacking avian toxicity reference values are also listed.

[2] Maximum surface water concentration.

[3] Maximum or 95 percent upper confidence limit of the mean subsurface soil concentration (95 percent upper confidence limit of the mean concentration used for those ecological COPCs with a minimum of eight detected values and less than seventy percent non-detected results).

[4] The small mammal (i.e., Norway rat) tissue concentrations were derived by (a) multiplying maximum subsurface soil concentrations by soil-to-small mammal bioaccumulation factors or (b) multiplying small mammal dietary intakes (see Table N-14 for small mammal dietary intake values) by small mammal diet-to-whole body BAF values (BAF_d assumed to be 1.0 for all chemicals [wet weight basis]) and dividing the products by 0.32 (solids content of small mammals).

[5] The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FIR_{hawk})(FC_{sm})(PDF_{sm})] + [(FIR_{hawk})(SC_x)(PDS)]+[(WIR_{hawk})(WC_x)]\}/BW_{hawk}$$

Where:

DI_x = Dietary intake of chemical x by the red-tailed hawk (mg/kg-body weight/day)
FIR_{hawk} = Mean food ingestion rate for the red-tailed hawk (0.08788 kg/day - dry weight; see Table 7-30)
FC_{sm}= Concentration of chemical x in small mammal tissue (chemical specific - dry weight; see Table N-12 above)
PDF_{sm} = Proportion of diet composed of small mammals (1.0 - dry weight basis [unitless]; see Table 7-31)
SC_x = Maximum or 95 percent UCL of the mean concentration in subsurface soil (chemical specific - dry weight; see Table N-12 above)
PDS = Proportion of diet composed of subsurface soil (0.0 - dry weight basis [unitless]; see Table 7-31)
WIR_{hawk} = Mean water ingestion rate for the mourning dove (0.06268 L/day; see Table 7-30)
WC_x = Maximum or 95 percent upper confidence limit of the mean concentration in surface water (chemical specific; see Table N-12 above)
BW_{hawk} = Mean body weight for the red-tailed hawk (1.0945 kg; see Table 7-30)

[6] MATC values were derived by calculating the geometric mean of the NOAEL and LOAEL values.

[7] Refined (Step 3a) NOAEL-, LOAEL-, and MATC-based risk estimates (i.e., HQs) were derived by dividing dietary intakes by NOAEL-, LOAEL-, and MATC-based toxicity reference values, respectively.

TABLEN-13
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR BROWN FLOWER BAT DIETARY EXPOSURES TO CHEMICALS IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 3A REFINED RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical [1]	Surface Water Concentration [2] (mg/L)	Subsurface Soil Concentration [3] (mg/kg)	Soil-to-Plant BAF/Uptake Equation (unitless)	Plant Tissue Concentration [4] (mg/kg)	Dietary Intake [5] (mg/kg-BW/day)	Unadjusted Toxicity Reference Values			Unadjusted Step 3a Refined Risk Estimates [7]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [6] (mg/kg-BW/day)	NOAEL-Based HQ (mg/kg-BW/day)	LOAEL-Based HQ (mg/kg-BW/day)	MATC-Based HQ (mg/kg-BW/day)
Metals:											
Selenium	0.0008	1.3470	$\ln(C_p) = 1.104[\ln(C_s)] - 0.678$	0.7053	0.09904	0.14300	0.21500	0.17534	0.69	0.46	0.56

Notes:

HQ = Hazard Quotient
BAF = Bioaccumulation Factor
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
mg/kg = milligram per kilogram
mg/kg-BW/day = milligram per kilogram-body weight per day
mg/kg-BW/day = milligram per kilogram-body weight per day
mg/L = milligram per liter
C_p = Concentration in plant tissue (mg/kg - dry weight)
C_s = Maximum or 95 percent upper confidence limit of the mean concentration in subsurface soil (mg/kg - dry weight; see Footnote 3 below).

(1) The chemicals listed are those identified as ecological chemicals of potential concern in the Step 2 screening level risk estimate becasue maximum brown flower bat exposure doses exceed NOAEL-based toxicity reference values. Detected chemicals lacking mammalian toxicity reference values are also listed.
(2) Maximum surface water concentration.
(3) Maximum or 95 percent upper confidence limit of the mean subsurface soil concentration (95 percent upper confidence limit of the mean concentration used for those ecological COPCs with a minimum of eight detected values and less than seventy percent non-detected results).
(4) Plant tissue concentrations were derived by soil-to-plant uptake equations.
(5) The dietary intake was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FI_{bat})(FC_{plant})(PDF_{plant})] + [(FIR_{bat})(SC_x)(PDS)]+[(WIR_{bat})(WC_x)]\}/BW_{bat}$$

Where:

DI_x = Dietary intake of chemical by the brown flower bat (mg/kg-body weight/day)
FIR_{bat} = Mean food ingestion rate for the brown flower bat (0.00257 kg/day - dry weight; see Table 7-30)
FC_{plant} = Concentration of chemical x in plant tissue (chemical-specific; see Table N-13 above)
PDF_{plant} = Proportion of diet composed of plants (1.0 - dry weight basis [unitless]; see Table 7-31)
SC_x = Maximum or 95 percent upper confidence limit of the mean concentration in subsurface soil (chemical-specific; see Table N-13 above)
PDS = Proportion of diet composed of subsurface soil (0.0 - dry weight basis [unitless]; see Table 7-31)
WIR_{bat} = Mean water ingestion rate for the brown flower bat (0.00270 L/day; see Table 7-30)
WC_x = Maximum or 95 percent upper confidence limit of the mean concentration in subsurface water (chemical-specific; see Table N-13 above)
BW_{bat} = Mean body weight for the brown flower bat (0.0183 kg; see Table 7-30)

(6) MATC value was derived by calculating the geometric mean of the NOAEL and LOAEL values.
(7) Refined (Step 3a) NOAEL-, LOAEL-, and MATC-based risk estimates (i.e., HQs) were derived by dividing dietary intakes by NOAEL-, LOAEL-, and MATC-based toxicity reference values, respectively.

TABLE N-14
FOOD ITEM CONCENTRATIONS AND DIETARY INTAKES FOR NORWAY RAT DIETARY EXPOSURES TO ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SUBSURFACE SOIL COLLECTED DURING THE 2010 CMS FIELD INVESTIGATION: STEP 3A REFINED RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical [1]	Surface Water Concentration [2] (mg/L)	Subsurface Soil Concentration [3] (mg/kg)	Soil-to-Plant BAF/Uptake Equation (unitless)	Plant Tissue Concentration [4] (mg/kg)	Soil-to-Terrestrial Invertebrate BAF/Uptake Equation (unitless)	Invertebrate Tissue Concentration [5] (mg/kg)	Dietary Intake [6] (mg/kg-BW/day)
Metals:							
Beryllium	0.0010	0.4840	$\ln(C_p) = 0.7345[\ln(C_s)] - 0.5361$	0.3433	0.045	0.0218	0.01677

Notes:

BAF = Bioaccumulation Factor
mg/kg = milligram per kilogram
mg/kg-BW/day = milligram per kilogram-body weight per day
mg/L = milligram per liter
ln = natural logarithm
C_p = Concentration in plant tissue (mg/kg - dry weight)
C_s =Maximum or 95 percent upper confidence limit of the mean concentration in subsurface soil (mg/kg - dry weight; see Footnote 3 below).

(1) The chemicals listed are limited to those identified as ecological chemicals of potential concern for red-tailed hawk dietary exposures chemicals with Norway rat tissue concentrations estimated using dietary intakes and diet-to-whole body BAF values (i.e., beryllium; see Table N-12)
(2) Maximum surface water concentration.
(3) Maximum or 95 percent upper confidence limit of the mean surface soil concentration (95 percent upper confidence limit of the mean concentration used for those ecological COPCs with a minimum of eight detected value and less than seventy percent non-detected results)
(4) Plant tissue concentrations were derived by (a) multiplying maximum 95 percent upper confidence limit of the mean surface soil concentrations by soil-to-plant bioaccumulation factors, or (b) soil-to-plant uptake equation
(5) Soil invertebrate tissue concentrations were derived by soil-to-invertebrate uptake equations
(6) The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2)

$$DI_x = \{[(FIR_{rat})(FC_{plant})(PDF_{plant})] + [(FIR_{rat})(FC_{invert})(PDF_{invert})] + [(FIR_{rat})(SC_x)(PDS)]+[(WIR_{rat})(WC_x)]\}/BW_{rat}$$

Where:

DI_x = Dietary intake of beryllium by the Norway rat (mg/kg-body weight/day)
FIR_{rat} = Food ingestion rate for the Norway rat (0.03092 kg/day - dry weight; see Table 7-30)
FC_{plant} = Concentration of chemical x in plant tissue (chemical specific - dry weight; see Table N-14 above)
FC_{invert} = Concentration of chemical x in soil invertebrate tissue (chemical specific - dry weight; see Table N-14 above)
PDF_{plant} = Proportion of diet composed of plants (0.49 - dry weight basis [unitless]; see Table 7-31)
PDF_{invert} = Proportion of diet composed of soil invertebrates (0.49 - dry weight basis [unitless]; see Table 7-31)
SC_x = Maximum or 95 percent upper confidence limit of the mean concentration in subsurface soil (chemical-specific; see Table N-14 above)
PDS = Proportion of diet composed of subsurface soil (0.02 - dry weight basis [unitless]; see Table 7-31)
WIR_{rat} = Mean water ingestion rate for the Norway rat (0.03849 L/day; see Table 7-30)
WC_x = Maximum or 95 percent upper confidence limit of the mean concentration in surface water (chemical-specific; see Table N-14 above)
BW_{rat} = Midpoint body weight for the Norway rat (0.350 kg; see Table 7-30)

TABLE N-15
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR MOURNING DOVE DIETARY EXPOSURES
TO ECOLOGICAL CHEMICALS OF POTETNIAL CONCERN IN SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 3A REFINED RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical [1]	Surface Water Concentration [2] (mg/L)	Subsurface Soil Concentration [3] (mg/kg)	Soil-to-Plant BAF/Uptake Equation (unitless)	Plant Tissue Concentration [4] (mg/kg)	Dietary Intake [5] (mg/kg-BW/day)	Toxicity Reference Values			Step 3a Refined Risk Estimates [7]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [6] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Semivolatile Organics:											
Pentachlorobenzene	0.0051	0.0056	0.44363	0.0025	0.00099	NA	NA	NA	---	---	---
Metals:											
Beryllium	0.0000	0.3310	$In(C_p) = 0.7345[ln(C_s)] - 0.5361$	0.2597	0.03768	NA	NA	NA	---	---	---
Vanadium	0.0076	276.3000	0.00485	1.3401	2.16032	0.34400	0.68800	0.48649	3.55	1.77	2.51

Notes:

HQ = Hazard Quotient
BAF = Bioaccumulation Factor
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
mg/kg = milligram per kilogram
mg/kg-BW/day = milligram per kilogram-body weight per day
mg/L = milligram per liter
ln = natural logarithm
C_p = Concentration in plant tissue (mg/kg - dry weight)
C_s = Maximum or 95 percent upper confidence limit of the mean concentration in subsurface soil (mg/kg - dry weight; see Footnote 3 below)
NA = Not Available
--- = Step 3a refined risk estimate could not be calculated due to the lack of a toxicity reference value

(1) The chemicals listed are those identified as ecological chemicals of potential concern in the Step 2 screening level risk estimate becasue maximum mourning dove exposure doses exceed NOAEL-based toxicity reference values. Detected chemicals lacking avian toxicity reference values are also listed.

(2) Maximum surface water concentration.

(3) Maximum or 95 percent upper confidence limit of the mean subsurface soil concentration (95 percent upper confidence limit of the mean concentration used for those ecological COPCs with a minimum of eight detected values and less than seventy percent non-detected results).

(4) Plant tissue concentrations were derived by (a) multiplying maximum 95 percent upper confidence limit of the mean subsurface soil concentrations by soil-to-plant bioaccumulation factors, or (b) soil-to-plant uptake equations.

(5) The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FIR_{dove})(FC_{plant})(PDF_{plant})] + [(FIR_{dove})(SC_x)(PDS)]+[(WIR_{dove})(WC_x)]\}/BW_{dove}$$

Where:

DI_x = Dietary intake of chemical x by the mourning dove (mg/kg-body weight/day)
FIR_{dove} = Mean food ingestion rate for the mourning dove (0.01646 kg/day - dry weight; see Table 7-30)
FC_{plant} = Concentration of chemical x in plant tissue (chemical specific - dry weight; see Table N-15 above)
PDF_{plant} = Proportion of diet composed of plants (0.95 - dry weight basis [unitless]; see Table 7-31)
SC_x = Maximum or 95 percent upper confidence limit of the mean concentration in subsurface soil (chemical specific - dry weight; see Table N-15 above)
PDS = Proportion of diet composed of subsurface soil (0.05 - dry weight basis [unitless]; see Table 7-30)
WIR_{dove} = Mean water ingestion rate for the mourning dove (0.01385 L/day; see Table 7-30)
WC_x = Maximum or 95 percent upper confidence limit of the mean concentration in surface water (chemical specific; see Table N-15 above)
BW_{dove} = Mean body weight for the mourning dove (0.115 kg; see Table 7-30)

(6) MATC values were derived by calculating the geometric mean of the NOAEL and LOAEL values.

(7) Refined (Step 3a) NOAEL-, LOAEL-, and MATC-based risk estimates (i.e., HQs) were derived by dividing dietary intakes by NOAEL-, LOAEL-, and MATC-based toxicity reference values, respectively.

TABLE N-16
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR AMERICAN ROBIN DIETARY EXPOSURES
TO ECOLOGICAL CHEMICALS OF POTETNIAL CONCERN IN SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 3A REFINED RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical [1]	Surface Water Concentration [2] (mg/L)	Subsurface Soil Concentration [3] (mg/kg)	Soil-to-Plant BAF/Uptake Equation (unitless)	Plant Tissue Concentration [4] (mg/kg)	Soil-to-Terrestrial Invertebrate BAF/Uptake Equation (unitless)	Invertebrate Tissue Concentration [5] (mg/kg)	Dietary Intake [6] (mg/kg-BW/day)	Toxicity Reference Values			Step 3a Refined Risk Estimates [8]		
								NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [7] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Semivolatile Organics:													
Pentachlorobenzene	0.0051	0.0056	0.44363	0.0025	1.58935	0.0089	0.00176	NA	NA	NA	---	---	---
Metals:													
Beryllium	0.0000	0.3310	$\ln(C_p) = 0.7345[\ln(C_s)] - 0.5361$	0.2597	0.04500	0.0149	0.00791	NA	NA	NA	---	---	---
Chromium, total	0.0008	79.8500	0.04100	3.2739	0.30600	24.4341	3.61493	2.66000	15.60000	6.44174	1.36	0.23	0.56
Copper	0.0040	130.7000	$\ln(C_p) = 0.394[\ln(C_s)] + 0.668$	13.3021	$\ln(C_e) = 0.264[\ln(C_s)] + 1.675$	19.3259	3.73596	4.05000	12.10000	7.00036	0.92	0.31	0.53
Mercury	0.0002	0.0686	$\ln(C_p) = 0.544[\ln(C_s)] - 0.996$	0.0860	1.69300	0.1161	0.01433	0.02600	0.07800	0.04503	0.55	0.18	0.32
Nickel	0.0010	32.4900	$\ln(C_p) = 0.748[\ln(C_s)] - 2.224$	1.4619	1.05900	34.4069	4.14467	6.71000	18.60000	11.17166	0.62	0.22	0.37
Vanadium	0.0076	276.3000	0.00485	1.3401	0.04200	11.6046	4.44521	0.34400	0.68800	0.48649	12.92	6.46	9.14
Zinc	0.0079	61.2400	$\ln(C_p) = 0.554[\ln(C_s)] + 1.575$	47.2097	$\ln(C_e) = 0.328[\ln(C_s)] + 4.449$	329.8555	37.18800	66.10000	171.00000	106.31604	0.56	0.22	0.35

Notes:

HQ = Hazard Quotient
BAF = Bioaccumulation Factor
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
mg/kg = milligram per kilogram
mg/kg-BW/day = milligram per kilogram-body weight per day
mg/L = milligram per liter
ln = natural logarithm
C_e = Concentration in earthworm tissue (mg/kg - dry weight)
C_p = Concentration in plant tissue (mg/kg - dry weight)
C_s = Maximum or 95 percent upper confidence limit of the mean concentration in subsurface soil (mg/kg - dry weight; see Footnote 3 below)
NA = Not Available
--- = Step 3a refined risk estimate could not be calculated due to the lack of a toxicity reference value

(1) The chemicals listed are those identified as ecological chemicals of potential concern in the Step 2 screening level risk estimate becasue maximum American robin exposure doses exceed NOAEL-based toxicity reference values. Detected chemicals lacking avian toxicity reference values are also listed.
(2) Maximum surface water concentration.
(3) Maximum or 95 percent upper confidence limit of the mean subsurface soil concentration (95 percent upper confidence limit of the mean concentration used for those ecological COPCs with a minimum of eight detected values and less than seventy percent non-detected results).
(4) Plant tissue concentrations were derived by (a) multiplying maximum or 95 percent upper confidence limit of the mean subsurface soil concentrations by soil-to-plant bioaccumulation factors or (b) soil-to-plant uptake equations.
(5) Soil invertebrate tissue concentrations were derived by (a) multiplying the maximum or 95 percent upper confidence limit of the mean subsurface soil concentrations by soil-to-invertebrate bioaccumulation factors or (b) soil-to-invertebrate uptake equations.
(6) The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FIR_{robin})(FC_{plant})(PDF_{plant})] + [(FIR_{robin})(FC_{invert})(PDF_{invert})] + [(FIR_{robin})(SC_x)(PDS)]+[(WIR_{robin})(WC_x)]\}/Bw_{robin}$$

Where:

DI_x = Dietary intake of chemical x by the American robin (mg/kg-body weight/day)
FIR_{robin} = Mean food ingestion rate for the American robin (0.01033 kg/day - dry weight; see Table 7-30)
FC_{plant} = Concentration of chemical x in plant tissue (chemical specific - dry weight; see Table N-16 above)
FC_{invert} = Concentration of chemical x in soil invertebrate tissue (chemical specific - dry weight; see Table N-16 above)
PDF_{plant} = Proportion of diet composed of plants (0.083 - dry weight basis [unitless]; see Table 7-31)
PDF_{invert} = Proportion of diet composed of soil invertebrates (0.83 - dry weight basis [unitless]; see Table 7-31)
SC_x = Maximum or 95 percent upper confidence limit of the mean concentration in surface soil (chemical specific - dry weight; see Table N-16 above)
PDS = Proportion of diet composed of surface soil (0.087 - dry weight basis [unitless]; see Table 7-31)
WIR_{robin} = Mean water ingestion rate for the American robin (0.01073 L/day; see Table 7-30)
WC_x = Maximum concentration of chemical x in surface water (chemical specific; see Table N-16 above)
BW_{robin} = Mean body weight for the American robin (0.0785 kg; see Table 7-30)

(7) MATC values were derived by calculating the geometric mean of the NOAEL and LOAEL values.
(8) Refined (Step 3a) NOAEL-, LOAEL-, and MATC-based risk estimates (i.e., HQs) were derived by dividing dietary intakes by NOAEL-, LOAEL-, and MATC-based toxicity reference values, respectively.

TABLE N-17
FOOD ITEM CONCENTRATIONS, DIETARY INTAKES, AND HAZARD QUOTIENT VALUES FOR RED-TAILED HAWK DIETARY EXPOSURES
TO ECOLOGICAL CHEMICALS OF POTETNIAL CONCERN IN SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 3A REFINED RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical [1]	Surface Water Concentration [2] (mg/L)	Subsurface Soil Concentration [3] (mg/kg)	Soil-to-Small Mammal BAF/Uptake Equation (unitless)	Small Mammal Concentration [4] (mg/kg)	Dietary Intake [5] (mg/kg-BW/day)	Toxicity Reference Values			Step 3a Refined Risk Estimates [7]		
						NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [6] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Semivolatile Organics:											
Pentachlorobenzene	0.0051	0.0056	$C_m = [(BAF_d)(DI)]/0.32$	0.0033	0.00056	NA	NA	NA	---	---	---
Metals:											
Beryllium	0.0000	0.3310	$C_m = [(BAF_d)(DI)]/0.32$	0.0390	0.00313	NA	NA	NA	---	---	---
Vanadium	0.0076	276.3000	0.01037	2.8652	0.23050	0.34400	0.68800	0.48649	0.38	0.19	0.27

Notes:

HQ = Hazard Quotient
BAF = Bioaccumulation Factor
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
mg/kg = milligram per kilogram
mg/kg-BW/day = milligram per kilogram-body weight per day
mg/L = milligram per liter
C_m = Concentration in small mammal tissue (mg/kg - dry weight)
BAF_d = small mammal diet-to-whole body bioaccumulation factor (wet weight basis; assumed to be 1.0)
DI_m = Small mammal dietary intake (mg/kg-BW/day)
NA = Not Available
--- = Step 3a refined risk estimate could not be calculated due to the lack of a toxicity reference value

(1) The chemicals listed are those identified as ecological chemicals of potential concern in the Step 2 screening level risk estimate becasue maximum red-tailed hawk exposure doses exceed NOAEL-based toxicity reference values. Detected chemicals lacking avian toxicity reference values are also listed.

(2) Maximum surface water concentration.

(3) Maximum or 95 percent upper confidence limit of the mean subsurface soil concentration (95 percent upper confidence limit of the mean concentration used for those ecological COPCs with a minimum of eight detected values and less than seventy percent non-detected results).

(4) The small mammal (i.e., Norway rat) tissue concentrations were derived by (a) multiplying maximum subsurface soil concentrations by soil-to-small mammal bioaccumulation factors or (b) multiplying small mammal dietary intakes (see Table N-18 for small mammal dietary intake values) by small mammal diet-to-whole body BAF values (BAF_d assumed to be 1.0 for all chemicals [wet weight basis]) and dividing the products by 0.32 (solids content of small mammals).

(5) The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FIR_{hawk})(FC_{sm})(PDF_{sm})] + [(FIR_{hawk})(SC_x)(PDS)]+[(WIR_{hawk})(WC_x)]\}/BW_{hawk}$$

Where:

DI_x = Dietary intake of chemical x by the red-tailed hawk (mg/kg-body weight/day)
FIR_{hawk} = Mean food ingestion rate for the red-tailed hawk (0.08788 kg/day - dry weight; see Table 7-30)
FC_{sm}= Concentration of chemical x in small mammal tissue (chemical specific - dry weight; see Table N-17 above)
PDF_{sm} = Proportion of diet composed of small mammals (1.0 - dry weight basis [unitless]; see Table 7-31)
SC_x = Maximum or 95 percent UCL of the mean concentration in subsurface soil (chemical specific - dry weight; see Table N-17 above)
PDS = Proportion of diet composed of subsurface soil (0.0 - dry weight basis [unitless]; see Table 7-31)
WIR_{hawk} = Mean water ingestion rate for the mourning dove (0.06268 L/day; see Table 7-30)
WC_x = Maximum or 95 percent upper confidence limit of the mean concentration in surface water (chemical specific; see Table N-17 above)
BW_{hawk} = Mean body weight for the red-tailed hawk (1.0945 kg; see Table 7-30)

(6) MATC values were derived by calculating the geometric mean of the NOAEL and LOAEL values.

(7) Refined (Step 3a) NOAEL-, LOAEL-, and MATC-based risk estimates (i.e., HQs) were derived by dividing dietary intakes by NOAEL-, LOAEL-, and MATC-based toxicity reference values, respectively.

TABLE N-18
FOOD ITEM CONCENTRATIONS AND DIETARY INTAKES FOR NORWAY RAT DIETARY EXPOSURES TO ECOLOGICAL CHEMICALS OF POTENTIAL CONCERN IN SUBSURFACE SOIL COLLECTED DURING THE 2012 CMS FIELD INVESTIGATION: STEP 3A REFINED RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical [1]	Surface Water Concentration [2] (mg/L)	Subsurface Soil Concentration [3] (mg/kg)	Soil-to-Plant BAF/Uptake Equation (unitless)	Plant Tissue Concentration [4] (mg/kg)	Soil-to-Terrestrial Invertebrate BAF/Uptake Equation (unitless)	Invertebrate Tissue Concentration [5] (mg/kg)	Dietary Intake [6] (mg/kg-BW/day)
Semivolatile Organics:							
Pentachlorobenzene	0.0051	0.0056	0.44362703	0.0025	1.5894	0.0089	0.00106
Metals:							
Beryllium	0.0000	0.3310	$In(C_p) = 0.7345[ln(C_s)] - 0.5361$	0.2597	0.045	0.0149	0.01247

Notes:

BAF = Bioaccumulation Factor
mg/kg = milligram per kilogram
mg/kg-BW/day = milligram per kilogram-body weight per day
mg/L = milligram per liter
ln = natural logarithm
C_p = Concentration in plant tissue (mg/kg - dry weight)
C_s =Maximum or 95 percent upper confidence limit of the mean concentration in subsurface soil (mg/kg - dry weight; see Footnote 3 below).

(1) The chemicals listed are limited to those identified as ecological chemicals of potential concern for red-tailed hawk dietary exposures chemicals with Norway rat tissue concentrations estimated using dietary intakes and diet-to-whole body BAF values (i.e., beryllium; see Table N-17).
(2) Maximum surface water concentration.
(3) Maximum or 95 percent upper confidence limit of the mean surface soil concentration (95 percent upper confidence limit of the mean concentration used for those ecological COPCs with a minimum of eight detected values and less than seventy percent non-detected results).
(4) Plant tissue concentrations were derived by (a) multiplying maximum 95 percent upper confidence limit of the mean surface soil concentrations by soil-to-plant bioaccumulation factors, or (b) soil-to-plant uptake equations.
(5) Soil invertebrate tissue concentrations were derived by (a) multiplying the maximum or 95 percent upper confidence limit of the mean subsurface soil concentrations by soil-to-invertebrate bioaccumulation factors or (b) soil-to-invertebrate uptake equations.
(6) The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FIR_{rat})(FC_{plant})(PDF_{plant})] + [(FIR_{rat})(FC_{invert})(PDF_{invert})] + [(FIR_{rat})(SC_x)(PDS)]+[(WIR_{rat})(WC_x)]\}/BW_{rat}$$

Where:

DI_x = Dietary intake of beryllium by the Norway rat (mg/kg-body weight/day)
FIR_{rat} = Food ingestion rate for the Norway rat (0.03092 kg/day - dry weight; see Table 7-30)
FC_{plant} = Concentration of chemical x in plant tissue (chemical specific - dry weight; see Table N-18 above)
FC_{invert} = Concentration of chemical x in soil invertebrate tissue (chemical specific - dry weight; see Table N-18 above)
PDF_{plant} = Proportion of diet composed of plants (0.49 - dry weight basis [unitless]; see Table 7-31)
PDF_{invert} = Proportion of diet composed of soil invertebrates (0.49 - dry weight basis [unitless]; see Table 7-31)
SC_x = Maximum or 95 percent upper confidence limit of the mean concentration in subsurface soil (chemical-specific; see Table N-18 above)
PDS = Proportion of diet composed of subsurface soil (0.02 - dry weight basis [unitless]; see Table 7-31)
WIR_{rat} = Mean water ingestion rate for the Norway rat (0.03849 L/day; see Table 7-30)
WC_x = Maximum or 95 percent upper confidence limit of the mean concentration in surface water (chemical-specific; see Table N-18 above)
BW_{rat} = Midpoint body weight for the Norway rat (0.350 kg; see Table 7-30)

TABLE N-19
FOOD ITEM CONCENTRATIONS, DIETARY DOSES, AND HAZARD QUOTIENT VALUES FOR GREEN HERON DIETARY EXPOSURES TO CHEMICALS IN SEDIMENT: STEP 3 REFINED RISK CALCULATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical [1]	Surface Water Concentration [2] (mg/L)	Sediment Concentration [3] (mg/kg)	Sediment-to-Invertebrate BAF (unitless)	Aquatic Invertebrate Concentration [4] (mg/kg)	Sediment-to-Fish BAF (unitless)	Fish Concentration [4] (mg/kg)	Dietary Intake [5] (mg/kg-BW/day)	Toxicity Reference Values			Step 2 Screening Level Risk Estimates [7]		
								NOAEL (mg/kg-BW/day)	LOAEL (mg/kg-BW/day)	MATC [6] (mg/kg-BW/day)	NOAEL-Based HQ (unitless)	LOAEL-Based HQ (unitless)	MATC-Based HQ (unitless)
Semivolatile Organics:													
bis(2-Ethylhexyl)phthalate	0.0051	0.7300	66	48.2532	13	9.4976	2.54694	1.11000	5.55000	2.48204	2.29	0.46	1.03
Butyl benzyl phthalate	0.0051	0.0630	1	0.0630	1	0.0630	0.00826	NA	NA	NA	---	---	---
Organochlorine Pesticides:													
4,4'-DDE	0.0000	0.1600	16.234	2.5975	63.174	10.1078	0.97376	0.22700	2.27000	0.71784	4.29	0.43	1.36
Metals:													
Barium	0.0214	164.0000	1	164.0000	1	164.0000	20.14103	20.80000	41.70000	29.45098	0.97	0.48	0.68
Beryllium	0.0010	0.4500	1	0.4500	1	0.4500	0.05536	NA	NA	NA	---	---	---
Chromium, total	0.0008	42.1000	0.1	4.2100	0.038	1.5998	0.28948	2.66000	15.60000	6.44174	0.11	0.02	0.04
Copper	0.0040	137.6000	0.661	90.9536	0.1	13.7600	4.43908	4.05000	12.10000	7.00036	1.10	0.37	0.63
Lead	0.0010	47.6700	0.08	3.8136	0.13	6.1971	0.67621	1.63000	3.26000	2.30517	0.41	0.21	0.29
Mercury	0.0002	0.1900	1.136	0.2158	3.25	0.6175	0.06154	0.02600	0.07800	0.04503	2.37	0.79	1.37
Vanadium	0.0076	232.0000	1	232.0000	1	232.0000	28.48987	0.34400	0.68800	0.48649	82.82	41.41	58.56
Zinc	0.0079	238.1000	0.84	200.0040	1.25	297.6250	33.07209	66.10000	171.00000	106.31604	0.50	0.19	0.31

Notes:

BAF = Bioaccumulation Factor
PAH = Polynuclear Aromatic Hydrocarbon
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
MATC = Maximum Acceptable Toxicant Concentration
HQ = Hazard Quotient
mg/kg-BW/day = milligram per kilogram-body weight per day
ln = natural logarithm
NA = Not Available
--- = Step 3a refined risk estimate could not be calculated due to the lack of a toxicity reference value

(1) The chemicals listed are those identified as ecological chemicals of potential concern in the Step 2 screening level risk estimate becasue maximum green heron exposure doses exceed NOAEL-based toxicity reference values. Detected chemicals lacking avian toxicity reference values are also listed.

(2) Maximum surface water concentration.

(3) Maximum or 95 percent upper confidence limit of the mean sediment concentration (95 percent upper confidence limit of the mean concentration used for those ecological COPCs with a minimum of eight detected values and less than seventy percent non-detected results).

(4) As discussed in Section 7.5.2.2.1, fish tissue concentrations were derived by multiplying maximum sediment concentrations by sediment-to-fish bioaccumulation factors.

(5) The dietary intake for each chemical was derived using the equation shown below (see Section 7.5.2.2.2):

$$DI_x = \{[(FIR_{heron})(FC_f)(PDF_f)] + [(FIR_{heron})(FC_{invert})(PDF_{invert})] + [(FIR_{heron})(SC_x)(PDS)] + [(WIR_{heron})(WC_x)]\}/BW_{heron}$$

Where:

DI_x = Dietary intake of chemical x by the green heron (mg/kg-body weight/day)
FIR_{heron} = Mean food ingestion rate for the green heron (0.02296 kg/day - dry weight; see Table 7-30)
FC_{invert} = Concentration of chemical x in sediment invertebrate tissue (chemical-specific - dry weight; see Table N-19 above)
PDF_{invert} = Proportion of diet composed of invertebrates (0.29 - dry weight basis [unitless]; see Table 7-31)
FC_f= Concentration of chemical x in fish tissue (chemical-specific - dry weight; see Table N-19 above)
PDF_f = Proportion of diet composed of fish (0.71 - dry weight basis [unitless]; see Table 7-31)
SC_x = Maximum or 95 percent upper confidence limit of the mean concentration in sediment (chemical specific - dry weight; see Table N-19 above)
PDS = Proportion of diet composed of sediment (0.0 - dry weight basis [unitless]; see Table 7-31)
WIR_{heron} = Mean water ingestion rate for the green heron (0.01919 L/day; see Table 7-30)
WC_x = Maximum concentration of chemical x in drinking water (chemical specific; see Table N-19 above)
BW_{heron} = Mean body weight for the green heron (0.187 kg; see Table 7-30)

(6) MATC values were derived by calculating the geometric mean of the NOAEL and LOAEL values.

(7) Refined (Step 3a) NOAEL-, LOAEL-, and MATC-based risk estimates (i.e., HQs) were derived by dividing dietary intakes by NOAEL-, LOAEL-, and MATC-based toxicity reference values, respectively.

APPENDIX O
HHRA DATA SETS

APPENDIX O

SUMMARY OF ANALYTICAL RESULTS - SURFACE SOIL
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB06	59SB07	59SB08	59SB09	59SB11	59SB12
Sample ID	59SB01-00	59SB02-00	59SB03-00	59SB04-00	59SB06-00	59SB07-00	59SB08-00	59SB09-00	59SB11-00	59SB12-00
Sample Date	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	5/19/2010	5/18/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Volatile Organics (µg/kg)										
1,1,1,2-Tetrachloroethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
1,1,1-Trichloroethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
1,1,2,2-Tetrachloroethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
1,1,2-Trichloroethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
1,1-Dichloroethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
1,1-Dichloroethene	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
1,2,3-Trichloropropane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dibromo-3-chloropropane (DBCP)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
1,2-Dibromoethane (EDB)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
1,2-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloroethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
1,2-Dichloroethene (trans)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
1,2-Dichloropropane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
1,3-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Dichloropropene (cis)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
1,3-Dichloropropene (trans)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
1,4-Dichloro-2-butene (trans)	22 U	21 U	16 U	15 U	18 U	17 U	15 U	19 U	17 U	18 U
1,4-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dioxane (p-)	280 R	260 R	210 R	190 R	220 R	210 R	190 R	240 R	210 R	220 R
2-Butanone (MEK)	14 UJ	13 UJ	10 UJ	9.4 UJ	11 UJ	11 UJ	9.6 UJ	12 UJ	14 U	16 U
2-Chloro-1,3-butadiene (Chloroprene)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
2-Hexanone (MBK)	14 UJ	13 UJ	10 UJ	9.4 UJ	11 UJ	11 UJ	9.6 UJ	12 UJ	11 U	4.8 J
3-Chloropropene (Allyl Chloride)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
4-Methyl-2-pentanone (MIBK)	14 UJ	13 UJ	10 UJ	9.4 UJ	11 UJ	11 UJ	9.6 UJ	12 UJ	11 U	11 U
Acetone	14 UJ	15 UJ	24 J	25 J	17 UJ	91 J	9.6 UJ	37 J	64	110 J
Acetonitrile	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Acrolein	56 R	53 R	41 R	38 R	45 R	43 R	38 R	47 R	43 R	45 R
Acrylonitrile	56 U	53 U	41 U	38 U	45 U	43 U	38 U	47 U	43 U	3.4 J
Benzene	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4 U	0.37 J
Bromodichloromethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Bromoform	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Bromomethane	5.6 UJ	5.3 UJ	4.1 UJ	3.8 UJ	4.5 UJ	4.3 UJ	3.8 UJ	4.7 UJ	6.3	2.4 J
Carbon Disulfide	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	0.52 J

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB06	59SB07	59SB08	59SB09	59SB11	59SB12
Sample ID	59SB01-00	59SB02-00	59SB03-00	59SB04-00	59SB06-00	59SB07-00	59SB08-00	59SB09-00	59SB11-00	59SB12-00
Sample Date	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	5/19/2010	5/18/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Volatile Organics (µg/kg) (cont.)										
Carbon Tetrachloride	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Chlorobenzene	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Chloroethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 UJ	4.5 UJ
Chloroform	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Chloromethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	0.99 J	0.39 J
Dibromochloromethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Dibromomethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Ethyl Methacrylate	56 U	53 U	41 U	38 U	45 U	43 U	38 U	47 U	43 U	45 U
Ethylbenzene	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Freon 11 (Trichlorofluoromethane)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Freon-12 (Dichlorodifluoromethane)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Hexachlorobutadiene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Isobutyl Alcohol	280 R	260 R	210 R	190 R	220 R	210 R	190 R	240 R	210 R	220 R
Methyl Acrylonitrile	56 U	53 U	41 U	38 U	45 U	43 U	38 U	47 U	43 U	3.3 J
Methyl Iodide	5.6 U	0.97 J	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	12	1.9 J
Methyl Methacrylate	56 R	53 R	41 R	38 R	45 R	43 R	38 R	47 R	43 R	45 R
Methylene Chloride	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Pentachloroethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Propionitrile (Ethyl Cyanide)	280 R	260 R	210 R	190 R	220 R	210 R	8.1 J	240 R	210 R	220 R
Styrene (Ethenylbenzene)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Tetrachloroethene (PCE)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Toluene	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Trichloroethene (TCE)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Vinyl Acetate	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Vinyl Chloride	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Xylene, m/p-	11 U	0.32 J	8.2 U	0.15 J	9 U	8.5 U	0.14 J	9.5 U	8.5 U	8.9 U
Xylene, o-	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U
Xylenes, total	5.6 U	0.32 J	4.1 U	0.15 J	4.5 U	4.3 U	0.14 J	4.7 U	4.3 U	4.5 U
Semivolatile Organics (µg/kg)										
1,2,4,5-Tetrachlorobenzene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
1,2,4-Trichlorobenzene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
1,2-Dichlorobenzene (o-)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
1,3,5-Trinitrobenzene (TNB)	240 UJ	220 UJ	190 UJ	200 UJ	190 UJ	200 UJ	200 UJ	200 UJ	200 UJ	190 UJ

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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB06	59SB07	59SB08	59SB09	59SB11	59SB12
Sample ID	59SB01-00	59SB02-00	59SB03-00	59SB04-00	59SB06-00	59SB07-00	59SB08-00	59SB09-00	59SB11-00	59SB12-00
Sample Date	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	5/19/2010	5/18/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Semivolatile Organics (µg/kg) (cont.)										
1,3-Dichlorobenzene (m-)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
1,3-Dinitrobenzene (m-)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
1,4-Dichlorobenzene (p-)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
1,4-Naphthoquinone	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
1,4-Phenylenediamine	2400 R	2200 R	1900 R	2000 R	1900 R	2000 R	2000 R	2000 R	2000 R	1900 R
1-Naphthylamine	240 U	220 R	190 U	200 UJ	190 UJ	200 UJ	200 UJ	200 UJ	200 UJ	190 UJ
2,2'-Oxybis[1-chloropropane]	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
2,3,4,6-Tetrachlorophenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ
2,4,5-Trichlorophenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ
2,4,6-Trichlorophenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ
2,4-Dichlorophenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ
2,4-Dimethylphenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ
2,4-Dinitrophenol	460 UJ	430 UJ	360 UJ	390 UJ	370 UJ	390 UJ	390 UJ	380 UJ	380 UJ	370 UJ
2,4-Dinitrotoluene (DNT)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
2,6-Dichlorophenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ
2,6-Dinitrotoluene (DNT)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
2-Acetylaminofluorene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
2-Chloronaphthalene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
2-Chlorophenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ
2-Methyl-5-nitroaniline	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
2-Methylphenol (o-Cresol)	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ
2-Naphthylamine	240 U	220 R	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
2-Nitroaniline	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
2-Nitrophenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ
2-Picoline	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
3,3'-Dichlorobenzidine	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
3,3'-Dimethylbenzidine	240 U	220 R	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
3-Methylcholanthrene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
3-Methylphenol (m-Cresol)	350 U	320 U	270 U	290 U	280 U	290 U	290 U	290 U	290 UJ	280 UJ
3 & 4 Methylphenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3-Nitroaniline	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
4,6-Dinitro-2-methylphenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ
4-Aminobiphenyl	240 U	220 R	190 UJ	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
4-Bromophenyl-phenylether	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ

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CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB06	59SB07	59SB08	59SB09	59SB11	59SB12
Sample ID	59SB01-00	59SB02-00	59SB03-00	59SB04-00	59SB06-00	59SB07-00	59SB08-00	59SB09-00	59SB11-00	59SB12-00
Sample Date	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	5/19/2010	5/18/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Semivolatile Organics (µg/kg) (cont.)										
4-Chloro-3-methylphenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ
4-Chloroaniline	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
4-Chlorophenyl-phenylether	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
4-Dimethylaminoazobenzene (p-)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
4-Methylphenol (p-Cresol)	350 U	320 U	270 U	290 U	280 U	290 U	290 U	290 U	290 UJ	280 UJ
4-Nitroaniline	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
4-Nitrophenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ
4-Nitroquinoline-1-oxide	240 UJ	220 U	190 UJ	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
7,12-Dimethylbenz(a)anthracene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
a,a-Dimethylphenethylamine	460 UJ	430 UJ	360 UJ	390 UJ	370 UJ	390 UJ	390 UJ	380 UJ	540 UJ	520 UJ
Acetophenone	120 U	110 U	93 U	100 U	94 U	100 U	100 U	98 U	98 UJ	94 UJ
Aniline	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Aramite	240 UJ	220 U	190 UJ	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Benzyl Alcohol	240 UJ	220 UJ	190 UJ	200 UJ	190 UJ	200 UJ	200 UJ	200 UJ	200 UJ	190 UJ
Bis(2-chloroethoxy)methane	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Bis(2-chloroethyl)ether	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Bis(2-ethylhexyl) Phthalate (BEHP)	630 J	240	190 U	200 U	190 U	48 J	200	200 U	200 UJ	190 UJ
Butyl Benzyl Phthalate	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Diallate (cis)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Diallate (trans)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Diallate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzofuran	240 U	220 U	190 U	750	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Diethyl Phthalate (DEP)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Dimethyl Phthalate	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Di-n-butyl Phthalate (DBP)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Di-n-octyl Phthalate	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Dinoseb		NA	NA	NA	NA	NA	NA	NA	200 UJ	190 UJ
Ethyl Methane Sulfonate (EMS)	240 UJ	220 UJ	190 UJ	200 UJ	190 UJ	200 UJ	200 UJ	200 UJ	200 UJ	190 UJ
Hexachloro-1,3-butadiene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Hexachlorobenzene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Hexachlorocyclopentadiene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Hexachloroethane	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Hexachlorophene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloropropene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB06	59SB07	59SB08	59SB09	59SB11	59SB12
Sample ID	59SB01-00	59SB02-00	59SB03-00	59SB04-00	59SB06-00	59SB07-00	59SB08-00	59SB09-00	59SB11-00	59SB12-00
Sample Date	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	5/19/2010	5/18/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Semivolatile Organics (µg/kg) (cont.)										
Isophorone	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Isosafrole	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Methapyrilene	240 UJ	220 R	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Methyl Methane Sulfonate	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Nitrobenzene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
N-Nitro-o-toluidine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Nitrosodiethylamine	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
n-Nitrosodimethylamine (NDMA)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
n-Nitroso-di-n-butylamine	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
n-Nitrosodi-n-propylamine	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
n-Nitrosodiphenylamine	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
n-Nitrosomethylethylamine	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
n-Nitrosomorpholine	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
n-Nitrosopiperidine	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
n-Nitrosopyrrolidine	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
o-Toluidine	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
p-Dimethylamino azobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorobenzene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Pentachloronitrobenzene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Pentachlorophenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ
Phenacetin	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Phenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ
p-Phenylene diamine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pronamide	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Pyridine	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Safrole	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
PAHs (µg/kg)										
2-Methylnaphthalene	1.2 J	11 UJ	9.1 UJ	31 J	9.2 UJ	9.8 UJ	9.8 U	9.5 UJ	9.5 UJ	9.2 UJ
Acenaphthene	12 U	0.82 J	9.1 U	480	9.2 U	9.8 U	9.8 U	1.5 J	9.5 UJ	9.2 UJ
Acenaphthylene	12 U	11 U	9.1 U	27	9.2 U	9.8 U	9.8 U	16	9.5 UJ	9.2 UJ
Anthracene	11 U	2.3 J	9.1 U	690	0.57 J	0.82 J	0.64 J	12	0.6 J	2.2 J
Benzo(a)anthracene	3.9 J	5.8 J	0.91 J	84 J	1.8 J	0.72 J	1.4 J	46	1.1 J	9.6 J
Benzo(a)pyrene (BaP)	2.5 J	4.1 J	0.89 J	390	9.2 U	0.8 J	0.84 J	57	9.5 UJ	11 J

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SUMMARY OF ANALYTICAL RESULTS - SURFACE SOIL
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB06	59SB07	59SB08	59SB09	59SB11	59SB12
Sample ID	59SB01-00	59SB02-00	59SB03-00	59SB04-00	59SB06-00	59SB07-00	59SB08-00	59SB09-00	59SB11-00	59SB12-00
Sample Date	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	5/19/2010	5/18/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
PAHSs (µg/kg) (cont.)										
Benzo(b)fluoranthene	2.5 J	3.7 J	0.99 J	750	9.2 U	1.2 J	0.86 J	51	1.3 J	9.9 J
Benzo(g,h,i)perylene	2 J	2.5 J	9.1 UJ	220	1.3 J	1.5 J	9.8 UJ	53 J	0.53 J	9.2 UJ
Benzo(k)fluoranthene	2.6 J	5 J	1.2 J	730	9.2 UJ	0.78 J	0.91 J	62 J	0.75 J	9.8 J
Chrysene	3.7 J	3.9 J	0.77 J	1200	1.4 J	0.78 J	1.4 J	39	1.4 J	9.9 J
Dibenz(a,h)anthracene	0.92 J	11 U	9.1 U	92	9.2 U	9.8 U	9.8 UJ	9.5 U	9.5 UJ	9.2 UJ
Fluoranthene	6.9 J	11	9.1 U	4600	1.8 J	9.8 U	3.1 J	68	2.3 J	16 J
Fluorene	0.82 J	0.73 J	9.1 U	580	9.2 U	9.8 U	9.8 U	1.1 J	9.5 UJ	0.63 J
Indeno(1,2,3-cd)pyrene	3 J	3.6 J	9.1 UJ	240	1.8 J	9.8 UJ	9.8 UJ	65 J	9.5 UJ	9.2 UJ
Naphthalene	12 U	11 U	9.1 U	9.8 U	9.2 U	9.8 U	9.8 U	9.5 U	9.5 UJ	0.92 J
Phenanthrene	8.1 J	8.2 J	9.1 U	7000	1.5 J	9.8 U	3.4 J	28	9.5 UJ	9.2 UJ
Pyrene	6.5 J	8.3 J	1 J	3000	1.6 J	1.2 J	2.9 J	66	9.5 UJ	18 J
Pesticides (µg/kg)										
4,4'-DDD	4.6 UJ	0.6 J	0.79 J	3.9 UJ	3.7 U	3.9 U	3.9 UJ	2.4 J	19 UJ	3.7 U
4,4'-DDE	4.6 UJ	0.48 J	4.5	3.9 UJ	0.46 J	0.67 J	3.9 UJ	53	19 UJ	3.7 U
4,4'-DDT	4.6 UJ	4.3 U	3.2 J	3.9 UJ	3.7 U	0.66 J	3.9 UJ	15	19 UJ	0.85 J
Aldrin	2.4 UJ	2.2 U	1.8 U	2 UJ	1.9 U	2 U	2 UJ	1.9 U	9.7 UJ	1.9 U
BHC, alpha-	2.4 UJ	2.2 U	1.8 U	2 UJ	1.9 U	2 U	2 UJ	1.9 U	9.7 UJ	1.9 U
BHC, beta-	2.4 UJ	2.2 U	0.47 J	2.4 R	1.9 U	0.57 J	2 UJ	1.9 U	4.8 UJ	0.95 U
BHC, delta-	2.4 UJ	2.2 U	1.8 U	2 UJ	1.9 U	2 U	2 UJ	1.9 U	9.7 UJ	1.9 U
BHC, gamma- (Lindane)	2.4 UJ	2.2 U	1.8 U	2 UJ	1.9 U	2 U	2 UJ	1.9 U	9.7 UJ	1.9 U
Chlordane, alpha-	2.4 UJ	2.2 U	1.2 J	1.1 J	1.9 U	1.2 J	2 UJ	1.9 U	1.3 NJ	0.25 J
Chlordane, gamma-	2.4 UJ	2.2 U	1.8 U	2 UJ	0.57 J	2 U	2 UJ	1.9 U	9.7 UJ	1.9 U
Chlorobenzilate	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Dieldrin	4.6 UJ	4.3 U	3.6 U	3.9 UJ	3.7 U	3.9 U	3.9 UJ	3.8 U	19 UJ	3.7 U
Endosulfan I	2.4 UJ	2.2 U	1.8 U	2 UJ	1.9 U	2 U	2 UJ	1.9 U	9.7 UJ	1.9 U
Endosulfan II	4.6 UJ	4.3 U	3.6 U	3.9 UJ	3.7 U	3.9 U	3.9 UJ	3.8 U	19 UJ	3.7 U
Endosulfan Sulfate	4.6 UJ	4.3 U	3.6 U	0.72 J	3.7 U	3.9 U	3.9 UJ	0.61 J	19 UJ	0.52 J
Endrin	4.6 UJ	4.3 U	3.6 U	3.9 UJ	3.7 U	3.9 U	3.9 UJ	3.8 U	19 UJ	3.7 U
Endrin Aldehyde	4.6 R	4.3 R	3.6 R	3.9 R	3.7 R	3.9 R	3.9 R	1.8 J	19 UJ	3.7 U
Heptachlor	2.4 UJ	2.2 U	1.8 U	2 UJ	1.9 U	2 U	2 UJ	1.9 U	9.7 UJ	1.9 U
Heptachlor Epoxide	2.4 UJ	2.2 U	1.8 U	2 UJ	1.9 U	2 U	2 UJ	1.9 U	9.7 UJ	1.9 U
Isodrin	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ
Kepone (Chlordecone)	240 UJ	220 UJ	190 UJ	200 UJ	190 UJ	200 UJ	200 UJ	200 UJ	200 R	190 R

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CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB06	59SB07	59SB08	59SB09	59SB11	59SB12
Sample ID	59SB01-00	59SB02-00	59SB03-00	59SB04-00	59SB06-00	59SB07-00	59SB08-00	59SB09-00	59SB11-00	59SB12-00
Sample Date	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	5/19/2010	5/18/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Pesticides (µg/kg)										
Methoxychlor	24 UJ	22 U	18 U	20 UJ	19 U	20 U	20 UJ	19 U	26 NJ	19 U
Toxaphene	120 UJ	110 U	90 U	98 UJ	92 U	98 U	98 UJ	94 U	470 UJ	92 U
Metals (mg/kg)										
Antimony	6.5 UJ	1.3 UJ	1.1 UJ	1.1 UJ	1.1 UJ	1.1 UJ	1.2 UJ	1.2 J	5.7 UJ	0.77 J
Arsenic	1.2	0.81	0.78	0.57 U	0.53 U	1.4	0.58 U	0.89	2.8 U	0.69
Barium	184 J	40.2 J	90.2 J	155 J	87.3 J	42.9 J	267 J	154 J	36.6	81.5
Beryllium	0.34 J	0.41 J	0.14 J	0.26 J	0.21 J	0.21 J	0.36 J	0.2 J	2.8 U	0.23 J
Cadmium	0.071 J	0.93	0.5 J	0.087 J	0.35 J	0.31 J	1.3	2	0.25 J	0.8
Chromium	31 J	41.9 J	24.3 J	5.3 J	41.6 J	40.7 J	19 J	45.6 J	25.9 J	15.7 J
Cobalt	10.4 J	27.1 J	25.9 J	18.4 J	20.2 J	26.4 J	19.2 J	26.9 J	25.5	14.1
Copper	96.8 J	84.7 J	106 J	24.8 J	91.7 J	126 J	41.5 J	237 J	107	81.3
Lead	17 J	31 J	51.3 J	3.4 J	10.5 J	27.3 J	2.6 J	654 J	8.7 J	47.4
Mercury	0.05	0.017 J	0.02 J	0.014 J	0.015 J	0.009 J	0.014 J	0.081	0.017 J	0.095
Nickel	6.1	13.5	22.3	7.9	14.1	26.8	11	27.5	11.7	12
Selenium	16.3 U	1.1 J	0.21 J	0.22 J	0.36 J	0.46 J	0.57 J	0.47 J	14.2 U	0.5 J
Silver	3.3 U	0.65 U	0.53 U	0.57 U	0.53 U	0.57 U	0.58 U	2.6	2.8 U	0.55 U
Thallium	3.3 U	0.65 U	0.53 U	0.57 U	0.53 U	0.57 U	0.58 U	0.56 U	2.8 U	0.032 J
Tin	3 J	5.7 J	6.3	3.8 J	3.8 J	5.6 J	3.3 J	36.5	5.7 U	8.5
Vanadium	260 J	226 J	118 J	91.7 J	132 J	157 J	72.8 J	191 J	169	84.3
Zinc	34.1 J	57 J	101 J	62.3 J	77.9 J	82.4 J	80.5 J	468 J	64.5	232

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB13	59SB14	59SB15	59SB17	59SB18	59SB20	59SB21	59SB22	59SB23	59SB24
Sample ID	59SB13-00	59SB14-00	59SB15-00	59SB17-00	59SB18-00	59SB20-00	59SB21-00	59SB22-00	59SB23-00	59SB24-00
Sample Date	5/18/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	9/13/2012
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Volatile Organics (µg/kg)										
1,1,1,2-Tetrachloroethane	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	2.5 U
1,1,1-Trichloroethane	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	1 U
1,1,2,2-Tetrachloroethane	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	1.6 U
1,1,2-Trichloroethane	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	1.3 U
1,1-Dichloroethane	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	1.1 U
1,1-Dichloroethene	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	1.5 U
1,2,3-Trichloropropane	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	2.5 U
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	1 U
1,2-Dibromo-3-chloropropane (DBCP)	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	4.5 U
1,2-Dibromoethane (EDB)	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	1.5 U
1,2-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.3 U
1,2-Dichloroethane	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	1.1 U
1,2-Dichloroethene (trans)	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	1 U
1,2-Dichloropropane	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	1 U
1,3-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.6 U
1,3-Dichloropropene (cis)	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	1 U
1,3-Dichloropropene (trans)	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	1 U
1,4-Dichloro-2-butene (trans)	19 U	18 U	18 U	18 U	17 U	16 U	18 U	16 U	18 U	3 U
1,4-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	1 U
1,4-Dioxane (p-)	240 R	230 R	230 R	220 R	210 R	200 R	220 R	200 R	220 R	51 R
2-Butanone (MEK)	12 U	11 U	11 U	11 U	11 U	10 U	11 U	10 U	11 U	2.5 U
2-Chloro-1,3-butadiene (Chloroprene)	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	2.2 U
2-Hexanone (MBK)	12 U	11 U	11 U	11 U	11 U	10 U	11 U	10 U	11 U	3.4 U
3-Chloropropene (Allyl Chloride)	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	2.3 U
4-Methyl-2-pentanone (MIBK)	12 U	11 U	11 U	11 U	11 U	10 U	11 U	10 U	11 U	4.3 U
Acetone	16 U	14 U	59 J	72	34	31	190	97	38	11 UJ
Acetonitrile	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	42 U
Acrolein	47 R	45 R	46 R	45 R	42 R	41 R	45 R	40 R	44 R	25 U
Acrylonitrile	47 U	45 U	46 U	45 U	42 U	41 U	45 U	40 U	44 U	35 U
Benzene	4.7 U	4.5 U	0.73 J	4.5 U	0.53 J	4.1 U	4.5 U	4 U	4.4 U	1 U
Bromodichloromethane	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	1 U
Bromoform	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	1.5 U
Bromomethane	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	3.4 J	1.5 U
Carbon Disulfide	4.7 U	4.5 U	4.6 U	1 J	4.2 U	4.1 U	4.5 U	4 U	4.4 U	1.1 U

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB13	59SB14	59SB15	59SB17	59SB18	59SB20	59SB21	59SB22	59SB23	59SB24
Sample ID	59SB13-00	59SB14-00	59SB15-00	59SB17-00	59SB18-00	59SB20-00	59SB21-00	59SB22-00	59SB23-00	59SB24-00
Sample Date	5/18/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	9/13/2012
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Volatile Organics (µg/kg) (cont.)										
Carbon Tetrachloride	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	1 U
Chlorobenzene	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	1 U
Chloroethane	4.7 U	4.5 UJ	4.6 UJ	4.5 UJ	4.2 U	4.1 U	4.5 U	4 U	4.4 U	2.8 U
Chloroform	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	1.1 U
Chloromethane	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	0.35 J	0.52 J	0.47 J	2.1 U
Dibromochloromethane	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	1.8 U
Dibromomethane	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	1.8 U
Ethyl Methacrylate	47 U	45 U	46 U	45 U	42 U	41 U	45 U	40 U	44 U	3.5 U
Ethylbenzene	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	1.3 U
Freon 11 (Trichlorofluoromethane)	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	1.2 U
Freon-12 (Dichlorodifluoromethane)	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	1 U
Hexachlorobutadiene	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.2 U
Isobutyl Alcohol	240 R	230 R	230 R	220 R	210 R	200 R	220 R	200 R	220 R	54 R
Methyl Acrylonitrile	47 U	45 U	46 U	45 U	42 U	41 U	45 U	40 U	44 U	24 U
Methyl Iodide	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	2.6 J	1.9 U
Methyl Methacrylate	47 R	45 R	46 R	45 R	42 R	41 R	45 R	40 R	44 R	4.6 U
Methylene Chloride	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	1 U
Pentachloroethane	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	6.5 U
Propionitrile (Ethyl Cyanide)	240 R	230 R	230 R	220 R	210 R	200 R	220 R	200 R	220 R	27 U
Styrene (Ethenylbenzene)	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	1 U
Tetrachloroethene (PCE)	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	2 U
Toluene	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	1 U
Trichloroethene (TCE)	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	1.3 U
Vinyl Acetate	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 UJ	4.5 UJ	4 UJ	4.4 UJ	2.6 U
Vinyl Chloride	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	1.5 U
Xylene, m/p-	9.5 U	9.1 U	9.2 U	8.9 U	8.4 U	8.1 U	8.9 U	8 U	8.8 U	NA
Xylene, o-	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	NA
Xylenes, total	4.7 U	4.5 U	4.6 U	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	1.1 U
Semivolatile Organics (µg/kg)										
1,2,4,5-Tetrachlorobenzene	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	4.3 U
1,2,4-Trichlorobenzene	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	6.1 U
1,2-Dichlorobenzene (o-)	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	8.7 U
1,3,5-Trinitrobenzene (TNB)	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	22 U

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB13	59SB14	59SB15	59SB17	59SB18	59SB20	59SB21	59SB22	59SB23	59SB24
Sample ID	59SB13-00	59SB14-00	59SB15-00	59SB17-00	59SB18-00	59SB20-00	59SB21-00	59SB22-00	59SB23-00	59SB24-00
Sample Date	5/18/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	9/13/2012
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Semivolatile Organics (µg/kg) (cont.)										
1,3-Dichlorobenzene (m-)	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	7.4 U
1,3-Dinitrobenzene (m-)	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	22 U
1,4-Dichlorobenzene (p-)	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	6.8 U
1,4-Naphthoquinone	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	4.3 UJ
1,4-Phenylenediamine	2100 R	2100 R	1900 R	2000 R	2000 R	1800 R	2000 R	2000 R	2100 R	NA
1-Naphthylamine	210 UJ	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	22 UJ
2,2'-Oxybis[1-chloropropane]	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	9.5 U
2,3,4,6-Tetrachlorophenol	410 U	410 UJ	370 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U	4.3 U
2,4,5-Trichlorophenol	410 U	410 UJ	370 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U	10 U
2,4,6-Trichlorophenol	410 U	410 UJ	370 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U	10 U
2,4-Dichlorophenol	410 U	410 UJ	370 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U	9.5 U
2,4-Dimethylphenol	410 U	410 UJ	370 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U	10 U
2,4-Dinitrophenol	410 U	410 UJ	370 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U	55 U
2,4-Dinitrotoluene (DNT)	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	9.9 U
2,6-Dichlorophenol	410 U	410 UJ	370 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U	4.3 U
2,6-Dinitrotoluene (DNT)	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	10 U
2-Acetylaminofluorene	210 U	210 UJ	190 UJ	200 UJ	200 UJ	180 UJ	200 U	200 UJ	210 U	43 U
2-Chloronaphthalene	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	7.9 U
2-Chlorophenol	410 U	410 UJ	370 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U	7 U
2-Methyl-5-nitroaniline	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	NA
2-Methylphenol (o-Cresol)	410 U	410 UJ	370 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U	8.3 U
2-Naphthylamine	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	22 U
2-Nitroaniline	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	9.2 U
2-Nitrophenol	410 U	410 UJ	370 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U	7.6 U
2-Picoline	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	4.3 U
3,3'-Dichlorobenzidine	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	22 U
3,3'-Dimethylbenzidine	210 U	210 UJ	190 UJ	200 UJ	200 UJ	180 UJ	200 U	200 UJ	210 U	87 U
3-Methylcholanthrene	210 U	210 UJ	190 UJ	200 UJ	200 UJ	180 UJ	200 U	200 UJ	210 U	43 U
3-Methylphenol (m-Cresol)	310 U	310 UJ	280 UJ	300 UJ	290 U	270 U	290 U	290 U	310 U	NA
3 & 4 Methylphenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.6 U
3-Nitroaniline	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	8.8 U
4,6-Dinitro-2-methylphenol	410 U	410 UJ	370 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U	22 U
4-Aminobiphenyl	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	22 UJ
4-Bromophenyl-phenylether	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	9.1 U

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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB13	59SB14	59SB15	59SB17	59SB18	59SB20	59SB21	59SB22	59SB23	59SB24
Sample ID	59SB13-00	59SB14-00	59SB15-00	59SB17-00	59SB18-00	59SB20-00	59SB21-00	59SB22-00	59SB23-00	59SB24-00
Sample Date	5/18/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	9/13/2012
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Semivolatile Organics (µg/kg) (cont.)										
4-Chloro-3-methylphenol	410 U	410 UJ	370 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U	9.2 U
4-Chloroaniline	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	6.8 U
4-Chlorophenyl-phenylether	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	8.4 U
4-Dimethylaminoazobenzene (p-)	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	NA
4-Methylphenol (p-Cresol)	310 U	310 UJ	280 UJ	300 UJ	290 U	270 U	290 U	290 U	310 U	NA
4-Nitroaniline	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	22 U
4-Nitrophenol	410 U	410 UJ	370 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U	96 U
4-Nitroquinoline-1-oxide	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	55 U
7,12-Dimethylbenz(a)anthracene	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	22 U
a,a-Dimethylphenethylamine	590 U	580 UJ	520 UJ	560 UJ	540 UJ	510 UJ	540 U	550 UJ	590 U	430 UJ
Acetophenone	110 U	100 UJ	94 UJ	100 UJ	98 U	92 U	98 U	100 U	110 U	9 U
Aniline	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	11 U
Aramite	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	6.3 U
Benzyl Alcohol	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	8 U
Bis(2-chloroethoxy)methane	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	8.6 U
Bis(2-chloroethyl)ether	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	8.6 U
Bis(2-ethylhexyl) Phthalate (BEHP)	210 U	210 UJ	470 J	200 UJ	200 U	180 U	200 U	200 U	53 J	43 J
Butyl Benzyl Phthalate	210 U	210 UJ	170 J	200 UJ	200 U	180 U	200 U	200 U	210 U	8.8 U
Diallate (cis)	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	NA
Diallate (trans)	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	NA
Diallate	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.4 U
Dibenzofuran	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	8.8 U
Diethyl Phthalate (DEP)	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	9.7 U
Dimethyl Phthalate	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	9.9 U
Di-n-butyl Phthalate (DBP)	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	22 U
Di-n-octyl Phthalate	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	8.8 U
Dinoseb	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	8.8 U
Ethyl Methane Sulfonate (EMS)	210 UJ	210 UJ	190 UJ	200 UJ	200 UJ	180 UJ	200 UJ	200 UJ	210 UJ	10 U
Hexachloro-1,3-butadiene	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	9 U
Hexachlorobenzene	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	10 U
Hexachlorocyclopentadiene	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	4.9 U
Hexachloroethane	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	7.6 U
Hexachlorophene	NA	NA	NA	NA	NA	NA	NA	NA	NA	3200 UJ
Hexachloropropene	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	7 U

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Site ID	59SB13	59SB14	59SB15	59SB17	59SB18	59SB20	59SB21	59SB22	59SB23	59SB24
Sample ID	59SB13-00	59SB14-00	59SB15-00	59SB17-00	59SB18-00	59SB20-00	59SB21-00	59SB22-00	59SB23-00	59SB24-00
Sample Date	5/18/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	9/13/2012
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Semivolatile Organics (µg/kg) (cont.)										
Isophorone	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	9.2 U
Isosafrole	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	4.3 U
Methapyrilene	210 R	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	88 UJ
Methyl Methane Sulfonate	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	5 UJ
Nitrobenzene	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	8.7 U
N-Nitro-o-toluidine	NA	NA	NA	NA	NA	NA	NA	NA	NA	22 U
n-Nitrosodiethylamine	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	4.3 U
n-Nitrosodimethylamine (NDMA)	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	25 U
n-Nitroso-di-n-butylamine	210 UJ	210 UJ	190 UJ	200 UJ	200 UJ	180 UJ	200 UJ	200 UJ	210 UJ	22 U
n-Nitrosodi-n-propylamine	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	9.9 U
n-Nitrosodiphenylamine	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	8 U
n-Nitrosomethylethylamine	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	4.3 U
n-Nitrosomorpholine	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	5.9 U
n-Nitrosopiperidine	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	4.5 U
n-Nitrosopyrrolidine	210 U	210 UJ	190 UJ	200 UJ	200 UJ	180 UJ	200 U	200 UJ	210 U	4.7 U
o-Toluidine	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	4.3 U
p-Dimethylamino azobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	22 U
Pentachlorobenzene	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	4.3 U
Pentachloronitrobenzene	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	22 U
Pentachlorophenol	410 U	410 UJ	370 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U	22 U
Phenacetin	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	22 U
Phenol	410 U	410 UJ	370 UJ	390 UJ	380 U	360 U	380 U	390 U	410 U	8.6 U
p-Phenylene diamine	NA	NA	NA	NA	NA	NA	NA	NA	NA	1100 UJ
Pronamide	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	5.5 U
Pyridine	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	26 U
Safrole	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	4.3 U
PAHs (µg/kg)										
2-Methylnaphthalene	10 U	10 UJ	1.2 J	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U	4.3 U
Acenaphthene	10 U	10 UJ	9.2 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U	4.3 U
Acenaphthylene	10 U	10 UJ	1.7 J	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U	4.3 U
Anthracene	10 U	10 UJ	3.8 J	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U	4.3 U
Benzo(a)anthracene	10 U	10 UJ	22 J	0.87 J	9.5 U	9 U	9.5 U	9.8 U	10 U	4.3 U
Benzo(a)pyrene (BaP)	10 U	10 UJ	9.2 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U	4.3 U

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Site ID	59SB13	59SB14	59SB15	59SB17	59SB18	59SB20	59SB21	59SB22	59SB23	59SB24
Sample ID	59SB13-00	59SB14-00	59SB15-00	59SB17-00	59SB18-00	59SB20-00	59SB21-00	59SB22-00	59SB23-00	59SB24-00
Sample Date	5/18/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	9/13/2012
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
PAHSs (µg/kg) (cont.)										
Benzo(b)fluoranthene	10 U	10 UJ	9.2 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U	4.3 U
Benzo(g,h,i)perylene	10 U	10 UJ	9.2 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U	4.3 U
Benzo(k)fluoranthene	10 U	10 UJ	9.2 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U	4.3 U
Chrysene	10 U	10 UJ	32 J	1.2 J	1.5 J	9 U	9.5 U	9.8 U	2.3 J	4.3 U
Dibenz(a,h)anthracene	10 U	10 UJ	9.2 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U	8.8 U
Fluoranthene	10 U	10 UJ	15 J	9.9 UJ	1.8 J	9 U	9.5 U	9.8 U	4.6 J	4.3 U
Fluorene	10 U	10 UJ	9.2 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U	4.3 U
Indeno(1,2,3-cd)pyrene	10 U	10 UJ	9.2 UJ	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U	4.3 U
Naphthalene	10 U	1.4 J	2.2 J	1.2 J	9.5 U	9 U	9.5 U	9.8 U	10 U	4.3 U
Phenanthrene	10 U	10 UJ	9.2 UJ	9.9 UJ	9.5 U	9 U	1.7 J	9.8 U	10 U	8.8 U
Pyrene	10 U	10 UJ	81 J	9.9 UJ	2.1 J	3.2 J	9.5 U	9.8 U	3.5 J	4.3 U
Pesticides (µg/kg)										
4,4'-DDD	4.1 UJ	4.1 U	8.1 J	3.9 U	3.8 U	3.6 U	3.8 U	3.9 U	4.1 U	NA
4,4'-DDE	4.1 UJ	4.1 U	160	1.2 J	12	3.6 U	3.8 U	3.4 J	1.6 J	NA
4,4'-DDT	4.1 UJ	4.1 U	160	1.7 J	2.7 J	3.6 U	3.8 U	1.2 J	2.3 J	NA
Aldrin	2.1 UJ	2.1 U	19 U	2 U	2 U	1.8 U	2 U	2 U	2.1 U	NA
BHC, alpha-	2.1 UJ	2.1 U	19 U	2 U	2 U	1.8 U	2 U	2 U	2.1 U	NA
BHC, beta-	0.63 NJ	1.1 U	8.6 NJ	9.2 NJ	2 U	1.8 U	2 U	2 U	2.1 U	NA
BHC, delta-	2.1 UJ	2.1 U	19 U	2 U	2 U	1.8 U	2 U	2 U	2.1 U	NA
BHC, gamma- (Lindane)	2.1 UJ	2.1 U	19 U	2 U	2 U	1.8 U	2 U	2 U	2.1 U	NA
Chlordane, alpha-	2.1 UJ	2.1 U	19 U	2 U	2 U	1.8 U	2 U	1.9 J	1.1 J	NA
Chlordane, gamma-	2.1 UJ	2.1 U	3.5 J	2 U	2 U	1.8 U	2 U	2 U	2.1 U	NA
Chlorobenzilate	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	NA
Dieldrin	4.1 UJ	4.1 U	37 U	3.9 U	3.8 U	3.6 U	3.8 U	3.9 U	4.1 U	NA
Endosulfan I	2.1 UJ	2.1 U	19 U	2 U	2 U	1.8 U	2 U	2 U	2.1 U	NA
Endosulfan II	4.1 UJ	4.1 U	37 U	3.9 U	3.8 U	3.6 U	3.8 U	3.9 U	4.1 U	NA
Endosulfan Sulfate	4.1 UJ	4.1 U	37 U	3.9 U	3.8 U	3.6 U	3.8 U	3.9 U	4.1 U	NA
Endrin	4.1 UJ	4.1 U	37 U	3.9 U	3.8 U	3.6 U	3.8 U	3.9 U	4.1 U	NA
Endrin Aldehyde	4.1 UJ	4.1 U	37 U	3.9 U	3.8 U	3.6 U	3.8 U	3.9 U	4.1 U	NA
Heptachlor	2.1 UJ	2.1 U	19 U	2 U	2 U	1.8 U	2 U	2 U	2.1 U	NA
Heptachlor Epoxide	2.1 UJ	2.1 U	19 U	2 U	2 U	1.8 U	2 U	2 U	2.1 U	NA
Isodrin	210 U	210 UJ	190 UJ	200 UJ	200 U	180 U	200 U	200 U	210 U	NA
Kepone (Chlordecone)	210 U	210 R	1900 R	200 R	200 UJ	180 UJ	200 UJ	200 UJ	210 U	NA

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Site ID	59SB13	59SB14	59SB15	59SB17	59SB18	59SB20	59SB21	59SB22	59SB23	59SB24
Sample ID	59SB13-00	59SB14-00	59SB15-00	59SB17-00	59SB18-00	59SB20-00	59SB21-00	59SB22-00	59SB23-00	59SB24-00
Sample Date	5/18/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	9/13/2012
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Pesticides (µg/kg)										
Methoxychlor	21 UJ	21 U	190 U	20 U	20 U	18 U	20 U	20 U	21 U	NA
Toxaphene	100 UJ	100 U	920 U	99 U	95 U	90 U	95 U	98 U	100 U	NA
Metals (mg/kg)										
Antimony	0.29 J	5.9 UJ	8.5 J	5.7 UJ	0.17 J	0.88 J	5.6 UJ	5.7 UJ	0.17 J	0.65 U
Arsenic	0.63 U	2.9 U	5.5	2.9 U	0.29 J	2.5 U	2.8 U	2.9 U	0.71	1.8
Barium	33.4	122	145	86.7	48	104	102	107	81.6	210 J
Beryllium	0.23 J	2.9 U	0.31 J	0.29 J	0.15 J	0.62 J	0.27 J	2.9 U	0.19 J	0.63 J
Cadmium	0.15 J	0.34 J	2.6	2.9 U	0.26 J	0.64 J	0.26 J	0.42 J	0.35 J	0.16
Chromium	7.4	45.7 J	32.5 J	30 J	19.6	54.4	29.4	29.5	51.2	91
Cobalt	20.2 J	45.2	15.6	23.3	15.2 J	30.2 J	18.3 J	21.2 J	29 J	27 J
Copper	94.9 J	291	120	76.3	59.5 J	94.2 J	102 J	76.6 J	73.9 J	260 J
Lead	5.2	3.5	638	22.4	7.1	3.6	15.1	16.7	11.8	12 R
Mercury	0.041 U	0.041 U	0.053	0.026 J	0.038 U	0.01 J	0.009 J	0.011 J	0.041 U	0.011 U
Nickel	6.6	20.7	13.1	12.5	10.3	22.2	13.9	16.1	22.2	33 J
Selenium	0.27 J	14.7 U	0.61 J	0.86 J	0.34 J	2.4 J	13.9 U	14.3 U	0.46 J	0.32 U
Silver	0.093 J	2.9 U	0.55 U	2.9 U	0.1 J	0.48 J	2.8 U	2.9 U	0.14 J	0.088 J
Thallium	0.05 J	2.9 U	0.065 J	2.9 U	0.032 J	0.37 J	2.8 U	2.9 U	0.027 J	0.039 J
Tin	6.3 UJ	5.9 U	10.5	6	5.6 UJ	5.1 UJ	5.6 UJ	5.7 UJ	6.2 UJ	8.3 J
Vanadium	129 J	249	94.9	184	102 J	109 J	107 J	126 J	115 J	280 J
Zinc	58.6	123	747	132	59.9	81.5	87.7	77.4	52	100 J

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SUMMARY OF ANALYTICAL RESULTS - SURFACE SOIL
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB25-00	59SB26-00	59SB27-00	59SB28-00	59SB29-00	59SB30-00	59SB31-00	59SB32-00	59SB33-00
Sample Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Volatile Organics (µg/kg)									
1,1,1,2-Tetrachloroethane	2.3 U	2.3 U	2.4 U	2.1 U	1.7 U	1.9 U	2.2 U	2.6 U	2.4 U
1,1,1-Trichloroethane	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
1,1,2,2-Tetrachloroethane	1.6 U	1.5 U	1.6 U	1.4 U	1.1 U	1.3 U	1.4 U	1.7 U	1.6 U
1,1,2-Trichloroethane	1.3 U	1.2 U	1.3 U	1.1 U	0.93 U	1 U	1.2 U	1.4 U	1.3 U
1,1-Dichloroethane	1.1 U	1 U	1.1 U	0.97 U	0.79 U	0.88 U	0.99 U	1.2 U	1.1 U
1,1-Dichloroethene	1.5 U	1.4 U	1.5 U	1.3 U	1.1 U	1.2 U	1.3 U	1.6 U	1.5 U
1,2,3-Trichloropropane	2.3 U	2.3 U	2.4 U	2.1 U	1.7 U	1.9 U	2.2 U	2.6 U	2.4 U
1,2,4-Trichlorobenzene	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
1,2-Dibromo-3-chloropropane (DBCP)	4.3 U	4.2 U	4.4 U	3.9 U	3.1 U	3.5 U	4 U	4.7 U	4.4 U
1,2-Dibromoethane (EDB)	1.5 U	1.4 U	1.5 U	1.3 U	1.1 U	1.2 U	1.3 U	1.6 U	1.5 U
1,2-Dichlorobenzene	1.3 U	1.2 U	1.3 U	1.1 U	0.93 U	1 U	1.2 U	1.4 U	1.3 U
1,2-Dichloroethane	1.1 U	1 U	1.1 U	0.97 U	0.79 U	0.88 U	0.99 U	1.2 U	1.1 U
1,2-Dichloroethene (trans)	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
1,2-Dichloropropane	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
1,3-Dichlorobenzene	1.6 U	1.5 U	1.6 U	1.4 U	1.1 U	1.3 U	1.4 U	1.7 U	1.6 U
1,3-Dichloropropene (cis)	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
1,3-Dichloropropene (trans)	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
1,4-Dichloro-2-butene (trans)	2.8 U	2.8 U	2.9 U	2.5 U	2.1 U	2.3 U	2.6 U	3.1 U	2.9 U
1,4-Dichlorobenzene	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
1,4-Dioxane (p-)	48 R	48 R	49 R	44 R	36 R	40 R	45 R	53 R	50 R
2-Butanone (MEK)	2.3 U	2.3 U	2.4 U	2.1 U	1.7 U	1.9 U	2.2 U	2.6 U	2.4 U
2-Chloro-1,3-butadiene (Chloroprene)	2 U	2 U	2.1 U	1.8 U	1.5 U	1.7 U	1.9 U	2.2 U	2.1 U
2-Hexanone (MBK)	3.2 U	3.1 U	3.3 U	2.9 U	2.4 U	2.7 U	3 U	3.5 U	3.3 U
3-Chloropropene (Allyl Chloride)	2.1 U	2.1 U	2.2 U	1.9 U	1.6 U	1.8 U	2 U	2.4 U	2.2 U
4-Methyl-2-pentanone (MIBK)	4.1 U	4 U	4.2 U	3.7 U	3 U	3.4 U	3.8 U	4.5 U	4.2 U
Acetone	27 J	10 U	11 U	9.7 U	7.9 U	15 J	30 J	45 J	11 U
Acetonitrile	40 UJ	39 UJ	41 UJ	36 UJ	29 UJ	33 U	37 UJ	44 UJ	41 U
Acrolein	23 UJ	23 UJ	24 UJ	21 UJ	17 UJ	19 U	22 UJ	26 UJ	24 U
Acrylonitrile	33 UJ	32 UJ	34 UJ	30 UJ	24 UJ	27 U	31 UJ	36 UJ	34 U
Benzene	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
Bromodichloromethane	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
Bromoform	1.5 U	1.4 U	1.5 U	1.3 U	1.1 U	1.2 U	1.3 U	1.6 U	1.5 U
Bromomethane	1.5 U	1.4 U	1.5 U	1.3 U	1.1 U	1.2 U	1.3 U	1.6 U	1.5 U
Carbon Disulfide	1.1 U	1 U	1.1 U	0.97 U	0.79 U	0.88 U	0.99 U	1.2 U	1.1 U

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB25-00	59SB26-00	59SB27-00	59SB28-00	59SB29-00	59SB30-00	59SB31-00	59SB32-00	59SB33-00
Sample Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Volatile Organics (µg/kg) (cont.)									
Carbon Tetrachloride	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
Chlorobenzene	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
Chloroethane	2.6 U	2.6 U	2.7 U	2.4 U	1.9 U	2.2 U	2.4 U	2.9 U	2.7 U
Chloroform	1.1 U	1 U	1.1 U	0.97 U	0.79 U	0.88 U	0.99 U	1.2 U	1.1 U
Chloromethane	1.9 U	1.9 U	2 U	1.8 U	1.4 U	1.6 U	1.8 U	2.1 U	2 U
Dibromochloromethane	1.6 U	1.6 U	1.7 U	1.5 U	1.2 U	1.4 U	1.5 U	1.8 U	1.7 U
Dibromomethane	1.6 U	1.6 U	1.7 U	1.5 U	1.2 U	1.4 U	1.5 U	1.8 U	1.7 U
Ethyl Methacrylate	3.3 U	3.2 U	3.4 U	3 U	2.4 U	2.7 U	3.1 U	3.6 U	3.4 U
Ethylbenzene	1.3 U	1.2 U	1.3 U	1.1 U	0.93 U	1 U	1.2 U	1.4 U	1.3 U
Freon 11 (Trichlorofluoromethane)	1.2 U	1.1 U	1.2 U	1.1 U	0.86 U	0.96 U	1.1 U	1.3 U	1.2 U
Freon-12 (Dichlorodifluoromethane)	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
Hexachlorobutadiene	3 U	3 U	3.1 U	2.7 U	2.2 U	2.5 U	2.8 U	3.3 U	3.1 U
Isobutyl Alcohol	50 R	50 R	51 R	46 R	37 R	42 R	47 R	56 R	52 R
Methyl Acrylonitrile	22 UJ	22 UJ	23 UJ	20 UJ	16 UJ	18 U	21 UJ	25 UJ	23 U
Methyl Iodide	1.7 UJ	1.7 UJ	1.8 UJ	1.6 UJ	1.3 UJ	1.4 U	1.6 UJ	1.9 UJ	1.8 U
Methyl Methacrylate	4.4 U	4.3 U	4.5 U	4 U	3.2 U	3.6 U	4 U	4.8 U	4.5 U
Methylene Chloride	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
Pentachloroethane	6.1 U	6 U	6.2 U	5.5 U	4.5 U	5.1 U	5.7 U	6.7 U	6.3 U
Propionitrile (Ethyl Cyanide)	25 UJ	25 UJ	26 UJ	23 UJ	19 UJ	21 U	23 UJ	28 UJ	26 U
Styrene (Ethenylbenzene)	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
Tetrachloroethene (PCE)	1.8 U	1.8 U	1.9 U	1.7 U	1.4 U	1.5 U	1.7 U	2 U	1.9 U
Toluene	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U	1.1 U	1 U
Trichloroethene (TCE)	1.3 U	1.2 U	1.3 U	1.1 U	0.93 U	1 U	1.2 U	1.4 U	1.3 U
Vinyl Acetate	2.4 U	2.4 U	2.5 U	2.2 U	1.8 U	2 U	2.2 U	2.7 U	2.5 U
Vinyl Chloride	1.5 U	1.4 U	1.5 U	1.3 U	1.1 U	1.2 U	1.3 U	1.6 U	1.5 U
Xylene, m/p-	NA	NA	NA	NA	NA	NA	NA	NA	NA
Xylene, o-	NA	NA	NA	NA	NA	NA	NA	NA	NA
Xylenes, total	1.1 U	1 U	1.1 U	0.97 U	0.79 U	0.88 U	0.99 U	1.2 U	1.1 U
Semivolatile Organics (µg/kg)									
1,2,4,5-Tetrachlorobenzene	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
1,2,4-Trichlorobenzene	6.1 U	5.7 U	64 U	26 U	27 U	27 U	5.9 U	6.4 U	6.2 U
1,2-Dichlorobenzene (o-)	8.7 U	8.2 U	92 U	37 U	39 U	39 U	8.5 U	9.1 U	8.8 U
1,3,5-Trinitrobenzene (TNB)	22 U	21 U	240 UJ	96 UJ	100 UJ	100 UJ	22 U	24 U	23 UJ

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB25-00	59SB26-00	59SB27-00	59SB28-00	59SB29-00	59SB30-00	59SB31-00	59SB32-00	59SB33-00
Sample Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Semivolatile Organics (µg/kg) (cont.)									
1,3-Dichlorobenzene (m-)	7.4 U	7 U	78 U	32 U	33 U	33 U	7.2 U	7.8 U	7.5 U
1,3-Dinitrobenzene (m-)	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
1,4-Dichlorobenzene (p-)	6.9 U	6.5 U	73 U	29 U	31 U	31 U	6.7 U	7.2 U	7 U
1,4-Naphthoquinone	4.4 UJ	4.1 UJ	46 UJ	19 UJ	20 UJ	19 UJ	4.3 UJ	4.6 UJ	4.4 UJ
1,4-Phenylenediamine	NA	NA	NA	NA	NA	NA	NA	NA	NA
1-Naphthylamine	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 UJ
2,2'-Oxybis[1-chloropropane]	9.5 U	9 U	100 U	41 U	43 U	42 U	9.3 U	10 U	9.6 U
2,3,4,6-Tetrachlorophenol	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
2,4,5-Trichlorophenol	10 U	9.5 U	110 U	43 U	45 U	45 U	9.8 U	11 U	10 U
2,4,6-Trichlorophenol	10 U	9.8 U	110 U	44 U	47 U	47 U	10 U	11 U	11 U
2,4-Dichlorophenol	9.5 U	9 U	100 U	41 U	43 U	42 U	9.3 U	10 U	9.6 U
2,4-Dimethylphenol	10 U	9.5 U	110 U	43 U	45 U	45 U	9.8 U	11 U	10 U
2,4-Dinitrophenol	55 U	52 U	590 UJ	240 UJ	250 UJ	250 UJ	54 U	58 U	56 UJ
2,4-Dinitrotoluene (DNT)	9.9 U	9.3 U	100 U	42 U	44 U	44 U	9.7 U	10 U	10 U
2,6-Dichlorophenol	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
2,6-Dinitrotoluene (DNT)	10 U	9.8 U	110 U	44 U	47 U	47 U	10 U	11 U	11 U
2-Acetylaminofluorene	44 U	41 U	460 U	190 U	200 U	190 U	43 U	46 U	44 U
2-Chloronaphthalene	7.9 U	7.5 U	84 U	34 U	36 U	35 U	7.7 U	8.3 U	8 U
2-Chlorophenol	7 U	6.6 U	74 U	30 U	31 U	31 U	6.8 U	7.3 U	7.1 U
2-Methyl-5-nitroaniline	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylphenol (o-Cresol)	8.3 U	7.8 U	88 U	35 U	37 U	37 U	8.1 U	8.7 U	8.4 U
2-Naphthylamine	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
2-Nitroaniline	9.2 U	8.7 U	98 U	39 U	41 U	41 U	9 U	9.7 U	9.4 U
2-Nitrophenol	7.7 U	7.2 U	81 U	33 U	34 U	34 U	7.5 U	8 U	7.8 U
2-Picoline	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
3,3'-Dichlorobenzidine	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
3,3'-Dimethylbenzidine	87 U	82 U	920 UJ	370 UJ	390 UJ	390 UJ	85 U	91 U	88 UJ
3-Methylcholanthrene	44 U	41 U	460 U	190 U	200 U	190 U	43 U	46 U	44 U
3-Methylphenol (m-Cresol)	NA	NA	NA	NA	NA	NA	NA	NA	NA
3 & 4 Methylphenol	9.6 U	9.1 U	100 U	41 U	43 U	43 U	9.4 U	10 U	9.8 U
3-Nitroaniline	8.8 U	8.3 U	93 U	38 U	40 U	39 U	8.6 U	9.3 U	9 U
4,6-Dinitro-2-methylphenol	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
4-Aminobiphenyl	22 UJ	21 UJ	240 U	96 U	100 U	100 U	22 UJ	24 UJ	23 U
4-Bromophenyl-phenylether	9.1 U	8.6 U	96 U	39 U	41 U	41 U	8.9 U	9.6 U	9.2 U

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB25-00	59SB26-00	59SB27-00	59SB28-00	59SB29-00	59SB30-00	59SB31-00	59SB32-00	59SB33-00
Sample Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Semivolatile Organics (µg/kg) (cont.)									
4-Chloro-3-methylphenol	9.2 U	8.7 U	98 U	39 U	41 U	41 U	9 U	9.7 U	9.4 U
4-Chloroaniline	6.9 U	6.5 U	73 U	29 U	31 U	31 U	6.7 U	7.2 U	7 U
4-Chlorophenyl-phenylether	8.5 U	8 U	89 U	36 U	38 U	38 U	8.3 U	8.9 U	8.6 U
4-Dimethylaminoazobenzene (p-)	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Methylphenol (p-Cresol)	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Nitroaniline	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
4-Nitrophenol	96 U	91 U	1000 U	410 U	430 U	430 U	94 U	100 U	98 U
4-Nitroquinoline-1-oxide	55 U	52 U	590 U	240 U	250 U	250 U	54 U	58 U	56 U
7,12-Dimethylbenz(a)anthracene	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
a,a-Dimethylphenethylamine	440 UJ	410 UJ	4600 UJ	1900 UJ	2000 UJ	1900 UJ	430 UJ	460 UJ	440 UJ
Acetophenone	9 U	8.5 U	95 U	38 U	40 U	40 U	8.8 U	9.4 U	9.1 U
Aniline	11 U	10 U	110 U	46 U	49 U	48 U	11 U	11 U	11 U
Aramite	6.3 U	6 U	67 U	27 U	28 U	28 U	6.2 U	6.6 U	6.4 U
Benzyl Alcohol	8.1 U	7.6 U	85 U	34 U	36 U	36 U	7.9 U	8.4 U	8.2 U
Bis(2-chloroethoxy)methane	8.6 U	8.1 U	91 U	37 U	38 U	38 U	8.4 U	9 U	8.7 U
Bis(2-chloroethyl)ether	8.6 U	8.1 U	91 U	37 U	38 U	38 U	8.4 U	9 U	8.7 U
Bis(2-ethylhexyl) Phthalate (BEHP)	78 J	7.5 U	84 U	34 U	36 U	35 J	11 J	8.3 U	19 J
Butyl Benzyl Phthalate	8.8 U	8.3 U	93 U	38 U	40 U	39 U	8.6 U	9.3 U	9 U
Diallate (cis)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Diallate (trans)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Diallate	7.4 U	7 U	78 U	32 U	33 U	33 U	7.2 U	7.8 U	7.5 U
Dibenzofuran	8.8 U	8.3 U	93 U	38 U	40 U	39 U	8.6 U	9.3 U	9 U
Diethyl Phthalate (DEP)	9.8 U	9.2 U	100 U	42 U	44 U	44 U	9.5 U	10 U	9.9 U
Dimethyl Phthalate	9.9 U	9.3 U	100 U	42 U	44 U	44 U	9.7 U	10 U	10 U
Di-n-butyl Phthalate (DBP)	22 U	21 U	240 U	96 U	100 U	100 UJ	22 U	24 U	23 U
Di-n-octyl Phthalate	8.8 U	8.3 U	93 U	38 U	40 U	39 U	8.6 U	9.3 U	9 U
Dinoseb	8.8 U	8.3 U	93 UJ	38 UJ	40 UJ	39 UJ	8.6 U	9.3 U	9 UJ
Ethyl Methane Sulfonate (EMS)	10 U	9.7 U	110 U	44 U	46 U	46 U	10 U	11 U	10 U
Hexachloro-1,3-butadiene	9 U	8.5 U	95 U	38 U	40 U	40 U	8.8 U	9.4 U	9.1 U
Hexachlorobenzene	10 U	9.5 U	110 U	43 U	45 U	45 U	9.8 U	11 U	10 U
Hexachlorocyclopentadiene	4.9 U	4.6 U	52 U	21 U	22 U	22 U	4.8 U	5.1 U	5 U
Hexachloroethane	7.7 U	7.2 U	81 U	33 U	34 U	34 U	7.5 U	8 U	7.8 U
Hexachlorophene	3200 U	3000 U	33000 UJ	14000 UJ	14000 UJ	14000 UJ	3100 U	3300 U	3200 UJ
Hexachloropropene	7 U	6.6 U	74 U	30 U	31 U	31 U	6.8 U	7.3 U	7.1 U

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB25-00	59SB26-00	59SB27-00	59SB28-00	59SB29-00	59SB30-00	59SB31-00	59SB32-00	59SB33-00
Sample Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Semivolatile Organics (µg/kg) (cont.)									
Isophorone	9.2 U	8.7 U	98 U	39 U	41 U	41 U	9 U	9.7 U	9.4 U
Isosafrole	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
Methapyrilene	88 UJ	83 UJ	930 UJ	380 UJ	400 UJ	390 UJ	86 UJ	93 UJ	90 UJ
Methyl Methane Sulfonate	5 UJ	4.7 UJ	53 UJ	21 UJ	22 UJ	22 UJ	4.9 UJ	5.3 UJ	5.1 UJ
Nitrobenzene	8.7 U	8.2 U	92 U	37 U	39 U	39 U	8.5 U	9.1 U	8.8 U
N-Nitro-o-toluidine	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
n-Nitrosodiethylamine	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
n-Nitrosodimethylamine (NDMA)	25 U	24 U	270 U	110 U	110 U	110 U	25 U	26 U	25 U
n-Nitroso-di-n-butylamine	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
n-Nitrosodi-n-propylamine	9.9 U	9.3 U	100 U	42 U	44 U	44 U	9.7 U	10 U	10 U
n-Nitrosodiphenylamine	8.1 U	7.6 U	85 U	34 U	36 U	36 U	7.9 U	8.4 U	8.2 U
n-Nitrosomethylethylamine	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
n-Nitrosomorpholine	5.9 U	5.6 U	63 U	25 U	27 U	27 U	5.8 U	6.2 U	6 U
n-Nitrosopiperidine	4.5 U	4.2 U	47 U	19 U	20 U	20 U	4.4 U	4.7 U	4.6 U
n-Nitrosopyrrolidine	4.8 U	4.5 U	50 U	20 U	21 U	21 U	4.6 U	5 U	4.8 U
o-Toluidine	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
p-Dimethylamino azobenzene	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
Pentachlorobenzene	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
Pentachloronitrobenzene	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
Pentachlorophenol	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
Phenacetin	22 U	21 U	240 U	96 U	100 U	100 U	22 U	24 U	23 U
Phenol	8.6 U	8.1 U	91 U	37 U	38 U	38 U	8.4 U	9 U	8.7 U
p-Phenylene diamine	1100 U	1000 U	12000 UJ	4700 UJ	4900 UJ	4900 UJ	1100 U	1100 U	1100 UJ
Pronamide	5.5 U	5.2 U	59 U	24 U	25 U	25 U	5.4 U	5.8 U	5.6 U
Pyridine	26 U	25 U	280 U	110 U	120 U	120 U	26 U	28 U	27 U
Safrole	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
PAHs (µg/kg)									
2-Methylnaphthalene	4.4 U	4.1 U	46 U	19 U	20 U	19 U	6.4 J	4.6 U	4.4 U
Acenaphthene	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
Acenaphthylene	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
Anthracene	4.4 U	4.1 U	46 U	19 U	20 U	19 UJ	4.3 U	4.6 U	4.4 U
Benzo(a)anthracene	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
Benzo(a)pyrene (BaP)	4.4 U	4.1 U	46 U	19 U	20 U	19 UJ	4.3 U	4.6 U	4.4 U

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SUMMARY OF ANALYTICAL RESULTS - SURFACE SOIL
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB25-00	59SB26-00	59SB27-00	59SB28-00	59SB29-00	59SB30-00	59SB31-00	59SB32-00	59SB33-00
Sample Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
PAHSs (µg/kg) (cont.)									
Benzo(b)fluoranthene	4.4 U	4.1 U	46 U	19 U	20 U	19 UJ	4.3 U	4.6 U	4.4 U
Benzo(g,h,i)perylene	4.4 U	4.1 U	46 U	19 U	20 U	19 UJ	4.3 U	4.6 U	4.4 U
Benzo(k)fluoranthene	4.4 U	4.1 U	46 U	19 U	20 U	19 UJ	4.3 U	4.6 U	4.4 U
Chrysene	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
Dibenz(a,h)anthracene	8.8 U	8.3 U	93 U	38 U	40 U	39 UJ	8.6 U	9.3 U	9 U
Fluoranthene	4.4 U	4.1 U	46 U	19 U	20 U	19 UJ	4.3 U	4.6 U	4.4 U
Fluorene	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
Indeno(1,2,3-cd)pyrene	4.4 U	4.1 U	46 UJ	19 UJ	20 UJ	19 UJ	4.3 U	4.6 U	4.4 UJ
Naphthalene	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
Phenanthrene	8.8 U	8.3 U	93 U	38 U	40 U	39 UJ	6 J	9.3 U	9 U
Pyrene	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U	4.6 U	4.4 U
Pesticides (µg/kg)									
4,4'-DDD	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aldrin	NA	NA	NA	NA	NA	NA	NA	NA	NA
BHC, alpha-	NA	NA	NA	NA	NA	NA	NA	NA	NA
BHC, beta-	NA	NA	NA	NA	NA	NA	NA	NA	NA
BHC, delta-	NA	NA	NA	NA	NA	NA	NA	NA	NA
BHC, gamma- (Lindane)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chlordane, alpha-	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chlordane, gamma-	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzilate	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dieldrin	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan I	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan II	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan Sulfate	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endrin	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endrin Aldehyde	NA	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor	NA	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor Epoxide	NA	NA	NA	NA	NA	NA	NA	NA	NA
Isodrin	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kepone (Chlordecone)	NA	NA	NA	NA	NA	NA	NA	NA	NA

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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB25-00	59SB26-00	59SB27-00	59SB28-00	59SB29-00	59SB30-00	59SB31-00	59SB32-00	59SB33-00
Sample Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Pesticides (µg/kg)									
Methoxychlor	NA	NA	NA	NA	NA	NA	NA	NA	NA
Toxaphene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Metals (mg/kg)									
Antimony	0.64 U	0.62 U	0.69 U	0.57 U	0.6 U	0.59 U	0.64 U	0.69 U	0.66 U
Arsenic	1.3	0.69	0.84	0.46	0.9	1	0.82	1.7	1.4
Barium	160	110	100	24	160	130	99	91	130
Beryllium	0.28	0.38	0.097	0.11	0.22	0.26	0.37	0.33	0.18
Cadmium	0.47	0.075	0.1	0.062	0.11	0.071	0.11	0.047 J	0.12
Chromium	61	47	71	33	36	32	51	73	150
Cobalt	25 J	36 J	22 J	14 J	15 J	17 J	19 J	6 J	20 J
Copper	71	100	50	66	130	83	99	120	110
Lead	12 R	3 R	1.4 R	1.8 R	2.7 R	4.4 R	3.2 R	6.9 R	4.7 R
Mercury	0.069	0.0098 U	0.011 U	0.0093 U	0.014 J	0.017 J	0.01 U	0.038	0.012 U
Nickel	30	30	33	17	17	16	23	15	47
Selenium	0.74	0.31 U	0.35 U	0.29 U	0.3 U	0.47 J	0.32 U	1.2	0.33 U
Silver	0.15	0.062 U	0.069 U	0.057 U	0.06 U	0.059 U	0.064 U	0.35	0.066 U
Thallium	0.043 J	0.031 U	0.035 U	0.029 U	0.03 U	0.073 J	0.032 U	0.035 U	0.033 U
Tin	3.3 U	3.1 U	3.5 U	2.9 U	3 U	3 U	3.3 U	3.5 U	3.4 U
Vanadium	180	140	230	110	140	170	240	240	330
Zinc	73	76	42	44	68	50	78	46	57

Notes:

J - Estimated: The analyte was positively identified; the quantitation is an estimation.
U - Non detected at the Reporting Limit/Limit of Detection
UJ - Reported quantitation limit is qualified as estimated.
R - Rejected data; data is not usable.
ft bgs - feet below ground surface
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram
NA - Not Analyzed
PAHs - Polynuclear Aromatic Hydrocarbons

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SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB06	59SB07	59SB08	59SB09	59SB11	59SB12	59SB13	59SB14	59SB15
Sample ID	59SB01-00	59SB02-00	59SB03-00	59SB04-00	59SB06-00	59SB07-00	59SB08-00	59SB09-00	59SB11-00	59SB12-00	59SB13-00	59SB14-00	59SB15-00
Sample Date	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	5/18/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Volatile Organics (µg/kg)													
1,1,1,2-Tetrachloroethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
1,1,1-Trichloroethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
1,1,2,2-Tetrachloroethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
1,1,2-Trichloroethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
1,1-Dichloroethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
1,1-Dichloroethene	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
1,2,3-Trichloropropane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dibromo-3-chloropropane (DBCP)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
1,2-Dibromoethane (EDB)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
1,2-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloroethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
1,2-Dichloroethene (trans)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
1,2-Dichloropropane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
1,3-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Dichloropropene (cis)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
1,3-Dichloropropene (trans)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
1,4-Dichloro-2-butene (trans)	22 U	21 U	16 U	15 U	18 U	17 U	15 U	19 U	17 U	18 U	19 U	18 U	18 U
1,4-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dioxane (p-)	280 R	260 R	210 R	190 R	220 R	210 R	190 R	240 R	210 R	220 R	240 R	230 R	230 R
2-Butanone (MEK)	14 UJ	13 UJ	10 UJ	9.4 UJ	11 UJ	11 UJ	9.6 UJ	12 UJ	14 U	16 U	12 U	11 U	11 U
2-Chloro-1,3-butadiene (Chloroprene)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
2-Hexanone (MBK)	14 UJ	13 UJ	10 UJ	9.4 UJ	11 UJ	11 UJ	9.6 UJ	12 UJ	11 U	4.8 J	12 U	11 U	11 U
3-Chloropropene (Allyl Chloride)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
4-Methyl-2-pentanone (MIBK)	14 UJ	13 UJ	10 UJ	9.4 UJ	11 UJ	11 UJ	9.6 UJ	12 UJ	11 U	11 U	12 U	11 U	11 U
Acetone	14 UJ	15 UJ	24 J	25 J	17 UJ	91 J	9.6 UJ	37 J	64	110 J	16 U	14 U	59 J
Acetonitrile	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
Acrolein	56 R	53 R	41 R	38 R	45 R	43 R	38 R	47 R	43 R	45 R	47 R	45 R	46 R
Acrylonitrile	56 U	53 U	41 U	38 U	45 U	43 U	38 U	47 U	43 U	3.4 J	47 U	45 U	46 U
Benzene	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4 U	0.37 J	4.7 U	4.5 U	0.73 J
Bromodichloromethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
Bromoform	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
Bromomethane	5.6 UJ	5.3 UJ	4.1 UJ	3.8 UJ	4.5 UJ	4.3 UJ	3.8 UJ	4.7 UJ	6.3	2.4 J	4.7 U	4.5 U	4.6 U
Carbon Disulfide	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	0.52 J	4.7 U	4.5 U	4.6 U
Carbon Tetrachloride	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
Chlorobenzene	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
Chloroethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 UJ	4.5 UJ	4.7 U	4.5 UJ	4.6 UJ
Chloroform	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
Chloromethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	0.99 J	0.39 J	4.7 U	4.5 U	4.6 U
Dibromochloromethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U

APPENDIX O

SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB06	59SB07	59SB08	59SB09	59SB11	59SB12	59SB13	59SB14	59SB15
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Sample Date	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	5/18/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Volatile Organics (µg/kg) (cont.)													
Dibromomethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
Ethyl Methacrylate	56 U	53 U	41 U	38 U	45 U	43 U	38 U	47 U	43 U	45 U	47 U	45 U	46 U
Ethylbenzene	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
Freon 11 (Trichlorofluoromethane)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
Freon-12 (Dichlorodifluoromethane)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
Hexachlorobutadiene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Isobutyl Alcohol	280 R	260 R	210 R	190 R	220 R	210 R	190 R	240 R	210 R	220 R	240 R	230 R	230 R
Methyl Acrylonitrile	56 U	53 U	41 U	38 U	45 U	43 U	38 U	47 U	43 U	3.3 J	47 U	45 U	46 U
Methyl Iodide	5.6 U	0.97 J	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	12	1.9 J	4.7 U	4.5 U	4.6 U
Methyl Methacrylate	56 R	53 R	41 R	38 R	45 R	43 R	38 R	47 R	43 R	45 R	47 R	45 R	46 R
Methylene Chloride	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
Pentachloroethane	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
Propionitrile (Ethyl Cyanide)	280 R	260 R	210 R	190 R	220 R	210 R	8.1 J	240 R	210 R	220 R	240 R	230 R	230 R
Styrene (Ethenylbenzene)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
Tetrachloroethene (PCE)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
Toluene	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
Trichloroethene (TCE)	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
Vinyl Acetate	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
Vinyl Chloride	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
Xylene, m/p-	11 U	0.32 J	8.2 U	0.15 J	9 U	8.5 U	0.14 J	9.5 U	8.5 U	8.9 U	9.5 U	9.1 U	9.2 U
Xylene, o-	5.6 U	5.3 U	4.1 U	3.8 U	4.5 U	4.3 U	3.8 U	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
Xylenes, total	5.6 U	0.32 J	4.1 U	0.15 J	4.5 U	4.3 U	0.14 J	4.7 U	4.3 U	4.5 U	4.7 U	4.5 U	4.6 U
Semivolatile Organics (µg/kg)													
1,2,4,5-Tetrachlorobenzene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
1,2,4-Trichlorobenzene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
1,2-Dichlorobenzene (o-)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
1,3,5-Trinitrobenzene (TNB)	240 UJ	220 UJ	190 UJ	200 UJ	190 UJ	200 UJ	200 UJ	200 UJ	200 UJ	190 UJ	210 U	210 UJ	190 UJ
1,3-Dichlorobenzene (m-)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
1,3-Dinitrobenzene (m-)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
1,4-Dichlorobenzene (p-)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
1,4-Naphthoquinone	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
1,4-Phenylenediamine	2400 R	2200 R	1900 R	2000 R	1900 R	2000 R	2000 R	2000 R	2000 R	1900 R	2100 R	2100 R	1900 R
1-Naphthylamine	240 U	220 R	190 U	200 UJ	190 UJ	200 UJ	200 UJ	200 UJ	200 UJ	190 UJ	210 UJ	210 UJ	190 UJ
2,2'-Oxybis[1-chloropropane]	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
2,3,4,6-Tetrachlorophenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ	410 U	410 UJ	370 UJ
2,4,5-Trichlorophenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ	410 U	410 UJ	370 UJ
2,4,6-Trichlorophenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ	410 U	410 UJ	370 UJ
2,4-Dichlorophenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ	410 U	410 UJ	370 UJ
2,4-Dimethylphenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ	410 U	410 UJ	370 UJ

APPENDIX O

SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB06	59SB07	59SB08	59SB09	59SB11	59SB12	59SB13	59SB14	59SB15
Sample ID	59SB01-00	59SB02-00	59SB03-00	59SB04-00	59SB06-00	59SB07-00	59SB08-00	59SB09-00	59SB11-00	59SB12-00	59SB13-00	59SB14-00	59SB15-00
Sample Date	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	5/18/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Semivolatile Organics (µg/kg) (cont.)													
2,4-Dinitrophenol	460 UJ	430 UJ	360 UJ	390 UJ	370 UJ	390 UJ	390 UJ	380 UJ	380 UJ	370 UJ	410 U	410 UJ	370 UJ
2,4-Dinitrotoluene (DNT)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
2,6-Dichlorophenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ	410 U	410 UJ	370 UJ
2,6-Dinitrotoluene (DNT)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
2-Acetylaminofluorene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
2-Chloronaphthalene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
2-Chlorophenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ	410 U	410 UJ	370 UJ
2-Methyl-5-nitroaniline	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
2-Methylphenol (o-Cresol)	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ	410 U	410 UJ	370 UJ
2-Naphthylamine	240 U	220 R	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
2-Nitroaniline	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
2-Nitrophenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ	410 U	410 UJ	370 UJ
2-Picoline	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
3,3'-Dichlorobenzidine	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
3,3'-Dimethylbenzidine	240 U	220 R	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
3-Methylcholanthrene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
3-Methylphenol (m-Cresol)	350 U	320 U	270 U	290 U	280 U	290 U	290 U	290 U	290 UJ	280 UJ	310 U	310 UJ	280 UJ
3 & 4 Methylphenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3-Nitroaniline	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
4,6-Dinitro-2-methylphenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ	410 U	410 UJ	370 UJ
4-Aminobiphenyl	240 U	220 R	190 UJ	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
4-Bromophenyl-phenylether	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
4-Chloro-3-methylphenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ	410 U	410 UJ	370 UJ
4-Chloroaniline	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
4-Chlorophenyl-phenylether	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
4-Dimethylaminoazobenzene (p-)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
4-Methylphenol (p-Cresol)	350 U	320 U	270 U	290 U	280 U	290 U	290 U	290 U	290 UJ	280 UJ	310 U	310 UJ	280 UJ
4-Nitroaniline	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
4-Nitrophenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ	410 U	410 UJ	370 UJ
4-Nitroquinoline-1-oxide	240 UJ	220 U	190 UJ	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
7,12-Dimethylbenz(a)anthracene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
a,a-Dimethylphenethylamine	460 UJ	430 UJ	360 UJ	390 UJ	370 UJ	390 UJ	390 UJ	380 UJ	540 UJ	520 UJ	590 U	580 UJ	520 UJ
Acetophenone	120 U	110 U	93 U	100 U	94 U	100 U	100 U	98 U	98 UJ	94 UJ	110 U	100 UJ	94 UJ
Aniline	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
Aramite	240 UJ	220 U	190 UJ	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
Benzyl Alcohol	240 UJ	220 UJ	190 UJ	200 UJ	190 UJ	200 UJ	200 UJ	200 UJ	200 UJ	190 UJ	210 U	210 UJ	190 UJ
Bis(2-chloroethoxy)methane	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
Bis(2-chloroethyl)ether	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
Bis(2-ethylhexyl) Phthalate (BEHP)	630 J	240	190 U	200 U	190 U	48 J	200	200 U	200 UJ	190 UJ	210 U	210 UJ	470 J
Butyl Benzyl Phthalate	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	170 J

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SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB06	59SB07	59SB08	59SB09	59SB11	59SB12	59SB13	59SB14	59SB15
Sample ID	59SB01-00	59SB02-00	59SB03-00	59SB04-00	59SB06-00	59SB07-00	59SB08-00	59SB09-00	59SB11-00	59SB12-00	59SB13-00	59SB14-00	59SB15-00
Sample Date	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	5/18/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Semivolatile Organics (µg/kg) (cont.)													
Diallate (cis)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
Diallate (trans)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
Diallate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzofuran	240 U	220 U	190 U	750	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
Diethyl Phthalate (DEP)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
Dimethyl Phthalate	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
Di-n-butyl Phthalate (DBP)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
Di-n-octyl Phthalate	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
Dinoseb	NA	NA	NA	NA	NA	NA	NA	NA	200 UJ	190 UJ	210 U	210 UJ	190 UJ
Ethyl Methane Sulfonate (EMS)	240 UJ	220 UJ	190 UJ	200 UJ	190 UJ	200 UJ	200 UJ	200 UJ	200 UJ	190 UJ	210 UJ	210 UJ	190 UJ
Hexachloro-1,3-butadiene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
Hexachlorobenzene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
Hexachlorocyclopentadiene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
Hexachloroethane	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
Hexachlorophene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloropropene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
Isophorone	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
Isosafrole	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
Methapyrilene	240 UJ	220 R	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 R	210 UJ	190 UJ
Methyl Methane Sulfonate	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
Nitrobenzene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
N-Nitro-o-toluidine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Nitrosodiethylamine	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
n-Nitrosodimethylamine (NDMA)	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
n-Nitroso-di-n-butylamine	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 UJ	210 UJ	190 UJ
n-Nitrosodi-n-propylamine	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
n-Nitrosodiphenylamine	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
n-Nitrosomethylethylamine	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
n-Nitrosomorpholine	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
n-Nitrosopiperidine	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
n-Nitrosopyrrolidine	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
o-Toluidine	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
p-Dimethylamino azobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorobenzene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
Pentachloronitrobenzene	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
Pentachlorophenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ	410 U	410 UJ	370 UJ
Phenacetin	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
Phenol	460 U	430 U	360 U	390 U	370 U	390 U	390 U	380 U	380 UJ	370 UJ	410 U	410 UJ	370 UJ
p-Phenylene diamine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pronamide	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ

APPENDIX O

SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB06	59SB07	59SB08	59SB09	59SB11	59SB12	59SB13	59SB14	59SB15
Sample ID	59SB01-00	59SB02-00	59SB03-00	59SB04-00	59SB06-00	59SB07-00	59SB08-00	59SB09-00	59SB11-00	59SB12-00	59SB13-00	59SB14-00	59SB15-00
Sample Date	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	5/18/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Semivolatile Organics (µg/kg) (cont.)													
Pyridine	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
Safrole	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
PAHs (µg/kg)													
2-Methylnaphthalene	1.2 J	11 UJ	9.1 UJ	31 J	9.2 UJ	9.8 UJ	9.8 U	9.5 UJ	9.5 UJ	9.2 UJ	10 U	10 UJ	1.2 J
Acenaphthene	12 U	0.82 J	9.1 U	480	9.2 U	9.8 U	9.8 U	1.5 J	9.5 UJ	9.2 UJ	10 U	10 UJ	9.2 UJ
Acenaphthylene	12 U	11 U	9.1 U	27	9.2 U	9.8 U	9.8 U	16	9.5 UJ	9.2 UJ	10 U	10 UJ	1.7 J
Anthracene	11 U	2.3 J	9.1 U	690	0.57 J	0.82 J	0.64 J	12	0.6 J	2.2 J	10 U	10 UJ	3.8 J
Benzo(a)anthracene	3.9 J	5.8 J	0.91 J	84 J	1.8 J	0.72 J	1.4 J	46	1.1 J	9.6 J	10 U	10 UJ	22 J
Benzo(a)pyrene (BaP)	2.5 J	4.1 J	0.89 J	390	9.2 U	0.8 J	0.84 J	57	9.5 UJ	11 J	10 U	10 UJ	9.2 UJ
Benzo(b)fluoranthene	2.5 J	3.7 J	0.99 J	750	9.2 U	1.2 J	0.86 J	51	1.3 J	9.9 J	10 U	10 UJ	9.2 UJ
Benzo(g,h,i)perylene	2 J	2.5 J	9.1 UJ	220	1.3 J	1.5 J	9.8 UJ	53 J	0.53 J	9.2 UJ	10 U	10 UJ	9.2 UJ
Benzo(k)fluoranthene	2.6 J	5 J	1.2 J	730	9.2 UJ	0.78 J	0.91 J	62 J	0.75 J	9.8 J	10 U	10 UJ	9.2 UJ
Chrysene	3.7 J	3.9 J	0.77 J	1200	1.4 J	0.78 J	1.4 J	39	1.4 J	9.9 J	10 U	10 UJ	32 J
Dibenz(a,h)anthracene	0.92 J	11 U	9.1 U	92	9.2 U	9.8 U	9.8 UJ	9.5 U	9.5 UJ	9.2 UJ	10 U	10 UJ	9.2 UJ
Fluoranthene	6.9 J	11	9.1 U	4600	1.8 J	9.8 U	3.1 J	68	2.3 J	16 J	10 U	10 UJ	15 J
Fluorene	0.82 J	0.73 J	9.1 U	580	9.2 U	9.8 U	9.8 U	1.1 J	9.5 UJ	0.63 J	10 U	10 UJ	9.2 UJ
Indeno(1,2,3-cd)pyrene	3 J	3.6 J	9.1 UJ	240	1.8 J	9.8 UJ	9.8 UJ	65 J	9.5 UJ	9.2 UJ	10 U	10 UJ	9.2 UJ
Naphthalene	12 U	11 U	9.1 U	9.8 U	9.2 U	9.8 U	9.8 U	9.5 U	9.5 UJ	0.92 J	10 U	1.4 J	2.2 J
Phenanthrene	8.1 J	8.2 J	9.1 U	7000	1.5 J	9.8 U	3.4 J	28	9.5 UJ	9.2 UJ	10 U	10 UJ	9.2 UJ
Pyrene	6.5 J	8.3 J	1 J	3000	1.6 J	1.2 J	2.9 J	66	9.5 UJ	18 J	10 U	10 UJ	81 J
Pesticides (µg/kg)													
4,4'-DDD	4.6 UJ	0.6 J	0.79 J	3.9 UJ	3.7 U	3.9 U	3.9 UJ	2.4 J	19 UJ	3.7 U	4.1 UJ	4.1 U	8.1 J
4,4'-DDE	4.6 UJ	0.48 J	4.5	3.9 UJ	0.46 J	0.67 J	3.9 UJ	53	19 UJ	3.7 U	4.1 UJ	4.1 U	160
4,4'-DDT	4.6 UJ	4.3 U	3.2 J	3.9 UJ	3.7 U	0.66 J	3.9 UJ	15	19 UJ	0.85 J	4.1 UJ	4.1 U	160
Aldrin	2.4 UJ	2.2 U	1.8 U	2 UJ	1.9 U	2 U	2 UJ	1.9 U	9.7 UJ	1.9 U	2.1 UJ	2.1 U	19 U
BHC, alpha-	2.4 UJ	2.2 U	1.8 U	2 UJ	1.9 U	2 U	2 UJ	1.9 U	9.7 UJ	1.9 U	2.1 UJ	2.1 U	19 U
BHC, beta-	2.4 UJ	2.2 U	0.47 J	2.4 R	1.9 U	0.57 J	2 UJ	1.9 U	4.8 UJ	0.95 U	0.63 NJ	1.1 U	8.6 NJ
BHC, delta-	2.4 UJ	2.2 U	1.8 U	2 UJ	1.9 U	2 U	2 UJ	1.9 U	9.7 UJ	1.9 U	2.1 UJ	2.1 U	19 U
BHC, gamma- (Lindane)	2.4 UJ	2.2 U	1.8 U	2 UJ	1.9 U	2 U	2 UJ	1.9 U	9.7 UJ	1.9 U	2.1 UJ	2.1 U	19 U
Chlordane, alpha-	2.4 UJ	2.2 U	1.2 J	1.1 J	1.9 U	1.2 J	2 UJ	1.9 U	1.3 NJ	0.25 J	2.1 UJ	2.1 U	19 U
Chlordane, gamma-	2.4 UJ	2.2 U	1.8 U	2 UJ	0.57 J	2 U	2 UJ	1.9 U	9.7 UJ	1.9 U	2.1 UJ	2.1 U	3.5 J
Chlorobenzilate	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
Dieldrin	4.6 UJ	4.3 U	3.6 U	3.9 UJ	3.7 U	3.9 U	3.9 UJ	3.8 U	19 UJ	3.7 U	4.1 UJ	4.1 U	37 U
Endosulfan I	2.4 UJ	2.2 U	1.8 U	2 UJ	1.9 U	2 U	2 UJ	1.9 U	9.7 UJ	1.9 U	2.1 UJ	2.1 U	19 U
Endosulfan II	4.6 UJ	4.3 U	3.6 U	3.9 UJ	3.7 U	3.9 U	3.9 UJ	3.8 U	19 UJ	3.7 U	4.1 UJ	4.1 U	37 U
Endosulfan Sulfate	4.6 UJ	4.3 U	3.6 U	0.72 J	3.7 U	3.9 U	3.9 UJ	0.61 J	19 UJ	0.52 J	4.1 UJ	4.1 U	37 U
Endrin	4.6 UJ	4.3 U	3.6 U	3.9 UJ	3.7 U	3.9 U	3.9 UJ	3.8 U	19 UJ	3.7 U	4.1 UJ	4.1 U	37 U
Endrin Aldehyde	4.6 R	4.3 R	3.6 R	3.9 R	3.7 R	3.9 R	3.9 R	1.8 J	19 UJ	3.7 U	4.1 UJ	4.1 U	37 U

APPENDIX O

SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB06	59SB07	59SB08	59SB09	59SB11	59SB12	59SB13	59SB14	59SB15
Sample ID	59SB01-00	59SB02-00	59SB03-00	59SB04-00	59SB06-00	59SB07-00	59SB08-00	59SB09-00	59SB11-00	59SB12-00	59SB13-00	59SB14-00	59SB15-00
Sample Date	4/19/2010	4/20/2010	4/19/2010	4/22/2010	4/20/2010	4/21/2010	4/21/2010	4/22/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	5/18/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Pesticides (µg/kg) (cont.)													
Heptachlor	2.4 UJ	2.2 U	1.8 U	2 UJ	1.9 U	2 U	2 UJ	1.9 U	9.7 UJ	1.9 U	2.1 UJ	2.1 U	19 U
Heptachlor Epoxide	2.4 UJ	2.2 U	1.8 U	2 UJ	1.9 U	2 U	2 UJ	1.9 U	9.7 UJ	1.9 U	2.1 UJ	2.1 U	19 U
Isodrin	240 U	220 U	190 U	200 U	190 U	200 U	200 U	200 U	200 UJ	190 UJ	210 U	210 UJ	190 UJ
Kepone (Chlordecone)	240 UJ	220 UJ	190 UJ	200 UJ	190 UJ	200 UJ	200 UJ	200 UJ	200 R	190 R	210 U	210 R	1900 R
Methoxychlor	24 UJ	22 U	18 U	20 UJ	19 U	20 U	20 UJ	19 U	26 NJ	19 U	21 UJ	21 U	190 U
Toxaphene	120 UJ	110 U	90 U	98 UJ	92 U	98 U	98 UJ	94 U	470 UJ	92 U	100 UJ	100 U	920 U
Metals (mg/kg)													
Antimony	6.5 UJ	1.3 UJ	1.1 UJ	1.1 UJ	1.1 UJ	1.1 UJ	1.2 UJ	1.2 J	5.7 UJ	0.77 J	0.29 J	5.9 UJ	8.5 J
Arsenic	1.2	0.81	0.78	0.57 U	0.53 U	1.4	0.58 U	0.89	2.8 U	0.69	0.63 U	2.9 U	5.5
Barium	184 J	40.2 J	90.2 J	155 J	87.3 J	42.9 J	267 J	154 J	36.6	81.5	33.4	122	145
Beryllium	0.34 J	0.41 J	0.14 J	0.26 J	0.21 J	0.21 J	0.36 J	0.2 J	2.8 U	0.23 J	0.23 J	2.9 U	0.31 J
Cadmium	0.071 J	0.93	0.5 J	0.087 J	0.35 J	0.31 J	1.3	2	0.25 J	0.8	0.15 J	0.34 J	2.6
Chromium	31 J	41.9 J	24.3 J	5.3 J	41.6 J	40.7 J	19 J	45.6 J	25.9 J	15.7 J	7.4	45.7 J	32.5 J
Cobalt	10.4 J	27.1 J	25.9 J	18.4 J	20.2 J	26.4 J	19.2 J	26.9 J	25.5	14.1	20.2 J	45.2	15.6
Copper	96.8 J	84.7 J	106 J	24.8 J	91.7 J	126 J	41.5 J	237 J	107	81.3	94.9 J	291	120
Lead	17 J	31 J	51.3 J	3.4 J	10.5 J	27.3 J	2.6 J	654 J	8.7 J	47.4	5.2	3.5	638
Mercury	0.05	0.017 J	0.02 J	0.014 J	0.015 J	0.009 J	0.014 J	0.081	0.017 J	0.095	0.041 U	0.041 U	0.053
Nickel	6.1	13.5	22.3	7.9	14.1	26.8	11	27.5	11.7	12	6.6	20.7	13.1
Selenium	16.3 U	1.1 J	0.21 J	0.22 J	0.36 J	0.46 J	0.57 J	0.47 J	14.2 U	0.5 J	0.27 J	14.7 U	0.61 J
Silver	3.3 U	0.65 U	0.53 U	0.57 U	0.53 U	0.57 U	0.58 U	2.6	2.8 U	0.55 U	0.093 J	2.9 U	0.55 U
Thallium	3.3 U	0.65 U	0.53 U	0.57 U	0.53 U	0.57 U	0.58 U	0.56 U	2.8 U	0.032 J	0.05 J	2.9 U	0.065 J
Tin	3 J	5.7 J	6.3	3.8 J	3.8 J	5.6 J	3.3 J	36.5	5.7 U	8.5	6.3 UJ	5.9 U	10.5
Vanadium	260 J	226 J	118 J	91.7 J	132 J	157 J	72.8 J	191 J	169	84.3	129 J	249	94.9
Zinc	34.1 J	57 J	101 J	62.3 J	77.9 J	82.4 J	80.5 J	468 J	64.5	232	58.6	123	747

APPENDIX O

SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB17	59SB18	59SB20	59SB21	59SB22	59SB23	59SB01	59SB01	59SB02	59SB02	59SB03	59SB03
Sample ID	59SB17-00	59SB18-00	59SB20-00	59SB21-00	59SB22-00	59SB23-00	59SB01-01	59SB01-03	59SB02-01	59SB02-04	59SB03-01	59SB03-04
Sample Date	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	4/19/2010	4/19/2010	4/20/2010	4/20/2010	4/19/2010	4/19/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	1.0 - 3.0	5.0 - 7.0	1.0 - 3.0	7.0 - 9.0	1.0 - 3.0	7.0 - 9.0
Volatile Organics (µg/kg)												
1,1,1,2-Tetrachloroethane	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
1,1,1-Trichloroethane	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
1,1,2,2-Tetrachloroethane	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
1,1,2-Trichloroethane	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
1,1-Dichloroethane	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
1,1-Dichloroethene	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
1,2,3-Trichloropropane	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dibromo-3-chloropropane (DBCP)	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
1,2-Dibromoethane (EDB)	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
1,2-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloroethane	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
1,2-Dichloroethene (trans)	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
1,2-Dichloropropane	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
1,3-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Dichloropropene (cis)	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
1,3-Dichloropropene (trans)	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
1,4-Dichloro-2-butene (trans)	18 U	17 U	16 U	18 U	16 U	18 U	21 U	24 U	21 UJ	24 U	20 U	18 U
1,4-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dioxane (p-)	220 R	210 R	200 R	220 R	200 R	220 R	270 R	300 R	260 R	300 R	250 R	230 R
2-Butanone (MEK)	11 U	11 U	10 U	11 U	10 U	11 U	13 U	15 U	13 U	15 U	12 U	11 U
2-Chloro-1,3-butadiene (Chloroprene)	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
2-Hexanone (MBK)	11 U	11 U	10 U	11 U	10 U	11 U	13 U	15 U	13 UJ	15 U	12 U	11 U
3-Chloropropene (Allyl Chloride)	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
4-Methyl-2-pentanone (MIBK)	11 U	11 U	10 U	11 U	10 U	11 U	13 U	15 U	13 U	15 U	12 U	11 U
Acetone	72	34	31	190	97	38	13 U	15 U	150	15 U	12 U	11 U
Acetonitrile	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
Acrolein	45 R	42 R	41 R	45 R	40 R	44 R	54 R	60 R	52 R	59 R	50 R	46 R
Acrylonitrile	45 U	42 U	41 U	45 U	40 U	44 U	54 U	60 U	52 U	59 U	50 U	46 U
Benzene	4.5 U	0.53 J	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	0.4 J	5.9 U	5 U	4.6 U
Bromodichloromethane	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
Bromoform	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	35	5 U	4.6 U
Bromomethane	4.5 U	4.2 U	4.1 U	4.5 U	4 U	3.4 J	5.4 U	6 U	1.4 J	5.9 U	5 U	4.6 U
Carbon Disulfide	1 J	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
Carbon Tetrachloride	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
Chlorobenzene	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
Chloroethane	4.5 UJ	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
Chloroform	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
Chloromethane	4.5 U	4.2 U	4.1 U	0.35 J	0.52 J	0.47 J	5.4 U	6 U	1.1 J	5.9 U	5 U	4.6 U
Dibromochloromethane	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	0.9 J	5 U	4.6 U

APPENDIX O

SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB17	59SB18	59SB20	59SB21	59SB22	59SB23	59SB01	59SB01	59SB02	59SB02	59SB03	59SB03
Sample ID	59SB17-00	59SB18-00	59SB20-00	59SB21-00	59SB22-00	59SB23-00	59SB01-01	59SB01-03	59SB02-01	59SB02-04	59SB03-01	59SB03-04
Sample Date	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	4/19/2010	4/19/2010	4/20/2010	4/20/2010	4/19/2010	4/19/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	1.0 - 3.0	5.0 - 7.0	1.0 - 3.0	7.0 - 9.0	1.0 - 3.0	7.0 - 9.0
Volatile Organics (µg/kg) (cont.)												
Dibromomethane	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 UJ	5.9 U	5 U	4.6 U
Ethyl Methacrylate	45 U	42 U	41 U	45 U	40 U	44 U	54 U	60 U	52 U	59 U	50 U	46 U
Ethylbenzene	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
Freon 11 (Trichlorofluoromethane)	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
Freon-12 (Dichlorodifluoromethane)	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
Hexachlorobutadiene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Isobutyl Alcohol	220 R	210 R	200 R	220 R	200 R	220 R	270 R	300 R	260 R	300 R	250 R	230 R
Methyl Acrylonitrile	45 U	42 U	41 U	45 U	40 U	44 U	54 U	60 U	52 U	59 U	50 U	46 U
Methyl Iodide	4.5 U	4.2 U	4.1 U	4.5 U	4 U	2.6 J	5.4 U	6 U	30 J	5.9 U	5 U	4.6 U
Methyl Methacrylate	45 R	42 R	41 R	45 R	40 R	44 R	54 R	60 R	52 R	59 R	50 R	46 R
Methylene Chloride	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
Pentachloroethane	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
Propionitrile (Ethyl Cyanide)	220 R	210 R	200 R	220 R	200 R	220 R	270 R	300 R	260 R	300 R	250 R	230 R
Styrene (Ethenylbenzene)	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
Tetrachloroethene (PCE)	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
Toluene	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
Trichloroethene (TCE)	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
Vinyl Acetate	4.5 U	4.2 U	4.1 UJ	4.5 UJ	4 UJ	4.4 UJ	5.4 U	6 U	5.2 UJ	5.9 U	5 U	4.6 U
Vinyl Chloride	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
Xylene, m/p-	8.9 U	8.4 U	8.1 U	8.9 U	8 U	8.8 U	0.19 J	12 U	0.19 J	12 U	9.9 U	0.2 J
Xylene, o-	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	5.4 U	6 U	5.2 U	5.9 U	5 U	4.6 U
Xylenes, total	4.5 U	4.2 U	4.1 U	4.5 U	4 U	4.4 U	0.19 J	6 U	0.19 J	5.9 U	5 U	0.2 J
Semivolatile Organics (µg/kg)												
1,2,4,5-Tetrachlorobenzene	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
1,2,4-Trichlorobenzene	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
1,2-Dichlorobenzene (o-)	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
1,3,5-Trinitrobenzene (TNB)	200 UJ	200 U	180 U	200 U	200 U	210 U	250 UJ	250 UJ	220 UJ	240 UJ	200 UJ	200 UJ
1,3-Dichlorobenzene (m-)	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
1,3-Dinitrobenzene (m-)	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
1,4-Dichlorobenzene (p-)	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
1,4-Naphthoquinone	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
1,4-Phenylenediamine	2000 R	2000 R	1800 R	2000 R	2000 R	2100 R	2500 R	2500 R	2200 R	2400 R	2000 R	2000 R
1-Naphthylamine	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
2,2'-Oxybis[1-chloropropane]	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
2,3,4,6-Tetrachlorophenol	390 UJ	380 U	360 U	380 U	390 U	410 U	480 U	480 U	430 U	470 U	400 U	390 U
2,4,5-Trichlorophenol	390 UJ	380 U	360 U	380 U	390 U	410 U	480 U	480 U	430 U	470 U	400 U	390 U
2,4,6-Trichlorophenol	390 UJ	380 U	360 U	380 U	390 U	410 U	480 U	480 U	430 U	470 U	400 U	390 U
2,4-Dichlorophenol	390 UJ	380 U	360 U	380 U	390 U	410 U	480 U	480 U	430 U	470 U	400 U	390 U
2,4-Dimethylphenol	390 UJ	380 U	360 U	380 U	390 U	410 U	480 U	480 U	430 U	470 U	400 U	390 U

APPENDIX O

SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB17	59SB18	59SB20	59SB21	59SB22	59SB23	59SB01	59SB01	59SB02	59SB02	59SB03	59SB03
Sample ID	59SB17-00	59SB18-00	59SB20-00	59SB21-00	59SB22-00	59SB23-00	59SB01-01	59SB01-03	59SB02-01	59SB02-04	59SB03-01	59SB03-04
Sample Date	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	4/19/2010	4/19/2010	4/20/2010	4/20/2010	4/19/2010	4/19/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	1.0 - 3.0	5.0 - 7.0	1.0 - 3.0	7.0 - 9.0	1.0 - 3.0	7.0 - 9.0
Semivolatile Organics (µg/kg) (cont.)												
2,4-Dinitrophenol	390 UJ	380 U	360 U	380 U	390 U	410 U	480 UJ	480 UJ	430 UJ	470 UJ	400 UJ	390 UJ
2,4-Dinitrotoluene (DNT)	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
2,6-Dichlorophenol	390 UJ	380 U	360 U	380 U	390 U	410 U	480 U	480 U	430 U	470 U	400 U	390 U
2,6-Dinitrotoluene (DNT)	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
2-Acetylaminofluorene	200 UJ	200 UJ	180 UJ	200 U	200 UJ	210 U	250 U	250 U	220 U	240 U	200 U	200 U
2-Chloronaphthalene	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
2-Chlorophenol	390 UJ	380 U	360 U	380 U	390 U	410 U	480 U	480 U	430 U	470 U	400 U	390 U
2-Methyl-5-nitroaniline	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
2-Methylphenol (o-Cresol)	390 UJ	380 U	360 U	380 U	390 U	410 U	480 U	480 U	430 U	470 U	400 U	390 U
2-Naphthylamine	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
2-Nitroaniline	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
2-Nitrophenol	390 UJ	380 U	360 U	380 U	390 U	410 U	480 U	480 U	430 U	470 U	400 U	390 U
2-Picoline	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
3,3'-Dichlorobenzidine	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
3,3'-Dimethylbenzidine	200 UJ	200 UJ	180 UJ	200 U	200 UJ	210 U	250 U	250 U	220 U	240 U	200 U	200 U
3-Methylcholanthrene	200 UJ	200 UJ	180 UJ	200 U	200 UJ	210 U	250 U	250 U	220 U	240 U	200 U	200 U
3-Methylphenol (m-Cresol)	300 UJ	290 U	270 U	290 U	290 U	310 U	370 U	370 U	320 U	360 U	300 U	290 U
3 & 4 Methylphenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3-Nitroaniline	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
4,6-Dinitro-2-methylphenol	390 UJ	380 U	360 U	380 U	390 U	410 U	480 U	480 U	430 U	470 U	400 U	390 U
4-Aminobiphenyl	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
4-Bromophenyl-phenylether	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
4-Chloro-3-methylphenol	390 UJ	380 U	360 U	380 U	390 U	410 U	480 U	480 U	430 U	470 U	400 U	390 U
4-Chloroaniline	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
4-Chlorophenyl-phenylether	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
4-Dimethylaminoazobenzene (p-)	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
4-Methylphenol (p-Cresol)	300 UJ	290 U	270 U	290 U	290 U	310 U	370 U	370 U	320 U	360 U	300 U	290 U
4-Nitroaniline	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
4-Nitrophenol	390 UJ	380 U	360 U	380 U	390 U	410 U	480 U	480 U	430 U	470 U	400 U	390 U
4-Nitroquinoline-1-oxide	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
7,12-Dimethylbenz(a)anthracene	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
a,a-Dimethylphenethylamine	560 UJ	540 UJ	510 UJ	540 U	550 UJ	590 U	480 UJ	480 UJ	430 UJ	470 UJ	400 UJ	390 UJ
Acetophenone	100 UJ	98 U	92 U	98 U	100 U	110 U	120 U	120 U	110 U	120 U	100 U	100 U
Aniline	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
Aramite	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
Benzyl Alcohol	200 UJ	200 U	180 U	200 U	200 U	210 U	250 UJ	250 UJ	220 UJ	240 UJ	200 UJ	200 UJ
Bis(2-chloroethoxy)methane	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
Bis(2-chloroethyl)ether	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
Bis(2-ethylhexyl) Phthalate (BEHP)	200 UJ	200 U	180 U	200 U	200 U	53 J	250 U	250 U	220 U	240 U	200 U	200 U
Butyl Benzyl Phthalate	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U

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SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB17	59SB18	59SB20	59SB21	59SB22	59SB23	59SB01	59SB01	59SB02	59SB02	59SB03	59SB03
Sample ID	59SB17-00	59SB18-00	59SB20-00	59SB21-00	59SB22-00	59SB23-00	59SB01-01	59SB01-03	59SB02-01	59SB02-04	59SB03-01	59SB03-04
Sample Date	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	4/19/2010	4/19/2010	4/20/2010	4/20/2010	4/19/2010	4/19/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	1.0 - 3.0	5.0 - 7.0	1.0 - 3.0	7.0 - 9.0	1.0 - 3.0	7.0 - 9.0
Semivolatile Organics (µg/kg) (cont.)												
Diallate (cis)	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
Diallate (trans)	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
Diallate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzofuran	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
Diethyl Phthalate (DEP)	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
Dimethyl Phthalate	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
Di-n-butyl Phthalate (DBP)	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
Di-n-octyl Phthalate	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
Dinoseb	200 UJ	200 U	180 U	200 U	200 U	210 U	NA	NA	NA	NA	NA	NA
Ethyl Methane Sulfonate (EMS)	200 UJ	200 UJ	180 UJ	200 UJ	200 UJ	210 UJ	250 U	250 U	220 U	240 U	200 U	200 U
Hexachloro-1,3-butadiene	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
Hexachlorobenzene	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
Hexachlorocyclopentadiene	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
Hexachloroethane	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
Hexachlorophene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloropropene	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
Isophorone	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
Isosafrole	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
Methapyrilene	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
Methyl Methane Sulfonate	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
Nitrobenzene	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
N-Nitro-o-toluidine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Nitrosodiethylamine	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
n-Nitrosodimethylamine (NDMA)	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
n-Nitroso-di-n-butylamine	200 UJ	200 UJ	180 UJ	200 UJ	200 UJ	210 UJ	250 UJ	250 UJ	220 UJ	240 UJ	200 UJ	200 UJ
n-Nitrosodi-n-propylamine	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
n-Nitrosodiphenylamine	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
n-Nitrosomethylethylamine	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
n-Nitrosomorpholine	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
n-Nitrosopiperidine	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
n-Nitrosopyrrolidine	200 UJ	200 UJ	180 UJ	200 U	200 UJ	210 U	250 U	250 U	220 U	240 U	200 U	200 U
o-Toluidine	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
p-Dimethylamino azobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorobenzene	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
Pentachloronitrobenzene	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
Pentachlorophenol	390 UJ	380 U	360 U	380 U	390 U	410 U	480 U	480 U	430 U	470 U	400 U	390 U
Phenacetin	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
Phenol	390 UJ	380 U	360 U	380 U	390 U	410 U	480 U	480 U	430 U	470 U	400 U	390 U
p-Phenylene diamine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pronamide	200 UJ	200 U	180 U	200 U	200 U	210 U	480 U	480 U	430 U	470 U	400 U	390 U

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SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB17	59SB18	59SB20	59SB21	59SB22	59SB23	59SB01	59SB01	59SB02	59SB02	59SB03	59SB03
Sample ID	59SB17-00	59SB18-00	59SB20-00	59SB21-00	59SB22-00	59SB23-00	59SB01-01	59SB01-03	59SB02-01	59SB02-04	59SB03-01	59SB03-04
Sample Date	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	4/19/2010	4/19/2010	4/20/2010	4/20/2010	4/19/2010	4/19/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	1.0 - 3.0	5.0 - 7.0	1.0 - 3.0	7.0 - 9.0	1.0 - 3.0	7.0 - 9.0
Semivolatile Organics (µg/kg) (cont.)												
Pyridine	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
Safrole	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
PAHs (µg/kg)												
2-Methylnaphthalene	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U	12 UJ	12 UJ	7.9 J	12 UJ	10 UJ	9.8 UJ
Acenaphthene	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U	12 U	12 U	7.7 J	12 U	10 U	9.8 U
Acenaphthylene	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U	12 U	12 U	11 U	12 U	10 U	9.8 U
Anthracene	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U	12 U	12 U	3.1 J	12 U	10 U	9.8 U
Benzo(a)anthracene	0.87 J	9.5 U	9 U	9.5 U	9.8 U	10 U	12 U	12 U	2.3 J	12 U	10 U	9.8 U
Benzo(a)pyrene (BaP)	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U	12 U	12 U	1 J	12 U	10 U	9.8 U
Benzo(b)fluoranthene	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U	12 U	12 U	1 J	12 U	10 UJ	9.8 UJ
Benzo(g,h,i)perylene	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U	12 U	12 U	1.2 J	12 U	10 UJ	9.8 UJ
Benzo(k)fluoranthene	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U	12 UJ	12 UJ	1.5 J	12 UJ	10 U	9.8 U
Chrysene	1.2 J	1.5 J	9 U	9.5 U	9.8 U	2.3 J	12 UJ	12 UJ	2 J	12 UJ	10 UJ	9.8 UJ
Dibenz(a,h)anthracene	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U	12 U	12 U	11 U	12 U	10 U	9.8 U
Fluoranthene	9.9 UJ	1.8 J	9 U	9.5 U	9.8 U	4.6 J	12 U	12 U	8.6 J	12 U	10 U	9.8 U
Fluorene	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U	12 UJ	12 UJ	6 J	12 UJ	10 UJ	9.8 UJ
Indeno(1,2,3-cd)pyrene	9.9 UJ	9.5 U	9 U	9.5 U	9.8 U	10 U	12 UJ	12 UJ	0.77 J	12 UJ	10 UJ	9.8 UJ
Naphthalene	1.2 J	9.5 U	9 U	9.5 U	9.8 U	10 U	12 U	12 U	11 U	12 U	10 U	9.8 U
Phenanthrene	9.9 UJ	9.5 U	9 U	1.7 J	9.8 U	10 U	12 U	12 U	20 J	12 U	10 U	9.8 U
Pyrene	9.9 UJ	2.1 J	3.2 J	9.5 U	9.8 U	3.5 J	12 U	12 U	5.7 J	12 U	10 U	9.8 U
Pesticides (µg/kg)												
4,4'-DDD	3.9 U	3.8 U	3.6 U	3.8 U	3.9 U	4.1 U	4.9 U	4.9 U	4.3 U	4.7 U	4 U	3.9 U
4,4'-DDE	1.2 J	12	3.6 U	3.8 U	3.4 J	1.6 J	4.9 U	4.9 U	4.3 U	4.7 U	4 U	3.9 U
4,4'-DDT	1.7 J	2.7 J	3.6 U	3.8 U	1.2 J	2.3 J	4.9 U	4.9 U	4.3 U	4.7 U	4 U	3.9 U
Aldrin	2 U	2 U	1.8 U	2 U	2 U	2.1 U	2.5 U	2.5 U	2.2 U	2.4 U	2 U	2 U
BHC, alpha-	2 U	2 U	1.8 U	2 U	2 U	2.1 U	2.5 U	2.5 U	2.2 U	2.4 U	2 U	2 U
BHC, beta-	9.2 NJ	2 U	1.8 U	2 U	2 U	2.1 U	2.5 U	0.91 J	0.87 J	2.4 U	2 U	2 U
BHC, delta-	2 U	2 U	1.8 U	2 U	2 U	2.1 U	2.5 U	2.5 U	2.2 U	2.4 U	2 U	0.27 J
BHC, gamma- (Lindane)	2 U	2 U	1.8 U	2 U	2 U	2.1 U	2.5 U	2.5 U	2.2 U	2.4 U	2 U	2 U
Chlordane, alpha-	2 U	2 U	1.8 U	2 U	1.9 J	1.1 J	2.5 U	2.5 U	2.2 U	2.4 U	2 U	8.4
Chlordane, gamma-	2 U	2 U	1.8 U	2 U	2 U	2.1 U	2.5 U	2.5 U	2.2 U	2.4 U	2 U	2 U
Chlorobenzilate	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
Dieldrin	3.9 U	3.8 U	3.6 U	3.8 U	3.9 U	4.1 U	4.9 U	4.9 U	4.3 U	4.7 U	4 U	3.9 U
Endosulfan I	2 U	2 U	1.8 U	2 U	2 U	2.1 U	2.5 U	2.5 U	2.2 U	2.4 U	2 U	2 U
Endosulfan II	3.9 U	3.8 U	3.6 U	3.8 U	3.9 U	4.1 U	4.9 U	4.9 U	4.3 U	4.7 U	4 U	3.9 U
Endosulfan Sulfate	3.9 U	3.8 U	3.6 U	3.8 U	3.9 U	4.1 U	4.9 U	4.9 U	4.3 U	4.7 U	4 U	3.9 U
Endrin	3.9 U	3.8 U	3.6 U	3.8 U	3.9 U	4.1 U	4.9 U	4.9 U	4.3 U	4.7 U	4 U	3.9 U
Endrin Aldehyde	3.9 U	3.8 U	3.6 U	3.8 U	3.9 U	4.1 U	4.9 U	4.9 U	4.3 U	4.7 U	4 U	3.9 U

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SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB17	59SB18	59SB20	59SB21	59SB22	59SB23	59SB01	59SB01	59SB02	59SB02	59SB03	59SB03
Sample ID	59SB17-00	59SB18-00	59SB20-00	59SB21-00	59SB22-00	59SB23-00	59SB01-01	59SB01-03	59SB02-01	59SB02-04	59SB03-01	59SB03-04
Sample Date	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/19/2010	4/19/2010	4/19/2010	4/20/2010	4/20/2010	4/19/2010	4/19/2010
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	1.0 - 3.0	5.0 - 7.0	1.0 - 3.0	7.0 - 9.0	1.0 - 3.0	7.0 - 9.0
Pesticides (µg/kg) (cont.)												
Heptachlor	2 U	2 U	1.8 U	2 U	2 U	2.1 U	2.5 U	2.5 U	2.2 U	2.4 U	2 U	2 U
Heptachlor Epoxide	2 U	2 U	1.8 U	2 U	2 U	2.1 U	2.5 U	2.5 U	2.2 U	2.4 U	2 U	2 U
Isodrin	200 UJ	200 U	180 U	200 U	200 U	210 U	250 U	250 U	220 U	240 U	200 U	200 U
Kepone (Chlordecone)	200 R	200 UJ	180 UJ	200 UJ	200 UJ	210 U	250 R	250 R	220 R	240 R	200 R	200 R
Methoxychlor	20 U	20 U	18 U	20 U	20 U	21 U	25 U	25 U	22 U	24 U	20 U	20 U
Toxaphene	99 U	95 U	90 U	95 U	98 U	100 U	120 U	120 U	110 U	120 U	100 U	98 U
Metals (mg/kg)												
Antimony	5.7 UJ	0.17 J	0.88 J	5.6 UJ	5.7 UJ	0.17 J	7.1 UJ	7.3 UJ	6.5 UJ	6.9 UJ	1.2 UJ	1.2 UJ
Arsenic	2.9 U	0.29 J	2.5 U	2.8 U	2.9 U	0.71	3.5 UJ	3.6 UJ	1.3 J	3.5 UJ	0.6 UJ	0.26 J
Barium	86.7	48	104	102	107	81.6	33.3 R	16.4 R	186 R	79.2 R	62.1 R	23.7 R
Beryllium	0.29 J	0.15 J	0.62 J	0.27 J	2.9 U	0.19 J	3.5 U	3.6 U	0.47 J	0.79 J	0.24 J	0.19 J
Cadmium	2.9 U	0.26 J	0.64 J	0.26 J	0.42 J	0.35 J	3.5 U	3.6 U	0.76 J	0.26 J	0.22 J	0.22 J
Chromium	30 J	19.6	54.4	29.4	29.5	51.2	13 J	10.3 J	50.9 J	35.4 J	50.3 J	25.5 J
Cobalt	23.3	15.2 J	30.2 J	18.3 J	21.2 J	29 J	9.6 J	28.5 J	72.1 J	83.9 J	32.6 J	30.3 J
Copper	76.3	59.5 J	94.2 J	102 J	76.6 J	73.9 J	126 J	41 J	91.9 J	90.4 J	71.1 J	98.4 J
Lead	22.4	7.1	3.6	15.1	16.7	11.8	3.5 UJ	3.6 UJ	33 J	3.5 UJ	1 J	0.72 J
Mercury	0.026 J	0.038 U	0.01 J	0.009 J	0.011 J	0.041 U	0.048 U	0.005 J	0.1	0.047 U	0.04 U	0.039 U
Nickel	12.5	10.3	22.2	13.9	16.1	22.2	9.1 J	8.8 J	17.8 J	22 J	18.5 J	16.4 J
Selenium	0.86 J	0.34 J	2.4 J	13.9 U	14.3 U	0.46 J	17.7 UJ	18.2 UJ	2.6 J	17.3 UJ	0.41 J	0.3 J
Silver	2.9 U	0.1 J	0.48 J	2.8 U	2.9 U	0.14 J	3.5 U	3.6 U	0.41 J	3.5 U	0.6 U	0.58 U
Thallium	2.9 U	0.032 J	0.37 J	2.8 U	2.9 U	0.027 J	3.5 U	3.6 U	0.041 J	3.5 U	0.6 U	0.58 U
Tin	6	5.6 UJ	5.1 UJ	5.6 UJ	5.7 UJ	6.2 UJ	2.8 J	2.8 J	2 J	2.2 J	2.5 J	3.1 J
Vanadium	184	102 J	109 J	107 J	126 J	115 J	73.1 J	67.2 J	282 J	344 J	161 J	136 J
Zinc	132	59.9	81.5	87.7	77.4	52	66.8 J	87.3 J	77.3 J	105 J	63.2 J	55.6 J

APPENDIX O

SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB04	59SB04	59SB05	59SB05	59SB06	59SB06	59SB07	59SB07	59SB08	59SB08	59SB09	59SB09
Sample ID	59SB04-01	59SB04-05	59SB05-01	59SB05-05	59SB06-01	59SB06-03	59SB07-01	59SB07-05	59SB08-01	59SB08-05	59SB09-01	59SB09-05
Sample Date	4/22/2010	4/22/2010	4/20/2010	4/20/2010	4/20/2010	4/20/2010	4/21/2010	4/21/2010	4/21/2010	4/21/2010	4/22/2010	4/22/2010
Sample Depth (ft bgs)	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	5.0 - 7.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Volatile Organics (µg/kg)												
1,1,1,2-Tetrachloroethane	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
1,1,1-Trichloroethane	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
1,1,2,2-Tetrachloroethane	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
1,1,2-Trichloroethane	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
1,1-Dichloroethane	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
1,1-Dichloroethene	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
1,2,3-Trichloropropane	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dibromo-3-chloropropane (DBCP)	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
1,2-Dibromoethane (EDB)	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
1,2-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloroethane	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
1,2-Dichloroethene (trans)	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
1,2-Dichloropropane	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
1,3-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Dichloropropene (cis)	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
1,3-Dichloropropene (trans)	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
1,4-Dichloro-2-butene (trans)	22 U	17 U	15 UJ	18 UJ	18 UJ	18 UJ	18 UJ	17 UJ	15 UJ	19 UJ	16 UJ	19 UJ
1,4-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dioxane (p-)	280 R	210 R	190 R	220 R	220 R	230 R	230 R	210 R	190 R	230 R	200 R	240 R
2-Butanone (MEK)	14 UJ	11 UJ	9.6 U	11 U	11 U	12 U	11 U	10 U	9.4 U	12 U	10 U	12 U
2-Chloro-1,3-butadiene (Chloroprene)	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
2-Hexanone (MBK)	14 UJ	11 UJ	9.6 UJ	11 UJ	11 UJ	12 UJ	11 UJ	10 UJ	9.4 UJ	12 UJ	10 UJ	12 UJ
3-Chloropropene (Allyl Chloride)	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
4-Methyl-2-pentanone (MIBK)	14 UJ	11 UJ	9.6 U	11 U	11 U	12 U	11 U	10 U	9.4 U	12 U	10 U	12 U
Acetone	25 UJ	11 UJ	9.6 U	11 U	11 U	12 U	11 U	10 U	9.4 U	12 U	26	12 U
Acetonitrile	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
Acrolein	55 R	42 R	38 R	44 R	44 R	46 R	46 R	42 R	38 R	47 R	41 R	48 R
Acrylonitrile	55 U	42 U	38 U	44 U	44 U	46 U	46 U	42 U	38 U	47 U	41 U	48 U
Benzene	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
Bromodichloromethane	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
Bromoform	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
Bromomethane	5.5 UJ	4.2 UJ	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
Carbon Disulfide	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	10	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
Carbon Tetrachloride	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
Chlorobenzene	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
Chloroethane	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
Chloroform	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
Chloromethane	5.5 U	4.2 U	3.8 UJ	4.4 UJ	4.4 UJ	4.6 UJ	4.6 UJ	4.2 UJ	3.8 UJ	4.7 UJ	4.1 UJ	4.8 UJ
Dibromochloromethane	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U

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SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB04	59SB04	59SB05	59SB05	59SB06	59SB06	59SB07	59SB07	59SB08	59SB08	59SB09	59SB09
Sample ID	59SB04-01	59SB04-05	59SB05-01	59SB05-05	59SB06-01	59SB06-03	59SB07-01	59SB07-05	59SB08-01	59SB08-05	59SB09-01	59SB09-05
Sample Date	4/22/2010	4/22/2010	4/20/2010	4/20/2010	4/20/2010	4/20/2010	4/21/2010	4/21/2010	4/21/2010	4/21/2010	4/22/2010	4/22/2010
Sample Depth (ft bgs)	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	5.0 - 7.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Volatile Organics (µg/kg) (cont.)												
Dibromomethane	5.5 U	4.2 U	3.8 UJ	4.4 UJ	4.4 UJ	4.6 UJ	4.6 UJ	4.2 UJ	3.8 UJ	4.7 UJ	4.1 UJ	4.8 UJ
Ethyl Methacrylate	55 U	42 U	38 U	44 U	44 U	46 U	46 U	42 U	38 U	47 U	41 U	48 U
Ethylbenzene	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
Freon 11 (Trichlorofluoromethane)	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
Freon-12 (Dichlorodifluoromethane)	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
Hexachlorobutadiene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Isobutyl Alcohol	280 R	210 R	190 R	220 R	220 R	230 R	230 R	210 R	190 R	230 R	200 R	240 R
Methyl Acrylonitrile	55 U	42 U	38 U	44 U	44 U	46 U	46 U	42 U	38 U	47 U	41 U	48 U
Methyl Iodide	5.5 U	4.2 U	3.8 UJ	4.4 UJ	1.9 J	4.6 UJ	4.6 UJ	4.2 UJ	3.8 UJ	4.7 UJ	1.3 J	4.8 UJ
Methyl Methacrylate	55 R	42 R	38 R	44 R	44 R	46 R	46 R	42 R	38 R	47 R	41 R	48 R
Methylene Chloride	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
Pentachloroethane	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
Propionitrile (Ethyl Cyanide)	280 R	210 R	190 R	220 R	220 R	230 R	230 R	210 R	190 R	230 R	200 R	240 R
Styrene (Ethenylbenzene)	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
Tetrachloroethene (PCE)	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
Toluene	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
Trichloroethene (TCE)	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
Vinyl Acetate	5.5 U	4.2 U	3.8 UJ	4.4 UJ	4.4 UJ	4.6 UJ	4.6 UJ	4.2 UJ	3.8 UJ	4.7 UJ	4.1 UJ	4.8 UJ
Vinyl Chloride	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
Xylene, m/p-	11 U	0.15 J	0.15 J	0.24 J	0.16 J	0.13 J	0.19 J	8.4 U	0.12 J	9.4 U	0.15 J	9.7 U
Xylene, o-	5.5 U	4.2 U	3.8 U	4.4 U	4.4 U	4.6 U	4.6 U	4.2 U	3.8 U	4.7 U	4.1 U	4.8 U
Xylenes, total	5.5 U	0.15 J	0.15 J	0.24 J	0.16 J	0.13 J	0.18 J	4.2 U	0.12 J	4.7 U	0.15 J	4.8 U
Semivolatile Organics (µg/kg)												
1,2,4,5-Tetrachlorobenzene	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
1,2,4-Trichlorobenzene	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
1,2-Dichlorobenzene (o-)	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
1,3,5-Trinitrobenzene (TNB)	230 UJ	200 UJ	190 UJ	220 UJ	200 UJ	210 UJ	210 UJ	200 UJ	190 UJ	200 UJ	190 UJ	200 UJ
1,3-Dichlorobenzene (m-)	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
1,3-Dinitrobenzene (m-)	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
1,4-Dichlorobenzene (p-)	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
1,4-Naphthoquinone	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
1,4-Phenylenediamine	2300 R	2000 R	1900 R	2200 R	2000 R	2100 R	2100 R	2000 R	1900 R	2000 R	1900 R	2000 R
1-Naphthylamine	230 UJ	200 UJ	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
2,2'-Oxybis[1-chloropropane]	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
2,3,4,6-Tetrachlorophenol	440 U	400 U	370 U	420 U	380 U	410 U	410 U	390 U	370 U	390 U	360 U	390 U
2,4,5-Trichlorophenol	440 U	400 U	370 U	420 U	380 U	410 U	410 U	390 U	370 U	390 U	360 U	390 U
2,4,6-Trichlorophenol	440 U	400 U	370 U	420 U	380 U	410 U	410 U	390 U	370 U	390 U	360 U	390 U
2,4-Dichlorophenol	440 U	400 U	370 U	420 U	380 U	410 U	410 U	390 U	370 U	390 U	360 U	390 U
2,4-Dimethylphenol	440 U	400 U	370 U	420 U	380 U	410 U	410 U	390 U	370 U	390 U	360 U	390 U

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SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB04	59SB04	59SB05	59SB05	59SB06	59SB06	59SB07	59SB07	59SB08	59SB08	59SB09	59SB09
Sample ID	59SB04-01	59SB04-05	59SB05-01	59SB05-05	59SB06-01	59SB06-03	59SB07-01	59SB07-05	59SB08-01	59SB08-05	59SB09-01	59SB09-05
Sample Date	4/22/2010	4/22/2010	4/20/2010	4/20/2010	4/20/2010	4/20/2010	4/21/2010	4/21/2010	4/21/2010	4/21/2010	4/22/2010	4/22/2010
Sample Depth (ft bgs)	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	5.0 - 7.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Semivolatile Organics (µg/kg) (cont.)												
2,4-Dinitrophenol	440 UJ	400 UJ	370 UJ	420 UJ	380 UJ	410 UJ	410 UJ	390 UJ	370 UJ	390 UJ	360 UJ	390 UJ
2,4-Dinitrotoluene (DNT)	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
2,6-Dichlorophenol	440 U	400 U	370 U	420 U	380 U	410 U	410 U	390 U	370 U	390 U	360 U	390 U
2,6-Dinitrotoluene (DNT)	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
2-Acetylaminofluorene	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
2-Chloronaphthalene	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
2-Chlorophenol	440 U	400 U	370 U	420 U	380 U	410 U	410 U	390 U	370 U	390 U	360 U	390 U
2-Methyl-5-nitroaniline	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
2-Methylphenol (o-Cresol)	440 U	400 U	370 U	420 U	380 U	410 U	410 U	390 U	370 U	390 U	360 U	390 U
2-Naphthylamine	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
2-Nitroaniline	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
2-Nitrophenol	440 U	400 U	370 U	420 U	380 U	410 U	410 U	390 U	370 U	390 U	360 U	390 U
2-Picoline	230 U	200 U	190 UJ	220 UJ	200 U	210 U	210 U	200 UJ	190 UJ	200 UJ	190 UJ	200 UJ
3,3'-Dichlorobenzidine	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
3,3'-Dimethylbenzidine	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
3-Methylcholanthrene	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
3-Methylphenol (m-Cresol)	330 U	300 U	280 U	320 U	290 U	310 U	310 U	290 U	280 U	300 U	270 U	300 U
3 & 4 Methylphenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3-Nitroaniline	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
4,6-Dinitro-2-methylphenol	440 U	400 U	370 U	420 U	380 U	410 U	410 U	390 U	370 U	390 U	360 U	390 U
4-Aminobiphenyl	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
4-Bromophenyl-phenylether	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
4-Chloro-3-methylphenol	440 U	400 U	370 U	420 U	380 U	410 U	410 U	390 U	370 U	390 U	360 U	390 U
4-Chloroaniline	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
4-Chlorophenyl-phenylether	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
4-Dimethylaminoazobenzene (p-)	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
4-Methylphenol (p-Cresol)	330 U	300 U	280 U	320 U	290 U	310 U	310 U	290 U	280 U	300 U	270 U	300 U
4-Nitroaniline	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
4-Nitrophenol	440 U	400 U	370 U	420 U	380 U	410 U	410 U	390 U	370 U	390 U	360 U	390 U
4-Nitroquinoline-1-oxide	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
7,12-Dimethylbenz(a)anthracene	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
a,a-Dimethylphenethylamine	440 UJ	400 UJ	370 UJ	420 UJ	380 UJ	410 UJ	410 UJ	390 UJ	370 UJ	390 UJ	360 UJ	390 UJ
Acetophenone	110 U	100 U	94 U	110 U	99 U	110 U	100 U	100 U	96 U	100 U	93 U	100 U
Aniline	230 U	200 U	190 UJ	220 UJ	200 U	210 U	210 U	200 UJ	190 UJ	200 UJ	190 UJ	200 UJ
Aramite	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
Benzyl Alcohol	230 UJ	200 UJ	190 UJ	220 UJ	200 UJ	210 UJ	210 UJ	200 UJ	190 UJ	200 UJ	190 UJ	200 UJ
Bis(2-chloroethoxy)methane	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
Bis(2-chloroethyl)ether	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
Bis(2-ethylhexyl) Phthalate (BEHP)	230 U	230	190 U	98 J	200 U	210 U	58 J	200 U	83 J	200 U	190 U	200 U
Butyl Benzyl Phthalate	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U

APPENDIX O

SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB04	59SB04	59SB05	59SB05	59SB06	59SB06	59SB07	59SB07	59SB08	59SB08	59SB09	59SB09
Sample ID	59SB04-01	59SB04-05	59SB05-01	59SB05-05	59SB06-01	59SB06-03	59SB07-01	59SB07-05	59SB08-01	59SB08-05	59SB09-01	59SB09-05
Sample Date	4/22/2010	4/22/2010	4/20/2010	4/20/2010	4/20/2010	4/20/2010	4/21/2010	4/21/2010	4/21/2010	4/21/2010	4/22/2010	4/22/2010
Sample Depth (ft bgs)	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	5.0 - 7.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Semivolatile Organics (µg/kg) (cont.)												
Diallate (cis)	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
Diallate (trans)	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
Diallate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzofuran	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
Diethyl Phthalate (DEP)	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
Dimethyl Phthalate	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
Di-n-butyl Phthalate (DBP)	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
Di-n-octyl Phthalate	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
Dinoseb	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethyl Methane Sulfonate (EMS)	230 UJ	200 UJ	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
Hexachloro-1,3-butadiene	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
Hexachlorobenzene	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
Hexachlorocyclopentadiene	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
Hexachloroethane	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
Hexachlorophene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloropropene	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
Isophorone	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
Isosafrole	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
Methapyrilene	230 U	200 U	190 UJ	220 UJ	200 U	210 U	210 U	200 UJ	190 UJ	200 UJ	190 UJ	200 UJ
Methyl Methane Sulfonate	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
Nitrobenzene	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
N-Nitro-o-toluidine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Nitrosodiethylamine	230 U	200 U	190 UJ	220 UJ	200 U	210 U	210 U	200 UJ	190 UJ	200 UJ	190 UJ	200 UJ
n-Nitrosodimethylamine (NDMA)	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
n-Nitroso-di-n-butylamine	230 U	200 U	190 UJ	220 UJ	200 UJ	210 UJ	210 UJ	200 UJ	190 UJ	200 UJ	190 UJ	200 UJ
n-Nitrosodi-n-propylamine	230 U	200 U	190 UJ	220 UJ	200 U	210 U	210 U	200 UJ	190 UJ	200 UJ	190 UJ	200 UJ
n-Nitrosodiphenylamine	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
n-Nitrosomethylethylamine	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
n-Nitrosomorpholine	230 U	200 U	190 UJ	220 UJ	200 U	210 U	210 U	200 UJ	190 UJ	200 UJ	190 UJ	200 UJ
n-Nitrosopiperidine	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
n-Nitrosopyrrolidine	230 U	200 U	190 UJ	220 UJ	200 U	210 U	210 U	200 UJ	190 UJ	200 UJ	190 UJ	200 UJ
o-Toluidine	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
p-Dimethylamino azobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorobenzene	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
Pentachloronitrobenzene	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
Pentachlorophenol	440 U	400 U	370 U	420 U	380 U	410 U	410 U	390 U	370 U	390 U	360 U	390 U
Phenacetin	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
Phenol	440 U	400 U	370 U	420 U	380 U	410 U	410 U	390 U	370 U	390 U	360 U	390 U
p-Phenylene diamine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pronamide	230 U	200 U	370 U	420 U	380 U	410 U	410 U	390 U	370 U	390 U	360 U	390 U

APPENDIX O

SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB04	59SB04	59SB05	59SB05	59SB06	59SB06	59SB07	59SB07	59SB08	59SB08	59SB09	59SB09
Sample ID	59SB04-01	59SB04-05	59SB05-01	59SB05-05	59SB06-01	59SB06-03	59SB07-01	59SB07-05	59SB08-01	59SB08-05	59SB09-01	59SB09-05
Sample Date	4/22/2010	4/22/2010	4/20/2010	4/20/2010	4/20/2010	4/20/2010	4/21/2010	4/21/2010	4/21/2010	4/21/2010	4/22/2010	4/22/2010
Sample Depth (ft bgs)	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	5.0 - 7.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Semivolatile Organics (µg/kg) (cont.)												
Pyridine	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
Safrole	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
PAHs (µg/kg)												
2-Methylnaphthalene	11 U	10 U	0.96 J	11 UJ	9.7 UJ	10 UJ	10 UJ	9.8 UJ	9.3 UJ	9.9 UJ	9.1 UJ	9.9 UJ
Acenaphthene	11 U	10 U	9.2 U	11 U	9.7 U	10 U	10 U	9.8 U	9.3 U	9.9 U	9.1 U	9.9 U
Acenaphthylene	11 U	10 U	9.2 U	11 U	9.7 U	10 U	10 U	9.8 U	0.65 J	9.9 U	9.1 U	9.9 U
Anthracene	11 U	10 U	9.2 U	11 U	9.7 U	10 U	10 U	9.8 U	9.3 U	9.9 U	9.1 U	9.9 U
Benzo(a)anthracene	11 U	10 U	0.8 J	11 U	9.7 U	10 U	10 U	9.8 U	1.2 J	9.9 U	0.63 J	9.9 U
Benzo(a)pyrene (BaP)	11 U	10 U	0.94 J	11 U	9.7 U	10 U	10 U	9.8 U	3 J	9.9 U	0.85 J	9.9 U
Benzo(b)fluoranthene	11 U	10 U	1.2 J	11 UJ	9.7 UJ	10 UJ	10 UJ	9.8 UJ	2.8 J	9.9 UJ	0.64 J	9.9 UJ
Benzo(g,h,i)perylene	11 UJ	10 UJ	9.2 UJ	11 UJ	9.7 UJ	10 UJ	10 UJ	9.8 UJ	1.9 J	9.9 UJ	0.58 J	9.9 UJ
Benzo(k)fluoranthene	11 UJ	10 UJ	0.49 J	11 U	9.7 U	10 U	10 U	9.8 U	4.1 J	9.9 U	0.92 J	9.9 U
Chrysene	11 U	10 U	2 J	11 UJ	9.7 UJ	10 UJ	10 UJ	9.8 UJ	3 J	9.9 UJ	9.1 UJ	9.9 UJ
Dibenz(a,h)anthracene	11 UJ	10 UJ	9.2 U	11 U	9.7 U	10 U	10 U	9.8 U	0.39 J	9.9 U	9.1 U	9.9 U
Fluoranthene	11 U	10 U	9.2 U	11 U	9.7 U	10 U	10 U	9.8 U	7.3 J	9.9 U	9.1 U	9.9 U
Fluorene	11 U	10 U	9.2 UJ	11 UJ	9.7 UJ	10 UJ	10 UJ	9.8 UJ	9.3 UJ	9.9 UJ	9.1 UJ	9.9 UJ
Indeno(1,2,3-cd)pyrene	11 UJ	10 UJ	9.2 UJ	11 UJ	9.7 UJ	10 UJ	10 UJ	9.8 UJ	2.8 J	9.9 UJ	0.84 J	9.9 UJ
Naphthalene	11 U	10 U	9.2 U	11 U	9.7 U	10 U	10 U	9.8 U	9.3 U	9.9 U	9.1 U	9.9 U
Phenanthrene	11 U	10 U	1.8 J	11 U	9.7 U	10 U	10 U	9.8 U	5.6 J	9.9 U	9.1 U	9.9 U
Pyrene	11 U	10 U	1.1 J	0.92 J	9.7 U	10 U	10 U	9.8 U	6.1 J	9.9 U	9.1 U	9.9 U
Pesticides (µg/kg)												
4,4'-DDD	4.4 U	4 U	3.7 U	4.2 U	3.8 U	4.1 U	4.1 U	3.9 U	3.7 U	3.9 U	3.6 U	3.9 U
4,4'-DDE	4.4 U	4 U	3.5 J	4.2 U	3.8 U	4.1 U	4.1 U	3.9 U	3.7 U	1.6 J	3.6 U	3.9 U
4,4'-DDT	4.4 U	4 U	0.77 J	4.2 U	3.8 U	4.1 U	4.1 U	3.9 U	3.7 U	1.5 J	3.6 U	3.9 U
Aldrin	2.3 U	2 U	1.9 U	2.2 U	2 U	2.1 U	2.1 U	2 U	1.9 U	2 U	1.9 U	2 U
BHC, alpha-	2.3 U	2 U	1.9 U	2.2 U	2 U	2.1 U	2.1 U	2 U	1.9 U	2 U	1.9 U	2 U
BHC, beta-	2.3 U	0.57 J	0.84 J	2.2 U	0.88 J	2.1 U	2.1 U	2 U	1.9 U	2 U	1.9 U	2 U
BHC, delta-	2.3 U	2 U	1.9 U	2.2 U	2 U	2.1 U	2.1 U	2 U	1.9 U	2 U	1.9 U	2 U
BHC, gamma- (Lindane)	2.3 U	2 U	1.9 U	2.2 U	2 U	2.1 U	2.1 U	2 U	1.9 U	2 U	1.9 U	2 U
Chlordane, alpha-	2.3 U	2 U	1.9 U	2.2 U	2 U	2.1 U	2.1 U	2 U	1.9 U	2 U	1.9 U	2 U
Chlordane, gamma-	2.3 U	2 U	1.9 U	2.2 U	2 U	2.1 U	2.1 U	2 U	1.9 U	2 U	1.9 U	2 U
Chlorobenzilate	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
Dieldrin	4.4 U	4 U	3.7 U	4.2 U	3.8 U	4.1 U	4.1 U	3.9 U	3.7 U	3.9 U	3.6 U	3.9 U
Endosulfan I	2.3 U	2 U	1.9 U	2.2 U	2 U	2.1 U	2.1 U	2 U	1.9 U	2 U	1.9 U	2 U
Endosulfan II	4.4 U	4 U	3.7 U	4.2 U	3.8 U	4.1 U	4.1 U	3.9 U	3.7 U	3.9 U	3.6 U	3.9 U
Endosulfan Sulfate	4.4 U	4 U	3.7 U	4.2 U	3.8 U	4.1 U	4.1 U	3.9 U	3.7 U	3.9 U	3.6 U	3.9 U
Endrin	0.56 J	4 U	3.7 U	4.2 U	3.8 U	4.1 U	4.1 U	3.9 U	3.7 U	3.9 U	3.6 U	3.9 U
Endrin Aldehyde	4.4 R	4 R	0.46 J	4.2 U	3.8 U	4.1 U	4.1 U	3.9 U	3.7 U	3.9 U	3.6 U	3.9 U

APPENDIX O

SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB04	59SB04	59SB05	59SB05	59SB06	59SB06	59SB07	59SB07	59SB08	59SB08	59SB09	59SB09
Sample ID	59SB04-01	59SB04-05	59SB05-01	59SB05-05	59SB06-01	59SB06-03	59SB07-01	59SB07-05	59SB08-01	59SB08-05	59SB09-01	59SB09-05
Sample Date	4/22/2010	4/22/2010	4/20/2010	4/20/2010	4/20/2010	4/20/2010	4/21/2010	4/21/2010	4/21/2010	4/21/2010	4/22/2010	4/22/2010
Sample Depth (ft bgs)	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	5.0 - 7.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Pesticides (µg/kg) (cont.)												
Heptachlor	2.3 U	2 U	1.9 U	2.2 U	2 U	2.1 U	2.1 U	2 U	1.9 U	2 U	1.9 U	2 U
Heptachlor Epoxide	2.3 U	2 U	1.9 U	2.2 U	2 U	2.1 U	2.1 U	2 U	1.9 U	2 U	1.9 U	2 U
Isodrin	230 U	200 U	190 U	220 U	200 U	210 U	210 U	200 U	190 U	200 U	190 U	200 U
Kepone (Chlordecone)	230 UJ	200 UJ	190 R	220 R	200 R	210 R	210 R	200 R	190 R	200 R	190 R	200 R
Methoxychlor	23 U	20 U	19 U	22 U	20 U	21 U	21 U	20 U	19 U	20 U	19 U	20 U
Toxaphene	110 U	100 U	92 U	110 U	97 U	100 U	100 U	98 U	93 U	99 U	91 U	99 U
Metals (mg/kg)												
Antimony	6.5 UJ	1.2 UJ	1.1 UJ	1.2 UJ	5.8 UJ	6 UJ	6 UJ	5.9 UJ	1.1 UJ	1.2 UJ	5.3 UJ	1.2 UJ
Arsenic	3.2 U	0.41 J	1.2 J	0.61 UJ	2.9 UJ	1.6 J	3 UJ	2.9 UJ	0.19 J	0.58 UJ	2.7 UJ	0.6 UJ
Barium	229 J	25.3 J	69.9 R	21 R	151 R	23.6 R	173 R	54 R	149 R	171 R	127 R	184 R
Beryllium	3.2 U	0.28 J	0.3 J	0.21 J	2.9 U	3 U	0.27 J	0.26 J	0.38 J	0.36 J	2.7 U	0.13 J
Cadmium	0.75 J	0.5 J	0.34 J	0.4 J	0.22 J	3 U	0.35 J	2.9 U	0.62	5	0.31 J	0.39 J
Chromium	63.5 J	9.6 J	17.2 J	86.2 J	46.4 J	37.4 J	73.5 J	41.4 J	16.2 J	14.6 J	59.5 J	40.6 J
Cobalt	53.4 J	16.7 J	15.9 J	25.1 J	17.5 J	4.3 J	28.8 J	24 J	13 J	21.7 J	32.6 J	32.8 J
Copper	217 J	88.1 J	82.6 J	164 J	77.7 J	64.7 J	74.3 J	194 J	5.1 J	49.3 J	77.6 J	66.9 J
Lead	3.2 UJ	1.3 J	14.1 J	3.6 J	5.3 J	21.3 J	4.7 J	2.9 UJ	1.8 J	2.4 J	3 J	2.5 J
Mercury	0.009 J	0.04 U	0.014 J	0.042 U	0.038 U	0.15	0.04 U	0.039 U	0.037 U	0.039 U	0.016 J	0.017 J
Nickel	20.7	7.1	10.8 J	28.8 J	16.3 J	4.7 J	27.9 J	18 J	8.7 J	8.8 J	27.9 J	24 J
Selenium	16.2 U	0.3 J	0.48 J	0.46 J	14.5 UJ	2.1 J	0.48 J	14.7 UJ	0.56 J	0.3 J	13.3 UJ	0.34 J
Silver	3.2 U	0.6 U	0.56 U	0.61 U	2.9 U	3 U	3 U	2.9 U	0.55 U	0.58 U	2.7 U	0.6 U
Thallium	3.2 U	0.6 U	0.036 J	0.61 U	2.9 U	3 U	3 U	2.9 U	0.029 J	0.58 U	2.7 U	0.027 J
Tin	2.7 J	2.6 J	2.8 J	2.3 J	2.3 J	2.3 J	2.6 J	3 J	1.9 J	2.8 J	2.7 J	3.3 J
Vanadium	138 J	123 J	85.1 J	188 J	146 J	245 J	151 J	56.8 J	73.6 J	81 J	190 J	153 J
Zinc	242 J	87.8 J	49.5 J	140 J	61.9 J	35.2 J	78.6 J	88.4 J	90.6 J	114 J	75.4 J	61.3 J

APPENDIX O

SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB10	59SB10	59SB11	59SB11	59SB12	59SB12	59SB13	59SB13	59SB14	59SB14	59SB15	59SB15
Sample ID	59SB10-01	59SB10-05	59SB11-01	59SB11-02	59SB12-01	59SB12-05	59SB13-01	59SB13-05	59SB14-01	59SB14-05	59SB15-01	59SB15-05
Sample Date	4/21/2010	4/21/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010
Sample Depth (ft bgs)	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	3.0 - 5.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Volatile Organics (µg/kg)												
1,1,1,2-Tetrachloroethane	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
1,1,1-Trichloroethane	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
1,1,2,2-Tetrachloroethane	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
1,1,2-Trichloroethane	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
1,1-Dichloroethane	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
1,1-Dichloroethene	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
1,2,3-Trichloropropane	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dibromo-3-chloropropane (DBCP)	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
1,2-Dibromoethane (EDB)	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
1,2-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloroethane	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
1,2-Dichloroethene (trans)	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
1,2-Dichloropropane	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
1,3-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Dichloropropene (cis)	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
1,3-Dichloropropene (trans)	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
1,4-Dichloro-2-butene (trans)	19 UJ	20 UJ	16 U	19 U	22 U	20 U	19 U	18 U	18 U	22 U	20 U	19 U
1,4-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dioxane (p-)	240 R	250 R	200 R	230 R	270 R	250 R	240 R	230 R	230 R	280 R	250 R	240 R
2-Butanone (MEK)	12 U	13 U	10 U	12 U	14 U	12 U	12 U	11 U	11 U	14 U	12 U	12 U
2-Chloro-1,3-butadiene (Chloroprene)	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
2-Hexanone (MBK)	12 UJ	13 UJ	10 U	12 U	14 U	12 U	12 U	11 U	11 U	14 U	12 U	12 U
3-Chloropropene (Allyl Chloride)	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
4-Methyl-2-pentanone (MIBK)	12 U	13 U	10 U	12 U	14 U	12 U	12 U	11 U	11 U	14 U	12 U	12 U
Acetone	12 U	13 U	11 U	15 U	27 U	12 U	19 U	11 U	19 U	14 U	13 U	12 U
Acetonitrile	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
Acrolein	47 R	50 R	40 R	47 R	54 R	50 R	48 R	46 R	46 R	55 R	50 R	48 R
Acrylonitrile	47 U	50 U	40 U	47 U	54 U	50 U	48 U	46 U	46 U	55 U	50 U	48 U
Benzene	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
Bromodichloromethane	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
Bromoform	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
Bromomethane	4.7 U	5 U	1.2 J	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
Carbon Disulfide	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	0.76 J	4.6 U	4.6 U	5.5 U	5 U	4.8 U
Carbon Tetrachloride	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
Chlorobenzene	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
Chloroethane	4.7 U	5 U	4 UJ	4.7 U	5.4 UJ	5 UJ	4.8 U	4.6 U	4.6 UJ	5.5 UJ	5 UJ	4.8 UJ
Chloroform	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
Chloromethane	4.7 UJ	5 UJ	4 U	4.7 U	0.37 J	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
Dibromochloromethane	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U

APPENDIX O

SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB10	59SB10	59SB11	59SB11	59SB12	59SB12	59SB13	59SB13	59SB14	59SB14	59SB15	59SB15
Sample ID	59SB10-01	59SB10-05	59SB11-01	59SB11-02	59SB12-01	59SB12-05	59SB13-01	59SB13-05	59SB14-01	59SB14-05	59SB15-01	59SB15-05
Sample Date	4/21/2010	4/21/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010
Sample Depth (ft bgs)	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	3.0 - 5.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Volatile Organics (µg/kg) (cont.)												
Dibromomethane	4.7 UJ	5 UJ	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
Ethyl Methacrylate	47 U	50 U	40 U	47 U	54 U	50 U	48 U	46 U	46 U	55 U	50 U	48 U
Ethylbenzene	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
Freon 11 (Trichlorofluoromethane)	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
Freon-12 (Dichlorodifluoromethane)	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
Hexachlorobutadiene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Isobutyl Alcohol	240 R	250 R	200 R	230 R	270 R	250 R	240 R	230 R	230 R	280 R	250 R	240 R
Methyl Acrylonitrile	47 U	50 U	40 U	47 U	54 U	50 U	48 U	46 U	46 U	55 U	50 U	48 U
Methyl Iodide	4.7 UJ	5 UJ	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
Methyl Methacrylate	47 R	50 R	40 R	47 R	54 R	50 R	48 R	46 R	46 R	55 R	50 R	48 R
Methylene Chloride	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
Pentachloroethane	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
Propionitrile (Ethyl Cyanide)	240 R	250 R	200 R	230 R	270 R	250 R	240 R	230 R	230 R	280 R	250 R	240 R
Styrene (Ethenylbenzene)	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
Tetrachloroethene (PCE)	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
Toluene	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
Trichloroethene (TCE)	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
Vinyl Acetate	4.7 UJ	5 UJ	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
Vinyl Chloride	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
Xylene, m/p-	0.14 J	10 U	8 U	9.4 U	11 U	9.9 U	9.7 U	9.1 U	9.2 U	11 U	9.9 U	9.7 U
Xylene, o-	4.7 U	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
Xylenes, total	0.14 J	5 U	4 U	4.7 U	5.4 U	5 U	4.8 U	4.6 U	4.6 U	5.5 U	5 U	4.8 U
Semivolatile Organics (µg/kg)												
1,2,4,5-Tetrachlorobenzene	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
1,2,4-Trichlorobenzene	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
1,2-Dichlorobenzene (o-)	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
1,3,5-Trinitrobenzene (TNB)	220 UJ	230 UJ	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
1,3-Dichlorobenzene (m-)	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
1,3-Dinitrobenzene (m-)	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
1,4-Dichlorobenzene (p-)	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
1,4-Naphthoquinone	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
1,4-Phenylenediamine	2200 R	2300 R	2000 R	2000 R	2100 R	2300 R	2200 R	2300 R	2200 R	2400 R	1900 R	2000 R
1-Naphthylamine	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 UJ	230 U	220 UJ	240 UJ	190 UJ	200 UJ
2,2'-Oxybis[1-chloropropane]	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
2,3,4,6-Tetrachlorophenol	430 U	440 U	390 UJ	400 UJ	400 UJ	440 UJ	420 U	450 U	420 UJ	470 UJ	370 UJ	400 UJ
2,4,5-Trichlorophenol	430 U	440 U	390 UJ	400 UJ	400 UJ	440 UJ	420 U	450 U	420 UJ	470 UJ	370 UJ	400 UJ
2,4,6-Trichlorophenol	430 U	440 U	390 UJ	400 UJ	400 UJ	440 UJ	420 U	450 U	420 UJ	470 UJ	370 UJ	400 UJ
2,4-Dichlorophenol	430 U	440 U	390 UJ	400 UJ	400 UJ	440 UJ	420 U	450 U	420 UJ	470 UJ	370 UJ	400 UJ
2,4-Dimethylphenol	430 U	440 U	390 UJ	400 UJ	400 UJ	440 UJ	420 U	450 U	420 UJ	470 UJ	370 UJ	400 UJ

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SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB10	59SB10	59SB11	59SB11	59SB12	59SB12	59SB13	59SB13	59SB14	59SB14	59SB15	59SB15
Sample ID	59SB10-01	59SB10-05	59SB11-01	59SB11-02	59SB12-01	59SB12-05	59SB13-01	59SB13-05	59SB14-01	59SB14-05	59SB15-01	59SB15-05
Sample Date	4/21/2010	4/21/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010
Sample Depth (ft bgs)	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	3.0 - 5.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Semivolatile Organics (µg/kg) (cont.)												
2,4-Dinitrophenol	430 UJ	440 UJ	390 UJ	400 UJ	400 UJ	440 UJ	420 U	450 U	420 UJ	470 UJ	370 UJ	400 UJ
2,4-Dinitrotoluene (DNT)	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
2,6-Dichlorophenol	430 U	440 U	390 UJ	400 UJ	400 UJ	440 UJ	420 U	450 U	420 UJ	470 UJ	370 UJ	400 UJ
2,6-Dinitrotoluene (DNT)	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
2-Acetylaminofluorene	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
2-Chloronaphthalene	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
2-Chlorophenol	430 U	440 U	390 UJ	400 UJ	400 UJ	440 UJ	420 U	450 U	420 UJ	470 UJ	370 UJ	400 UJ
2-Methyl-5-nitroaniline	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
2-Methylphenol (o-Cresol)	430 U	440 U	390 UJ	400 UJ	400 UJ	440 UJ	420 UJ	450 UJ	420 UJ	470 UJ	370 UJ	400 UJ
2-Naphthylamine	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
2-Nitroaniline	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
2-Nitrophenol	430 U	440 U	390 UJ	400 UJ	400 UJ	440 UJ	420 U	450 U	420 UJ	470 UJ	370 UJ	400 UJ
2-Picoline	220 UJ	230 UJ	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
3,3'-Dichlorobenzidine	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
3,3'-Dimethylbenzidine	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
3-Methylcholanthrene	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
3-Methylphenol (m-Cresol)	330 U	340 U	290 UJ	300 UJ	300 UJ	330 UJ	320 U	340 U	320 UJ	360 UJ	280 UJ	300 UJ
3 & 4 Methylphenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3-Nitroaniline	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
4,6-Dinitro-2-methylphenol	430 U	440 U	390 UJ	400 UJ	400 UJ	440 UJ	420 U	450 U	420 UJ	470 UJ	370 UJ	400 UJ
4-Aminobiphenyl	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
4-Bromophenyl-phenylether	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
4-Chloro-3-methylphenol	430 U	440 U	390 UJ	400 UJ	400 UJ	440 UJ	420 U	450 U	420 UJ	470 UJ	370 UJ	400 UJ
4-Chloroaniline	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
4-Chlorophenyl-phenylether	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
4-Dimethylaminoazobenzene (p-)	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
4-Methylphenol (p-Cresol)	330 U	340 U	290 UJ	300 UJ	300 UJ	330 UJ	320 U	340 U	320 UJ	360 UJ	280 UJ	300 UJ
4-Nitroaniline	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
4-Nitrophenol	430 U	440 U	390 UJ	400 UJ	400 UJ	440 UJ	420 U	450 U	420 UJ	470 UJ	370 UJ	400 UJ
4-Nitroquinoline-1-oxide	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
7,12-Dimethylbenz(a)anthracene	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 UJ	220 UJ	240 UJ	190 UJ	200 UJ
a,a-Dimethylphenethylamine	430 UJ	440 UJ	550 UJ	570 UJ	570 UJ	630 UJ	590 UJ	640 U	600 UJ	670 UJ	530 UJ	570 UJ
Acetophenone	110 U	110 U	100 UJ	100 UJ	100 UJ	110 UJ	110 U	120 U	110 UJ	120 UJ	96 UJ	100 UJ
Aniline	220 UJ	230 UJ	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
Aramite	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
Benzyl Alcohol	220 UJ	230 UJ	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
Bis(2-chloroethoxy)methane	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
Bis(2-chloroethyl)ether	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
Bis(2-ethylhexyl) Phthalate (BEHP)	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
Butyl Benzyl Phthalate	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ

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SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB10	59SB10	59SB11	59SB11	59SB12	59SB12	59SB13	59SB13	59SB14	59SB14	59SB15	59SB15
Sample ID	59SB10-01	59SB10-05	59SB11-01	59SB11-02	59SB12-01	59SB12-05	59SB13-01	59SB13-05	59SB14-01	59SB14-05	59SB15-01	59SB15-05
Sample Date	4/21/2010	4/21/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010
Sample Depth (ft bgs)	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	3.0 - 5.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Semivolatile Organics (µg/kg) (cont.)												
Diallate (cis)	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
Diallate (trans)	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 UJ	230 UJ	220 UJ	240 UJ	190 UJ	200 UJ
Diallate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzofuran	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
Diethyl Phthalate (DEP)	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
Dimethyl Phthalate	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
Di-n-butyl Phthalate (DBP)	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
Di-n-octyl Phthalate	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
Dinoseb	NA	NA	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
Ethyl Methane Sulfonate (EMS)	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
Hexachloro-1,3-butadiene	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
Hexachlorobenzene	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
Hexachlorocyclopentadiene	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
Hexachloroethane	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
Hexachlorophene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloropropene	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
Isophorone	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
Isosafrole	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
Methapyrilene	220 UJ	230 UJ	200 R	200 UJ	210 UJ	230 UJ	220 R	230 U	220 UJ	240 UJ	190 UJ	200 UJ
Methyl Methane Sulfonate	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
Nitrobenzene	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
N-Nitro-o-toluidine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Nitrosodiethylamine	220 UJ	230 UJ	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
n-Nitrosodimethylamine (NDMA)	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
n-Nitroso-di-n-butylamine	220 UJ	230 UJ	200 UJ	200 UJ	210 UJ	230 UJ	220 UJ	230 UJ	220 UJ	240 UJ	190 UJ	200 UJ
n-Nitrosodi-n-propylamine	220 UJ	230 UJ	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
n-Nitrosodiphenylamine	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
n-Nitrosomethylethylamine	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
n-Nitrosomorpholine	220 UJ	230 UJ	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
n-Nitrosopiperidine	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
n-Nitrosopyrrolidine	220 UJ	230 UJ	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
o-Toluidine	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
p-Dimethylamino azobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorobenzene	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
Pentachloronitrobenzene	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
Pentachlorophenol	430 U	440 U	390 UJ	400 UJ	400 UJ	440 UJ	420 U	450 U	420 UJ	470 UJ	370 UJ	400 UJ
Phenacetin	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
Phenol	430 U	440 U	390 UJ	400 UJ	400 UJ	440 UJ	420 U	450 U	420 UJ	470 UJ	370 UJ	400 UJ
p-Phenylene diamine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pronamide	430 U	440 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ

APPENDIX O

SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB10	59SB10	59SB11	59SB11	59SB12	59SB12	59SB13	59SB13	59SB14	59SB14	59SB15	59SB15
Sample ID	59SB10-01	59SB10-05	59SB11-01	59SB11-02	59SB12-01	59SB12-05	59SB13-01	59SB13-05	59SB14-01	59SB14-05	59SB15-01	59SB15-05
Sample Date	4/21/2010	4/21/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010
Sample Depth (ft bgs)	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	3.0 - 5.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Semivolatile Organics (µg/kg) (cont.)												
Pyridine	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
Safrole	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
PAHs (µg/kg)												
2-Methylnaphthalene	11 UJ	11 UJ	9.8 UJ	10 UJ	10 UJ	11 UJ	11 U	11 U	11 UJ	12 UJ	9.3 UJ	10 UJ
Acenaphthene	11 U	11 U	9.8 UJ	10 UJ	10 UJ	11 UJ	11 U	11 U	11 UJ	12 UJ	9.3 UJ	10 UJ
Acenaphthylene	11 U	11 U	9.8 UJ	10 UJ	10 UJ	11 UJ	11 U	11 U	11 UJ	12 UJ	9.3 UJ	10 UJ
Anthracene	11 U	11 U	9.8 UJ	10 UJ	10 UJ	11 UJ	11 UJ	11 UJ	11 UJ	12 UJ	9.3 UJ	10 UJ
Benzo(a)anthracene	11 U	11 U	9.8 UJ	4.7 J	10 UJ	11 UJ	11 U	11 U	11 UJ	12 UJ	9.3 UJ	0.75 J
Benzo(a)pyrene (BaP)	11 U	11 U	9.8 UJ	10 UJ	10 UJ	11 UJ	11 U	11 U	11 UJ	12 UJ	9.3 UJ	10 UJ
Benzo(b)fluoranthene	11 U	11 UJ	9.8 UJ	10 UJ	10 UJ	11 UJ	11 U	11 UJ	11 UJ	12 UJ	9.3 UJ	10 UJ
Benzo(g,h,i)perylene	11 UJ	11 UJ	9.8 UJ	10 UJ	10 UJ	11 UJ	11 U	11 UJ	11 UJ	12 UJ	9.3 UJ	10 UJ
Benzo(k)fluoranthene	11 U	11 U	9.8 UJ	10 UJ	10 UJ	11 UJ	11 U	11 UJ	11 UJ	12 UJ	9.3 UJ	10 UJ
Chrysene	11 UJ	11 UJ	9.8 UJ	16 J	10 UJ	11 UJ	11 U	11 U	11 UJ	12 UJ	9.3 UJ	1 J
Dibenz(a,h)anthracene	11 U	11 U	9.8 UJ	10 UJ	10 UJ	11 UJ	11 U	11 U	11 UJ	12 UJ	9.3 UJ	10 UJ
Fluoranthene	11 U	11 U	9.8 UJ	1.7 J	10 UJ	11 UJ	11 U	11 U	11 UJ	12 UJ	9.3 UJ	10 UJ
Fluorene	11 U	11 UJ	9.8 UJ	10 UJ	10 UJ	11 UJ	11 U	11 U	11 UJ	12 UJ	9.3 UJ	10 UJ
Indeno(1,2,3-cd)pyrene	11 UJ	11 UJ	9.8 UJ	10 UJ	10 UJ	11 UJ	11 U	11 U	11 UJ	12 UJ	9.3 UJ	10 UJ
Naphthalene	11 U	11 U	9.8 UJ	10 UJ	10 UJ	1.2 J	11 U	11 U	11 UJ	12 UJ	9.3 UJ	10 UJ
Phenanthrene	11 U	11 U	9.8 UJ	10 UJ	10 UJ	11 UJ	11 U	11 U	11 UJ	12 UJ	9.3 UJ	10 UJ
Pyrene	11 U	11 U	9.8 UJ	21 J	10 UJ	11 UJ	11 U	11 UJ	11 UJ	12 UJ	9.3 UJ	10 UJ
Pesticides (µg/kg)												
4,4'-DDD	4.3 U	4.5 U	3.9 U	4 UJ	4 U	4.4 U	4.2 U	4.5 U	4.2 U	4.7 U	3.7 U	4 U
4,4'-DDE	4.3 U	4.5 U	3.9 U	4 UJ	4 U	4.4 U	4.2 U	4.5 U	4.2 U	4.7 U	0.66 J	4 U
4,4'-DDT	4.3 U	4.5 U	3.9 U	4 UJ	4 U	4.4 U	4.2 U	4.5 U	4.2 U	4.7 U	3.7 U	4 U
Aldrin	2.2 U	2.3 U	2 U	2 UJ	2.1 U	2.3 U	2.2 U	2.3 U	2.2 U	2.4 U	1.9 U	2 U
BHC, alpha-	2.2 U	2.3 U	2 U	2 UJ	2.1 U	2.3 U	2.2 U	2.3 U	2.2 U	2.4 U	1.9 U	2 U
BHC, beta-	2.2 U	2.3 U	1 U	1 UJ	1 U	12 NJ	1.1 U	1.2 U	1.1 U	1.2 U	8.9 NJ	1 U
BHC, delta-	2.2 U	2.3 U	2 U	2 UJ	2.1 U	2.3 U	2.2 U	2.3 U	2.2 U	2.4 U	1.9 U	2 U
BHC, gamma- (Lindane)	2.2 U	2.3 U	2 U	2 UJ	2.1 U	2.3 U	2.2 U	2.3 U	2.2 U	2.4 U	1.9 U	2 U
Chlordane, alpha-	2.2 U	2.3 U	2 U	2 UJ	2.1 U	2.3 U	2.2 U	2.3 U	2.2 U	2.4 U	1.9 U	2 U
Chlordane, gamma-	2.2 U	2.3 U	2 U	2 UJ	2.1 U	2.3 U	2.2 U	2.3 U	2.2 U	2.4 U	1.9 U	2 U
Chlorobenzilate	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
Dieldrin	4.3 U	4.5 U	3.9 U	4 UJ	4 U	4.4 U	4.2 U	4.5 U	4.2 U	4.7 U	3.7 U	4 U
Endosulfan I	2.2 U	2.3 U	2 U	2 UJ	2.1 U	2.3 U	2.2 U	2.3 U	2.2 U	2.4 U	1.9 U	2 U
Endosulfan II	4.3 U	4.5 U	3.9 U	4 UJ	4 U	4.4 U	4.2 U	4.5 U	4.2 U	4.7 U	3.7 U	4 U
Endosulfan Sulfate	4.3 U	4.5 U	3.9 U	4 UJ	4 U	4.4 U	4.2 U	4.5 U	4.2 U	4.7 U	3.7 U	4 U
Endrin	4.3 U	4.5 U	3.9 U	4 UJ	4 U	4.4 U	4.2 U	4.5 U	4.2 U	4.7 U	3.7 U	4 U
Endrin Aldehyde	0.54 J	4.5 U	3.9 U	4 UJ	4 U	4.4 U	4.2 U	4.5 U	4.2 U	4.7 U	3.7 U	4 U

APPENDIX O

SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB10	59SB10	59SB11	59SB11	59SB12	59SB12	59SB13	59SB13	59SB14	59SB14	59SB15	59SB15
Sample ID	59SB10-01	59SB10-05	59SB11-01	59SB11-02	59SB12-01	59SB12-05	59SB13-01	59SB13-05	59SB14-01	59SB14-05	59SB15-01	59SB15-05
Sample Date	4/21/2010	4/21/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010
Sample Depth (ft bgs)	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	3.0 - 5.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Pesticides (µg/kg) (cont.)												
Heptachlor	2.2 U	2.3 U	2 U	2 UJ	2.1 U	2.3 U	0.22 J	2.3 U	2.2 U	2.4 U	1.9 U	2 U
Heptachlor Epoxide	2.2 U	2.3 U	2 U	2 UJ	2.1 U	2.3 U	2.2 U	2.3 U	2.2 U	2.4 U	1.9 U	2 U
Isodrin	220 U	230 U	200 UJ	200 UJ	210 UJ	230 UJ	220 U	230 U	220 UJ	240 UJ	190 UJ	200 UJ
Kepone (Chlordecone)	220 R	230 R	200 R	200 R	210 R	230 R	220 UJ	230 U	220 R	240 R	190 R	200 R
Methoxychlor	22 U	23 U	20 U	20 UJ	21 U	23 U	22 U	23 U	22 U	24 U	19 U	20 U
Toxaphene	110 U	110 U	98 U	100 UJ	100 U	110 U	110 U	110 U	110 U	120 U	92 U	100 U
Metals (mg/kg)												
Antimony	1.3 UJ	1.4 UJ	5.9 UJ	5.8 UJ	6.1 UJ	6.5 UJ	0.39 J	0.38 J	6.4 UJ	7 UJ	1 J	5.9 UJ
Arsenic	0.65 UJ	0.68 UJ	2.9 U	2.9 U	3.1 U	1.9 J	0.54 J	0.67 U	3.2 U	3.5 U	0.63	3 U
Barium	163 R	198 R	86.8	69	82.8	4.1 J	267 J	45.3 J	76	61.8	58	139
Beryllium	0.44 J	0.075 J	2.9 U	0.25 J	0.3 J	0.32 J	0.96	0.11 J	3.2 U	3.5 U	0.18 J	3 U
Cadmium	0.28 J	0.45 J	2.9 U	0.45 J	3.1 U	3.3 U	0.28 J	0.7 J	0.36 J	0.52 J	0.23 J	0.38 J
Chromium	22.5 J	29 J	25.3 J	52.9 J	79.3 J	19.9 J	8	18.5	39.8 J	7 UJ	32.1 J	22.5 J
Cobalt	28 J	14.3 J	26.9	21.4	28.8	15.6	67.6 J	21.2 J	41.6	30.9	27.7	16.4
Copper	49.3 J	65.2 J	89.6	86.9	76.2	123	83.1 J	58.5 J	270	9.8	56.2	66.2
Lead	1.3 J	1.8 J	2.9 U	2.9 U	3.1 U	37.4	28.4 R	2.3 R	4.1	3.5 U	3.2	3
Mercury	0.009 J	0.005 J	0.039 U	0.012 J	0.04 U	0.044 U	0.042 U	0.045 U	0.01 J	0.016 J	0.037 U	0.04 U
Nickel	29.6 J	25.3 J	14.9	26.8	22.6	11	6.3	16.9	21.6	9	13.3	11.4
Selenium	0.64 J	0.38 J	14.7 U	14.6 U	15.3 U	16.3 U	0.48 J	0.32 J	16 U	17.4 U	0.21 J	14.8 U
Silver	0.65 U	0.68 U	2.9 U	2.9 U	3.1 U	3.3 U	0.1 J	0.11 J	3.2 U	3.5 U	0.56 U	3 U
Thallium	0.65 U	0.68 U	0.1 J	2.9 U	3.1 U	3.3 U	0.055 J	0.67 U	3.2 U	3.5 U	0.072 J	3 U
Tin	2.3 J	2.5 J	5.9 U	5.8 U	6.1 U	6.5 U	6.3 U	6.7 U	6.4 U	7 U	5.6 U	5.9 U
Vanadium	46.9 J	154 J	145	158	136	407	107 J	294 J	236	152	125	189
Zinc	68.7 J	53.5 J	71	61.8	75.3	117	160	59.7	92.8	79.4	78.4	85.1

APPENDIX O

SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB16	59SB16	59SB17	59SB17	59SB18	59SB18	59SB19	59SB19	59SB20	59SB20	59SB21	59SB21
Sample ID	59SB16-01	59SB16-05	59SB17-01	59SB17-05	59SB18-01	59SB18-02	59SB19-01	59SB19-05	59SB20-01	59SB20-05	59SB21-01	59SB21-05
Sample Date	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010
Sample Depth (ft bgs)	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	3.0 - 5.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Volatile Organics (µg/kg)												
1,1,1,2-Tetrachloroethane	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
1,1,1-Trichloroethane	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
1,1,2,2-Tetrachloroethane	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
1,1,2-Trichloroethane	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
1,1-Dichloroethane	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
1,1-Dichloroethene	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
1,2,3-Trichloropropane	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dibromo-3-chloropropane (DBCP)	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
1,2-Dibromoethane (EDB)	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
1,2-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloroethane	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
1,2-Dichloroethene (trans)	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
1,2-Dichloropropane	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
1,3-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Dichloropropene (cis)	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
1,3-Dichloropropene (trans)	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
1,4-Dichloro-2-butene (trans)	18 U	19 U	17 U	21 U	17 U	17 U	21 U	22 U	16 U	21 U	17 U	16 U
1,4-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dioxane (p-)	220 R	240 R	210 R	270 R	220 R	210 R	260 R	270 R	200 R	260 R	210 R	200 R
2-Butanone (MEK)	11 U	12 U	11 U	13 U	11 U	10 U	13 U	14 U	10 U	13 U	10 U	9.9 U
2-Chloro-1,3-butadiene (Chloroprene)	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
2-Hexanone (MBK)	11 U	12 U	11 U	13 U	11 U	10 U	13 U	14 U	10 U	13 U	10 U	9.9 U
3-Chloropropene (Allyl Chloride)	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
4-Methyl-2-pentanone (MIBK)	11 U	12 U	11 U	13 U	11 U	10 U	13 U	14 U	10 U	13 U	10 U	9.9 U
Acetone	13 U	12 U	37	13 U	18 U	10 U	13 U	14 U	10 U	13 U	10 U	9.9 U
Acetonitrile	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
Acrolein	45 R	48 R	43 R	53 R	43 R	42 R	52 R	55 R	41 R	53 R	42 R	40 R
Acrylonitrile	45 U	48 U	43 U	53 U	43 U	42 U	52 U	55 U	41 U	53 U	42 U	40 U
Benzene	4.5 U	4.8 U	4.3 U	5.3 U	0.71 J	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
Bromodichloromethane	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
Bromoform	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
Bromomethane	4.5 U	4.8 U	1.6 J	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
Carbon Disulfide	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
Carbon Tetrachloride	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
Chlorobenzene	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
Chloroethane	4.5 UJ	4.8 UJ	4.3 UJ	5.3 UJ	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
Chloroform	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
Chloromethane	4.5 U	4.8 U	0.74 J	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
Dibromochloromethane	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U

APPENDIX O

SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB16	59SB16	59SB17	59SB17	59SB18	59SB18	59SB19	59SB19	59SB20	59SB20	59SB21	59SB21
Sample ID	59SB16-01	59SB16-05	59SB17-01	59SB17-05	59SB18-01	59SB18-02	59SB19-01	59SB19-05	59SB20-01	59SB20-05	59SB21-01	59SB21-05
Sample Date	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010
Sample Depth (ft bgs)	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	3.0 - 5.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Volatile Organics (µg/kg) (cont.)												
Dibromomethane	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
Ethyl Methacrylate	45 U	48 U	43 U	53 U	43 U	42 U	52 U	55 U	41 U	53 U	42 U	40 U
Ethylbenzene	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
Freon 11 (Trichlorofluoromethane)	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
Freon-12 (Dichlorodifluoromethane)	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
Hexachlorobutadiene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Isobutyl Alcohol	220 R	240 R	210 R	270 R	220 R	210 R	260 R	270 R	200 R	260 R	210 R	200 R
Methyl Acrylonitrile	45 U	48 U	43 U	53 U	43 U	42 U	52 U	55 U	41 U	53 U	42 U	40 U
Methyl Iodide	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
Methyl Methacrylate	45 R	48 R	43 R	53 R	43 R	42 R	52 R	55 R	41 R	53 R	42 R	40 R
Methylene Chloride	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
Pentachloroethane	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
Propionitrile (Ethyl Cyanide)	220 R	240 R	210 R	270 R	220 R	210 R	260 R	270 R	200 R	260 R	210 R	200 R
Styrene (Ethenylbenzene)	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
Tetrachloroethene (PCE)	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
Toluene	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
Trichloroethene (TCE)	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
Vinyl Acetate	4.5 U	4.8 U	4.3 U	5.3 U	4.3 UJ	4.2 UJ	5.2 UJ	5.5 UJ	4.1 UJ	5.3 UJ	4.2 UJ	4 UJ
Vinyl Chloride	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
Xylene, m/p-	8.9 U	9.5 U	8.6 U	11 U	8.6 U	8.3 U	10 U	11 U	8.1 U	11 U	8.3 U	7.9 U
Xylene, o-	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
Xylenes, total	4.5 U	4.8 U	4.3 U	5.3 U	4.3 U	4.2 U	5.2 U	5.5 U	4.1 U	5.3 U	4.2 U	4 U
Semivolatile Organics (µg/kg)												
1,2,4,5-Tetrachlorobenzene	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
1,2,4-Trichlorobenzene	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
1,2-Dichlorobenzene (o-)	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
1,3,5-Trinitrobenzene (TNB)	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
1,3-Dichlorobenzene (m-)	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
1,3-Dinitrobenzene (m-)	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
1,4-Dichlorobenzene (p-)	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
1,4-Naphthoquinone	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
1,4-Phenylenediamine	2100 R	2200 R	2000 R	2400 R	1800 R	2100 R	2200 R	2300 R	1800 R	1900 R	1800 R	1800 R
1-Naphthylamine	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
2,2'-Oxybis[1-chloropropane]	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
2,3,4,6-Tetrachlorophenol	410 UJ	430 UJ	390 UJ	460 UJ	350 U	410 U	430 U	440 U	360 U	380 U	360 U	350 U
2,4,5-Trichlorophenol	410 UJ	430 UJ	390 UJ	460 UJ	350 U	410 U	430 U	440 U	360 U	380 U	360 U	350 U
2,4,6-Trichlorophenol	410 UJ	430 UJ	390 UJ	460 UJ	350 U	410 U	430 U	440 U	360 U	380 U	360 U	350 U
2,4-Dichlorophenol	410 UJ	430 UJ	390 UJ	460 UJ	350 U	410 U	430 U	440 U	360 U	380 U	360 U	350 U
2,4-Dimethylphenol	410 UJ	430 UJ	390 UJ	460 UJ	350 U	410 U	430 U	440 U	360 U	380 U	360 U	350 U

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SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB16	59SB16	59SB17	59SB17	59SB18	59SB18	59SB19	59SB19	59SB20	59SB20	59SB21	59SB21
Sample ID	59SB16-01	59SB16-05	59SB17-01	59SB17-05	59SB18-01	59SB18-02	59SB19-01	59SB19-05	59SB20-01	59SB20-05	59SB21-01	59SB21-05
Sample Date	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010
Sample Depth (ft bgs)	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	3.0 - 5.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Semivolatile Organics (µg/kg) (cont.)												
2,4-Dinitrophenol	410 UJ	430 UJ	390 UJ	460 UJ	350 U	410 U	430 U	440 U	360 U	380 U	360 U	350 U
2,4-Dinitrotoluene (DNT)	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
2,6-Dichlorophenol	410 UJ	430 UJ	390 UJ	460 UJ	350 U	410 U	430 U	440 U	360 U	380 U	360 U	350 U
2,6-Dinitrotoluene (DNT)	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
2-Acetylaminofluorene	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 UJ
2-Chloronaphthalene	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
2-Chlorophenol	410 UJ	430 UJ	390 UJ	460 UJ	350 U	410 U	430 U	440 U	360 U	380 U	360 U	350 U
2-Methyl-5-nitroaniline	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
2-Methylphenol (o-Cresol)	410 UJ	430 UJ	390 UJ	460 UJ	350 U	410 U	430 U	440 U	360 U	380 U	360 U	350 U
2-Naphthylamine	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
2-Nitroaniline	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
2-Nitrophenol	410 UJ	430 UJ	390 UJ	460 UJ	350 U	410 U	430 U	440 U	360 U	380 U	360 U	350 U
2-Picoline	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
3,3'-Dichlorobenzidine	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
3,3'-Dimethylbenzidine	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 UJ
3-Methylcholanthrene	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 UJ
3-Methylphenol (m-Cresol)	310 UJ	320 UJ	300 UJ	350 UJ	260 U	310 U	320 U	330 U	270 U	280 U	270 U	270 U
3 & 4 Methylphenol	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3-Nitroaniline	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
4,6-Dinitro-2-methylphenol	410 UJ	430 UJ	390 UJ	460 UJ	350 U	410 U	430 U	440 U	360 U	380 U	360 U	350 U
4-Aminobiphenyl	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
4-Bromophenyl-phenylether	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
4-Chloro-3-methylphenol	410 UJ	430 UJ	390 UJ	460 UJ	350 U	410 U	430 U	440 U	360 U	380 U	360 U	350 U
4-Chloroaniline	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
4-Chlorophenyl-phenylether	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
4-Dimethylaminoazobenzene (p-)	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
4-Methylphenol (p-Cresol)	310 UJ	320 UJ	300 UJ	350 UJ	260 U	310 U	320 U	330 U	270 U	280 U	270 U	270 U
4-Nitroaniline	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
4-Nitrophenol	410 UJ	430 UJ	390 UJ	460 UJ	350 U	410 U	430 U	440 U	360 U	380 U	360 U	350 U
4-Nitroquinoline-1-oxide	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
7,12-Dimethylbenz(a)anthracene	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
a,a-Dimethylphenethylamine	590 UJ	610 UJ	560 UJ	650 UJ	500 U	580 U	610 U	630 UJ	510 U	530 U	510 UJ	500 UJ
Acetophenone	110 UJ	110 UJ	100 UJ	120 UJ	90 U	100 U	110 U	110 U	92 U	96 U	92 U	91 U
Aniline	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
Aramite	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
Benzyl Alcohol	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 UJ	180 U	190 U	180 UJ	180 U
Bis(2-chloroethoxy)methane	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
Bis(2-chloroethyl)ether	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
Bis(2-ethylhexyl) Phthalate (BEHP)	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
Butyl Benzyl Phthalate	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U

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SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB16	59SB16	59SB17	59SB17	59SB18	59SB18	59SB19	59SB19	59SB20	59SB20	59SB21	59SB21
Sample ID	59SB16-01	59SB16-05	59SB17-01	59SB17-05	59SB18-01	59SB18-02	59SB19-01	59SB19-05	59SB20-01	59SB20-05	59SB21-01	59SB21-05
Sample Date	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010
Sample Depth (ft bgs)	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	3.0 - 5.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Semivolatile Organics (µg/kg) (cont.)												
Diallate (cis)	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
Diallate (trans)	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
Diallate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzofuran	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
Diethyl Phthalate (DEP)	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
Dimethyl Phthalate	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
Di-n-butyl Phthalate (DBP)	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
Di-n-octyl Phthalate	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
Dinoseb	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
Ethyl Methane Sulfonate (EMS)	210 UJ	220 UJ	200 UJ	240 UJ	180 UJ	210 UJ	220 UJ	230 UJ	180 UJ	190 UJ	180 UJ	180 UJ
Hexachloro-1,3-butadiene	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
Hexachlorobenzene	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
Hexachlorocyclopentadiene	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
Hexachloroethane	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
Hexachlorophene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloropropene	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
Isophorone	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
Isosafrole	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
Methapyrilene	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
Methyl Methane Sulfonate	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
Nitrobenzene	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
N-Nitro-o-toluidine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Nitrosodiethylamine	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
n-Nitrosodimethylamine (NDMA)	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
n-Nitroso-di-n-butylamine	210 UJ	220 UJ	200 UJ	240 UJ	180 UJ	210 UJ	220 UJ	230 UJ	180 UJ	190 UJ	180 UJ	180 UJ
n-Nitrosodi-n-propylamine	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
n-Nitrosodiphenylamine	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
n-Nitrosomethylethylamine	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
n-Nitrosomorpholine	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
n-Nitrosopiperidine	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
n-Nitrosopyrrolidine	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 UJ
o-Toluidine	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
p-Dimethylamino azobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorobenzene	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
Pentachloronitrobenzene	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
Pentachlorophenol	410 UJ	430 UJ	390 UJ	460 UJ	350 U	410 U	430 U	440 U	360 U	380 U	360 U	350 U
Phenacetin	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
Phenol	410 UJ	430 UJ	390 UJ	460 UJ	350 U	410 U	430 U	440 U	360 U	380 U	360 U	350 U
p-Phenylene diamine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pronamide	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U

APPENDIX O

SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB16	59SB16	59SB17	59SB17	59SB18	59SB18	59SB19	59SB19	59SB20	59SB20	59SB21	59SB21
Sample ID	59SB16-01	59SB16-05	59SB17-01	59SB17-05	59SB18-01	59SB18-02	59SB19-01	59SB19-05	59SB20-01	59SB20-05	59SB21-01	59SB21-05
Sample Date	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010
Sample Depth (ft bgs)	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	3.0 - 5.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Semivolatile Organics (µg/kg) (cont.)												
Pyridine	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
Safrole	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
PAHs (µg/kg)												
2-Methylnaphthalene	10 UJ	11 UJ	9.9 UJ	12 UJ	8.8 U	10 U	11 U	11 U	9 U	9.4 U	9 U	8.9 U
Acenaphthene	10 UJ	11 UJ	9.9 UJ	12 UJ	2 J	10 U	11 U	11 U	9 U	9.4 U	9 U	8.9 U
Acenaphthylene	10 UJ	11 UJ	9.9 UJ	12 UJ	0.61 J	10 U	11 U	11 U	9 U	9.4 U	9 U	8.9 U
Anthracene	10 UJ	11 UJ	9.9 UJ	12 UJ	8.8 U	10 U	11 U	11 U	9 U	9.4 U	9 U	8.9 U
Benzo(a)anthracene	10 UJ	11 UJ	0.7 J	12 UJ	12	10 U	11 U	11 U	9 U	9.4 U	9 U	8.9 U
Benzo(a)pyrene (BaP)	10 UJ	11 UJ	0.88 J	12 UJ	8.8 U	10 U	11 U	11 U	9 U	9.4 U	9 U	8.9 U
Benzo(b)fluoranthene	10 UJ	11 UJ	1.4 J	12 UJ	8.8 U	10 U	11 U	11 U	9 U	9.4 U	9 U	8.9 U
Benzo(g,h,i)perylene	10 UJ	11 UJ	9.9 UJ	12 UJ	8.8 U	10 U	11 U	11 U	9 U	9.4 U	9 U	8.9 U
Benzo(k)fluoranthene	10 UJ	11 UJ	0.99 J	12 UJ	8.8 U	10 U	11 U	11 U	9 U	9.4 U	9 U	8.9 U
Chrysene	10 UJ	11 UJ	0.85 J	12 UJ	15	10 U	11 U	11 U	9 U	9.4 U	9 U	8.9 U
Dibenz(a,h)anthracene	10 UJ	11 UJ	9.9 UJ	12 UJ	8.8 U	10 U	11 U	11 U	9 U	9.4 U	9 U	8.9 U
Fluoranthene	10 UJ	11 UJ	9.9 UJ	12 UJ	21	10 U	11 U	11 U	9 U	9.4 U	9 U	8.9 U
Fluorene	10 UJ	11 UJ	9.9 UJ	12 UJ	8.8 U	10 U	11 U	11 U	9 U	9.4 U	9 U	8.9 U
Indeno(1,2,3-cd)pyrene	10 UJ	11 UJ	9.9 UJ	12 UJ	8.8 U	10 U	11 U	11 U	9 U	9.4 U	9 U	8.9 U
Naphthalene	1.1 J	1.4 J	9.9 UJ	12 UJ	8.8 U	10 U	11 U	11 U	9 U	9.4 U	9 U	8.9 U
Phenanthrene	10 UJ	11 UJ	9.9 UJ	12 UJ	6.5 J	10 U	11 U	11 U	9 U	9.4 U	9 U	8.9 U
Pyrene	10 UJ	11 UJ	9.9 UJ	12 UJ	24	2.1 J	11 U	11 U	9 U	9.4 U	9 U	8.9 U
Pesticides (µg/kg)												
4,4'-DDD	4.1 U	4.3 U	3.9 U	4.6 U	0.39 J	4.1 U	4.3 U	4.4 UJ	3.6 U	3.8 U	3.6 U	3.5 U
4,4'-DDE	4.1 U	4.3 U	3.9 U	4.6 U	1.2 J	4.1 U	4.3 U	4.4 UJ	3.6 U	3.8 U	3.6 U	3.5 U
4,4'-DDT	4.1 U	4.3 U	3.9 U	4.6 U	1.3 J	4.1 U	4.3 U	4.4 UJ	3.6 U	3.8 U	3.6 U	3.5 U
Aldrin	2.1 U	2.2 U	2 U	2.4 U	1.8 U	2.1 U	2.2 U	2.3 UJ	1.8 U	1.9 U	1.8 U	1.8 U
BHC, alpha-	2.1 U	2.2 U	2 U	2.4 U	1.8 U	2.1 U	2.2 U	2.3 UJ	1.8 U	1.9 U	1.8 U	1.8 U
BHC, beta-	1.1 U	1.1 U	1 U	1.2 U	1.8 U	2.1 U	2.2 U	2.3 UJ	1.8 U	1.9 U	1.8 U	1.8 U
BHC, delta-	2.1 U	2.2 U	2 U	2.4 U	1.8 U	2.1 U	2.2 U	2.3 UJ	1.8 U	1.9 U	1.8 U	1.8 U
BHC, gamma- (Lindane)	2.1 U	2.2 U	2 U	2.4 U	1.8 U	2.1 U	2.2 U	2.3 UJ	1.8 U	1.9 U	1.8 U	1.8 U
Chlordane, alpha-	2.1 U	2.2 U	2 U	2.4 U	1.8 U	2.1 U	2.2 U	2.3 UJ	1.8 U	1.9 U	1.8 U	1.8 U
Chlordane, gamma-	2.1 U	2.2 U	2 U	2.4 U	1.8 U	2.1 U	2.2 U	2.3 UJ	1.8 U	1.9 U	1.8 U	1.8 U
Chlorobenzilate	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
Dieldrin	4.1 U	4.3 U	3.9 U	4.6 U	3.5 U	4.1 U	4.3 U	4.4 UJ	3.6 U	3.8 U	3.6 U	3.5 U
Endosulfan I	2.1 U	2.2 U	2 U	2.4 U	1.8 U	2.1 U	2.2 U	2.3 UJ	1.8 U	1.9 U	1.8 U	1.8 U
Endosulfan II	4.1 U	4.3 U	3.9 U	4.6 U	3.5 U	4.1 U	4.3 U	4.4 UJ	3.6 U	3.8 U	3.6 U	3.5 U
Endosulfan Sulfate	4.1 U	4.3 U	3.9 U	4.6 U	3.5 U	4.1 U	4.3 U	4.4 UJ	3.6 U	3.8 U	3.6 U	3.5 U
Endrin	4.1 U	4.3 U	3.9 U	4.6 U	3.5 U	4.1 U	4.3 U	4.4 UJ	3.6 U	3.8 U	3.6 U	3.5 U
Endrin Aldehyde	4.1 U	4.3 U	3.9 U	4.6 U	0.53 J	4.1 U	4.3 U	4.4 UJ	3.6 U	3.8 U	3.6 U	3.5 U

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SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB16	59SB16	59SB17	59SB17	59SB18	59SB18	59SB19	59SB19	59SB20	59SB20	59SB21	59SB21
Sample ID	59SB16-01	59SB16-05	59SB17-01	59SB17-05	59SB18-01	59SB18-02	59SB19-01	59SB19-05	59SB20-01	59SB20-05	59SB21-01	59SB21-05
Sample Date	5/18/2010	5/18/2010	5/18/2010	5/18/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010	5/19/2010	5/18/2010	5/18/2010
Sample Depth (ft bgs)	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	3.0 - 5.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0
Pesticides (µg/kg) (cont.)												
Heptachlor	2.1 U	2.2 U	2 U	2.4 U	1.8 U	2.1 U	2.2 U	2.3 UJ	1.8 U	1.9 U	1.8 U	1.8 U
Heptachlor Epoxide	2.1 U	2.2 U	2 U	2.4 U	1.8 U	2.1 U	2.2 U	2.3 UJ	1.8 U	1.9 U	1.8 U	1.8 U
Isodrin	210 UJ	220 UJ	200 UJ	240 UJ	180 U	210 U	220 U	230 U	180 U	190 U	180 U	180 U
Kepone (Chlordecone)	210 R	220 R	200 R	240 R	180 U	210 U	220 U	230 UJ	180 UJ	190 UJ	180 UJ	180 UJ
Methoxychlor	21 U	22 U	20 U	24 U	18 U	21 U	22 U	23 UJ	18 U	19 U	18 U	18 U
Toxaphene	100 U	110 U	99 U	120 U	88 U	100 U	110 U	110 UJ	90 U	94 U	90 U	89 U
Metals (mg/kg)												
Antimony	6.2 UJ	6.3 UJ	5.7 UJ	6.7 UJ	1.1 J	0.97 J	1.2 J	1.1 J	0.15 J	5.6 UJ	5.3 UJ	5.3 UJ
Arsenic	3.1 U	3.2 U	1 J	3.4 U	1.8	0.23 J	0.51 J	3 U	0.54 U	2.8 U	2.6 U	2.7 U
Barium	76.8	31.4 J	89.1	49.1	51.2	62.6	161	312	29.5	54.4	111	52.3
Beryllium	0.34 J	3.2 U	0.37 J	0.86 J	0.4 J	0.65	0.71	0.63 J	0.091 J	2.8 U	2.6 U	0.27 J
Cadmium	3.1 U	0.38 J	0.43 J	3.4 U	0.68	0.75	0.77	0.77 J	0.12 J	0.31 J	0.44 J	0.43 J
Chromium	29.5 J	232 J	57.2 J	21 J	14.3	8.1	23.1	33.5	24.4	63.9	16.3	17.3
Cobalt	31.6	25.7	28.6	44.7	14.4 J	21.5 J	20.2 J	12.9 J	9.8 J	19 J	21 J	15.2 J
Copper	115	50.5	109	57.1	51.1 J	83.3 J	64.6 J	37.4 J	34.9 J	73.1 J	54 J	104 J
Lead	3.1 U	12.5	24.6	3.4 U	31.3	2	1.9	3 U	2	2.8 U	3	2.7 U
Mercury	0.041 U	0.13	0.032 J	0.012 J	0.009 J	0.008 J	0.043 U	0.044 U	0.036 U	0.038 U	0.01 J	0.01 J
Nickel	14.1	44.4	47.3	27.9	8.4	9.8	14.2	10.2	9.8	25.6	7.9	5.3
Selenium	15.5 U	15.8 U	0.95 J	16.8 U	2 J	2.1 J	2.4 J	2.9 J	0.2 J	14 U	13.2 U	13.3 U
Silver	3.1 U	3.2 U	2.8 U	3.4 U	0.43 J	0.54 J	0.57 J	0.56 J	0.12 J	2.8 U	2.6 U	2.7 U
Thallium	3.1 U	3.2 U	2.8 U	3.4 U	0.4 J	0.53 J	0.5 J	0.45 J	0.54 U	2.8 U	2.6 U	2.7 U
Tin	6.2 U	6.3 U	26	6.7 U	5.1 UJ	6.1 UJ	6.5 UJ	6.1 UJ	5.4 UJ	5.6 UJ	5.3 UJ	5.3 UJ
Vanadium	214	71.3	188	89	65.3 J	118 J	87.2 J	59.7 J	43.5 J	135 J	93.1 J	72.3 J
Zinc	40.2	113	148	94.6	50.7	63.5	67.3	57.9	39.3	54.1	132	88.1

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SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB22	59SB22	59SB23	59SB23	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31
Sample ID	59SB22-01	59SB22-05	59SB23-01	59SB23-05	59SB24-00	59SB25-00	59SB26-00	59SB27-00	59SB28-00	59SB29-00	59SB30-00	59SB31-00
Sample Date	5/18/2010	5/18/2010	5/19/2010	5/19/2010	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Sample Depth (ft bgs)	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Volatile Organics (µg/kg)												
1,1,1,2-Tetrachloroethane	3.9 U	4.2 U	4.2 U	5.2 U	2.5 U	2.3 U	2.3 U	2.4 U	2.1 U	1.7 U	1.9 U	2.2 U
1,1,1-Trichloroethane	3.9 U	4.2 U	4.2 U	5.2 U	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U
1,1,2,2-Tetrachloroethane	3.9 U	4.2 U	4.2 U	5.2 U	1.6 U	1.6 U	1.5 U	1.6 U	1.4 U	1.1 U	1.3 U	1.4 U
1,1,2-Trichloroethane	3.9 U	4.2 U	4.2 U	5.2 U	1.3 U	1.3 U	1.2 U	1.3 U	1.1 U	0.93 U	1 U	1.2 U
1,1-Dichloroethane	3.9 U	4.2 U	4.2 U	5.2 U	1.1 U	1.1 U	1 U	1.1 U	0.97 U	0.79 U	0.88 U	0.99 U
1,1-Dichloroethene	3.9 U	4.2 U	4.2 U	5.2 U	1.5 U	1.5 U	1.4 U	1.5 U	1.3 U	1.1 U	1.2 U	1.3 U
1,2,3-Trichloropropane	3.9 U	4.2 U	4.2 U	5.2 U	2.5 U	2.3 U	2.3 U	2.4 U	2.1 U	1.7 U	1.9 U	2.2 U
1,2,4-Trichlorobenzene	NA	NA	NA	NA	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U
1,2-Dibromo-3-chloropropane (DBCP)	3.9 U	4.2 U	4.2 U	5.2 U	4.5 U	4.3 U	4.2 U	4.4 U	3.9 U	3.1 U	3.5 U	4 U
1,2-Dibromoethane (EDB)	3.9 U	4.2 U	4.2 U	5.2 U	1.5 U	1.5 U	1.4 U	1.5 U	1.3 U	1.1 U	1.2 U	1.3 U
1,2-Dichlorobenzene	NA	NA	NA	NA	1.3 U	1.3 U	1.2 U	1.3 U	1.1 U	0.93 U	1 U	1.2 U
1,2-Dichloroethane	3.9 U	4.2 U	4.2 U	5.2 U	1.1 U	1.1 U	1 U	1.1 U	0.97 U	0.79 U	0.88 U	0.99 U
1,2-Dichloroethene (trans)	3.9 U	4.2 U	4.2 U	5.2 U	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U
1,2-Dichloropropane	3.9 U	4.2 U	4.2 U	5.2 U	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U
1,3-Dichlorobenzene	NA	NA	NA	NA	1.6 U	1.6 U	1.5 U	1.6 U	1.4 U	1.1 U	1.3 U	1.4 U
1,3-Dichloropropene (cis)	3.9 U	4.2 U	4.2 U	5.2 U	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U
1,3-Dichloropropene (trans)	3.9 U	4.2 U	4.2 U	5.2 U	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U
1,4-Dichloro-2-butene (trans)	16 U	17 U	17 U	21 U	3 U	2.8 U	2.8 U	2.9 U	2.5 U	2.1 U	2.3 U	2.6 U
1,4-Dichlorobenzene	NA	NA	NA	NA	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U
1,4-Dioxane (p-)	190 R	210 R	210 R	260 R	51 R	48 R	48 R	49 R	44 R	36 R	40 R	45 R
2-Butanone (MEK)	9.7 U	11 U	10 U	13 U	2.5 U	2.3 U	2.3 U	2.4 U	2.1 U	1.7 U	1.9 U	2.2 U
2-Chloro-1,3-butadiene (Chloroprene)	3.9 U	4.2 U	4.2 U	5.2 U	2.2 U	2 U	2 U	2.1 U	1.8 U	1.5 U	1.7 U	1.9 U
2-Hexanone (MBK)	9.7 U	11 U	10 U	13 U	3.4 U	3.2 U	3.1 U	3.3 U	2.9 U	2.4 U	2.7 U	3 U
3-Chloropropene (Allyl Chloride)	3.9 U	4.2 U	4.2 U	5.2 U	2.3 U	2.1 U	2.1 U	2.2 U	1.9 U	1.6 U	1.8 U	2 U
4-Methyl-2-pentanone (MIBK)	9.7 U	11 U	10 U	13 U	4.3 U	4.1 U	4 U	4.2 U	3.7 U	3 U	3.4 U	3.8 U
Acetone	40	11 U	10 U	16 U	11 UJ	27 J	10 U	11 U	9.7 U	7.9 U	15 J	30 J
Acetonitrile	3.9 U	4.2 U	4.2 U	5.2 U	42 U	40 UJ	39 UJ	41 UJ	36 UJ	29 UJ	33 U	37 UJ
Acrolein	39 R	42 R	42 R	52 R	25 U	23 UJ	23 UJ	24 UJ	21 UJ	17 UJ	19 U	22 UJ
Acrylonitrile	39 U	42 U	42 U	52 U	35 U	33 UJ	32 UJ	34 UJ	30 UJ	24 UJ	27 U	31 UJ
Benzene	3.9 U	4.2 U	4.2 U	5.2 U	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U
Bromodichloromethane	3.9 U	4.2 U	4.2 U	5.2 U	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U
Bromoform	3.9 U	4.2 U	4.2 U	5.2 U	1.5 U	1.5 U	1.4 U	1.5 U	1.3 U	1.1 U	1.2 U	1.3 U
Bromomethane	3.9 U	4.2 U	4.2 U	5.2 U	1.5 U	1.5 U	1.4 U	1.5 U	1.3 U	1.1 U	1.2 U	1.3 U
Carbon Disulfide	0.54 J	0.99 J	4.2 U	1.6 J	1.1 U	1.1 U	1 U	1.1 U	0.97 U	0.79 U	0.88 U	0.99 U
Carbon Tetrachloride	3.9 U	4.2 U	4.2 U	5.2 U	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U
Chlorobenzene	3.9 U	4.2 U	4.2 U	5.2 U	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U
Chloroethane	3.9 U	4.2 U	4.2 U	5.2 U	2.8 U	2.6 U	2.6 U	2.7 U	2.4 U	1.9 U	2.2 U	2.4 U
Chloroform	3.9 U	4.2 U	4.2 U	5.2 U	1.1 U	1.1 U	1 U	1.1 U	0.97 U	0.79 U	0.88 U	0.99 U
Chloromethane	0.43 J	4.2 U	4.2 U	5.2 U	2.1 U	1.9 U	1.9 U	2 U	1.8 U	1.4 U	1.6 U	1.8 U
Dibromochloromethane	3.9 U	4.2 U	4.2 U	5.2 U	1.8 U	1.6 U	1.6 U	1.7 U	1.5 U	1.2 U	1.4 U	1.5 U

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SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB22	59SB22	59SB23	59SB23	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31
Sample ID	59SB22-01	59SB22-05	59SB23-01	59SB23-05	59SB24-00	59SB25-00	59SB26-00	59SB27-00	59SB28-00	59SB29-00	59SB30-00	59SB31-00
Sample Date	5/18/2010	5/18/2010	5/19/2010	5/19/2010	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Sample Depth (ft bgs)	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Volatile Organics (µg/kg) (cont.)												
Dibromomethane	3.9 U	4.2 U	4.2 U	5.2 U	1.8 U	1.6 U	1.6 U	1.7 U	1.5 U	1.2 U	1.4 U	1.5 U
Ethyl Methacrylate	39 U	42 U	42 U	52 U	3.5 U	3.3 U	3.2 U	3.4 U	3 U	2.4 U	2.7 U	3.1 U
Ethylbenzene	3.9 U	4.2 U	4.2 U	5.2 U	1.3 U	1.3 U	1.2 U	1.3 U	1.1 U	0.93 U	1 U	1.2 U
Freon 11 (Trichlorofluoromethane)	3.9 U	4.2 U	4.2 U	5.2 U	1.2 U	1.2 U	1.1 U	1.2 U	1.1 U	0.86 U	0.96 U	1.1 U
Freon-12 (Dichlorodifluoromethane)	3.9 U	4.2 U	4.2 U	5.2 U	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U
Hexachlorobutadiene	NA	NA	NA	NA	3.2 U	3 U	3 U	3.1 U	2.7 U	2.2 U	2.5 U	2.8 U
Isobutyl Alcohol	190 R	210 R	210 R	260 R	54 R	50 R	50 R	51 R	46 R	37 R	42 R	47 R
Methyl Acrylonitrile	39 U	42 U	42 U	52 U	24 U	22 UJ	22 UJ	23 UJ	20 UJ	16 UJ	18 U	21 UJ
Methyl Iodide	3.9 U	4.2 U	4.2 U	5.2 U	1.9 U	1.7 UJ	1.7 UJ	1.8 UJ	1.6 UJ	1.3 UJ	1.4 U	1.6 UJ
Methyl Methacrylate	39 R	42 R	42 R	52 R	4.6 U	4.4 U	4.3 U	4.5 U	4 U	3.2 U	3.6 U	4 U
Methylene Chloride	3.9 U	4.2 U	4.2 U	5.2 U	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U
Pentachloroethane	3.9 U	4.2 U	4.2 U	5.2 U	6.5 U	6.1 U	6 U	6.2 U	5.5 U	4.5 U	5.1 U	5.7 U
Propionitrile (Ethyl Cyanide)	190 R	210 R	210 R	260 R	27 U	25 UJ	25 UJ	26 UJ	23 UJ	19 UJ	21 U	23 UJ
Styrene (Ethenylbenzene)	3.9 U	4.2 U	4.2 U	5.2 U	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U
Tetrachloroethene (PCE)	3.9 U	4.2 U	4.2 U	5.2 U	2 U	1.8 U	1.8 U	1.9 U	1.7 U	1.4 U	1.5 U	1.7 U
Toluene	3.9 U	4.2 U	4.2 U	5.2 U	1 U	0.97 U	0.95 U	0.99 U	0.88 U	0.71 U	0.8 U	0.9 U
Trichloroethene (TCE)	3.9 U	4.2 U	4.2 U	5.2 U	1.3 U	1.3 U	1.2 U	1.3 U	1.1 U	0.93 U	1 U	1.2 U
Vinyl Acetate	3.9 UJ	4.2 UJ	4.2 UJ	5.2 UJ	2.6 U	2.4 U	2.4 U	2.5 U	2.2 U	1.8 U	2 U	2.2 U
Vinyl Chloride	3.9 U	4.2 U	4.2 U	5.2 U	1.5 U	1.5 U	1.4 U	1.5 U	1.3 U	1.1 U	1.2 U	1.3 U
Xylene, m/p-	7.8 U	8.5 U	8.4 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA
Xylene, o-	3.9 U	4.2 U	4.2 U	5.2 U	NA	NA	NA	NA	NA	NA	NA	NA
Xylenes, total	3.9 U	4.2 U	4.2 U	5.2 U	1.1 U	1.1 U	1 U	1.1 U	0.97 U	0.79 U	0.88 U	0.99 U
Semivolatile Organics (µg/kg)												
1,2,4,5-Tetrachlorobenzene	200 U	210 U	190 U	230 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U
1,2,4-Trichlorobenzene	200 U	210 U	190 U	230 U	6.1 U	6.1 U	5.7 U	64 U	26 U	27 U	27 U	5.9 U
1,2-Dichlorobenzene (o-)	200 U	210 U	190 U	230 U	8.7 U	8.7 U	8.2 U	92 U	37 U	39 U	39 U	8.5 U
1,3,5-Trinitrobenzene (TNB)	200 U	210 U	190 U	230 U	22 U	22 U	21 U	240 UJ	96 UJ	100 UJ	100 UJ	22 U
1,3-Dichlorobenzene (m-)	200 U	210 U	190 U	230 U	7.4 U	7.4 U	7 U	78 U	32 U	33 U	33 U	7.2 U
1,3-Dinitrobenzene (m-)	200 U	210 U	190 U	230 U	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U
1,4-Dichlorobenzene (p-)	200 U	210 U	190 U	230 U	6.8 U	6.9 U	6.5 U	73 U	29 U	31 U	31 U	6.7 U
1,4-Naphthoquinone	200 U	210 U	190 U	230 U	4.3 UJ	4.4 UJ	4.1 UJ	46 UJ	19 UJ	20 UJ	19 UJ	4.3 UJ
1,4-Phenylenediamine	2000 R	2100 R	1900 R	2300 R	NA	NA	NA	NA	NA	NA	NA	NA
1-Naphthylamine	200 U	210 U	190 U	230 U	22 UJ	22 U	21 U	240 U	96 U	100 U	100 U	22 U
2,2'-Oxybis[1-chloropropane]	200 U	210 U	190 U	230 U	9.5 U	9.5 U	9 U	100 U	41 U	43 U	42 U	9.3 U
2,3,4,6-Tetrachlorophenol	380 UJ	410 U	380 U	440 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U
2,4,5-Trichlorophenol	380 UJ	410 U	380 U	440 U	10 U	10 U	9.5 U	110 U	43 U	45 U	45 U	9.8 U
2,4,6-Trichlorophenol	380 UJ	410 U	380 U	440 U	10 U	10 U	9.8 U	110 U	44 U	47 U	47 U	10 U
2,4-Dichlorophenol	380 UJ	410 U	380 U	440 U	9.5 U	9.5 U	9 U	100 U	41 U	43 U	42 U	9.3 U
2,4-Dimethylphenol	380 UJ	410 U	380 U	440 U	10 U	10 U	9.5 U	110 U	43 U	45 U	45 U	9.8 U

APPENDIX O

SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB22	59SB22	59SB23	59SB23	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31
Sample ID	59SB22-01	59SB22-05	59SB23-01	59SB23-05	59SB24-00	59SB25-00	59SB26-00	59SB27-00	59SB28-00	59SB29-00	59SB30-00	59SB31-00
Sample Date	5/18/2010	5/18/2010	5/19/2010	5/19/2010	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Sample Depth (ft bgs)	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Semivolatile Organics (µg/kg) (cont.)												
2,4-Dinitrophenol	380 UJ	410 U	380 U	440 U	55 U	55 U	52 U	590 UJ	240 UJ	250 UJ	250 UJ	54 U
2,4-Dinitrotoluene (DNT)	200 U	210 U	190 U	230 U	9.9 U	9.9 U	9.3 U	100 U	42 U	44 U	44 U	9.7 U
2,6-Dichlorophenol	380 UJ	410 U	380 U	440 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U
2,6-Dinitrotoluene (DNT)	200 U	210 U	190 U	230 U	10 U	10 U	9.8 U	110 U	44 U	47 U	47 U	10 U
2-Acetylaminofluorene	200 UJ	210 UJ	190 U	230 U	43 U	44 U	41 U	460 U	190 U	200 U	190 U	43 U
2-Chloronaphthalene	200 U	210 U	190 U	230 U	7.9 U	7.9 U	7.5 U	84 U	34 U	36 U	35 U	7.7 U
2-Chlorophenol	380 UJ	410 U	380 U	440 U	7 U	7 U	6.6 U	74 U	30 U	31 U	31 U	6.8 U
2-Methyl-5-nitroaniline	200 U	210 U	190 U	230 U	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylphenol (o-Cresol)	380 UJ	410 U	380 U	440 U	8.3 U	8.3 U	7.8 U	88 U	35 U	37 U	37 U	8.1 U
2-Naphthylamine	200 U	210 U	190 U	230 U	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U
2-Nitroaniline	200 U	210 U	190 U	230 U	9.2 U	9.2 U	8.7 U	98 U	39 U	41 U	41 U	9 U
2-Nitrophenol	380 UJ	410 U	380 U	440 U	7.6 U	7.7 U	7.2 U	81 U	33 U	34 U	34 U	7.5 U
2-Picoline	200 U	210 U	190 U	230 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U
3,3'-Dichlorobenzidine	200 U	210 U	190 U	230 U	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U
3,3'-Dimethylbenzidine	200 UJ	210 UJ	190 U	230 U	87 U	87 U	82 U	920 UJ	370 UJ	390 UJ	390 UJ	85 U
3-Methylcholanthrene	200 UJ	210 UJ	190 U	230 U	43 U	44 U	41 U	460 U	190 U	200 U	190 U	43 U
3-Methylphenol (m-Cresol)	290 UJ	310 U	280 U	330 U	NA	NA	NA	NA	NA	NA	NA	NA
3 & 4 Methylphenol	NA	NA	NA	NA	9.6 U	9.6 U	9.1 U	100 U	41 U	43 U	43 U	9.4 U
3-Nitroaniline	200 U	210 U	190 U	230 U	8.8 U	8.8 U	8.3 U	93 U	38 U	40 U	39 U	8.6 U
4,6-Dinitro-2-methylphenol	380 UJ	410 U	380 U	440 U	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U
4-Aminobiphenyl	200 U	210 U	190 U	230 U	22 UJ	22 UJ	21 UJ	240 U	96 U	100 U	100 U	22 UJ
4-Bromophenyl-phenylether	200 U	210 U	190 U	230 U	9.1 U	9.1 U	8.6 U	96 U	39 U	41 U	41 U	8.9 U
4-Chloro-3-methylphenol	380 UJ	410 U	380 U	440 U	9.2 U	9.2 U	8.7 U	98 U	39 U	41 U	41 U	9 U
4-Chloroaniline	200 U	210 U	190 U	230 U	6.8 U	6.9 U	6.5 U	73 U	29 U	31 U	31 U	6.7 U
4-Chlorophenyl-phenylether	200 U	210 U	190 U	230 U	8.4 U	8.5 U	8 U	89 U	36 U	38 U	38 U	8.3 U
4-Dimethylaminoazobenzene (p-)	200 U	210 U	190 U	230 U	NA	NA	NA	NA	NA	NA	NA	NA
4-Methylphenol (p-Cresol)	290 UJ	310 U	280 U	330 U	NA	NA	NA	NA	NA	NA	NA	NA
4-Nitroaniline	200 U	210 U	190 U	230 U	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U
4-Nitrophenol	380 UJ	410 U	380 U	440 U	96 U	96 U	91 U	1000 U	410 U	430 U	430 U	94 U
4-Nitroquinoline-1-oxide	200 U	210 U	190 U	230 U	55 U	55 U	52 U	590 U	240 U	250 U	250 U	54 U
7,12-Dimethylbenz(a)anthracene	200 U	210 U	190 U	230 U	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U
a,a-Dimethylphenethylamine	540 UJ	590 UJ	530 U	630 U	430 UJ	440 UJ	410 UJ	4600 UJ	1900 UJ	2000 UJ	1900 UJ	430 UJ
Acetophenone	98 U	110 U	96 U	110 U	9 U	9 U	8.5 U	95 U	38 U	40 U	40 U	8.8 U
Aniline	200 U	210 U	190 U	230 U	11 U	11 U	10 U	110 U	46 U	49 U	48 U	11 U
Aramite	200 U	210 U	190 U	230 U	6.3 U	6.3 U	6 U	67 U	27 U	28 U	28 U	6.2 U
Benzyl Alcohol	200 UJ	210 U	190 U	230 U	8 U	8.1 U	7.6 U	85 U	34 U	36 U	36 U	7.9 U
Bis(2-chloroethoxy)methane	200 U	210 U	190 U	230 U	8.6 U	8.6 U	8.1 U	91 U	37 U	38 U	38 U	8.4 U
Bis(2-chloroethyl)ether	200 U	210 U	190 U	230 U	8.6 U	8.6 U	8.1 U	91 U	37 U	38 U	38 U	8.4 U
Bis(2-ethylhexyl) Phthalate (BEHP)	200 U	210 U	190 U	230 U	43 J	78 J	7.5 U	84 U	34 U	36 U	35 J	11 J
Butyl Benzyl Phthalate	200 U	210 U	190 U	230 U	8.8 U	8.8 U	8.3 U	93 U	38 U	40 U	39 U	8.6 U

APPENDIX O

SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB22	59SB22	59SB23	59SB23	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31
Sample ID	59SB22-01	59SB22-05	59SB23-01	59SB23-05	59SB24-00	59SB25-00	59SB26-00	59SB27-00	59SB28-00	59SB29-00	59SB30-00	59SB31-00
Sample Date	5/18/2010	5/18/2010	5/19/2010	5/19/2010	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Sample Depth (ft bgs)	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Semivolatile Organics (µg/kg) (cont.)												
Diallate (cis)	200 U	210 U	190 U	230 U	NA	NA	NA	NA	NA	NA	NA	NA
Diallate (trans)	200 U	210 U	190 U	230 U	NA	NA	NA	NA	NA	NA	NA	NA
Diallate	NA	NA	NA	NA	7.4 U	7.4 U	7 U	78 U	32 U	33 U	33 U	7.2 U
Dibenzofuran	200 U	210 U	190 U	230 U	8.8 U	8.8 U	8.3 U	93 U	38 U	40 U	39 U	8.6 U
Diethyl Phthalate (DEP)	200 U	210 U	190 U	230 U	9.7 U	9.8 U	9.2 U	100 U	42 U	44 U	44 U	9.5 U
Dimethyl Phthalate	200 U	210 U	190 U	230 U	9.9 U	9.9 U	9.3 U	100 U	42 U	44 U	44 U	9.7 U
Di-n-butyl Phthalate (DBP)	200 U	210 U	190 U	230 U	22 U	22 U	21 U	240 U	96 U	100 U	100 UJ	22 U
Di-n-octyl Phthalate	55 J	210 U	190 U	230 U	8.8 U	8.8 U	8.3 U	93 U	38 U	40 U	39 U	8.6 U
Dinoseb	200 U	210 U	190 U	230 U	8.8 U	8.8 U	8.3 U	93 UJ	38 UJ	40 UJ	39 UJ	8.6 U
Ethyl Methane Sulfonate (EMS)	200 UJ	210 UJ	190 UJ	230 UJ	10 U	10 U	9.7 U	110 U	44 U	46 U	46 U	10 U
Hexachloro-1,3-butadiene	200 U	210 U	190 U	230 U	9 U	9 U	8.5 U	95 U	38 U	40 U	40 U	8.8 U
Hexachlorobenzene	200 U	210 U	190 U	230 U	10 U	10 U	9.5 U	110 U	43 U	45 U	45 U	9.8 U
Hexachlorocyclopentadiene	200 U	210 U	190 U	230 U	4.9 U	4.9 U	4.6 U	52 U	21 U	22 U	22 U	4.8 U
Hexachloroethane	200 U	210 U	190 U	230 U	7.6 U	7.7 U	7.2 U	81 U	33 U	34 U	34 U	7.5 U
Hexachlorophene	NA	NA	NA	NA	3200 UJ	3200 U	3000 U	33000 UJ	14000 UJ	14000 UJ	14000 UJ	3100 U
Hexachloropropene	200 U	210 U	190 U	230 U	7 U	7 U	6.6 U	74 U	30 U	31 U	31 U	6.8 U
Isophorone	200 U	210 U	190 U	230 U	9.2 U	9.2 U	8.7 U	98 U	39 U	41 U	41 U	9 U
Isosafrole	200 U	210 U	190 U	230 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U
Methapyrilene	200 U	210 U	190 U	230 U	88 UJ	88 UJ	83 UJ	930 UJ	380 UJ	400 UJ	390 UJ	86 UJ
Methyl Methane Sulfonate	200 U	210 U	190 U	230 U	5 UJ	5 UJ	4.7 UJ	53 UJ	21 UJ	22 UJ	22 UJ	4.9 UJ
Nitrobenzene	200 U	210 U	190 U	230 U	8.7 U	8.7 U	8.2 U	92 U	37 U	39 U	39 U	8.5 U
N-Nitro-o-toluidine	NA	NA	NA	NA	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U
n-Nitrosodiethylamine	200 U	210 U	190 U	230 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U
n-Nitrosodimethylamine (NDMA)	200 U	210 U	190 U	230 U	25 U	25 U	24 U	270 U	110 U	110 U	110 U	25 U
n-Nitroso-di-n-butylamine	200 UJ	210 UJ	190 UJ	230 UJ	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U
n-Nitrosodi-n-propylamine	200 U	210 U	190 U	230 U	9.9 U	9.9 U	9.3 U	100 U	42 U	44 U	44 U	9.7 U
n-Nitrosodiphenylamine	200 U	210 U	190 U	230 U	8 U	8.1 U	7.6 U	85 U	34 U	36 U	36 U	7.9 U
n-Nitrosomethylethylamine	200 U	210 U	190 U	230 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U
n-Nitrosomorpholine	200 U	210 U	190 U	230 U	5.9 U	5.9 U	5.6 U	63 U	25 U	27 U	27 U	5.8 U
n-Nitrosopiperidine	200 U	210 U	190 U	230 U	4.5 U	4.5 U	4.2 U	47 U	19 U	20 U	20 U	4.4 U
n-Nitrosopyrrolidine	200 UJ	210 UJ	190 U	230 U	4.7 U	4.8 U	4.5 U	50 U	20 U	21 U	21 U	4.6 U
o-Toluidine	200 U	210 U	190 U	230 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U
p-Dimethylamino azobenzene	NA	NA	NA	NA	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U
Pentachlorobenzene	200 U	210 U	190 U	230 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U
Pentachloronitrobenzene	200 U	210 U	190 U	230 U	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U
Pentachlorophenol	380 UJ	410 U	380 U	440 U	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U
Phenacetin	200 U	210 U	190 U	230 U	22 U	22 U	21 U	240 U	96 U	100 U	100 U	22 U
Phenol	380 UJ	410 U	380 U	440 U	8.6 U	8.6 U	8.1 U	91 U	37 U	38 U	38 U	8.4 U
p-Phenylene diamine	NA	NA	NA	NA	1100 UJ	1100 U	1000 U	12000 UJ	4700 UJ	4900 UJ	4900 UJ	1100 U
Pronamide	200 U	210 U	190 U	230 U	5.5 U	5.5 U	5.2 U	59 U	24 U	25 U	25 U	5.4 U

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SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB22	59SB22	59SB23	59SB23	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31
Sample ID	59SB22-01	59SB22-05	59SB23-01	59SB23-05	59SB24-00	59SB25-00	59SB26-00	59SB27-00	59SB28-00	59SB29-00	59SB30-00	59SB31-00
Sample Date	5/18/2010	5/18/2010	5/19/2010	5/19/2010	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Sample Depth (ft bgs)	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Semivolatile Organics (µg/kg) (cont.)												
Pyridine	200 U	210 U	190 U	230 U	26 U	26 U	25 U	280 U	110 U	120 U	120 U	26 U
Safrole	200 U	210 U	190 U	230 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U
PAHs (µg/kg)												
2-Methylnaphthalene	9.5 U	10 U	9.4 U	11 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	6.4 J
Acenaphthene	9.5 U	10 U	9.4 U	11 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U
Acenaphthylene	9.5 U	10 U	9.4 U	11 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U
Anthracene	9.5 U	10 U	9.4 U	11 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 UJ	4.3 U
Benzo(a)anthracene	9.5 U	10 U	9.4 U	11 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U
Benzo(a)pyrene (BaP)	9.5 U	10 U	9.4 U	11 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 UJ	4.3 U
Benzo(b)fluoranthene	9.5 U	10 U	9.4 U	11 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 UJ	4.3 U
Benzo(g,h,i)perylene	9.5 U	10 U	9.4 U	11 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 UJ	4.3 U
Benzo(k)fluoranthene	9.5 U	10 U	9.4 U	11 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 UJ	4.3 U
Chrysene	0.88 J	10 U	9.4 U	11 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U
Dibenz(a,h)anthracene	9.5 U	10 U	9.4 U	11 U	8.8 U	8.8 U	8.3 U	93 U	38 U	40 U	39 UJ	8.6 U
Fluoranthene	9.5 U	10 U	9.4 U	11 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 UJ	4.3 U
Fluorene	9.5 U	10 U	9.4 U	11 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U
Indeno(1,2,3-cd)pyrene	9.5 U	10 U	9.4 U	11 U	4.3 U	4.4 U	4.1 U	46 UJ	19 UJ	20 UJ	19 UJ	4.3 U
Naphthalene	9.5 U	10 U	9.4 U	11 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U
Phenanthrene	9.5 U	10 U	9.4 U	11 U	8.8 U	8.8 U	8.3 U	93 U	38 U	40 U	39 UJ	6 J
Pyrene	1.5 J	10 U	9.4 U	11 U	4.3 U	4.4 U	4.1 U	46 U	19 U	20 U	19 U	4.3 U
Pesticides (µg/kg)												
4,4'-DDD	3.8 U	4.1 UJ	3.8 U	4.4 U	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE	3.8 U	4.1 UJ	2.9 J	0.69 J	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT	3.8 U	4.1 UJ	0.63 J	4.4 U	NA	NA	NA	NA	NA	NA	NA	NA
Aldrin	2 U	2.1 UJ	1.9 U	2.3 U	NA	NA	NA	NA	NA	NA	NA	NA
BHC, alpha-	2 U	2.1 UJ	1.9 U	2.3 U	NA	NA	NA	NA	NA	NA	NA	NA
BHC, beta-	2 U	2.1 UJ	1.9 U	2.3 U	NA	NA	NA	NA	NA	NA	NA	NA
BHC, delta-	2 U	2.1 UJ	1.9 U	2.3 U	NA	NA	NA	NA	NA	NA	NA	NA
BHC, gamma- (Lindane)	2 U	2.1 UJ	1.9 U	2.3 U	NA	NA	NA	NA	NA	NA	NA	NA
Chlordane, alpha-	2 U	2.1 UJ	1.9 U	2.3 U	NA	NA	NA	NA	NA	NA	NA	NA
Chlordane, gamma-	2 U	2.1 UJ	1.9 U	2.3 U	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzilate	200 U	210 U	190 U	230 U	NA	NA	NA	NA	NA	NA	NA	NA
Dieldrin	3.8 U	4.1 UJ	3.8 U	4.4 U	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan I	2 U	2.1 UJ	1.9 U	2.3 U	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan II	3.8 U	4.1 UJ	3.8 U	4.4 U	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan Sulfate	3.8 U	4.1 UJ	3.8 U	4.4 U	NA	NA	NA	NA	NA	NA	NA	NA
Endrin	3.8 U	4.1 UJ	3.8 U	4.4 U	NA	NA	NA	NA	NA	NA	NA	NA
Endrin Aldehyde	3.8 U	4.1 UJ	3.8 U	4.4 U	NA	NA	NA	NA	NA	NA	NA	NA

APPENDIX O

SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB22	59SB22	59SB23	59SB23	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31
Sample ID	59SB22-01	59SB22-05	59SB23-01	59SB23-05	59SB24-00	59SB25-00	59SB26-00	59SB27-00	59SB28-00	59SB29-00	59SB30-00	59SB31-00
Sample Date	5/18/2010	5/18/2010	5/19/2010	5/19/2010	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Sample Depth (ft bgs)	1.0 - 3.0	9.0 - 11.0	1.0 - 3.0	9.0 - 11.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Pesticides (µg/kg) (cont.)												
Heptachlor	2 U	2.1 UJ	1.9 U	2.3 U	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor Epoxide	2 U	2.1 UJ	1.9 U	2.3 U	NA	NA	NA	NA	NA	NA	NA	NA
Isodrin	200 U	210 U	190 U	230 U	NA	NA	NA	NA	NA	NA	NA	NA
Kepone (Chlordecone)	200 UJ	210 UJ	190 U	230 U	NA	NA	NA	NA	NA	NA	NA	NA
Methoxychlor	20 U	21 UJ	19 U	23 U	NA	NA	NA	NA	NA	NA	NA	NA
Toxaphene	95 U	100 UJ	94 U	110 U	NA	NA	NA	NA	NA	NA	NA	NA
Metals (mg/kg)												
Antimony	5.3 UJ	5.9 UJ	5.6 UJ	6.4 UJ	0.65 U	0.64 U	0.62 U	0.69 U	0.57 U	0.6 U	0.59 U	0.64 U
Arsenic	2.6 U	2.9 U	2.8 U	3.2 U	1.8	1.3	0.69	0.84	0.46	0.9	1	0.82
Barium	118	158	88.3	113	210 J	160	110	100	24	160	130	99
Beryllium	2.6 U	0.32 J	0.34 J	0.35 J	0.63 J	0.28	0.38	0.097	0.11	0.22	0.26	0.37
Cadmium	0.52 J	2.9 U	0.37 J	3.2 U	0.16	0.47	0.075	0.1	0.062	0.11	0.071	0.11
Chromium	32.7	54.7	34.5	67.2	91	61	47	71	33	36	32	51
Cobalt	22.1 J	16.8 J	22.6 J	20.1 J	27 J	25 J	36 J	22 J	14 J	15 J	17 J	19 J
Copper	74.8 J	119 J	79.4 J	74.8 J	260 J	71	100	50	66	130	83	99
Lead	15.7	13.7	18.7	6.8	12 R	12 R	3 R	1.4 R	1.8 R	2.7 R	4.4 R	3.2 R
Mercury	0.038 U	0.024 J	0.022 J	0.034 J	0.011 U	0.069	0.0098 U	0.011 U	0.0093 U	0.014 J	0.017 J	0.01 U
Nickel	16.9	12.6	14.4	20.3	33 J	30	30	33	17	17	16	23
Selenium	13.2 U	1.1 J	0.97 J	16 U	0.32 U	0.74	0.31 U	0.35 U	0.29 U	0.3 U	0.47 J	0.32 U
Silver	2.6 U	2.9 U	2.8 U	3.2 U	0.088 J	0.15	0.062 U	0.069 U	0.057 U	0.06 U	0.059 U	0.064 U
Thallium	2.6 U	2.9 U	2.8 U	3.2 U	0.039 J	0.043 J	0.031 U	0.035 U	0.029 U	0.03 U	0.073 J	0.032 U
Tin	5.3 UJ	5.9 UJ	5.6 UJ	6.4 UJ	8.3 J	3.3 U	3.1 U	3.5 U	2.9 U	3 U	3 U	3.3 U
Vanadium	126 J	182 J	171 J	214 J	280 J	180	140	230	110	140	170	240
Zinc	71.8 J	49.9	119	58.6	100 J	73	76	42	44	68	50	78

APPENDIX O

SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB32	59SB33	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB32-00	59SB33-00	59SB24-01	59SB25-01	59SB26-01	59SB27-01	59SB28-01	59SB29-01	59SB30-01	59SB31-01	59SB32-01	59SB33-01
Sample Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0
Volatile Organics (µg/kg)												
1,1,1,2-Tetrachloroethane	2.6 U	2.4 U	2.4 U	2.3 U	2.3 U	2.7 U	2 U	2.3 U	2.3 U	3.4 U	2.1 U	2.5 U
1,1,1-Trichloroethane	1.1 U	1 U	0.99 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
1,1,2,2-Tetrachloroethane	1.7 U	1.6 U	1.6 U	1.5 U	1.6 U	1.8 U	1.3 U	1.5 U	1.5 U	2.3 U	1.4 U	1.7 U
1,1,2-Trichloroethane	1.4 U	1.3 U	1.3 U	1.2 U	1.3 U	1.5 U	1.1 U	1.2 U	1.3 U	1.8 U	1.1 U	1.4 U
1,1-Dichloroethane	1.2 U	1.1 U	1.1 U	1 U	1.1 U	1.2 U	0.91 U	1 U	1.1 U	1.5 U	0.95 U	1.2 U
1,1-Dichloroethene	1.6 U	1.5 U	1.5 U	1.4 U	1.5 U	1.7 U	1.2 U	1.4 U	1.4 U	2.1 U	1.3 U	1.6 U
1,2,3-Trichloropropane	2.6 U	2.4 U	2.4 U	2.3 U	2.3 U	2.7 U	2 U	2.3 U	2.3 U	3.4 U	2.1 U	2.5 U
1,2,4-Trichlorobenzene	1.1 U	1 U	0.99 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
1,2-Dibromo-3-chloropropane (DBCP)	4.7 U	4.4 U	4.4 U	4.2 U	4.3 U	4.9 U	3.6 U	4.2 U	4.2 U	6.2 U	3.8 U	4.7 U
1,2-Dibromoethane (EDB)	1.6 U	1.5 U	1.5 U	1.4 U	1.5 U	1.7 U	1.2 U	1.4 U	1.4 U	2.1 U	1.3 U	1.6 U
1,2-Dichlorobenzene	1.4 U	1.3 U	1.3 U	1.2 U	1.3 U	1.5 U	1.1 U	1.2 U	1.3 U	1.8 U	1.1 U	1.4 U
1,2-Dichloroethane	1.2 U	1.1 U	1.1 U	1 U	1.1 U	1.2 U	0.91 U	1 U	1.1 U	1.5 U	0.95 U	1.2 U
1,2-Dichloroethene (trans)	1.1 U	1 U	0.99 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
1,2-Dichloropropane	1.1 U	1 U	0.99 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
1,3-Dichlorobenzene	1.7 U	1.6 U	1.6 U	1.5 U	1.6 U	1.8 U	1.3 U	1.5 U	1.5 U	2.3 U	1.4 U	1.7 U
1,3-Dichloropropene (cis)	1.1 U	1 U	0.99 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
1,3-Dichloropropene (trans)	1.1 U	1 U	0.99 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
1,4-Dichloro-2-butene (trans)	3.1 U	2.9 U	2.9 U	2.7 U	2.8 U	3.3 U	2.4 U	2.8 U	2.8 U	4.1 U	2.5 U	3.1 U
1,4-Dichlorobenzene	1.1 U	1 U	0.99 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
1,4-Dioxane (p-)	53 R	50 R	49 R	47 R	49 R	56 R	41 R	48 R	48 R	70 R	43 R	53 R
2-Butanone (MEK)	2.6 U	2.4 U	2.4 U	2.3 U	2.3 U	2.7 U	2 U	2.3 U	2.3 U	3.4 U	2.1 U	2.5 U
2-Chloro-1,3-butadiene (Chloroprene)	2.2 U	2.1 U	2.1 U	2 U	2 U	2.4 U	1.7 U	2 U	2 U	3 U	1.8 U	2.2 U
2-Hexanone (MBK)	3.5 U	3.3 U	3.3 U	3.1 U	3.2 U	3.7 U	2.7 U	3.1 U	3.2 U	4.6 U	2.8 U	3.5 U
3-Chloropropene (Allyl Chloride)	2.4 U	2.2 U	2.2 U	2.1 U	2.1 U	2.5 U	1.8 U	2.1 U	2.1 U	3.1 U	1.9 U	2.3 U
4-Methyl-2-pentanone (MIBK)	4.5 U	4.2 U	4.2 U	4 U	4.1 U	4.7 U	3.5 U	4 U	4 U	5.9 U	3.6 U	4.5 U
Acetone	45 J	11 U	11 UJ	16 J	11 U	12 U	9.1 U	40 J	14 J	15 U	9.5 U	12 U
Acetonitrile	44 UJ	41 U	41 U	39 U	40 UJ	46 UJ	34 UJ	39 UJ	40 U	58 U	35 UJ	44 U
Acrolein	26 UJ	24 U	24 U	23 U	23 UJ	27 UJ	20 UJ	23 UJ	23 U	34 UJ	21 UJ	25 U
Acrylonitrile	36 UJ	34 U	34 U	32 U	33 UJ	38 UJ	28 UJ	32 UJ	33 U	48 UJ	29 UJ	36 U
Benzene	1.1 U	1 U	0.99 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
Bromodichloromethane	1.1 U	1 U	0.99 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
Bromoform	1.6 U	1.5 U	1.5 U	1.4 U	1.5 U	1.7 U	1.2 U	1.4 U	1.4 U	2.1 U	1.3 U	1.6 U
Bromomethane	1.6 U	1.5 U	1.5 U	1.4 U	1.5 U	1.7 U	1.2 U	1.4 U	1.4 U	2.1 U	1.3 U	1.6 U
Carbon Disulfide	1.2 U	1.1 U	1.1 U	1 U	1.1 U	1.2 U	0.91 U	1 U	1.1 U	1.5 U	0.95 U	1.2 U
Carbon Tetrachloride	1.1 U	1 U	0.99 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
Chlorobenzene	1.1 U	1 U	0.99 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
Chloroethane	2.9 U	2.7 U	2.7 U	2.5 U	2.6 U	3 U	2.2 U	2.6 U	2.6 U	3.8 U	2.3 U	2.9 U
Chloroform	1.2 U	1.1 U	1.1 U	1 U	1.1 U	1.2 U	0.91 U	1 U	1.1 U	1.5 U	0.95 U	1.2 U
Chloromethane	2.1 U	2 U	2 U	1.9 U	1.9 U	2.2 U	1.7 U	1.9 U	1.9 U	2.8 U	1.7 U	2.1 U
Dibromochloromethane	1.8 U	1.7 U	1.7 U	1.6 U	1.7 U	1.9 U	1.4 U	1.6 U	1.6 U	2.4 U	1.5 U	1.8 U

APPENDIX O

SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB32	59SB33	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB32-00	59SB33-00	59SB24-01	59SB25-01	59SB26-01	59SB27-01	59SB28-01	59SB29-01	59SB30-01	59SB31-01	59SB32-01	59SB33-01
Sample Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0
Volatile Organics (µg/kg) (cont.)												
Dibromomethane	1.8 U	1.7 U	1.7 U	1.6 U	1.7 U	1.9 U	1.4 U	1.6 U	1.6 U	2.4 U	1.5 U	1.8 U
Ethyl Methacrylate	3.6 U	3.4 U	3.4 U	3.2 U	3.3 U	3.8 U	2.8 U	3.2 U	3.3 U	4.8 U	2.9 U	3.6 U
Ethylbenzene	1.4 U	1.3 U	1.3 U	1.2 U	1.3 U	1.5 U	1.1 U	1.2 U	1.3 U	1.8 U	1.1 U	1.4 U
Freon 11 (Trichlorofluoromethane)	1.3 U	1.2 U	1.2 U	1.1 U	1.2 U	1.3 U	0.99 U	1.1 U	1.2 U	1.7 U	1 U	1.3 U
Freon-12 (Dichlorodifluoromethane)	1.1 U	1 U	0.99 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
Hexachlorobutadiene	3.3 U	3.1 U	3.1 U	2.9 U	3 U	3.5 U	2.6 U	2.9 U	3 U	4.4 U	2.7 U	3.3 U
Isobutyl Alcohol	56 R	52 R	51 R	49 R	51 R	58 R	43 R	49 R	50 R	73 R	45 R	55 R
Methyl Acrylonitrile	25 UJ	23 U	23 U	22 U	22 UJ	26 UJ	19 UJ	22 UJ	22 U	32 U	20 UJ	24 U
Methyl Iodide	1.9 UJ	1.8 U	1.8 U	1.7 U	1.8 UJ	2 UJ	1.5 UJ	1.7 UJ	1.7 U	2.5 UJ	1.5 UJ	1.9 U
Methyl Methacrylate	4.8 U	4.5 U	4.5 U	4.2 U	4.4 U	5.1 U	3.7 U	4.3 U	4.3 U	6.3 U	3.9 U	4.8 U
Methylene Chloride	1.1 U	1 U	0.99 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	7.2	0.86 U	1.1 U
Pentachloroethane	6.7 U	6.3 U	6.2 U	5.9 U	6.1 U	7.1 U	5.2 U	6 U	6.1 U	8.9 U	5.4 U	6.7 U
Propionitrile (Ethyl Cyanide)	28 UJ	26 U	26 U	25 U	25 UJ	29 UJ	22 UJ	25 UJ	25 U	37 U	22 UJ	28 U
Styrene (Ethenylbenzene)	1.1 U	1 U	0.99 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
Tetrachloroethene (PCE)	2 U	1.9 U	1.9 U	1.8 U	1.8 U	2.1 U	1.6 U	1.8 U	1.8 U	2.7 U	1.6 U	2 U
Toluene	1.1 U	1 U	0.99 U	0.94 U	0.97 U	1.1 U	0.83 U	0.95 U	0.96 U	1.4 U	0.86 U	1.1 U
Trichloroethene (TCE)	1.4 U	1.3 U	1.3 U	1.2 U	1.3 U	1.5 U	1.1 U	1.2 U	1.3 U	1.8 U	1.1 U	1.4 U
Vinyl Acetate	2.7 U	2.5 U	2.5 U	2.4 U	2.4 U	2.8 U	2.1 U	2.4 U	2.4 U	3.5 U	2.2 U	2.7 U
Vinyl Chloride	1.6 U	1.5 U	1.5 U	1.4 U	1.5 U	1.7 U	1.2 U	1.4 U	1.4 U	2.1 U	1.3 U	1.6 U
Xylene, m/p-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Xylene, o-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Xylenes, total	1.2 U	1.1 U	1.1 U	1 U	1.1 U	1.2 U	0.91 U	1 U	1.1 U	1.5 U	0.95 U	1.2 U
Semivolatile Organics (µg/kg)												
1,2,4,5-Tetrachlorobenzene	4.6 U	4.4 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
1,2,4-Trichlorobenzene	6.4 U	6.2 U	5.9 U	6 U	6.3 U	6.5 U	5.2 U	6.1 U	6.2 U	6.5 U	5.8 U	6.3 U
1,2-Dichlorobenzene (o-)	9.1 U	8.8 U	8.5 U	8.7 U	9.1 U	9.4 U	7.4 U	8.7 U	9 U	9.4 U	8.3 U	9.1 U
1,3,5-Trinitrobenzene (TNB)	24 U	23 UJ	22 U	22 U	23 U	24 U	19 U	22 UJ	23 UJ	24 U	21 U	23 UJ
1,3-Dichlorobenzene (m-)	7.8 U	7.5 U	7.2 U	7.4 U	7.7 U	7.9 U	6.3 U	7.4 U	7.6 U	8 U	7.1 U	7.7 U
1,3-Dinitrobenzene (m-)	24 U	23 U	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
1,4-Dichlorobenzene (p-)	7.2 U	7 U	6.7 U	6.8 U	7.2 U	7.4 U	5.9 U	6.9 U	7.1 U	7.4 U	6.6 U	7.2 U
1,4-Naphthoquinone	4.6 UJ	4.4 UJ	4.2 UJ	4.3 UJ	4.5 UJ	4.7 UJ	3.7 UJ	4.4 UJ	4.5 UJ	4.7 UJ	4.2 UJ	4.5 UJ
1,4-Phenylenediamine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1-Naphthylamine	24 U	23 UJ	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
2,2'-Oxybis[1-chloropropane]	10 U	9.6 U	9.2 U	9.5 U	9.9 U	10 U	8.1 U	9.5 U	9.8 U	10 U	9.1 U	9.9 U
2,3,4,6-Tetrachlorophenol	4.6 U	4.4 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
2,4,5-Trichlorophenol	11 U	10 U	9.7 U	10 U	10 U	11 U	8.6 U	10 U	10 U	11 U	9.6 U	10 U
2,4,6-Trichlorophenol	11 U	11 U	10 U	10 U	11 U	11 U	8.9 U	10 U	11 U	11 U	10 U	11 U
2,4-Dichlorophenol	10 U	9.6 U	9.2 U	9.5 U	9.9 U	10 U	8.1 U	9.5 U	9.8 U	10 U	9.1 U	9.9 U
2,4-Dimethylphenol	11 U	10 U	9.7 U	17 J	10 U	11 U	8.6 U	10 U	10 U	11 U	9.6 U	10 U

APPENDIX O

SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB32	59SB33	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB32-00	59SB33-00	59SB24-01	59SB25-01	59SB26-01	59SB27-01	59SB28-01	59SB29-01	59SB30-01	59SB31-01	59SB32-01	59SB33-01
Sample Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0
Semivolatile Organics (µg/kg) (cont.)												
2,4-Dinitrophenol	58 U	56 UJ	54 U	55 U	58 U	60 U	47 U	55 UJ	57 UJ	60 U	53 U	58 UJ
2,4-Dinitrotoluene (DNT)	10 U	10 U	9.6 U	9.9 U	10 U	11 U	8.5 U	9.9 U	10 U	11 U	9.5 U	10 U
2,6-Dichlorophenol	4.6 U	4.4 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
2,6-Dinitrotoluene (DNT)	11 U	11 U	10 U	10 U	11 U	11 U	8.9 U	10 U	11 U	11 U	10 U	11 U
2-Acetylaminofluorene	46 U	44 U	42 U	43 U	45 U	47 U	37 U	44 U	45 U	47 U	42 U	45 U
2-Chloronaphthalene	8.3 U	8 U	7.7 U	7.9 U	8.3 U	8.5 U	6.8 U	7.9 U	8.1 U	8.5 U	7.6 U	8.3 U
2-Chlorophenol	7.3 U	7.1 U	6.8 U	7 U	7.3 U	7.5 U	6 U	7 U	7.2 U	7.5 U	6.7 U	7.3 U
2-Methyl-5-nitroaniline	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylphenol (o-Cresol)	8.7 U	8.4 U	8.1 U	8.3 U	8.7 U	8.9 U	7.1 U	8.3 U	8.6 U	9 U	7.9 U	8.7 U
2-Naphthylamine	24 U	23 U	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
2-Nitroaniline	9.7 U	9.4 U	9 U	9.2 U	9.6 U	9.9 U	7.9 U	9.2 U	9.5 U	10 U	8.8 U	9.6 U
2-Nitrophenol	8 U	7.8 U	7.4 U	7.6 U	8 U	8.2 U	6.5 U	7.7 U	7.9 U	8.3 U	7.3 U	8 U
2-Picoline	4.6 U	4.4 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
3,3'-Dichlorobenzidine	24 U	23 U	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
3,3'-Dimethylbenzidine	91 U	88 UJ	85 U	87 U	91 U	94 U	74 U	87 UJ	90 UJ	94 U	83 U	91 UJ
3-Methylcholanthrene	46 U	44 U	42 U	43 U	45 U	47 U	37 U	44 U	45 U	47 U	42 U	45 U
3-Methylphenol (m-Cresol)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3 & 4 Methylphenol	10 U	9.8 U	9.4 U	9.6 U	10 U	10 U	8.2 U	9.6 U	9.9 U	10 U	9.2 U	10 U
3-Nitroaniline	9.3 U	9 U	8.6 U	8.8 U	9.2 U	9.5 U	7.6 U	8.8 U	9.1 U	9.5 U	8.4 U	9.2 U
4,6-Dinitro-2-methylphenol	24 U	23 U	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
4-Aminobiphenyl	24 UJ	23 U	22 UJ	22 UJ	23 UJ	24 UJ	19 UJ	22 U	23 U	24 UJ	21 UJ	23 U
4-Bromophenyl-phenylether	9.6 U	9.2 U	8.8 U	9.1 U	9.5 U	9.8 U	7.8 U	9.1 U	9.4 U	9.8 U	8.7 U	9.5 U
4-Chloro-3-methylphenol	9.7 U	9.4 U	9 U	9.2 U	9.6 U	9.9 U	7.9 U	9.2 U	9.5 U	10 U	8.8 U	9.6 U
4-Chloroaniline	7.2 U	7 U	6.7 U	6.8 U	7.2 U	7.4 U	5.9 U	6.9 U	7.1 U	7.4 U	6.6 U	7.2 U
4-Chlorophenyl-phenylether	8.9 U	8.6 U	8.2 U	8.4 U	8.8 U	9.1 U	7.2 U	8.4 U	8.7 U	9.1 U	8.1 U	8.8 U
4-Dimethylaminoazobenzene (p-)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Methylphenol (p-Cresol)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Nitroaniline	24 U	23 U	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
4-Nitrophenol	100 U	98 U	94 U	96 U	100 U	100 U	82 U	96 U	99 U	100 U	92 U	100 U
4-Nitroquinoline-1-oxide	58 U	56 U	54 U	55 U	58 U	60 U	47 U	55 U	57 U	60 U	53 U	58 U
7,12-Dimethylbenz(a)anthracene	24 U	23 U	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
a,a-Dimethylphenethylamine	460 UJ	440 UJ	420 UJ	430 UJ	450 UJ	470 UJ	370 UJ	440 UJ	450 UJ	470 UJ	420 UJ	450 UJ
Acetophenone	9.4 U	9.1 U	8.7 U	8.9 U	9.4 U	9.6 U	7.7 U	9 U	9.2 U	9.7 U	8.6 U	9.4 U
Aniline	11 U	11 U	11 U	11 U	11 U	12 U	9.3 U	11 U	11 U	12 U	10 U	11 U
Aramite	6.6 U	6.4 U	6.2 U	6.3 U	6.6 U	6.8 U	5.4 U	6.3 U	6.5 U	6.8 U	6.1 U	6.6 U
Benzyl Alcohol	8.4 U	8.2 U	7.8 U	8 U	8.4 U	8.7 U	6.9 U	8 U	8.3 U	8.7 U	7.7 U	8.4 U
Bis(2-chloroethoxy)methane	9 U	8.7 U	8.3 U	8.5 U	8.9 U	9.2 U	7.3 U	8.6 U	8.8 U	9.3 U	8.2 U	9 U
Bis(2-chloroethyl)ether	9 U	8.7 U	8.3 U	8.5 U	8.9 U	9.2 U	7.3 U	8.6 U	8.8 U	9.3 U	8.2 U	9 U
Bis(2-ethylhexyl) Phthalate (BEHP)	8.3 U	19 J	12 J	59 J	43 J	14 J	15 J	7.9 U	18 J	8.6 J	8.5 J	8.3 U
Butyl Benzyl Phthalate	9.3 U	9 U	8.6 U	8.8 U	9.2 U	9.5 U	7.6 U	8.8 U	9.1 U	9.5 U	8.4 U	9.2 U

APPENDIX O

SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB32	59SB33	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB32-00	59SB33-00	59SB24-01	59SB25-01	59SB26-01	59SB27-01	59SB28-01	59SB29-01	59SB30-01	59SB31-01	59SB32-01	59SB33-01
Sample Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0
Semivolatile Organics (µg/kg) (cont.)												
Diallate (cis)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Diallate (trans)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Diallate	7.8 U	7.5 U	7.2 U	7.4 U	7.7 U	7.9 U	6.3 U	7.4 U	7.6 U	8 U	7.1 U	7.7 U
Dibenzofuran	9.3 U	9 U	8.6 U	8.8 U	9.2 U	9.5 U	7.6 U	8.8 U	9.1 U	9.5 U	8.4 U	9.2 U
Diethyl Phthalate (DEP)	10 U	9.9 U	9.5 U	9.7 U	10 U	10 U	8.4 U	9.8 U	10 U	11 U	9.3 U	10 U
Dimethyl Phthalate	10 U	10 U	9.6 U	9.9 U	10 U	11 U	8.5 U	9.9 U	10 U	11 U	9.5 U	10 U
Di-n-butyl Phthalate (DBP)	24 U	23 U	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
Di-n-octyl Phthalate	9.3 U	9 U	8.6 U	8.8 U	9.2 U	9.5 U	7.6 U	8.8 U	9.1 U	9.5 U	8.4 U	9.2 U
Dinoseb	9.3 U	9 UJ	8.6 U	8.8 U	9.2 U	9.5 U	7.6 U	8.8 UJ	9.1 UJ	9.5 U	8.4 U	9.2 UJ
Ethyl Methane Sulfonate (EMS)	11 U	10 U	10 U	10 U	11 U	11 U	8.8 U	10 U	11 U	11 U	9.8 U	11 U
Hexachloro-1,3-butadiene	9.4 U	9.1 U	8.7 U	8.9 U	9.4 U	9.6 U	7.7 U	9 U	9.2 U	9.7 U	8.6 U	9.4 U
Hexachlorobenzene	11 U	10 U	9.7 U	10 U	10 U	11 U	8.6 U	10 U	10 U	11 U	9.6 U	10 U
Hexachlorocyclopentadiene	5.1 U	5 U	4.7 U	4.9 U	5.1 U	5.2 U	4.2 U	4.9 U	5 U	5.3 U	4.7 U	5.1 U
Hexachloroethane	8 U	7.8 U	7.4 U	7.6 U	8 U	8.2 U	6.5 U	7.7 U	7.9 U	8.3 U	7.3 U	8 U
Hexachlorophene	3300 U	3200 UJ	3100 U	3200 U	3300 U	3400 U	2700 U	3200 UJ	3300 UJ	3400 U	3000 U	3300 UJ
Hexachloropropene	7.3 U	7.1 U	6.8 U	7 U	7.3 U	7.5 U	6 U	7 U	7.2 U	7.5 U	6.7 U	7.3 U
Isophorone	9.7 U	9.4 U	9 U	9.2 U	9.6 U	9.9 U	7.9 U	9.2 U	9.5 U	10 U	8.8 U	9.6 U
Isosafrole	4.6 U	4.4 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Methapyrilene	93 UJ	90 UJ	86 UJ	88 UJ	92 UJ	95 UJ	76 UJ	88 UJ	91 UJ	95 UJ	84 UJ	92 UJ
Methyl Methane Sulfonate	5.3 UJ	5.1 UJ	4.9 UJ	5 UJ	5.2 UJ	5.4 UJ	4.3 UJ	5 UJ	5.2 UJ	5.4 UJ	4.8 UJ	5.2 UJ
Nitrobenzene	9.1 U	8.8 U	8.5 U	8.7 U	9.1 U	9.4 U	7.4 U	8.7 U	9 U	9.4 U	8.3 U	9.1 U
N-Nitro-o-toluidine	24 U	23 U	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
n-Nitrosodiethylamine	4.6 U	4.4 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
n-Nitrosodimethylamine (NDMA)	26 U	25 U	24 U	25 U	26 U	27 U	21 U	25 U	26 U	27 U	24 U	26 U
n-Nitroso-di-n-butylamine	24 U	23 U	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
n-Nitrosodi-n-propylamine	10 U	10 U	9.6 U	9.9 U	10 U	11 U	8.5 U	9.9 U	10 U	11 U	9.5 U	10 U
n-Nitrosodiphenylamine	8.4 U	8.2 U	7.8 U	8 U	8.4 U	8.7 U	6.9 U	8 U	8.3 U	8.7 U	7.7 U	8.4 U
n-Nitrosomethylethylamine	4.6 U	4.4 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
n-Nitrosomorpholine	6.2 U	6 U	5.8 U	5.9 U	6.2 U	6.4 U	5.1 U	5.9 U	6.1 U	6.4 U	5.7 U	6.2 U
n-Nitrosopiperidine	4.7 U	4.6 U	4.4 U	4.5 U	4.7 U	4.8 U	3.8 U	4.5 U	4.6 U	4.8 U	4.3 U	4.7 U
n-Nitrosopyrrolidine	5 U	4.8 U	4.6 U	4.7 U	5 U	5.1 U	4.1 U	4.7 U	4.9 U	5.1 U	4.5 U	5 U
o-Toluidine	4.6 U	4.4 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
p-Dimethylamino azobenzene	24 U	23 U	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
Pentachlorobenzene	4.6 U	4.4 U	5.6 J	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Pentachloronitrobenzene	24 U	23 U	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
Pentachlorophenol	24 U	23 U	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
Phenacetin	24 U	23 U	22 U	22 U	23 U	24 U	19 U	22 U	23 U	24 U	21 U	23 U
Phenol	9 U	8.7 U	8.3 U	8.5 U	8.9 U	9.2 U	7.3 U	8.6 U	8.8 U	9.3 U	8.2 U	9 U
p-Phenylene diamine	1100 U	1100 UJ	1100 U	1100 U	1100 U	1200 U	940 U	1100 UJ	1100 UJ	1200 U	1000 U	1100 UJ
Pronamide	5.8 U	5.6 U	5.4 U	5.5 U	5.8 U	6 U	4.7 U	5.5 U	5.7 U	6 U	5.3 U	5.8 U

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SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB32	59SB33	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB32-00	59SB33-00	59SB24-01	59SB25-01	59SB26-01	59SB27-01	59SB28-01	59SB29-01	59SB30-01	59SB31-01	59SB32-01	59SB33-01
Sample Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0
Semivolatile Organics (µg/kg) (cont.)												
Pyridine	28 U	27 U	26 U	26 U	28 U	28 U	23 U	26 U	27 U	28 U	25 U	28 U
Safrole	4.6 U	4.4 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
PAHs (µg/kg)												
2-Methylnaphthalene	4.6 U	4.4 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Acenaphthene	4.6 U	4.4 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Acenaphthylene	4.6 U	4.4 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Anthracene	4.6 U	4.4 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Benzo(a)anthracene	4.6 U	4.4 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Benzo(a)pyrene (BaP)	4.6 U	4.4 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Benzo(b)fluoranthene	4.6 U	4.4 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Benzo(g,h,i)perylene	4.6 U	4.4 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Benzo(k)fluoranthene	4.6 U	4.4 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Chrysene	4.6 U	4.4 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Dibenz(a,h)anthracene	9.3 U	9 U	8.6 U	8.8 U	9.2 U	9.5 U	7.6 U	8.8 U	9.1 U	9.5 U	8.4 U	9.2 U
Fluoranthene	4.6 U	4.4 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Fluorene	4.6 U	4.4 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Indeno(1,2,3-cd)pyrene	4.6 U	4.4 UJ	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 UJ	4.5 UJ	4.7 U	4.2 U	4.5 UJ
Naphthalene	4.6 U	4.4 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Phenanthrene	9.3 U	9 U	8.6 U	8.8 U	9.2 U	9.5 U	7.6 U	4.6 J	9.1 U	9.5 U	8.4 U	9.2 U
Pyrene	4.6 U	4.4 U	4.2 U	4.3 U	4.5 U	4.7 U	3.7 U	4.4 U	4.5 U	4.7 U	4.2 U	4.5 U
Pesticides (µg/kg)												
4,4'-DDD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aldrin	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BHC, alpha-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BHC, beta-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BHC, delta-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BHC, gamma- (Lindane)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chlordane, alpha-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chlordane, gamma-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzilate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dieldrin	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan I	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan II	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan Sulfate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endrin	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endrin Aldehyde	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

APPENDIX O

SUMMARY OF ANALYTICAL DATA - TOTAL SOIL
SWMU - 59 FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB32	59SB33	59SB24	59SB25	59SB26	59SB27	59SB28	59SB29	59SB30	59SB31	59SB32	59SB33
Sample ID	59SB32-00	59SB33-00	59SB24-01	59SB25-01	59SB26-01	59SB27-01	59SB28-01	59SB29-01	59SB30-01	59SB31-01	59SB32-01	59SB33-01
Sample Date	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012	9/13/2012
Sample Depth (ft bgs)	0.0 - 1.0	0.0 - 1.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0	1.0 - 3.0
Pesticides (µg/kg) (cont.)												
Heptachlor	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor Epoxide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Isodrin	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kepone (Chlordecone)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methoxychlor	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Toxaphene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Metals (mg/kg)												
Antimony	0.69 U	0.66 U	0.63 U	0.64 U	0.68 U	0.7 U	0.55 U	0.65 U	0.67 U	0.7 U	0.64 U	0.7 U
Arsenic	1.7	1.4	1.2	1.1	1	0.7	1.1	0.95	1	0.74	1.1	0.86
Barium	91	130	120	120	77	120	30	110	120	81	51	43 J
Beryllium	0.33	0.18	0.5	0.24	0.42	0.12	0.13	0.27	0.22	0.24	0.31	0.14
Cadmium	0.047 J	0.12	0.048 J	0.45	0.22	0.11	0.043 J	0.049 J	0.034 U	0.041 J	0.016 J	0.066 J
Chromium	73	150	45	63	60	25	23	64	70	110	16	120
Cobalt	6 J	20 J	18 J	24 J	15 J	16 J	15 J	15 J	4.7 J	14 J	3.5 J	15 J
Copper	120	110	210	60	110	73	150	89	110	48	67	110
Lead	6.9 R	4.7 R	6.3 R	12 R	2.8 R	1.2 R	0.64 R	3.5 R	3.8 R	0.85 R	4.6 R	2.1 R
Mercury	0.038	0.012 U	0.011 U	0.067	0.011 U	0.013 J	0.0091 U	0.083	0.011 U	0.011 U	0.011 U	0.011 J
Nickel	15	47	18	29	43	26	14	25	17	32	5.7	44
Selenium	1.2	0.33 U	0.32 U	0.69	0.34 U	0.35 U	0.28 U	0.56 J	0.49 J	0.35 U	0.57 J	0.35 U
Silver	0.35	0.066 U	0.063 U	0.064 U	0.068 U	0.07 U	0.055 U	0.065 U	0.067 U	0.07 U	0.064 U	0.26
Thallium	0.035 U	0.033 U	0.032 U	0.032 U	0.034 U	0.035 U	0.028 U	0.033 U	0.034 U	0.035 U	0.037 J	0.035 U
Tin	3.5 U	3.4 U	3.2 U	3.3 U	3.5 U	3.6 U	2.8 U	3.3 U	3.4 U	3.6 U	3.3 U	3.5 U
Vanadium	240	330	180	170	180	170	110	280	280	320	140	400
Zinc	46	57	62	61	77	41	47	56	35	39	68	47

APPENDIX O

SUMMARY OF ANALYTICAL RESULTS - TOTAL SOIL
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Notes:

J - Estimated: The analyte was positively identified; the quantitation is an estimation.
U - Non detected at the Reporting Limit/Limit of Detection.
UJ - Reported quantitation limit is qualified as estimated.
R - Rejected data; data is not usable.
ft bgs - feet below ground surface
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram
NA - Not Analyzed
PAHs - Polynuclear Aromatic Hydrocarbons

APPENDIX O

SUMMARY OF ANALYTICAL RESULTS - GROUNDWATER
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB05	59SB06	59SB07	59SB08	59SB09	59SB10
Sample ID	59GW01	59GW02	59GW03	59GW04	59GW05	59GW06	59GW07	59GW08	59GW09	59GW10
Sample Date	5/22/2010	5/23/2010	5/22/2010	5/23/2010	5/22/2010	5/21/2010	5/21/2010	5/22/2010	5/21/2010	5/22/2010
Volatile Organics (µg/L)										
1,1,1,2-Tetrachloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,1-Trichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2,2-Tetrachloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2-Trichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-Dichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-Dichloroethene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,3-Trichloropropane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dibromo-3-chloropropane (DBCP)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dibromoethane (EDB)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloroethene (trans)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloropropane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,3-Dichloropropene (cis)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,3-Dichloropropene (trans)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,4-Dichloro-2-butene (trans)	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
1,4-Dioxane (p-)	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R
2-Butanone (MEK)	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R
2-Chloro-1,3-butadiene (Chloroprene)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
2-Hexanone (MBK)	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
3-Chloropropene (Allyl Chloride)	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ
4-Methyl-2-pentanone (MIBK)	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
Acetone	3.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R	2.5 R
Acetonitrile	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Acrolein	5 R	5 R	5 R	5 R	5 R	5 R	5 R	5 R	5 R	5 R
Acrylonitrile	5 R	5 R	5 R	5 R	5 R	5 R	5 R	5 R	5 R	5 R
Benzene	0.5 U	0.5 U	0.5 U	0.055 J	0.5 U	0.5 U	0.036 J	0.067 J	0.1 J	0.5 U
Bromodichloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromoform	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Bromomethane	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ
Carbon Disulfide	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.059 J	0.05 J	0.5 U	0.15 J	0.5 U
Carbon Tetrachloride	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chlorobenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloroform	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U

APPENDIX O

SUMMARY OF ANALYTICAL RESULTS - GROUNDWATER
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB05	59SB06	59SB07	59SB08	59SB09	59SB10
Sample ID	59GW01	59GW02	59GW03	59GW04	59GW05	59GW06	59GW07	59GW08	59GW09	59GW10
Sample Date	5/22/2010	5/23/2010	5/22/2010	5/23/2010	5/22/2010	5/21/2010	5/21/2010	5/22/2010	5/21/2010	5/22/2010
Volatile Organics (µg/L) (cont.)										
Dibromochloromethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Dibromomethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Ethyl Methacrylate	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Ethylbenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Freon 11 (Trichlorofluoromethane)	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ
Freon-12 (Dichlorodifluoromethane)	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ
Isobutyl Alcohol	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R
Methyl Acrylonitrile	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Methyl Iodide	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ
Methyl Methacrylate	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Methylene Chloride	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Pentachloroethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Propionitrile (Ethyl Cyanide)	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R	25 R
Styrene (Ethenylbenzene)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Tetrachloroethene (PCE)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Toluene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Trichloroethene (TCE)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Vinyl Acetate	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Vinyl Chloride	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Xylene, m/p-	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Xylene, o-	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Xylenes, total	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Semivolatile Organics (µg/L)										
1,2,4,5-Tetrachlorobenzene	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
1,2,4-Trichlorobenzene	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
1,2-Dichlorobenzene (o-)	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
1,3,5-Trinitrobenzene (TNB)	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
1,3-Dichlorobenzene (m-)	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
1,3-Dinitrobenzene (m-)	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
1,4-Dichlorobenzene (p-)	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
1,4-Naphthoquinone	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
1,4-Phenylenediamine	51 R	54 R	51 R	51 R	51 R	51 R	51 R	51 R	52 R	51 R
1-Naphthylamine	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
2,2'-Oxybis[1-chloropropane]	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ

APPENDIX O

SUMMARY OF ANALYTICAL RESULTS - GROUNDWATER
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB05	59SB06	59SB07	59SB08	59SB09	59SB10
Sample ID	59GW01	59GW02	59GW03	59GW04	59GW05	59GW06	59GW07	59GW08	59GW09	59GW10
Sample Date	5/22/2010	5/23/2010	5/22/2010	5/23/2010	5/22/2010	5/21/2010	5/21/2010	5/22/2010	5/21/2010	5/22/2010
Semivolatile Organics (µg/L) (cont.)										
2,3,4,6-Tetrachlorophenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
2,4,5-Trichlorophenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
2,4,6-Trichlorophenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
2,4-Dichlorophenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
2,4-Dimethylphenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
2,4-Dinitrophenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
2,4-Dinitrotoluene (DNT)	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
2,6-Dichlorophenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
2,6-Dinitrotoluene (DNT)	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
2-Acetylaminofluorene	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
2-Chloronaphthalene	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
2-Chlorophenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
2-Methyl-5-nitroaniline	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
2-Methylphenol (o-Cresol)	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
2-Naphthylamine	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
2-Nitroaniline	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
2-Nitrophenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
2-Picoline	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
3,3'-Dichlorobenzidine	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
3,3'-Dimethylbenzidine	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
3-Methylcholanthrene	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
3-Methylphenol (m-Cresol)	8 UJ	8.4 UJ	8 UJ	8 UJ	8 UJ	8 UJ	8 UJ	8 UJ	8.2 UJ	8 UJ
3-Nitroaniline	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
4,6-Dinitro-2-methylphenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
4-Aminobiphenyl	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
4-Bromophenyl-phenylether	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
4-Chloro-3-methylphenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
4-Chloroaniline	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
4-Chlorophenyl-phenylether	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
4-Dimethylaminoazobenzene (p-)	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
4-Methylphenol (p-Cresol)	8 UJ	8.4 UJ	8 UJ	8 UJ	8 UJ	8 UJ	8 UJ	8 UJ	8.2 UJ	8 UJ
4-Nitroaniline	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
4-Nitrophenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
4-Nitroquinoline-1-oxide	5 R	5.3 R	5 R	5 R	5 UJ	5 R	5 R	5 R	5.1 R	5 R
7,12-Dimethylbenz(a)anthracene	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ

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SUMMARY OF ANALYTICAL RESULTS - GROUNDWATER
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB05	59SB06	59SB07	59SB08	59SB09	59SB10
Sample ID	59GW01	59GW02	59GW03	59GW04	59GW05	59GW06	59GW07	59GW08	59GW09	59GW10
Sample Date	5/22/2010	5/23/2010	5/22/2010	5/23/2010	5/22/2010	5/21/2010	5/21/2010	5/22/2010	5/21/2010	5/22/2010
Semivolatile Organics (µg/L) (cont.)										
a,a-Dimethylphenethylamine	50 UJ	53 UJ	50 UJ	50 UJ	50 UJ	50 UJ	50 UJ	50 UJ	51 UJ	50 UJ
Acetophenone	2.5 UJ	2.6 UJ	2.5 UJ	2.5 UJ	2.5 UJ	2.5 UJ	2.5 UJ	2.5 UJ	2.6 UJ	2.5 UJ
Aniline	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Aramite	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Benzyl Alcohol	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Bis(2-chloroethoxy)methane	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Bis(2-chloroethyl)ether	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Bis(2-ethylhexyl) Phthalate (BEHP)	5 UJ	5.3 UJ	5 UJ	5 UJ	2.4 J	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Butyl Benzyl Phthalate	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Diallate (cis)	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Diallate (trans)	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Dibenzofuran	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Diethyl Phthalate (DEP)	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Dimethyl Phthalate	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Di-n-butyl Phthalate (DBP)	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Di-n-octyl Phthalate	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Dinoseb	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Ethyl Methane Sulfonate (EMS)	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Hexachloro-1,3-butadiene	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Hexachlorobenzene	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Hexachlorocyclopentadiene	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Hexachloroethane	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Hexachloropropene	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Isophorone	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Isosafrole	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Methapyrilene	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Methyl Methane Sulfonate	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Nitrobenzene	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
n-Nitrosodiethylamine	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
n-Nitrosodimethylamine (NDMA)	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
n-Nitroso-di-n-butylamine	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
n-Nitrosodi-n-propylamine	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
n-Nitrosodiphenylamine	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
n-Nitrosomethylethylamine	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
n-Nitrosomorpholine	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ

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CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB05	59SB06	59SB07	59SB08	59SB09	59SB10
Sample ID	59GW01	59GW02	59GW03	59GW04	59GW05	59GW06	59GW07	59GW08	59GW09	59GW10
Sample Date	5/22/2010	5/23/2010	5/22/2010	5/23/2010	5/22/2010	5/21/2010	5/21/2010	5/22/2010	5/21/2010	5/22/2010
Semivolatile Organics (µg/L) (cont.)										
n-Nitrosopiperidine	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
n-Nitrosopyrrolidine	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
o-Toluidine	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Pentachlorobenzene	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Pentachloronitrobenzene	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Pentachlorophenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
Phenacetin	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Phenol	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
Pronamide	5 UJ	5.3 R	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Pyridine	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Safrole	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
PAHs (µg/L)										
2-Methylnaphthalene	0.2 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Acenaphthene	0.2 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Acenaphthylene	0.2 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Anthracene	0.2 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Benzo(a)anthracene	0.2 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Benzo(a)pyrene (BaP)	0.2 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Benzo(b)fluoranthene	0.2 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Benzo(g,h,i)perylene	0.2 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Benzo(k)fluoranthene	0.2 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Chrysene	0.2 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Dibenz(a,h)anthracene	0.2 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Fluoranthene	0.2 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Fluorene	0.2 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Indeno(1,2,3-cd)pyrene	0.2 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Naphthalene	0.2 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	1.3 J	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Phenanthrene	0.2 UJ	0.21 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.054 J
Pyrene	0.01 J	0.01 J	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ	0.21 UJ	0.2 UJ
Pesticides (µg/L)										
4,4'-DDD	0.11 U	0.11 U	0.11 U	0.1 U	0.1 U	0.1 U	0.1 U	0.11 U	0.1 U	0.11 U
4,4'-DDE	0.11 U	0.11 U	0.11 U	0.1 U	0.1 U	0.1 U	0.1 U	0.11 U	0.1 U	0.11 U
4,4'-DDT	0.11 U	0.11 U	0.11 U	0.1 U	0.1 U	0.1 U	0.1 U	0.11 U	0.1 U	0.11 U

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB05	59SB06	59SB07	59SB08	59SB09	59SB10
Sample ID	59GW01	59GW02	59GW03	59GW04	59GW05	59GW06	59GW07	59GW08	59GW09	59GW10
Sample Date	5/22/2010	5/23/2010	5/22/2010	5/23/2010	5/22/2010	5/21/2010	5/21/2010	5/22/2010	5/21/2010	5/22/2010
Pesticides (µg/L) (cont.)										
Aldrin	0.056 U	0.056 U	0.056 U	0.05 U	0.05 U	0.051 U	0.05 U	0.054 U	0.051 U	0.054 U
BHC, alpha-	0.056 U	0.056 U	0.056 U	0.05 U	0.05 U	0.051 U	0.05 U	0.054 U	0.051 U	0.054 U
BHC, beta-	0.056 U	0.056 U	0.056 U	0.05 U	0.05 U	0.051 U	0.05 U	0.054 U	0.051 U	0.054 U
BHC, delta-	0.056 U	0.056 U	0.056 U	0.05 U	0.05 U	0.051 U	0.05 U	0.054 U	0.051 U	0.054 U
BHC, gamma- (Lindane)	0.056 U	0.056 U	0.056 U	0.05 U	0.05 U	0.051 U	0.05 U	0.054 U	0.051 U	0.054 U
Chlordane, alpha-	0.056 U	0.056 U	0.056 U	0.016 NJ	0.05 U	0.051 U	0.05 U	0.054 U	0.051 U	0.054 U
Chlordane, gamma-	0.056 U	0.056 U	0.056 U	0.05 U	0.05 U	0.051 U	0.05 U	0.054 U	0.051 U	0.054 U
Chlorobenzilate	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Dieldrin	0.11 U	0.11 U	0.11 U	0.1 U	0.1 U	0.1 U	0.1 U	0.11 U	0.1 U	0.11 U
Endosulfan I	0.056 U	0.056 U	0.056 U	0.05 U	0.05 U	0.051 U	0.05 U	0.054 U	0.051 U	0.054 U
Endosulfan II	0.11 U	0.11 U	0.11 U	0.1 U	0.1 U	0.1 U	0.1 U	0.11 U	0.1 U	0.11 U
Endosulfan Sulfate	0.11 U	0.11 U	0.11 U	0.1 U	0.1 U	0.1 U	0.1 U	0.11 U	0.1 U	0.11 U
Endrin	0.11 U	0.11 U	0.11 U	0.1 U	0.1 U	0.1 U	0.1 U	0.11 U	0.1 U	0.11 U
Endrin Aldehyde	0.11 U	0.11 UJ	0.11 U	0.1 U	0.1 U	0.1 U	0.1 U	0.11 U	0.1 U	0.11 U
Heptachlor	0.056 U	0.056 U	0.056 U	0.05 U	0.05 U	0.051 U	0.05 U	0.054 U	0.051 U	0.054 U
Heptachlor Epoxide	0.056 U	0.056 U	0.056 U	0.05 U	0.05 U	0.051 U	0.05 U	0.054 U	0.051 U	0.054 U
Kepone (Chlordecone)	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Isodrin	5 UJ	5.3 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5.1 UJ	5 UJ
Methoxychlor	0.56 U	0.56 U	0.56 U	0.5 U	0.5 U	0.51 U	0.5 U	0.54 U	0.51 U	0.54 U
Toxaphene	2.8 U	2.8 U	2.8 U	2.5 U	2.5 U	2.6 U	2.5 U	2.7 U	2.6 U	2.7 U
Total Inorganics (µg/L)										
Antimony	0.5 J	2 U	0.52 J	0.36 J	0.26 J	2 U	0.26 J	2 U	0.54 J	2 U
Arsenic	6.2	4.5	1.1	2.9	3.1	4.1	4.3	0.94 J	2.9	2.1
Barium	22.2	46.5	20.4	16.2	6.5 J	49.1	15.1	27.9	7.5 J	34.4
Beryllium	1 U	1 U	0.055 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Cadmium	0.71 J	1 U	0.19 J	0.26 J	0.093 J	0.67 J	1 U	0.11 J	0.069 J	1 U
Chromium	1.4 J	0.48 J	5.5	0.6 J	1.3 J	2.2	0.67 J	0.46 J	0.58 J	0.6 J
Cobalt	2.6	2.1	5.8	1.9	1.5	5.5	0.81 J	0.77 J	0.3 J	1.8
Copper	21.3	4.7 J	20.1	8.7	8	10.9	8.2	3.9	5	4.3
Lead	1 U	1 U	5	1 U	1 U	1.7	1 U	1 U	1 U	1 U
Mercury	0.2 R	0.2 R	0.2 R	0.2 R	0.2 R	0.2 R	0.2 R	0.2 R	0.1 R	0.2 R
Nickel	8	1.2	4.6	2.8	2.1	3.9	2.4	1 U	1.6	1.8
Selenium	24.2	13.9	0.48 J	11.7	15.3	18.1	10.1	4.1 J	2.1 J	2.5 J
Silver	0.65 J	1 UJ	0.061 J	0.19 J	0.054 J	0.41 J	0.082 J	1 UJ	1 UJ	1 UJ

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SB01	59SB02	59SB03	59SB04	59SB05	59SB06	59SB07	59SB08	59SB09	59SB10
Sample ID	59GW01	59GW02	59GW03	59GW04	59GW05	59GW06	59GW07	59GW08	59GW09	59GW10
Sample Date	5/22/2010	5/23/2010	5/22/2010	5/23/2010	5/22/2010	5/21/2010	5/21/2010	5/22/2010	5/21/2010	5/22/2010
Total Metals (µg/L)										
Thallium	0.43 J	1 U	1 U	0.2 J	0.096 J	1 U	0.2 J	1 U	0.1 J	1 U
Tin	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Vanadium	24.9	9.2	66.2	20.2	107	22.2	97	30.1	85.1 J	171
Zinc	15 R	24.4 R	32.9 R	8.9 R	3.8 R	11.3 R	3.4 R	3 R	11.3 R	3.2 R
Dissolved Metals (µg/L)										
Antimony	0.45 J	0.23 J	0.3 J	0.47 J	0.23 J	2 U	0.25 J	2 U	0.44 J	2 U
Arsenic	5.3	4.4	0.92 J	2.7	3	3.7	4.2	1	2.4	2.3
Barium	21.3	44.7	4.6 J	13.7	6.1 J	45.7	15.7	27.3	6.6 J	31.5
Beryllium	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Cadmium	0.55 J	1 U	1 U	0.19 J	0.1 J	0.55 J	1 U	1 U	1 U	1 U
Chromium	1.4 J	0.54 J	2 U	0.6 J	1.2 J	1.3 J	0.69 J	0.27 J	0.47 J	0.33 J
Cobalt	2.6	2	0.4 J	1.3	1.3	3.5	0.84 J	0.69 J	0.19 J	1.5
Copper	19	5.8 J	2.3	9.7	8.2	8.3	8.4	3.4	4.3	3.9
Lead	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Mercury	0.2 R	0.2 R	0.2 R	0.2 R	0.2 R	0.2 R	0.2 R	0.2 R	0.2 R	0.2 R
Nickel	8.3	1.1	1 U	2.7	2.3	3.3	2.6	1 U	1.4	1.7
Selenium	23.8	14.1	0.6 J	12	16	19.3	10.4	4.7 J	2.2 J	2.8 J
Silver	0.045 J	1 U	1 U	0.055 J	1 U	1 U	1 U	1 U	1 U	1 U
Thallium	0.39 J	1 U	1 U	0.29 J	0.084 J	1 U	0.19 J	1 U	0.098 J	1 U
Tin	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Vanadium	22.8	9.5	57.6	19.8	106	16.8	102	29.6	113 J	179
Zinc	13.4 J	12.1 R	2.6 J	8.2 J	3.8 J	4.8 J	2.8 J	2 UJ	4.4 J	2 UJ

Notes:

J - Estimated: The analyted was postivietly identified; the quantitation is and esitimation.
U - Non detected at the Reporting Limit.
UJ - Reported quantitation limit is qualified as estimated.
R - Rejected data; data is not usable.
µg/L - microgram per liter
PAHs - Polynuclear Aromatic Hydrocarbons

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SUMMARY OF ANALYTICAL RESULTS - SURFACE WATER
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SW01	59SW02	59SW03
Sample ID	59SW01	59SW02	59SW03
Sample Date	4/20/2010	5/20/2010	5/20/2010
Volatile Organics (µg/L)			
1,1,1,2-Tetrachloroethane	0.5 U	0.5 U	0.5 U
1,1,1-Trichloroethane	0.5 U	0.5 U	0.5 U
1,1,2,2-Tetrachloroethane	0.5 UJ	0.5 U	0.5 U
1,1,2-Trichloroethane	0.5 UJ	0.5 U	0.5 U
1,1-Dichloroethane	0.5 U	0.5 U	0.5 U
1,1-Dichloroethene	0.5 U	0.5 U	0.5 U
1,2,3-Trichloropropane	0.5 UJ	0.5 U	0.5 U
1,2-Dibromo-3-chloropropane (DBCP)	0.5 UJ	0.5 U	0.5 U
1,2-Dibromoethane (EDB)	0.5 UJ	0.5 U	0.5 U
1,2-Dichloroethane	0.5 U	0.5 U	0.5 U
1,2-Dichloroethene (trans)	0.5 U	0.5 U	0.5 U
1,2-Dichloropropane	0.5 U	0.5 U	0.5 U
1,3-Dichloropropene (cis)	0.5 U	0.5 U	0.5 U
1,3-Dichloropropene (trans)	0.5 U	0.5 U	0.5 U
1,4-Dichloro-2-butene (trans)	2 UJ	2 U	2 U
1,4-Dioxane (p-)	25 R	25 R	25 R
2-Butanone (MEK)	2.5 R	2.5 R	2.5 R
2-Chloro-1,3-butadiene (Chloroprene)	0.5 U	0.5 U	0.5 U
2-Hexanone (MBK)	2.5 UJ	2.5 U	2.5 U
3-Chloropropene (Allyl Chloride)	0.5 U	0.5 U	0.5 U
4-Methyl-2-pentanone (MIBK)	2.5 UJ	2.5 U	2.5 U
Acetone	2.5 R	2.5 R	2.8 R
Acetonitrile	0.5 UJ	0.5 U	0.5 U
Acrolein	5 R	5 R	5 R
Acrylonitrile	5 R	5 R	5 R
Benzene	0.5 U	0.5 U	0.5 U
Bromodichloromethane	0.34 J	0.5 U	0.5 U
Bromoform	0.5 U	0.5 U	0.5 U
Bromomethane	0.5 U	0.5 U	0.5 U
Carbon Disulfide	0.5 U	0.5 U	0.021 J
Carbon Tetrachloride	0.5 U	0.5 U	0.5 U
Chlorobenzene	0.5 U	0.5 U	0.5 U
Chloroethane	0.5 U	0.5 U	0.5 U
Chloroform	1.2	0.5 U	0.5 U
Chloromethane	0.5 U	0.5 U	0.5 U
Dibromochloromethane	0.16 J	0.5 U	0.5 U
Dibromomethane	0.5 U	0.5 U	0.5 U
Ethyl Methacrylate	5 UJ	5 U	5 U
Ethylbenzene	0.5 U	0.5 U	0.5 U
Freon 11 (Trichlorofluoromethane)	0.5 U	0.5 UJ	0.5 UJ
Freon-12 (Dichlorodifluoromethane)	0.5 U	0.5 U	0.5 U
Isobutyl Alcohol	25 R	25 R	25 R
Methyl Acrylonitrile	5 UJ	5 U	5 U
Methyl Iodide	0.5 U	0.5 U	0.5 U
Methyl Methacrylate	5 U	5 U	5 U
Methylene Chloride	0.5 U	0.5 U	0.5 U
Pentachloroethane	0.5 U	0.5 U	0.5 U
Propionitrile (Ethyl Cyanide)	25 R	25 R	25 R
Styrene (Ethenylbenzene)	0.5 U	0.5 U	0.5 U
Tetrachloroethene (PCE)	0.5 U	0.5 U	0.5 U

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SUMMARY OF ANALYTICAL RESULTS - SURFACE WATER
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SW01	59SW02	59SW03
Sample ID	59SW01	59SW02	59SW03
Sample Date	4/20/2010	5/20/2010	5/20/2010
Volatile Organics (µg/L) (cont.)			
Toluene	0.5 U	0.5 U	0.5 U
Trichloroethene (TCE)	0.5 UJ	0.5 U	0.5 U
Vinyl Acetate	1 UJ	1 U	1 U
Vinyl Chloride	0.5 U	0.5 U	0.5 U
Xylene, m/p-	1 U	1 U	1 U
Xylene, o-	0.5 U	0.5 U	0.5 U
Xylenes, total	0.5 U	0.5 U	0.5 U
Semivolatile Organics (µg/L)			
1,2,4,5-Tetrachlorobenzene	5 U	5.1 UJ	5 UJ
1,2,4-Trichlorobenzene	5 U	5.1 UJ	5 UJ
1,2-Dichlorobenzene (o-)	5 U	5.1 UJ	5 UJ
1,3,5-Trinitrobenzene (TNB)	5 UJ	5.1 UJ	5 UJ
1,3-Dichlorobenzene (m-)	5 U	5.1 UJ	5 UJ
1,3-Dinitrobenzene (m-)	5 U	5.1 UJ	5 UJ
1,4-Dichlorobenzene (p-)	5 U	5.1 UJ	5 UJ
1,4-Naphthoquinone	5 U	5.1 UJ	5 UJ
1,4-Phenylenediamine	51 R	52 R	51 R
1-Naphthylamine	5 U	5.1 UJ	5 UJ
2,2'-Oxybis[1-chloropropane]	5 U	5.1 UJ	5 UJ
2,3,4,6-Tetrachlorophenol	10 U	10 UJ	10 UJ
2,4,5-Trichlorophenol	10 U	10 UJ	10 UJ
2,4,6-Trichlorophenol	10 U	10 UJ	10 UJ
2,4-Dichlorophenol	10 U	10 UJ	10 UJ
2,4-Dimethylphenol	10 U	10 UJ	10 UJ
2,4-Dinitrophenol	10 UJ	10 UJ	10 UJ
2,4-Dinitrotoluene (DNT)	5 U	5.1 UJ	5 UJ
2,6-Dichlorophenol	10 U	10 UJ	10 UJ
2,6-Dinitrotoluene (DNT)	5 U	5.1 UJ	5 UJ
2-Acetylaminofluorene	5 U	5.1 UJ	5 UJ
2-Chloronaphthalene	5 U	5.1 UJ	5 UJ
2-Chlorophenol	10 U	10 UJ	10 UJ
2-Methyl-5-nitroaniline	5 U	5.1 UJ	5 UJ
2-Methylphenol (o-Cresol)	10 U	10 UJ	10 UJ
2-Naphthylamine	5 U	5.1 UJ	5 UJ
2-Nitroaniline	5 U	5.1 UJ	5 UJ
2-Nitrophenol	10 U	10 UJ	10 UJ
2-Picoline	5 U	5.1 UJ	5 UJ
3,3'-Dichlorobenzidine	5 U	5.1 UJ	5 UJ
3,3'-Dimethylbenzidine	5 U	5.1 UJ	5 UJ
3-Methylcholanthrene	5 U	5.1 UJ	5 UJ
3-Methylphenol (m-Cresol)	8 U	8.2 UJ	8 UJ
3-Nitroaniline	5 U	5.1 UJ	5 UJ
4,6-Dinitro-2-methylphenol	10 U	10 UJ	10 UJ
4-Aminobiphenyl	5 U	5.1 UJ	5 UJ
4-Bromophenyl-phenylether	5 U	5.1 UJ	5 UJ
4-Chloro-3-methylphenol	10 U	10 UJ	10 UJ
4-Chloroaniline	5 U	5.1 UJ	5 UJ
4-Chlorophenyl-phenylether	5 U	5.1 UJ	5 UJ
4-Dimethylaminoazobenzene (p-)	5 U	5.1 UJ	5 UJ

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SW01	59SW02	59SW03
Sample ID	59SW01	59SW02	59SW03
Sample Date	4/20/2010	5/20/2010	5/20/2010
Semivolatile Organics (µg/L) (cont.)			
4-Methylphenol (p-Cresol)	8 U	8.2 UJ	8 UJ
4-Nitroaniline	5 U	5.1 UJ	5 UJ
4-Nitrophenol	10 U	10 UJ	10 UJ
4-Nitroquinoline-1-oxide	5 U	5.1 R	5 R
7,12-Dimethylbenz(a)anthracene	5 U	5.1 UJ	5 UJ
a,a-Dimethylphenethylamine	50 UJ	51 UJ	50 UJ
Acetophenone	2.5 U	2.6 UJ	2.5 UJ
Aniline	5 U	5.1 UJ	5 UJ
Aramite	5 U	5.1 UJ	5 UJ
Benzyl Alcohol	5 UJ	5.1 UJ	5 UJ
Bis(2-chloroethoxy)methane	5 U	5.1 UJ	5 UJ
Bis(2-chloroethyl)ether	5 U	5.1 UJ	5 UJ
Bis(2-ethylhexyl) Phthalate (BEHP)	5 U	5.1 UJ	5 UJ
Butyl Benzyl Phthalate	5 U	5.1 UJ	5 UJ
Diallate (cis)	5 U	5.1 UJ	5 UJ
Diallate (trans)	5 U	5.1 UJ	5 UJ
Dibenzofuran	5 U	5.1 UJ	5 UJ
Diethyl Phthalate (DEP)	5 U	5.1 UJ	5 UJ
Dimethyl Phthalate	5 U	5.1 UJ	5 UJ
Di-n-butyl Phthalate (DBP)	5 U	5.1 UJ	5 UJ
Di-n-octyl Phthalate	5 U	5.1 UJ	5 UJ
Dinoseb	NA	5.1 UJ	5 UJ
Ethyl Methane Sulfonate (EMS)	5 U	5.1 UJ	5 UJ
Hexachloro-1,3-butadiene	5 U	5.1 UJ	5 UJ
Hexachlorobenzene	5 U	5.1 UJ	5 UJ
Hexachlorocyclopentadiene	5 U	5.1 UJ	5 UJ
Hexachloroethane	5 U	5.1 UJ	5 UJ
Hexachloropropene	5 U	5.1 UJ	5 UJ
Isophorone	5 U	5.1 UJ	5 UJ
Isosafrole	5 U	5.1 UJ	5 UJ
Methapyrilene	5 U	5.1 UJ	5 UJ
Methyl Methane Sulfonate	5 U	5.1 UJ	5 UJ
Nitrobenzene	5 U	5.1 UJ	5 UJ
n-Nitrosodiethylamine	5 U	5.1 UJ	5 UJ
n-Nitrosodimethylamine (NDMA)	5 U	5.1 UJ	5 UJ
n-Nitroso-di-n-butylamine	5 U	5.1 UJ	5 UJ
n-Nitrosodi-n-propylamine	5 U	5.1 UJ	5 UJ
n-Nitrosodiphenylamine	5 U	5.1 UJ	5 UJ
n-Nitrosomethylethylamine	5 U	5.1 UJ	5 UJ
n-Nitrosomorpholine	5 U	5.1 UJ	5 UJ
n-Nitrosopiperidine	5 U	5.1 UJ	5 UJ
n-Nitrosopyrrolidine	5 U	5.1 UJ	5 UJ
o-Toluidine	5 U	5.1 UJ	5 UJ
Pentachlorobenzene	5 U	5.1 UJ	5 UJ
Pentachloronitrobenzene	5 U	5.1 UJ	5 UJ
Pentachlorophenol	10 U	10 UJ	10 UJ
Phenacetin	5 U	5.1 UJ	5 UJ
Phenol	10 U	10 UJ	10 UJ
Pronamide	10 U	5.1 UJ	5 UJ

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
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Site ID	59SW01	59SW02	59SW03
Sample ID	59SW01	59SW02	59SW03
Sample Date	4/20/2010	5/20/2010	5/20/2010
Semivolatile Organics (µg/L) (cont.)			
Pyridine	5 U	5.1 UJ	5 UJ
Safrole	5 U	5.1 UJ	5 UJ
PAHs (µg/L)			
2-Methylnaphthalene	0.2 UJ	0.21 UJ	0.2 UJ
Acenaphthene	0.2 U	0.21 UJ	0.2 UJ
Acenaphthylene	0.2 U	0.21 UJ	0.2 UJ
Anthracene	0.2 U	0.21 UJ	0.2 UJ
Benzo(a)anthracene	0.2 U	0.21 UJ	0.2 UJ
Benzo(a)pyrene (BaP)	0.2 U	0.21 UJ	0.2 UJ
Benzo(b)fluoranthene	0.2 U	0.21 UJ	0.2 UJ
Benzo(g,h,i)perylene	0.2 U	0.21 UJ	0.2 UJ
Benzo(k)fluoranthene	0.2 UJ	0.21 UJ	0.2 UJ
Chrysene	0.2 U	0.21 UJ	0.2 UJ
Dibenz(a,h)anthracene	0.2 U	0.21 UJ	0.2 UJ
Fluoranthene	0.2 U	0.019 J	0.017 J
Fluorene	0.2 U	0.21 UJ	0.2 UJ
Indeno(1,2,3-cd)pyrene	0.2 U	0.21 UJ	0.2 UJ
Phenanthrene	0.2 U	0.21 UJ	0.2 UJ
Naphthalene	0.2 U	0.21 UJ	0.2 UJ
Pyrene	0.2 U	0.02 J	0.018 J
Pesticides (µg/L)			
4,4'-DDD	0.1 U	0.1 U	0.1 U
4,4'-DDE	0.006 J	0.1 U	0.1 U
4,4'-DDT	0.0065 J	0.1 U	0.1 U
Aldrin	0.05 U	0.05 U	0.051 U
BHC, alpha-	0.05 U	0.05 U	0.051 U
BHC, beta-	0.05 U	0.05 U	0.051 U
BHC, delta-	0.05 U	0.05 U	0.051 U
BHC, gamma- (Lindane)	0.05 U	0.05 U	0.051 U
Chlordane, alpha-	0.05 U	0.05 U	0.051 U
Chlordane, gamma-	0.05 U	0.05 U	0.051 U
Chlorobenzilate	5 U	5.1 UJ	5 UJ
Dieldrin	0.1 U	0.1 U	0.1 U
Endosulfan I	0.05 U	0.05 U	0.051 U
Endosulfan II	0.1 U	0.1 U	0.1 U
Endosulfan Sulfate	0.1 U	0.1 U	0.1 U
Endrin	0.1 U	0.1 U	0.1 U
Endrin Aldehyde	0.1 R	0.1 U	0.1 U
Heptachlor	0.05 U	0.05 U	0.051 U
Heptachlor Epoxide	0.05 U	0.05 U	0.051 U
Isodrin	5 U	5.1 UJ	5 UJ
Kepone (Chlordecone)	5 U	5.1 UJ	5 UJ
Methoxychlor	0.5 U	0.5 U	0.51 U
Toxaphene	2.5 U	2.5 U	2.6 U

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SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SW01	59SW02	59SW03
Sample ID	59SW01	59SW02	59SW03
Sample Date	4/20/2010	5/20/2010	5/20/2010
Total Metals (µg/L)			
Antimony	2 U	0.26 J	0.23 J
Arsenic	0.49 J	0.44 J	0.42 J
Barium	21.4	19.9	19.4
Beryllium	1 U	1 U	1 U
Cadmium	1 U	1 U	1 U
Calcium	18900	NA	NA
Chromium	0.68 J	0.76 J	0.75 J
Cobalt	0.32 J	0.34 J	0.34 J
Copper	3.8	4	4
Lead	1 U	1 U	1 U
Magnesium	5000 U	NA	NA
Mercury	0.2 U	0.2 R	0.2 R
Nickel	1 U	1 U	1 U
Selenium	0.75 J	0.52 J	0.47 J
Silver	1 U	1 UJ	1 UJ
Thallium	1 U	1 U	1 U
Tin	20 U	20 U	20 U
Vanadium	7	7.6	7.3
Zinc	7.9 J	7 R	7.1 R
Dissolved Metals (µg/L)			
Antimony	2 U	0.23 J	0.23 J
Arsenic	0.52 J	0.41 J	0.4 J
Barium	20.5	17.8	17.7
Beryllium	1 U	1 U	1 U
Cadmium	1 U	1 U	1 U
Chromium	0.39 J	0.4 J	0.39 J
Cobalt	0.084 J	0.062 J	0.061 J
Copper	3.1	3	2.9
Lead	1 U	1 U	1 U
Mercury	0.2 U	0.2 R	0.2 R
Nickel	1 U	1 U	1 U
Selenium	0.82 J	0.51 J	0.48 J
Silver	1 U	1 U	1 U
Thallium	1 U	1 U	1 U
Tin	20 U	20 U	20 U
Vanadium	6.3	6.1	6.1
Zinc	5.5 J	2.2 J	2.4 J

Notes:

J - Estimated: The analyted was postively identified; the quantitation is an estimation.
U - Non detected at the Reporting Limit.
UJ - Reported quantitation limit is qualified as estimated.
R - Rejected data; data is not usable.
µg/L - microgram per liter
PAHs - Polynuclear Aromatic Hydrocarbons

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SUMMARY OF ANALYTICAL RESULTS - SEDIMENT
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SD01	59SD02	59SD03	59SD04	59SD04	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Sample ID	59SD01	59SD02	59SD03	59SD04	59SD04D	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Sample Date	4/22/2010	5/20/2010	5/20/2010	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012
Sample Depth (ft bgs)	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5
Volatile Organics (µg/kg)													
1,1,1,2-Tetrachloroethane	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1,2,2-Tetrachloroethane	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethene	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,3-Trichloropropane	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dibromo-3-chloropropane (DBCP)	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dibromoethane (EDB)	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloroethane	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloroethene (trans)	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Dichloropropene (cis)	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Dichloropropene (trans)	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dichloro-2-butene (trans)	42 UJ	47 UJ	27 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dioxane (p-)	530 R	590 R	340 R	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Butanone (MEK)	26 UJ	29 UJ	17 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Chloro-1,3-butadiene (Chloroprene)	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Hexanone (MBK)	26 UJ	29 UJ	17 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3-Chloropropene (Allyl Chloride)	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Methyl-2-pentanone (MIBK)	26 UJ	29 UJ	17 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acetone	28 R	150 J	78	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acetonitrile	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acrolein	110 R	120 R	67 R	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acrylonitrile	110 R	120 UJ	67 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bromodichloromethane	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bromoform	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bromomethane	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbon Disulfide	2.3 J	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbon Tetrachloride	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzene	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroethane	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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SUMMARY OF ANALYTICAL RESULTS - SEDIMENT
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SD01	59SD02	59SD03	59SD04	59SD04	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Sample ID	59SD01	59SD02	59SD03	59SD04	59SD04D	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Sample Date	4/22/2010	5/20/2010	5/20/2010	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012
Sample Depth (ft bgs)	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5
Volatile Organics (µg/kg) (cont.)													
Chloromethane	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibromochloromethane	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibromomethane	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethyl Methacrylate	110 UJ	120 UJ	67 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Freon 11 (Trichlorofluoromethane)	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Freon-12 (Dichlorodifluoromethane)	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Isobutyl Alcohol	530 R	590 R	340 R	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Acrylonitrile	110 UJ	120 UJ	67 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Iodide	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Methacrylate	110 UJ	120 R	67 R	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methylene Chloride	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachloroethane	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Propionitrile (Ethyl Cyanide)	530 R	590 R	340 R	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Styrene (Ethenylbenzene)	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene (PCE)	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Toluene	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethene (TCE)	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Acetate	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Chloride	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Xylene, m/p-	0.79 J	24 UJ	13 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Xylene, o-	11 UJ	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Xylenes, total	0.79 J	12 UJ	6.7 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organics (µg/kg)													
1,2,4,5-Tetrachlorobenzene	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene (o-)	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3,5-Trinitrobenzene (TNB)	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Dichlorobenzene (m-)	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Dinitrobenzene (m-)	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene (p-)	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Naphthoquinone	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Phenylenediamine	3500 R	3600 R	3100 R	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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Site ID	59SD01	59SD02	59SD03	59SD04	59SD04	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Sample ID	59SD01	59SD02	59SD03	59SD04	59SD04D	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Sample Date	4/22/2010	5/20/2010	5/20/2010	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012
Sample Depth (ft bgs)	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5
Semivolatile Organics (µg/kg) (cont.)													
1-Naphthylamine	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,2'-Oxybis[1-chloropropane]	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,3,4,6-Tetrachlorophenol	690 UJ	700 UJ	600 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4,5-Trichlorophenol	690 UJ	700 UJ	600 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4,6-Trichlorophenol	690 UJ	700 UJ	600 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dichlorophenol	690 UJ	700 UJ	600 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dimethylphenol	690 UJ	700 UJ	600 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrophenol	690 UJ	700 UJ	600 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrotoluene (DNT)	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,6-Dichlorophenol	690 UJ	700 UJ	600 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,6-Dinitrotoluene (DNT)	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Acetylaminofluorene	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Chloronaphthalene	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Chlorophenol	690 UJ	700 UJ	600 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Methyl-5-nitroaniline	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylphenol (o-Cresol)	690 UJ	700 UJ	600 UJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Naphthylamine	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Nitroaniline	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Nitrophenol	690 UJ	700 UJ	600 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Picoline	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3,3'-Dichlorobenzidine	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3,3'-Dimethylbenzidine	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3-Methylcholanthrene	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3-Methylphenol (m-Cresol)	520 UJ	530 UJ	450 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3-Nitroaniline	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,6-Dinitro-2-methylphenol	690 UJ	700 UJ	600 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Aminobiphenyl	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Bromophenyl-phenylether	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chloro-3-methylphenol	690 UJ	700 UJ	600 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chloroaniline	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chlorophenyl-phenylether	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Dimethylaminoazobenzene (p-)	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Methylphenol (p-Cresol)	520 UJ	530 UJ	450 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Nitroaniline	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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Site ID	59SD01	59SD02	59SD03	59SD04	59SD04	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Sample ID	59SD01	59SD02	59SD03	59SD04	59SD04D	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Sample Date	4/22/2010	5/20/2010	5/20/2010	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012
Sample Depth (ft bgs)	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5
Semivolatile Organics (µg/kg) (cont.)													
4-Nitrophenol	690 UJ	700 UJ	600 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Nitroquinoline-1-oxide	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7,12-Dimethylbenz(a)anthracene	350 UJ	360 UJ	310 UJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
a,a-Dimethylphenethylamine	690 UJ	1000 UJ	850 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acetophenone	180 UJ	180 UJ	150 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aniline	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aramite	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzyl Alcohol	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bis(2-chloroethoxy)methane	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bis(2-chloroethyl)ether	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bis(2-ethylhexyl) Phthalate (BEHP)	140 J	110 J	730	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Butyl Benzyl Phthalate	63 J	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Diallate (cis)	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Diallate (trans)	350 UJ	360 UJ	310 UJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzofuran	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Diethyl Phthalate (DEP)	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dimethyl Phthalate	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-butyl Phthalate (DBP)	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-octyl Phthalate	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dinoseb	NA	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethyl Methane Sulfonate (EMS)	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloro-1,3-butadiene	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorocyclopentadiene	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloroethane	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloropropene	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Isophorone	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Isosafrole	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methapyrilene	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Methane Sulfonate	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrobenzene	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Nitrosodiethylamine	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Nitrosodimethylamine (NDMA)	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Nitroso-di-n-butylamine	350 UJ	360 UJ	310 UJ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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Site ID	59SD01	59SD02	59SD03	59SD04	59SD04	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Sample ID	59SD01	59SD02	59SD03	59SD04	59SD04D	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Sample Date	4/22/2010	5/20/2010	5/20/2010	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012
Sample Depth (ft bgs)	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5
Semivolatile Organics (µg/kg) (cont.)													
n-Nitrosodi-n-propylamine	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Nitrosodiphenylamine	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Nitrosomethylethylamine	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Nitrosomorpholine	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Nitrosopiperidine	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Nitrosopyrrolidine	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
o-Toluidine	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorobenzene	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachloronitrobenzene	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	690 UJ	700 UJ	600 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenacetin	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenol	690 UJ	700 UJ	600 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pronamide	690 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyridine	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Safrole	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PAHs (µg/L)													
2-Methylnaphthalene	4.4 J	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthene	17 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthylene	1.6 J	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Anthracene	4.6 J	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	5 J	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene (BaP)	17 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	17 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	17 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	17 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	6.9 J	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenz(a,h)anthracene	17 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	7.2 J	360 UJ	36 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluorene	2.3 J	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	8.3 J	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	17 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	6.3 J	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	8.8 J	360 UJ	41 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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Site ID	59SD01	59SD02	59SD03	59SD04	59SD04	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Sample ID	59SD01	59SD02	59SD03	59SD04	59SD04D	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Sample Date	4/22/2010	5/20/2010	5/20/2010	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012
Sample Depth (ft bgs)	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5
Pesticides (µg/kg)													
4,4'-DDD	1.6 J	2.6 J	5.9 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE	35 J	32 J	160	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT	1.3 J	7 UJ	6 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aldrin	3.5 UJ	3.6 UJ	0.66 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BHC, alpha-	3.5 UJ	3.6 UJ	3.1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BHC, beta-	1.8 UJ	1.8 UJ	1.5 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BHC, delta-	3.5 UJ	3.6 UJ	3.1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BHC, gamma- (Lindane)	3.5 UJ	3.6 UJ	3.1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chlordane, alpha-	2.1 NJ	25 NJ	3.1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chlordane, gamma-	18 J	31 J	3.1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chlorobenzilate	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dieldrin	0.9 J	7 UJ	6 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan I	3.5 UJ	3.6 UJ	3.1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan II	6.9 UJ	7 UJ	6 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endosulfan Sulfate	6.9 UJ	7 UJ	6 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endrin	6.9 UJ	7 UJ	6 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endrin Aldehyde	1.1 J	0.87 J	6 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor	3.5 UJ	1.2 J	3.1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Heptachlor Epoxide	3.5 UJ	3.6 UJ	3.1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Isodrin	350 UJ	360 UJ	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kepone (Chlordecone)	350 UJ	360 U	310 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methoxychlor	35 UJ	36 UJ	31 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Toxaphene	170 UJ	180 UJ	150 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Metals (mg/kg)													
Antimony	2.1 UJ	0.8 J	0.58 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	0.98 J	0.65 J	1.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Barium	81.6 J	164 J	109 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	0.38 J	0.45 J	0.35 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	0.9 J	0.69 J	0.99 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	39.1 J	42.1 J	37.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt	20.9 J	31.9 J	22.4 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Copper	125 J	144 J	90.7 J	107	83.8	187 J	160 J	87.6 J	134 J	36.2 J	78.3 J	161 J	52.4 J

APPENDIX O

SUMMARY OF ANALYTICAL RESULTS - SEDIMENT
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	59SD01	59SD02	59SD03	59SD04	59SD04	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Sample ID	59SD01	59SD02	59SD03	59SD04	59SD04D	59SD05	59SD06	59SD07	59SD08	59SD09	59SD10	59SD11	59SD12
Sample Date	4/22/2010	5/20/2010	5/20/2010	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012	9/15/2012
Sample Depth (ft bgs)	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5	0.0 - 0.5
Metals (mg/kg) (cont.)													
Lead	71.2 J	37.6 R	36.9 R	45.3 J	30.1 J	55 J	70 J	20.4 J	23.1 J	4.92 J	10.9 J	22.6 J	4.93 J
Mercury	0.087	0.033 J	0.19	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	18.7 J	22.6 J	28.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	0.8 J	1 J	0.69 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Silver	0.17 J	0.23 J	0.17 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	1 UJ	0.14 J	0.053 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tin	10.4 UJ	10.5 UJ	8.1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	156 J	232 J	144 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	122 J	139 J	176	193 J	130 J	357 J	319 J	191 J	154 J	71.7 J	108 J	232 J	262 J
TOC (mg/kg)													
Total Organic Carbon	21290	21000	68100	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
AVS/SEM Metals (uMole/g)													
Cadmium	NA	0.003	0.003	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Copper	NA	0.588	0.339	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead	NA	0.071 J	0.049 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	NA	0.075	0.066	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Silver	NA	0.002 U	0.001 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	NA	0.92	1.12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sulfide (uMole/g)													
Sulfide	NA	0.17 U	0.15	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Solids, Total (%)													
Solids, Total	NA	50.3	62.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

APPENDIX O

SUMMARY OF ANALYTICAL RESULTS - SEDIMENT
SWMU 59 - FORMER MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Notes:

J - Estimated: The analyted was positiviely identified; the quantitation is an estimation.
U - Non detected at the Reporting Limit/Limit of Detection.
UJ - Reported quantitation limit is qualified as estimated.
R - Rejected data; data is not usable.
% - percent
AVS - Acid Volatile Sulfides
ft bgs - feet below ground surface
µg/kg - mirogram per kilogram
µMole/g - micromole per gram
mg/kg - milligram per kilogram
NA - Not Analyzed
PAHs - Polynuclear Aromatic Hydrocarbons
SEM - Simultaneously Extracted Metals
TOC - Total Organic Carbon

APPENDIX P
HHRA STATISTICAL SUMMARY (ProUCL Computational Output)

General UCL Statistics for Data Sets with Non-Detects: Combined Surface Soil Data

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Methyl Iodide

General Statistics

Number of Valid Data	29	Number of Detected Data	4
Number of Distinct Detected Data	4	Number of Non-Detect Data	25
		Percent Non-Detects	86.21%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.97	Minimum Detected	-0.0305
Maximum Detected	12	Maximum Detected	2.485
Mean of Detected	4.368	Mean of Detected	1.013
SD of Detected	5.132	SD of Detected	1.064
Minimum Non-Detect	1.3	Minimum Non-Detect	0.262
Maximum Non-Detect	5.6	Maximum Non-Detect	1.723

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	28
Number treated as Detected	1
Single DL Non-Detect Percentage	96.55%

Warning: There are only 4 Distinct Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.75	Shapiro Wilk Test Statistic	0.934
5% Shapiro Wilk Critical Value	0.748	5% Shapiro Wilk Critical Value	0.748
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	2.027	Mean	0.48
SD	2.039	SD	0.616
95% DL/2 (t) UCL	2.671	95% H-Stat (DL/2) UCL	2.48
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-0.0316
		SD in Log Scale	0.658
Gamma Distribution Test with Detected Values Only		Mean in Original Scale	1.363
k star (bias corrected)	0.473	SD in Original Scale	2.104
Theta Star	9.241	95% t UCL	2.028
nu star	3.781	95% Percentile Bootstrap UCL	2.097
		95% BCA Bootstrap UCL	2.641
A-D Test Statistic	0.434	95% H-UCL	1.56
5% A-D Critical Value	0.665		
K-S Test Statistic	0.665	**Data Distribution Test with Detected Values Only**	
5% K-S Critical Value	0.401	Data appear Normal at 5% Significance Level	
Data appear Gamma Distributed at 5% Significance Level			
		Nonparametric Statistics	
Assuming Gamma Distribution		Kaplan-Meier (KM) Method	
Gamma ROS Statistics using Extrapolated Data		Mean	1.54
Minimum	0.000001	SD	2.033
Maximum	12	SE of Mean	0.449
Mean	1.081	95% KM (t) UCL	2.305
Median	0.17	95% KM (z) UCL	2.279
SD	2.293	95% KM (jackknife) UCL	2.263
k star	0.151	95% KM (bootstrap t) UCL	2.863
Theta star	7.159	95% KM (BCA) UCL	12
Nu star	8.762	95% KM (Percentile Bootstrap) UCL	3.694
AppChi2	3.184	95% KM (Chebyshev) UCL	3.499
95% Gamma Approximate UCL (Use when n >= 40)	2.976	97.5% KM (Chebyshev) UCL	4.346
95% Adjusted Gamma UCL (Use when n < 40)	N/A	99% KM (Chebyshev) UCL	6.011
		Potential UCLs to Use	
		95% KM (t) UCL	2.305
		95% KM (Percentile Bootstrap) UCL	3.694

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Benzo(a)anthracene

General Statistics

Number of Valid Data	29	Number of Detected Data	12
Number of Distinct Detected Data	12	Number of Non-Detect Data	17
		Percent Non-Detects	58.62%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.72	Minimum Detected	-0.329
Maximum Detected	84	Maximum Detected	4.431
Mean of Detected	14.84	Mean of Detected	1.432
SD of Detected	25.52	SD of Detected	1.648
Minimum Non-Detect	4.1	Minimum Non-Detect	1.411
Maximum Non-Detect	46	Maximum Non-Detect	3.829

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	27
Number treated as Detected	2
Single DL Non-Detect Percentage	93.10%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.634	Shapiro Wilk Test Statistic	0.895
5% Shapiro Wilk Critical Value	0.859	5% Shapiro Wilk Critical Value	0.859
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	9.553	Mean	1.477
SD	17.07	SD	1.158
95% DL/2 (t) UCL	14.95	95% H-Stat (DL/2) UCL	15.37
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	0.897
		SD in Log Scale	1.196
		Mean in Original Scale	7.258
		SD in Original Scale	17.27
		95% t UCL	12.71
		95% Percentile Bootstrap UCL	12.9
		95% BCA Bootstrap UCL	16.33
		95% H-UCL	9.278

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	0.432	Data Follow Appr. Gamma Distribution at 5% Significance Level
Theta Star	34.36	
nu star	10.37	
A-D Test Statistic	0.863	
5% A-D Critical Value	0.785	
K-S Test Statistic	0.785	
5% K-S Critical Value	0.259	
Data follow Appr. Gamma Distribution at 5% Significance Level		

Assuming Gamma Distribution	
Gamma ROS Statistics using Extrapolated Data	
Minimum	0.000001
Maximum	84
Mean	7.439
Median	1.093
SD	17.44
k star	0.16
Theta star	46.58
Nu star	9.263
AppChi2	3.487
95% Gamma Approximate UCL (Use when n >= 40)	19.76
95% Adjusted Gamma UCL (Use when n < 40)	21.03

Note: DL/2 is not a recommended method.

Nonparametric Statistics	
Kaplan-Meier (KM) Method	
Mean	7.298
SD	17.02
SE of Mean	3.326
95% KM (t) UCL	12.96
95% KM (z) UCL	12.77
95% KM (jackknife) UCL	12.82
95% KM (bootstrap t) UCL	25.18
95% KM (BCA) UCL	13.7
95% KM (Percentile Bootstrap) UCL	12.99
95% KM (Chebyshev) UCL	21.79
97.5% KM (Chebyshev) UCL	28.07
99% KM (Chebyshev) UCL	40.39
Potential UCLs to Use	
95% KM (t) UCL	12.96

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Benzo(a)pyrene (BaP)

General Statistics

Number of Valid Data	29	Number of Detected Data	8
Number of Distinct Detected Data	8	Number of Non-Detect Data	21
		Percent Non-Detects	72.41%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.8	Minimum Detected	-0.223
Maximum Detected	390	Maximum Detected	5.966
Mean of Detected	58.39	Mean of Detected	1.778
SD of Detected	135.3	SD of Detected	2.247
Minimum Non-Detect	4.1	Minimum Non-Detect	1.411
Maximum Non-Detect	46	Maximum Non-Detect	3.829

Note: Data have multiple DLs - Use of KM Method is recommended	Number treated as Non-Detect	27
For all methods (except KM, DL/2, and ROS Methods),	Number treated as Detected	2
Observations < Largest ND are treated as NDs	Single DL Non-Detect Percentage	93.10%

Warning: There are only 8 Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.508	Shapiro Wilk Test Statistic	0.87
5% Shapiro Wilk Critical Value	0.818	5% Shapiro Wilk Critical Value	0.818
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	20.17	Mean	1.589
SD	71.91	SD	1.245
95% DL/2 (t) UCL	42.89	95% H-Stat (DL/2) UCL	20.46
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	0.819
		SD in Log Scale	1.402
		Mean in Original Scale	17.53
		SD in Original Scale	72.38
		95% t UCL	40.39
		95% Percentile Bootstrap UCL	43.73
		95% BCA Bootstrap UCL	68.46
		95% H-UCL	13.45

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	0.271	Data Follow Appr. Gamma Distribution at 5% Significance Level
Theta Star	215.1	
nu star	4.343	
A-D Test Statistic	0.893	
5% A-D Critical Value	0.797	
K-S Test Statistic	0.797	
5% K-S Critical Value	0.317	
Data follow Appr. Gamma Distribution at 5% Significance Level		

Assuming Gamma Distribution	
Gamma ROS Statistics using Extrapolated Data	
Minimum	0.000001
Maximum	390
Mean	18.38
Median	0.000001
SD	72.4
k star	0.104
Theta star	177.1
Nu star	6.02
AppChi2	1.65
95% Gamma Approximate UCL (Use when n >= 40)	67.05
95% Adjusted Gamma UCL (Use when n < 40)	72.89

Note: DL/2 is not a recommended method.

Nonparametric Statistics	
Kaplan-Meier (KM) Method	
Mean	17.4
SD	71.15
SE of Mean	14.13
95% KM (t) UCL	41.44
95% KM (z) UCL	40.65
95% KM (jackknife) UCL	40.29
95% KM (bootstrap t) UCL	365.9
95% KM (BCA) UCL	44.46
95% KM (Percentile Bootstrap) UCL	43.81
95% KM (Chebyshev) UCL	79.01
97.5% KM (Chebyshev) UCL	105.7
99% KM (Chebyshev) UCL	158
Potential UCLs to Use	
95% KM (t) UCL	41.44

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Benzo(b)fluoranthene

General Statistics

Number of Valid Data	29	Number of Detected Data	9
Number of Distinct Detected Data	9	Number of Non-Detect Data	20
		Percent Non-Detects	68.97%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.86	Minimum Detected	-0.151
Maximum Detected	750	Maximum Detected	6.62
Mean of Detected	91.27	Mean of Detected	1.706
SD of Detected	247.6	SD of Detected	2.265
Minimum Non-Detect	4.1	Minimum Non-Detect	1.411
Maximum Non-Detect	46	Maximum Non-Detect	3.829

Note: Data have multiple DLs - Use of KM Method is recommended	Number treated as Non-Detect	27
For all methods (except KM, DL/2, and ROS Methods),	Number treated as Detected	2
Observations < Largest ND are treated as NDs	Single DL Non-Detect Percentage	93.10%

Warning: There are only 9 Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.43	Shapiro Wilk Test Statistic	0.815
5% Shapiro Wilk Critical Value	0.829	5% Shapiro Wilk Critical Value	0.829
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	32.23	Mean	1.574
SD	138.4	SD	1.322
95% DL/2 (t) UCL	75.94	95% H-Stat (DL/2) UCL	23.79
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	0.967
		SD in Log Scale	1.417
		Mean in Original Scale	29.91
		SD in Original Scale	138.8
		95% t UCL	73.76
		95% Percentile Bootstrap UCL	81.28
		95% BCA Bootstrap UCL	108.7
		95% H-UCL	16.16

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.242	Data do not follow a Discernable Distribution (0.05)	
Theta Star	376.5		
nu star	4.364		
A-D Test Statistic	1.423	**Nonparametric Statistics**	
5% A-D Critical Value	0.825	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.825	Mean	29.64
5% K-S Critical Value	0.304	SD	136.4
Data not Gamma Distributed at 5% Significance Level		SE of Mean	26.88
		95% KM (t) UCL	75.36
Assuming Gamma Distribution		95% KM (z) UCL	73.84
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	73.51
Minimum	0.000001	95% KM (bootstrap t) UCL	1456
Maximum	750	95% KM (BCA) UCL	82
Mean	30.74	95% KM (Percentile Bootstrap) UCL	80.84
Median	0.86	95% KM (Chebyshev) UCL	146.8
SD	138.9	97.5% KM (Chebyshev) UCL	197.5
k star	0.103	99% KM (Chebyshev) UCL	297.1
Theta star	299		
Nu star	5.963	Potential UCLs to Use	
AppChi2	1.621	99% KM (Chebyshev) UCL	297.1
95% Gamma Approximate UCL (Use when n >= 40)	113.1		
95% Adjusted Gamma UCL (Use when n < 40)	123		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Benzo(k)fluoranthene

General Statistics

Number of Valid Data	29	Number of Detected Data	9
Number of Distinct Detected Data	9	Number of Non-Detect Data	20
		Percent Non-Detects	68.97%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.75	Minimum Detected	-0.288
Maximum Detected	730	Maximum Detected	6.593
Mean of Detected	90.34	Mean of Detected	1.68
SD of Detected	240.7	SD of Detected	2.345
Minimum Non-Detect	4.1	Minimum Non-Detect	1.411
Maximum Non-Detect	46	Maximum Non-Detect	3.829

Note: Data have multiple DLs - Use of KM Method is recommended	Number treated as Non-Detect	27
For all methods (except KM, DL/2, and ROS Methods),	Number treated as Detected	2
Observations < Largest ND are treated as NDs	Single DL Non-Detect Percentage	93.10%

Warning: There are only 9 Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.44	Shapiro Wilk Test Statistic	0.839
5% Shapiro Wilk Critical Value	0.829	5% Shapiro Wilk Critical Value	0.829
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	31.94	Mean	1.566
SD	134.7	SD	1.36
95% DL/2 (t) UCL	74.5	95% H-Stat (DL/2) UCL	25.76
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	0.767
		SD in Log Scale	1.509
		Mean in Original Scale	29.26
		SD in Original Scale	135.2
		95% t UCL	71.98
		95% Percentile Bootstrap UCL	79.24
		95% BCA Bootstrap UCL	106.5
		95% H-UCL	16.56

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.242	Data appear Lognormal at 5% Significance Level	
Theta Star	373.9		
nu star	4.349		
A-D Test Statistic	1.282	**Nonparametric Statistics**	
5% A-D Critical Value	0.826	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.826	Mean	29.17
5% K-S Critical Value	0.304	SD	132.9
Data not Gamma Distributed at 5% Significance Level		SE of Mean	26.18
		95% KM (t) UCL	73.71
Assuming Gamma Distribution		95% KM (z) UCL	72.23
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	71.9
Minimum	0.000001	95% KM (bootstrap t) UCL	1327
Maximum	730	95% KM (BCA) UCL	79
Mean	29.57	95% KM (Percentile Bootstrap) UCL	77.94
Median	0.000001	95% KM (Chebyshev) UCL	143.3
SD	135.4	97.5% KM (Chebyshev) UCL	192.7
k star	0.0899	99% KM (Chebyshev) UCL	289.7
Theta star	328.8		
Nu star	5.216	Potential UCLs to Use	
AppChi2	1.253	99% KM (Chebyshev) UCL	289.7
95% Gamma Approximate UCL (Use when n >= 40)	123.1		
95% Adjusted Gamma UCL (Use when n < 40)	135		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Chrysene

General Statistics

Number of Valid Data	29	Number of Detected Data	14
Number of Distinct Detected Data	12	Number of Non-Detect Data	15
		Percent Non-Detects	51.72%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.77	Minimum Detected	-0.261
Maximum Detected	1200	Maximum Detected	7.09
Mean of Detected	92.8	Mean of Detected	1.507
SD of Detected	318.9	SD of Detected	2.04
Minimum Non-Detect	4.1	Minimum Non-Detect	1.411
Maximum Non-Detect	46	Maximum Non-Detect	3.829

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	28
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	1
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	96.55%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.322	Shapiro Wilk Test Statistic	0.788
5% Shapiro Wilk Critical Value	0.874	5% Shapiro Wilk Critical Value	0.874
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	47.88	Mean	1.502
SD	221.8	SD	1.485
95% DL/2 (t) UCL	117.9	95% H-Stat (DL/2) UCL	32.5
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	1.107
		SD in Log Scale	1.489
		Mean in Original Scale	46.01
		SD in Original Scale	222.1
		95% t UCL	116.2
		95% Percentile Bootstrap UCL	128.4
		95% BCA Bootstrap UCL	170
		95% H-UCL	22.1

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.234	Data do not follow a Discernable Distribution (0.05)	
Theta Star	396.9		
nu star	6.547		
A-D Test Statistic	2.653	**Nonparametric Statistics**	
5% A-D Critical Value	0.858	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.858	Mean	45.92
5% K-S Critical Value	0.251	SD	218.3
Data not Gamma Distributed at 5% Significance Level		SE of Mean	42.07
		95% KM (t) UCL	117.5
Assuming Gamma Distribution		95% KM (z) UCL	115.1
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	116.1
Minimum	0.000001	95% KM (bootstrap t) UCL	1638
Maximum	1200	95% KM (BCA) UCL	129.5
Mean	44.83	95% KM (Percentile Bootstrap) UCL	128.2
Median	0.351	95% KM (Chebyshev) UCL	229.3
SD	222.4	97.5% KM (Chebyshev) UCL	308.6
k star	0.102	99% KM (Chebyshev) UCL	464.5
Theta star	438.9		
Nu star	5.924	Potential UCLs to Use	
AppChi2	1.601	99% KM (Chebyshev) UCL	464.5
95% Gamma Approximate UCL (Use when n >= 40)	165.8		
95% Adjusted Gamma UCL (Use when n < 40)	180.5		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Indeno(1,2,3-cd)pyrene

General Statistics

Number of Valid Data	29	Number of Detected Data	5
Number of Distinct Detected Data	5	Number of Non-Detect Data	24
		Percent Non-Detects	82.76%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	1.8	Minimum Detected	0.588
Maximum Detected	240	Maximum Detected	5.481
Mean of Detected	62.68	Mean of Detected	2.524
SD of Detected	102.7	SD of Detected	2.167
Minimum Non-Detect	4.1	Minimum Non-Detect	1.411
Maximum Non-Detect	46	Maximum Non-Detect	3.829

Note: Data have multiple DLs - Use of KM Method is recommended	Number treated as Non-Detect	27
For all methods (except KM, DL/2, and ROS Methods),	Number treated as Detected	2
Observations < Largest ND are treated as NDs	Single DL Non-Detect Percentage	93.10%

Warning: There are only 5 Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.711	Shapiro Wilk Test Statistic	0.849
5% Shapiro Wilk Critical Value	0.762	5% Shapiro Wilk Critical Value	0.762
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	15.37	Mean	1.695
SD	44.79	SD	1.046
95% DL/2 (t) UCL	29.51	95% H-Stat (DL/2) UCL	15.5
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	1.382
		SD in Log Scale	1.17
		Mean in Original Scale	14.08
		SD in Original Scale	44.98
		95% t UCL	28.29
		95% Percentile Bootstrap UCL	30.26
		95% BCA Bootstrap UCL	40.27
		95% H-UCL	14.3

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.296	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	211.7		
nu star	2.96		
A-D Test Statistic	0.547	**Nonparametric Statistics**	
5% A-D Critical Value	0.724	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.724	Mean	13.12
5% K-S Critical Value	0.375	SD	44.36
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	9.219
		95% KM (t) UCL	28.81
Assuming Gamma Distribution		95% KM (z) UCL	28.29
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	27.42
Minimum	0.000001	95% KM (bootstrap t) UCL	247.9
Maximum	240	95% KM (BCA) UCL	43.86
Mean	17.11	95% KM (Percentile Bootstrap) UCL	39.81
Median	0.000001	95% KM (Chebyshev) UCL	53.31
SD	45.8	97.5% KM (Chebyshev) UCL	70.69
k star	0.0993	99% KM (Chebyshev) UCL	104.8
Theta star	172.3		
Nu star	5.759	Potential UCLs to Use	
AppChi2	1.518	95% KM (t) UCL	28.81
95% Gamma Approximate UCL (Use when n >= 40)	64.92		
95% Adjusted Gamma UCL (Use when n < 40)	70.76		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Antimony

General Statistics

Number of Valid Data	29	Number of Detected Data	7
Number of Distinct Detected Data	6	Number of Non-Detect Data	22
		Percent Non-Detects	75.86%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.17	Minimum Detected	-1.772
Maximum Detected	8.5	Maximum Detected	2.14
Mean of Detected	1.711	Mean of Detected	-0.407
SD of Detected	3.019	SD of Detected	1.375
Minimum Non-Detect	0.57	Minimum Non-Detect	-0.562
Maximum Non-Detect	6.5	Maximum Non-Detect	1.872

Note: Data have multiple DLs - Use of KM Method is recommended	Number treated as Non-Detect	28
For all methods (except KM, DL/2, and ROS Methods),	Number treated as Detected	1
Observations < Largest ND are treated as NDs	Single DL Non-Detect Percentage	96.55%

Warning: There are only 7 Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.571	Shapiro Wilk Test Statistic	0.894
5% Shapiro Wilk Critical Value	0.803	5% Shapiro Wilk Critical Value	0.803
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	1.247	Mean	-0.388
SD	1.738	SD	1.038
95% DL/2 (t) UCL	1.796	95% H-Stat (DL/2) UCL	1.905
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-1.222
		SD in Log Scale	0.881
		Mean in Original Scale	0.604
		SD in Original Scale	1.539
		95% t UCL	1.09
		95% Percentile Bootstrap UCL	1.151
		95% BCA Bootstrap UCL	1.478
		95% H-UCL	0.64

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	0.465	Data appear Gamma Distributed at 5% Significance Level
Theta Star	3.68	
nu star	6.511	
A-D Test Statistic	0.694	
5% A-D Critical Value	0.742	
K-S Test Statistic	0.742	
5% K-S Critical Value	0.325	
Data appear Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution		Nonparametric Statistics	
Gamma ROS Statistics using Extrapolated Data		Kaplan-Meier (KM) Method	
Minimum	0.000001	Mean	0.617
Maximum	8.5	SD	1.516
Mean	0.568	SE of Mean	0.308
Median	0.0726	95% KM (t) UCL	1.141
SD	1.593	95% KM (z) UCL	1.124
k star	0.144	95% KM (jackknife) UCL	1.113
Theta star	3.947	95% KM (bootstrap t) UCL	2.436
Nu star	8.35	95% KM (BCA) UCL	1.318
AppChi2	2.939	95% KM (Percentile Bootstrap) UCL	1.195
95% Gamma Approximate UCL (Use when n >= 40)	1.614	95% KM (Chebyshev) UCL	1.96
95% Adjusted Gamma UCL (Use when n < 40)	1.725	97.5% KM (Chebyshev) UCL	2.541
		99% KM (Chebyshev) UCL	3.682
		Potential UCLs to Use	
		95% KM (t) UCL	1.141

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Arsenic

General Statistics

Number of Valid Data	29	Number of Detected Data	19
Number of Distinct Detected Data	17	Number of Non-Detect Data	10
		Percent Non-Detects	34.48%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.29	Minimum Detected	-1.238
Maximum Detected	5.5	Maximum Detected	1.705
Mean of Detected	1.22	Mean of Detected	-0.0112
SD of Detected	1.109	SD of Detected	0.605
Minimum Non-Detect	0.53	Minimum Non-Detect	-0.635
Maximum Non-Detect	2.9	Maximum Non-Detect	1.065

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	28
Number treated as Detected	1
Single DL Non-Detect Percentage	96.55%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.576	Shapiro Wilk Test Statistic	0.918
5% Shapiro Wilk Critical Value	0.901	5% Shapiro Wilk Critical Value	0.901
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	1.129	Mean	-0.11
SD	0.956	SD	0.685
95% DL/2 (t) UCL	1.431	95% H-Stat (DL/2) UCL	1.49
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-0.194
		SD in Log Scale	0.608
		Mean in Original Scale	1.021
		SD in Original Scale	0.949
		95% t UCL	1.321
		95% Percentile Bootstrap UCL	1.342
		95% BCA Bootstrap UCL	1.473
		95% H-UCL	1.253

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	2.17	Data Follow Appr. Gamma Distribution at 5% Significance Level
Theta Star	0.562	
nu star	82.45	
A-D Test Statistic	1.061	
5% A-D Critical Value	0.75	
K-S Test Statistic	0.75	
5% K-S Critical Value	0.2	
Data follow Appr. Gamma Distribution at 5% Significance Level		

Assuming Gamma Distribution	
Gamma ROS Statistics using Extrapolated Data	
Minimum	0.000001
Maximum	5.5
Mean	1.007
Median	0.84
SD	1.005
k star	0.333
Theta star	3.023
Nu star	19.32
AppChi2	10.35
95% Gamma Approximate UCL (Use when n >= 40)	1.88
95% Adjusted Gamma UCL (Use when n < 40)	1.954

Note: DL/2 is not a recommended method.

Nonparametric Statistics	
Kaplan-Meier (KM) Method	
Mean	1.031
SD	0.944
SE of Mean	0.185
95% KM (t) UCL	1.347
95% KM (z) UCL	1.336
95% KM (jackknife) UCL	1.347
95% KM (bootstrap t) UCL	1.638
95% KM (BCA) UCL	1.405
95% KM (Percentile Bootstrap) UCL	1.389
95% KM (Chebyshev) UCL	1.839
97.5% KM (Chebyshev) UCL	2.189
99% KM (Chebyshev) UCL	2.876
Potential UCLs to Use	
95% KM (Percentile Bootstrap) UCL	1.389

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Cobalt

General Statistics

Number of Valid Observations	29	Number of Distinct Observations	28

Raw Statistics		Log-transformed Statistics	
Minimum	6	Minimum of Log Data	1.792
Maximum	45.2	Maximum of Log Data	3.811
Mean	21.84	Mean of log Data	3.017
Geometric Mean	20.43	SD of log Data	0.39
Median	20.2		
SD	7.826		
Std. Error of Mean	1.453		
Coefficient of Variation	0.358		
Skewness	0.774		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.958	Shapiro Wilk Test Statistic	0.946
Shapiro Wilk Critical Value	0.926	Shapiro Wilk Critical Value	0.926
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	24.31	95% H-UCL	25.28
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	29.1
95% Adjusted-CLT UCL (Chen-1995)	24.45	97.5% Chebyshev (MVUE) UCL	32.19
95% Modified-t UCL (Johnson-1978)	24.35	99% Chebyshev (MVUE) UCL	38.24

Gamma Distribution Test		Data Distribution
k star (bias corrected)	6.885	Data appear Normal at 5% Significance Level
Theta Star	3.172	
MLE of Mean	21.84	
MLE of Standard Deviation	8.322	
nu star	399.4	
Approximate Chi Square Value (.05)	354	**Nonparametric Statistics**
Adjusted Level of Significance	0.0407	95% CLT UCL 24.23
Adjusted Chi Square Value	351.5	95% Jackknife UCL 24.31
		95% Standard Bootstrap UCL 24.24
Anderson-Darling Test Statistic	0.317	95% Bootstrap-t UCL 24.55
Anderson-Darling 5% Critical Value	0.747	95% Hall's Bootstrap UCL 24.8
Kolmogorov-Smirnov Test Statistic	0.0923	95% Percentile Bootstrap UCL 24.18
Kolmogorov-Smirnov 5% Critical Value	0.163	95% BCA Bootstrap UCL 24.55
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 28.17
		97.5% Chebyshev(Mean, Sd) UCL 30.91
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 36.3
95% Approximate Gamma UCL (Use when n >= 40)	24.63	
95% Adjusted Gamma UCL (Use when n < 40)	24.81	

Potential UCL to Use	Use 95% Student's-t UCL 24.31

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Lead

General Statistics

Number of Valid Observations	19	Number of Distinct Observations	19

Raw Statistics		**Log-transformed Statistics**	
Minimum	2.6	Minimum of Log Data	0.956
Maximum	654	Maximum of Log Data	6.483
Mean	82.98	Mean of log Data	2.856
Geometric Mean	17.38	SD of log Data	1.553
Median	15.1		
SD	198.9		
Std. Error of Mean	45.64		
Coefficient of Variation	2.397		
Skewness	2.773		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.422	Shapiro Wilk Test Statistic	0.874
Shapiro Wilk Critical Value	0.901	Shapiro Wilk Critical Value	0.901
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	162.1	95% H-UCL	207.2
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	146.6
95% Adjusted-CLT UCL (Chen-1995)	189.1	97.5% Chebyshev (MVUE) UCL	187.8
95% Modified-t UCL (Johnson-1978)	167	99% Chebyshev (MVUE) UCL	268.7

Gamma Distribution Test		**Data Distribution**
k star (bias corrected)	0.387	Data do not follow a Discernable Distribution (0.05)
Theta Star	214.4	
MLE of Mean	82.98	
MLE of Standard Deviation	133.4	
nu star	14.71	
Approximate Chi Square Value (.05)	7.06	**Nonparametric Statistics**
Adjusted Level of Significance	0.0369	95% CLT UCL 158
Adjusted Chi Square Value	6.601	95% Jackknife UCL 162.1
		95% Standard Bootstrap UCL 155
Anderson-Darling Test Statistic	2.466	95% Bootstrap-t UCL 1018
Anderson-Darling 5% Critical Value	0.819	95% Hall's Bootstrap UCL 671.5
Kolmogorov-Smirnov Test Statistic	0.299	95% Percentile Bootstrap UCL 153.2
Kolmogorov-Smirnov 5% Critical Value	0.212	95% BCA Bootstrap UCL 185.4
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 281.9
		97.5% Chebyshev(Mean, Sd) UCL 368
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 537.1
95% Approximate Gamma UCL (Use when n >= 40)	172.9	
95% Adjusted Gamma UCL (Use when n < 40)	184.9	

Potential UCL to Use		Use 99% Chebyshev (Mean, Sd) UCL	537.1

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Thallium

General Statistics

Number of Valid Data	29	Number of Detected Data	9
Number of Distinct Detected Data	8	Number of Non-Detect Data	20
		Percent Non-Detects	68.97%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.027	Minimum Detected	-3.612
Maximum Detected	0.37	Maximum Detected	-0.994
Mean of Detected	0.0812	Mean of Detected	-2.914
SD of Detected	0.109	SD of Detected	0.792
Minimum Non-Detect	0.029	Minimum Non-Detect	-3.54
Maximum Non-Detect	3.3	Maximum Non-Detect	1.194

Note: Data have multiple DLs - Use of KM Method is recommended	Number treated as Non-Detect	29
For all methods (except KM, DL/2, and ROS Methods),	Number treated as Detected	0
Observations < Largest ND are treated as NDs	Single DL Non-Detect Percentage	100.00%

Warning: There are only 9 Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.519	Shapiro Wilk Test Statistic	0.775
5% Shapiro Wilk Critical Value	0.829	5% Shapiro Wilk Critical Value	0.829
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.401	Mean	-2.127
SD	0.567	SD	1.71
95% DL/2 (t) UCL	0.58	95% H-Stat (DL/2) UCL	1.575
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-3.423
		SD in Log Scale	0.655
		Mean in Original Scale	0.0448
		SD in Original Scale	0.0644
		95% t UCL	0.0652
		95% Percentile Bootstrap UCL	0.0669
		95% BCA Bootstrap UCL	0.079
		95% H-UCL	0.0523

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.995	Data do not follow a Discernable Distribution (0.05)	
Theta Star	0.0816		
nu star	17.92		
A-D Test Statistic	1.296	**Nonparametric Statistics**	
5% A-D Critical Value	0.737	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.737	Mean	0.0578
5% K-S Critical Value	0.285	SD	0.0818
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.0217
		95% KM (t) UCL	0.0947
Assuming Gamma Distribution		95% KM (z) UCL	0.0934
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.0928
Minimum	0.000001	95% KM (bootstrap t) UCL	0.264
Maximum	0.37	95% KM (BCA) UCL	0.102
Mean	0.0424	95% KM (Percentile Bootstrap) UCL	0.0966
Median	0.0323	95% KM (Chebyshev) UCL	0.152
SD	0.0695	97.5% KM (Chebyshev) UCL	0.193
k star	0.206	99% KM (Chebyshev) UCL	0.274
Theta star	0.206		
Nu star	11.92	Potential UCLs to Use	
AppChi2	5.178	95% KM (t) UCL	0.0947
95% Gamma Approximate UCL (Use when n >= 40)	0.0976	95% KM (% Bootstrap) UCL	0.0966
95% Adjusted Gamma UCL (Use when n < 40)	0.103		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Vanadium

General Statistics

Number of Valid Observations	29	Number of Distinct Observations	27

Raw Statistics		Log-transformed Statistics	
Minimum	72.8	Minimum of Log Data	4.288
Maximum	330	Maximum of Log Data	5.799
Mean	164.7	Mean of log Data	5.027
Geometric Mean	152.4	SD of log Data	0.401
Median	140		
SD	67.02		
Std. Error of Mean	12.44		
Coefficient of Variation	0.407		
Skewness	0.726		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.928	Shapiro Wilk Test Statistic	0.968
Shapiro Wilk Critical Value	0.926	Shapiro Wilk Critical Value	0.926
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	185.9	95% H-UCL	190.3
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	219.6
95% Adjusted-CLT UCL (Chen-1995)	187	97.5% Chebyshev (MVUE) UCL	243.4
95% Modified-t UCL (Johnson-1978)	186.2	99% Chebyshev (MVUE) UCL	290.1

Gamma Distribution Test		Data Distribution
k star (bias corrected)	5.938	Data appear Normal at 5% Significance Level
Theta Star	27.75	
MLE of Mean	164.7	
MLE of Standard Deviation	67.61	
nu star	344.4	
Approximate Chi Square Value (.05)	302.4	**Nonparametric Statistics**
Adjusted Level of Significance	0.0407	95% CLT UCL 185.2
Adjusted Chi Square Value	300	95% Jackknife UCL 185.9
		95% Standard Bootstrap UCL 183.8
Anderson-Darling Test Statistic	0.452	95% Bootstrap-t UCL 187.6
Anderson-Darling 5% Critical Value	0.747	95% Hall's Bootstrap UCL 187.9
Kolmogorov-Smirnov Test Statistic	0.126	95% Percentile Bootstrap UCL 184.5
Kolmogorov-Smirnov 5% Critical Value	0.163	95% BCA Bootstrap UCL 186.1
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 219
		97.5% Chebyshev(Mean, Sd) UCL 242.5
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 288.6
95% Approximate Gamma UCL (Use when n >= 40)	187.6	
95% Adjusted Gamma UCL (Use when n < 40)	189.1	

Potential UCL to Use	Use 95% Student's-t UCL 185.9

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

General UCL Statistics for Data Sets with Non-Detects: 2012 Surface Soil

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic

General Statistics

Number of Valid Observations	10	Number of Distinct Observations	10

Raw Statistics		**Log-transformed Statistics**	
Minimum	0.46	Minimum of Log Data	-0.777
Maximum	1.8	Maximum of Log Data	0.588
Mean	1.091	Mean of log Data	0.00915
Geometric Mean	1.009	SD of log Data	0.426
Median	0.95		
SD	0.441		
Std. Error of Mean	0.14		
Coefficient of Variation	0.405		
Skewness	0.423		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.943	Shapiro Wilk Test Statistic	0.962
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	1.347	95% H-UCL	1.493
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	1.745
95% Adjusted-CLT UCL (Chen-1995)	1.34	97.5% Chebyshev (MVUE) UCL	2.026
95% Modified-t UCL (Johnson-1978)	1.35	99% Chebyshev (MVUE) UCL	2.579

Gamma Distribution Test		**Data Distribution**
k star (bias corrected)	4.671	Data appear Normal at 5% Significance Level
Theta Star	0.234	
MLE of Mean	1.091	
MLE of Standard Deviation	0.505	
nu star	93.41	
Approximate Chi Square Value (.05)	72.12	**Nonparametric Statistics**
Adjusted Level of Significance	0.0267	95% CLT UCL 1.321
Adjusted Chi Square Value	68.88	95% Jackknife UCL 1.347
		95% Standard Bootstrap UCL 1.309
Anderson-Darling Test Statistic	0.236	95% Bootstrap-t UCL 1.408
Anderson-Darling 5% Critical Value	0.728	95% Hall's Bootstrap UCL 1.331
Kolmogorov-Smirnov Test Statistic	0.135	95% Percentile Bootstrap UCL 1.316
Kolmogorov-Smirnov 5% Critical Value	0.267	95% BCA Bootstrap UCL 1.321
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 1.699
		97.5% Chebyshev(Mean, Sd) UCL 1.963
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 2.48
95% Approximate Gamma UCL (Use when n >= 40)	1.413	
95% Adjusted Gamma UCL (Use when n < 40)	1.48	

Potential UCL to Use		Use 95% Student's-t UCL	1.347

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Cobalt

General Statistics

Number of Valid Observations	10	Number of Distinct Observations	10

Raw Statistics

Minimum	6
Maximum	36
Mean	20.1
Geometric Mean	18.36
Median	19.5
SD	8.171
Std. Error of Mean	2.584
Coefficient of Variation	0.407
Skewness	0.326

Log-transformed Statistics

Minimum of Log Data	1.792
Maximum of Log Data	3.584
Mean of log Data	2.91
SD of log Data	0.484

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.982
Shapiro Wilk Critical Value	0.842

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.912
Shapiro Wilk Critical Value	0.842

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	24.84

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	24.63
95% Modified-t UCL (Johnson-1978)	24.88

Assuming Lognormal Distribution

95% H-UCL	29.43
95% Chebyshev (MVUE) UCL	34.21
97.5% Chebyshev (MVUE) UCL	40.2
99% Chebyshev (MVUE) UCL	51.96

Gamma Distribution Test

k star (bias corrected)	4.044
Theta Star	4.97
MLE of Mean	20.1
MLE of Standard Deviation	9.995
nu star	80.88
Approximate Chi Square Value (.05)	61.16
Adjusted Level of Significance	0.0267
Adjusted Chi Square Value	58.19
Anderson-Darling Test Statistic	0.253
Anderson-Darling 5% Critical Value	0.729
Kolmogorov-Smirnov Test Statistic	0.152
Kolmogorov-Smirnov 5% Critical Value	0.267

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL (Use when n >= 40)	26.58
95% Adjusted Gamma UCL (Use when n < 40)	27.94

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	24.35
95% Jackknife UCL	24.84
95% Standard Bootstrap UCL	24.19
95% Bootstrap-t UCL	25.03
95% Hall's Bootstrap UCL	25.76
95% Percentile Bootstrap UCL	24.1
95% BCA Bootstrap UCL	24.2
95% Chebyshev(Mean, Sd) UCL	31.36
97.5% Chebyshev(Mean, Sd) UCL	36.24
99% Chebyshev(Mean, Sd) UCL	45.81

Potential UCL to Use

Use 95% Student's-t UCL 24.84

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Vanadium

General Statistics

Number of Valid Observations	10	Number of Distinct Observations	8

Raw Statistics

Minimum	110
Maximum	330
Mean	206
Geometric Mean	195.3
Median	205
SD	69.63
Std. Error of Mean	22.02
Coefficient of Variation	0.338
Skewness	0.362

Log-transformed Statistics

Minimum of Log Data	4.7
Maximum of Log Data	5.799
Mean of log Data	5.275
SD of log Data	0.349

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.956
Shapiro Wilk Critical Value	0.842

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.962
Shapiro Wilk Critical Value	0.842

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	246.4

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	244.9
95% Modified-t UCL (Johnson-1978)	246.8

Assuming Lognormal Distribution

95% H-UCL	262.7
95% Chebyshev (MVUE) UCL	306.3
97.5% Chebyshev (MVUE) UCL	349.5
99% Chebyshev (MVUE) UCL	434.5

Gamma Distribution Test

k star (bias corrected)	6.748
Theta Star	30.53
MLE of Mean	206
MLE of Standard Deviation	79.3
nu star	135
Approximate Chi Square Value (.05)	109.1
Adjusted Level of Significance	0.0267
Adjusted Chi Square Value	105.1
Anderson-Darling Test Statistic	0.257
Anderson-Darling 5% Critical Value	0.725
Kolmogorov-Smirnov Test Statistic	0.175
Kolmogorov-Smirnov 5% Critical Value	0.267

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL (Use when n >= 40)	254.8
95% Adjusted Gamma UCL (Use when n < 40)	264.6

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	242.2
95% Jackknife UCL	246.4
95% Standard Bootstrap UCL	239.6
95% Bootstrap-t UCL	253.2
95% Hall's Bootstrap UCL	246.3
95% Percentile Bootstrap UCL	240
95% BCA Bootstrap UCL	241
95% Chebyshev(Mean, Sd) UCL	302
97.5% Chebyshev(Mean, Sd) UCL	343.5
99% Chebyshev(Mean, Sd) UCL	425.1

Potential UCL to Use

Use 95% Student's-t UCL 246.4

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

General UCL Statistics for Data Sets with Non-Detects: Combined Total Soil

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Methyl Iodide

General Statistics

Number of Valid Data	85	Number of Detected Data	7
Number of Distinct Detected Data	6	Number of Non-Detect Data	78
		Percent Non-Detects	91.76%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.97	Minimum Detected	-0.0305
Maximum Detected	30	Maximum Detected	3.401
Mean of Detected	7.239	Mean of Detected	1.194
SD of Detected	10.75	SD of Detected	1.263
Minimum Non-Detect	1.3	Minimum Non-Detect	0.262
Maximum Non-Detect	6	Maximum Non-Detect	1.792

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	83
Number treated as Detected	2
Single DL Non-Detect Percentage	97.65%

Warning: There are only 7 Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only

Shapiro Wilk Test Statistic	0.662
5% Shapiro Wilk Critical Value	0.803

Data not Normal at 5% Significance Level

Assuming Normal Distribution

DL/2 Substitution Method	
Mean	2.381
SD	3.291
95% DL/2 (t) UCL	2.975
Maximum Likelihood Estimate(MLE) Method	N/A

MLE method failed to converge properly

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.53
Theta Star	13.66
nu star	7.418
A-D Test Statistic	0.8
5% A-D Critical Value	0.736
K-S Test Statistic	0.736
5% K-S Critical Value	0.323

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data	
Minimum	0.000001
Maximum	30
Mean	1.745
Median	0.000001
SD	3.856
k star	0.105
Theta star	16.67
Nu star	17.79
AppChi2	9.24
95% Gamma Approximate UCL (Use when n >= 40)	3.359
95% Adjusted Gamma UCL (Use when n < 40)	3.398

Lognormal Distribution Test with Detected Values Only

Shapiro Wilk Test Statistic	0.852
5% Shapiro Wilk Critical Value	0.803

Data appear Lognormal at 5% Significance Level

Assuming Lognormal Distribution

DL/2 Substitution Method	
Mean	0.632
SD	0.572
95% H-Stat (DL/2) UCL	2.493
Log ROS Method	
Mean in Log Scale	-0.0902
SD in Log Scale	0.76
Mean in Original Scale	1.478
SD in Original Scale	3.401
95% t UCL	2.092
95% Percentile Bootstrap UCL	2.144
95% BCA Bootstrap UCL	2.707
95% H-UCL	1.444

Data Distribution Test with Detected Values Only

Data appear Lognormal at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method	
Mean	1.678
SD	3.325
SE of Mean	0.403
95% KM (t) UCL	2.349
95% KM (z) UCL	2.341
95% KM (jackknife) UCL	2.252
95% KM (bootstrap t) UCL	3.467
95% KM (BCA) UCL	3.125
95% KM (Percentile Bootstrap) UCL	2.669
95% KM (Chebyshev) UCL	3.436
97.5% KM (Chebyshev) UCL	4.196
99% KM (Chebyshev) UCL	5.69

Potential UCLs to Use

95% KM (BCA) UCL	3.125

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Benzo(a)anthracene

General Statistics

Number of Valid Data	85	Number of Detected Data	20
Number of Distinct Detected Data	20	Number of Non-Detect Data	65
		Percent Non-Detects	76.47%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.63	Minimum Detected	-0.462
Maximum Detected	84	Maximum Detected	4.431
Mean of Detected	10.06	Mean of Detected	1.045
SD of Detected	20.46	SD of Detected	1.494
Minimum Non-Detect	3.7	Minimum Non-Detect	1.308
Maximum Non-Detect	46	Maximum Non-Detect	3.829

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	83
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	2
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	97.65%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.524	Shapiro Wilk Test Statistic	0.87
5% Shapiro Wilk Critical Value	0.905	5% Shapiro Wilk Critical Value	0.905
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	6.114	Mean	1.375
SD	10.29	SD	0.839
95% DL/2 (t) UCL	7.97	95% H-Stat (DL/2) UCL	6.812
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	0.495
		SD in Log Scale	0.994
		Mean in Original Scale	3.719
		SD in Original Scale	10.42
		95% t UCL	5.599
		95% Percentile Bootstrap UCL	5.928
		95% BCA Bootstrap UCL	6.798
		95% H-UCL	3.424

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.46	Data do not follow a Discernable Distribution (0.05)	
Theta Star	21.85		
nu star	18.42		
A-D Test Statistic	1.792	**Nonparametric Statistics**	
5% A-D Critical Value	0.802	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.802	Mean	3.601
5% K-S Critical Value	0.205	SD	10.41
Data not Gamma Distributed at 5% Significance Level		SE of Mean	1.188
		95% KM (t) UCL	5.578
Assuming Gamma Distribution		95% KM (z) UCL	5.556
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	5.544
Minimum	0.000001	95% KM (bootstrap t) UCL	8.86
Maximum	84	95% KM (BCA) UCL	5.627
Mean	5.237	95% KM (Percentile Bootstrap) UCL	5.757
Median	1.1	95% KM (Chebyshev) UCL	8.781
SD	11.11	97.5% KM (Chebyshev) UCL	11.02
k star	0.155	99% KM (Chebyshev) UCL	15.43
Theta star	33.85		
Nu star	26.3	Potential UCLs to Use	
AppChi2	15.61	95% KM (BCA) UCL	5.627
95% Gamma Approximate UCL (Use when n >= 40)	8.822		
95% Adjusted Gamma UCL (Use when n < 40)	8.903		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Benzo(a)pyrene (BaP)

General Statistics

Number of Valid Data	85	Number of Detected Data	13
Number of Distinct Detected Data	13	Number of Non-Detect Data	72
		Percent Non-Detects	84.71%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.8	Minimum Detected	-0.223
Maximum Detected	390	Maximum Detected	5.966
Mean of Detected	36.45	Mean of Detected	1.151
SD of Detected	107.3	SD of Detected	1.929
Minimum Non-Detect	3.7	Minimum Non-Detect	1.308
Maximum Non-Detect	46	Maximum Non-Detect	3.829

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	83
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	2
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	97.65%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.385	Shapiro Wilk Test Statistic	0.75
5% Shapiro Wilk Critical Value	0.866	5% Shapiro Wilk Critical Value	0.866
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	9.713	Mean	1.433
SD	42.22	SD	0.844
95% DL/2 (t) UCL	17.33	95% H-Stat (DL/2) UCL	7.261
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	0.515
		SD in Log Scale	1.103
		Mean in Original Scale	7.35
		SD in Original Scale	42.47
		95% t UCL	15.01
		95% Percentile Bootstrap UCL	16.46
		95% BCA Bootstrap UCL	25.49
		95% H-UCL	4.073

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.27	Data do not follow a Discernable Distribution (0.05)	
Theta Star	134.9		
nu star	7.024		
A-D Test Statistic	2.285	Nonparametric Statistics	
5% A-D Critical Value	0.836	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.836	Mean	6.881
5% K-S Critical Value	0.257	SD	42.25
Data not Gamma Distributed at 5% Significance Level		SE of Mean	4.78
		95% KM (t) UCL	14.83
Assuming Gamma Distribution		95% KM (z) UCL	14.74
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	14.57
Minimum	0.000001	95% KM (bootstrap t) UCL	84.23
Maximum	390	95% KM (BCA) UCL	16.24
Mean	14.46	95% KM (Percentile Bootstrap) UCL	15.82
Median	0.000001	95% KM (Chebyshev) UCL	27.72
SD	45.22	97.5% KM (Chebyshev) UCL	36.73
k star	0.0955	99% KM (Chebyshev) UCL	54.44
Theta star	151.4		
Nu star	16.24	Potential UCLs to Use	
AppChi2	8.131	95% KM (Chebyshev) UCL	27.72
95% Gamma Approximate UCL (Use when n >= 40)	28.89		
95% Adjusted Gamma UCL (Use when n < 40)	29.24		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Benzo(b)fluoranthene

General Statistics

Number of Valid Data	85	Number of Detected Data	14
Number of Distinct Detected Data	13	Number of Non-Detect Data	71
		Percent Non-Detects	83.53%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.64	Minimum Detected	-0.446
Maximum Detected	750	Maximum Detected	6.62
Mean of Detected	59.18	Mean of Detected	1.175
SD of Detected	199.3	SD of Detected	1.947
Minimum Non-Detect	3.7	Minimum Non-Detect	1.308
Maximum Non-Detect	46	Maximum Non-Detect	3.829

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	83
Number treated as Detected	2
Single DL Non-Detect Percentage	97.65%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.331	Shapiro Wilk Test Statistic	0.737
5% Shapiro Wilk Critical Value	0.874	5% Shapiro Wilk Critical Value	0.874
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	13.83	Mean	1.433
SD	81.01	SD	0.875
95% DL/2 (t) UCL	28.44	95% H-Stat (DL/2) UCL	7.526
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	0.623
		SD in Log Scale	1.124
		Mean in Original Scale	11.74
		SD in Original Scale	81.23
		95% t UCL	26.39
		95% Percentile Bootstrap UCL	29.14
		95% BCA Bootstrap UCL	47
		95% H-UCL	4.682

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	0.24	Data do not follow a Discernable Distribution (0.05)
Theta Star	246.3	
nu star	6.729	
A-D Test Statistic	2.911	**Nonparametric Statistics**
5% A-D Critical Value	0.855	Kaplan-Meier (KM) Method
K-S Test Statistic	0.855	Mean 11.13
5% K-S Critical Value	0.251	SD 80.8
Data not Gamma Distributed at 5% Significance Level		SE of Mean 9.099
		95% KM (t) UCL 26.27
Assuming Gamma Distribution		95% KM (z) UCL 26.1
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL 25.8
Minimum	0.000001	95% KM (bootstrap t) UCL 300.8
Maximum	750	95% KM (BCA) UCL 29.1
Mean	23.78	95% KM (Percentile Bootstrap) UCL 28.56
Median	0.000001	95% KM (Chebyshev) UCL 50.8
SD	85.69	97.5% KM (Chebyshev) UCL 67.96
k star	0.0909	99% KM (Chebyshev) UCL 101.7
Theta star	261.6	
Nu star	15.45	Potential UCLs to Use
AppChi2	7.577	95% KM (Chebyshev) UCL 50.8
95% Gamma Approximate UCL (Use when n >= 40)	48.49	
95% Adjusted Gamma UCL (Use when n < 40)	49.11	

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Benzo(k)fluoranthene

General Statistics

Number of Valid Data	85	Number of Detected Data	14
Number of Distinct Detected Data	14	Number of Non-Detect Data	71
		Percent Non-Detects	83.53%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.49	Minimum Detected	-0.713
Maximum Detected	730	Maximum Detected	6.593
Mean of Detected	58.65	Mean of Detected	1.152
SD of Detected	193.9	SD of Detected	2.028
Minimum Non-Detect	3.7	Minimum Non-Detect	1.308
Maximum Non-Detect	46	Maximum Non-Detect	3.829

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	83
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	2
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	97.65%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.339	Shapiro Wilk Test Statistic	0.788
5% Shapiro Wilk Critical Value	0.874	5% Shapiro Wilk Critical Value	0.874
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	13.74	Mean	1.429
SD	78.91	SD	0.905
95% DL/2 (t) UCL	27.98	95% H-Stat (DL/2) UCL	7.769
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	0.456
		SD in Log Scale	1.19
		Mean in Original Scale	11.37
		SD in Original Scale	79.17
		95% t UCL	25.65
		95% Percentile Bootstrap UCL	28.32
		95% BCA Bootstrap UCL	45.95
		95% H-UCL	4.39

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.24	Data do not follow a Discernable Distribution (0.05)	
Theta Star	244.9		
nu star	6.706		
A-D Test Statistic	2.606	Nonparametric Statistics	
5% A-D Critical Value	0.855	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.855	Mean	10.97
5% K-S Critical Value	0.251	SD	78.74
Data not Gamma Distributed at 5% Significance Level		SE of Mean	8.868
		95% KM (t) UCL	25.72
Assuming Gamma Distribution		95% KM (z) UCL	25.55
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	25.27
Minimum	0.000001	95% KM (bootstrap t) UCL	262.8
Maximum	730	95% KM (BCA) UCL	28.09
Mean	21.18	95% KM (Percentile Bootstrap) UCL	27.65
Median	0.000001	95% KM (Chebyshev) UCL	49.62
SD	82.64	97.5% KM (Chebyshev) UCL	66.35
k star	0.091	99% KM (Chebyshev) UCL	99.2
Theta star	232.9		
Nu star	15.46	Potential UCLs to Use	
AppChi2	7.585	97.5% KM (Chebyshev) UCL	66.35
95% Gamma Approximate UCL (Use when n >= 40)	43.19		
95% Adjusted Gamma UCL (Use when n < 40)	43.74		
Note: DL/2 is not a recommended method.			

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Chrysene

General Statistics

Number of Valid Data	85	Number of Detected Data	22
Number of Distinct Detected Data	19	Number of Non-Detect Data	63
		Percent Non-Detects	74.12%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.77	Minimum Detected	-0.261
Maximum Detected	1200	Maximum Detected	7.09
Mean of Detected	60.91	Mean of Detected	1.308
SD of Detected	254.6	SD of Detected	1.766
Minimum Non-Detect	3.7	Minimum Non-Detect	1.308
Maximum Non-Detect	46	Maximum Non-Detect	3.829

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	84
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	1
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	98.82%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.245	Shapiro Wilk Test Statistic	0.794
5% Shapiro Wilk Critical Value	0.911	5% Shapiro Wilk Critical Value	0.911
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	19.39	Mean	1.43
SD	129.7	SD	0.975
95% DL/2 (t) UCL	42.79	95% H-Stat (DL/2) UCL	8.501
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	0.78
		SD in Log Scale	1.144
		Mean in Original Scale	17.53
		SD in Original Scale	129.9
		95% t UCL	40.97
		95% Percentile Bootstrap UCL	45.51
		95% BCA Bootstrap UCL	60.58
		95% H-UCL	5.65

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.249	Data do not follow a Discernable Distribution (0.05)	
Theta Star	244.8		
nu star	10.95		
A-D Test Statistic	4.297	Nonparametric Statistics	
5% A-D Critical Value	0.868	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.868	Mean	17.14
5% K-S Critical Value	0.203	SD	129.2
Data not Gamma Distributed at 5% Significance Level		SE of Mean	14.34
		95% KM (t) UCL	40.99
Assuming Gamma Distribution		95% KM (z) UCL	40.73
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	40.58
Minimum	0.000001	95% KM (bootstrap t) UCL	492.6
Maximum	1200	95% KM (BCA) UCL	45.74
Mean	24.59	95% KM (Percentile Bootstrap) UCL	45.19
Median	0.000001	95% KM (Chebyshev) UCL	79.66
SD	131.2	97.5% KM (Chebyshev) UCL	106.7
k star	0.0947	99% KM (Chebyshev) UCL	159.9
Theta star	259.7		
Nu star	16.1	Potential UCLs to Use	
AppChi2	8.031	95% KM (Chebyshev) UCL	79.66
95% Gamma Approximate UCL (Use when n >= 40)	49.29		
95% Adjusted Gamma UCL (Use when n < 40)	49.9		
Note: DL/2 is not a recommended method.			

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Indeno(1,2,3-cd)pyrene

General Statistics

Number of Valid Data	85	Number of Detected Data	8
Number of Distinct Detected Data	8	Number of Non-Detect Data	77
		Percent Non-Detects	90.59%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.77	Minimum Detected	-0.261
Maximum Detected	240	Maximum Detected	5.481
Mean of Detected	39.73	Mean of Detected	1.652
SD of Detected	83.87	SD of Detected	2.07
Minimum Non-Detect	3.7	Minimum Non-Detect	1.308
Maximum Non-Detect	46	Maximum Non-Detect	3.829

Note: Data have multiple DLs - Use of KM Method is recommended	Number treated as Non-Detect	83
For all methods (except KM, DL/2, and ROS Methods),	Number treated as Detected	2
Observations < Largest ND are treated as NDs	Single DL Non-Detect Percentage	97.65%

Warning: There are only 8 Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.556	Shapiro Wilk Test Statistic	0.826
5% Shapiro Wilk Critical Value	0.818	5% Shapiro Wilk Critical Value	0.818
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	8.159	Mean	1.505
SD	26.4	SD	0.725
95% DL/2 (t) UCL	12.92	95% H-Stat (DL/2) UCL	6.875
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	0.821
		SD in Log Scale	1.139
		Mean in Original Scale	6.7
		SD in Original Scale	26.67
		95% t UCL	11.51
		95% Percentile Bootstrap UCL	12.18
		95% BCA Bootstrap UCL	16.71
		95% H-UCL	5.84

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.292	Data appear Lognormal at 5% Significance Level	
Theta Star	136.1		
nu star	4.672		
A-D Test Statistic	1.09	**Nonparametric Statistics**	
5% A-D Critical Value	0.791	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.791	Mean	5.673
5% K-S Critical Value	0.316	SD	26.47
Data not Gamma Distributed at 5% Significance Level		SE of Mean	3.101
		95% KM (t) UCL	10.83
Assuming Gamma Distribution		95% KM (z) UCL	10.77
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	10.55
Minimum	0.000001	95% KM (bootstrap t) UCL	33.58
Maximum	240	95% KM (BCA) UCL	11.71
Mean	15.67	95% KM (Percentile Bootstrap) UCL	11.17
Median	0.000001	95% KM (Chebyshev) UCL	19.19
SD	33.38	97.5% KM (Chebyshev) UCL	25.04
k star	0.0934	99% KM (Chebyshev) UCL	36.53
Theta star	167.8		
Nu star	15.88	Potential UCLs to Use	
AppChi2	7.876	97.5% KM (Chebyshev) UCL	25.04
95% Gamma Approximate UCL (Use when n >= 40)	31.6		
95% Adjusted Gamma UCL (Use when n < 40)	32		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Antimony

General Statistics

Number of Valid Data	85	Number of Detected Data	15
Number of Distinct Detected Data	12	Number of Non-Detect Data	70
		Percent Non-Detects	82.35%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.15	Minimum Detected	-1.897
Maximum Detected	8.5	Maximum Detected	2.14
Mean of Detected	1.218	Mean of Detected	-0.421
SD of Detected	2.054	SD of Detected	1.046
Minimum Non-Detect	0.55	Minimum Non-Detect	-0.598
Maximum Non-Detect	7.3	Maximum Non-Detect	1.988

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	84
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	1
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	98.82%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.459	Shapiro Wilk Test Statistic	0.893
5% Shapiro Wilk Critical Value	0.881	5% Shapiro Wilk Critical Value	0.881
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	1.616	Mean	0.00298
SD	1.473	SD	1.035
95% DL/2 (t) UCL	1.882	95% H-Stat (DL/2) UCL	2.216
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-1.08
		SD in Log Scale	0.681
		Mean in Original Scale	0.487
		SD in Original Scale	0.917
		95% t UCL	0.652
		95% Percentile Bootstrap UCL	0.675
		95% BCA Bootstrap UCL	0.798
		95% H-UCL	0.496

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.797	Data appear Lognormal at 5% Significance Level	
Theta Star	1.528		
nu star	23.91		
A-D Test Statistic	1.149	Nonparametric Statistics	
5% A-D Critical Value	0.766	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.766	Mean	0.514
5% K-S Critical Value	0.228	SD	0.93
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.116
		95% KM (t) UCL	0.707
Assuming Gamma Distribution		95% KM (z) UCL	0.704
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.705
Minimum	0.000001	95% KM (bootstrap t) UCL	0.841
Maximum	8.5	95% KM (BCA) UCL	0.73
Mean	0.598	95% KM (Percentile Bootstrap) UCL	0.725
Median	0.479	95% KM (Chebyshev) UCL	1.019
SD	0.99	97.5% KM (Chebyshev) UCL	1.237
k star	0.231	99% KM (Chebyshev) UCL	1.666
Theta star	2.587		
Nu star	39.27	Potential UCLs to Use	
AppChi2	25.92	95% KM (BCA) UCL	0.73
95% Gamma Approximate UCL (Use when n >= 40)	0.906		
95% Adjusted Gamma UCL (Use when n < 40)	0.912		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Arsenic

General Statistics

Number of Valid Data	85	Number of Detected Data	42
Number of Distinct Detected Data	31	Number of Non-Detect Data	43
		Percent Non-Detects	50.59%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.19	Minimum Detected	-1.661
Maximum Detected	5.5	Maximum Detected	1.705
Mean of Detected	1.06	Mean of Detected	-0.133
SD of Detected	0.824	SD of Detected	0.621
Minimum Non-Detect	0.53	Minimum Non-Detect	-0.635
Maximum Non-Detect	3.6	Maximum Non-Detect	1.281

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	84
Number treated as Detected	1
Single DL Non-Detect Percentage	98.82%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.636	Shapiro Wilk Test Statistic	0.923
5% Shapiro Wilk Critical Value	0.942	5% Shapiro Wilk Critical Value	0.942
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	1.113	Mean	-0.0889
SD	0.7	SD	0.677
95% DL/2 (t) UCL	1.239	95% H-Stat (DL/2) UCL	1.332
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-0.335
		SD in Log Scale	0.572
		Mean in Original Scale	0.852
		SD in Original Scale	0.65
		95% t UCL	0.969
		95% Percentile Bootstrap UCL	0.975
		95% BCA Bootstrap UCL	1.012
		95% H-UCL	0.948

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	2.595	Data appear Gamma Distributed at 5% Significance Level
Theta Star	0.408	
nu star	218	
A-D Test Statistic	0.751	
5% A-D Critical Value	0.756	
K-S Test Statistic	0.756	
5% K-S Critical Value	0.138	
Data appear Gamma Distributed at 5% Significance Level		

Assuming Gamma Distribution		Nonparametric Statistics	
Gamma ROS Statistics using Extrapolated Data		Kaplan-Meier (KM) Method	
Minimum	0.000001	Mean	0.872
Maximum	5.5	SD	0.68
Mean	0.884	SE of Mean	0.0848
Median	0.851	95% KM (t) UCL	1.013
SD	0.689	95% KM (z) UCL	1.011
k star	0.867	95% KM (jackknife) UCL	1.013
Theta star	1.021	95% KM (bootstrap t) UCL	1.053
Nu star	147.3	95% KM (BCA) UCL	1.023
AppChi2	120.3	95% KM (Percentile Bootstrap) UCL	1.014
95% Gamma Approximate UCL (Use when n >= 40)	1.083	95% KM (Chebyshev) UCL	1.241
95% Adjusted Gamma UCL (Use when n < 40)	1.087	97.5% KM (Chebyshev) UCL	1.401
		99% KM (Chebyshev) UCL	1.716
		Potential UCLs to Use	
		95% KM (t) UCL	1.013

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Cobalt

General Statistics

Number of Valid Observations	85	Number of Distinct Observations	70

Raw Statistics		Log-transformed Statistics	
Minimum	3.5	Minimum of Log Data	1.253
Maximum	83.9	Maximum of Log Data	4.43
Mean	23.56	Mean of log Data	3.027
Geometric Mean	20.63	SD of log Data	0.533
Median	21.2		
SD	13.27		
Std. Error of Mean	1.44		
Coefficient of Variation	0.563		
Skewness	2.231		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.165	Lilliefors Test Statistic	0.128
Lilliefors Critical Value	0.0961	Lilliefors Critical Value	0.0961
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	25.96	95% H-UCL	26.49
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	30.07
95% Adjusted-CLT UCL (Chen-1995)	26.3	97.5% Chebyshev (MVUE) UCL	32.81
95% Modified-t UCL (Johnson-1978)	26.02	99% Chebyshev (MVUE) UCL	38.21

Gamma Distribution Test		Data Distribution
k star (bias corrected)	3.784	Data do not follow a Discernable Distribution (0.05)
Theta Star	6.228	
MLE of Mean	23.56	
MLE of Standard Deviation	12.11	
nu star	643.2	
Approximate Chi Square Value (.05)	585.4	**Nonparametric Statistics**
Adjusted Level of Significance	0.0472	95% CLT UCL 25.93
Adjusted Chi Square Value	584.4	95% Jackknife UCL 25.96
		95% Standard Bootstrap UCL 25.94
Anderson-Darling Test Statistic	1.475	95% Bootstrap-t UCL 26.48
Anderson-Darling 5% Critical Value	0.756	95% Hall's Bootstrap UCL 26.51
Kolmogorov-Smirnov Test Statistic	0.114	95% Percentile Bootstrap UCL 25.93
Kolmogorov-Smirnov 5% Critical Value	0.0974	95% BCA Bootstrap UCL 26.18
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 29.84
		97.5% Chebyshev(Mean, Sd) UCL 32.55
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 37.89
95% Approximate Gamma UCL (Use when n >= 40)	25.89	
95% Adjusted Gamma UCL (Use when n < 40)	25.93	

Potential UCL to Use	Use 95% Chebyshev (Mean, Sd) UCL 29.84

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Lead

General Statistics

Number of Valid Data	63	Number of Detected Data	49
Number of Distinct Detected Data	43	Number of Non-Detect Data	14
		Percent Non-Detects	22.22%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.72	Minimum Detected	-0.329
Maximum Detected	654	Maximum Detected	6.483
Mean of Detected	37.84	Mean of Detected	2.082
SD of Detected	127.4	SD of Detected	1.447
Minimum Non-Detect	2.7	Minimum Non-Detect	0.993
Maximum Non-Detect	3.6	Maximum Non-Detect	1.281

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	32
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	31
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	50.79%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.283	Shapiro Wilk Test Statistic	0.923
5% Shapiro Wilk Critical Value	0.947	5% Shapiro Wilk Critical Value	0.947
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	29.78	Mean	1.719
SD	113.1	SD	1.446
95% DL/2 (t) UCL	53.58	95% H-Stat (DL/2) UCL	24.7
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	1.726
		SD in Log Scale	1.45
		Mean in Original Scale	29.82
		SD in Original Scale	113.1
		95% t UCL	53.61
		95% Percentile Bootstrap UCL	58.5
		95% BCA Bootstrap UCL	69.46
		95% H-UCL	25.08

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.409	Data do not follow a Discernable Distribution (0.05)	
Theta Star	92.62		
nu star	40.04		
A-D Test Statistic	5.197	Nonparametric Statistics	
5% A-D Critical Value	0.833	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.833	Mean	29.86
5% K-S Critical Value	0.135	SD	112.2
Data not Gamma Distributed at 5% Significance Level		SE of Mean	14.28
		95% KM (t) UCL	53.7
Assuming Gamma Distribution		95% KM (z) UCL	53.35
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	53.65
Minimum	0.000001	95% KM (bootstrap t) UCL	228.4
Maximum	654	95% KM (BCA) UCL	59.7
Mean	29.43	95% KM (Percentile Bootstrap) UCL	52.07
Median	3.5	95% KM (Chebyshev) UCL	92.1
SD	113.2	97.5% KM (Chebyshev) UCL	119
k star	0.161	99% KM (Chebyshev) UCL	171.9
Theta star	182.9		
Nu star	20.28	Potential UCLs to Use	
AppChi2	11.05	95% KM (Chebyshev) UCL	92.1
95% Gamma Approximate UCL (Use when n >= 40)	53.99		
95% Adjusted Gamma UCL (Use when n < 40)	54.78		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Thallium

General Statistics

Number of Valid Data	85	Number of Detected Data	21
Number of Distinct Detected Data	19	Number of Non-Detect Data	64
		Percent Non-Detects	75.29%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.027	Minimum Detected	-3.612
Maximum Detected	0.53	Maximum Detected	-0.635
Mean of Detected	0.143	Mean of Detected	-2.575
SD of Detected	0.179	SD of Detected	1.071
Minimum Non-Detect	0.028	Minimum Non-Detect	-3.576
Maximum Non-Detect	3.6	Maximum Non-Detect	1.281

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	85
Number treated as Detected	0
Single DL Non-Detect Percentage	100.00%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.651	Shapiro Wilk Test Statistic	0.798
5% Shapiro Wilk Critical Value	0.908	5% Shapiro Wilk Critical Value	0.908
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.665	Mean	-1.485
SD	0.682	SD	1.811
95% DL/2 (t) UCL	0.788	95% H-Stat (DL/2) UCL	2.167
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-3.276
		SD in Log Scale	0.894
		Mean in Original Scale	0.0642
		SD in Original Scale	0.102
		95% t UCL	0.0825
		95% Percentile Bootstrap UCL	0.0833
		95% BCA Bootstrap UCL	0.0878
		95% H-UCL	0.0694

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.823	Data do not follow a Discernable Distribution (0.05)	
Theta Star	0.174		
nu star	34.55		
A-D Test Statistic	2.464	**Nonparametric Statistics**	
5% A-D Critical Value	0.774	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.774	Mean	0.0927
5% K-S Critical Value	0.196	SD	0.143
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.0239
		95% KM (t) UCL	0.132
Assuming Gamma Distribution		95% KM (z) UCL	0.132
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.132
Minimum	0.000001	95% KM (bootstrap t) UCL	0.148
Maximum	0.53	95% KM (BCA) UCL	0.133
Mean	0.0719	95% KM (Percentile Bootstrap) UCL	0.132
Median	0.0313	95% KM (Chebyshev) UCL	0.197
SD	0.114	97.5% KM (Chebyshev) UCL	0.242
k star	0.176	99% KM (Chebyshev) UCL	0.331
Theta star	0.409		
Nu star	29.91	Potential UCLs to Use	
AppChi2	18.42	95% KM (BCA) UCL	0.133
95% Gamma Approximate UCL (Use when n >= 40)	0.117		
95% Adjusted Gamma UCL (Use when n < 40)	0.118		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

Vanadium

General Statistics

Number of Valid Observations	85	Number of Distinct Observations	69

Raw Statistics		Log-transformed Statistics	
Minimum	43.5	Minimum of Log Data	3.773
Maximum	407	Maximum of Log Data	6.009
Mean	162.1	Mean of log Data	4.973
Geometric Mean	144.4	SD of log Data	0.492
Median	146		
SD	79.1		
Std. Error of Mean	8.579		
Coefficient of Variation	0.488		
Skewness	0.999		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.122	Lilliefors Test Statistic	0.0496
Lilliefors Critical Value	0.0961	Lilliefors Critical Value	0.0961
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	176.4	95% H-UCL	179.9
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	202.6
95% Adjusted-CLT UCL (Chen-1995)	177.2	97.5% Chebyshev (MVUE) UCL	219.8
95% Modified-t UCL (Johnson-1978)	176.6	99% Chebyshev (MVUE) UCL	253.7

Gamma Distribution Test		Data Distribution
k star (bias corrected)	4.331	Data appear Gamma Distributed at 5% Significance Level
Theta Star	37.43	
MLE of Mean	162.1	
MLE of Standard Deviation	77.9	
nu star	736.3	
Approximate Chi Square Value (.05)	674.3	**Nonparametric Statistics**
Adjusted Level of Significance	0.0472	95% CLT UCL 176.2
Adjusted Chi Square Value	673.3	95% Jackknife UCL 176.4
		95% Standard Bootstrap UCL 176
Anderson-Darling Test Statistic	0.237	95% Bootstrap-t UCL 177
Anderson-Darling 5% Critical Value	0.755	95% Hall's Bootstrap UCL 178.1
Kolmogorov-Smirnov Test Statistic	0.0688	95% Percentile Bootstrap UCL 176.8
Kolmogorov-Smirnov 5% Critical Value	0.0973	95% BCA Bootstrap UCL 177.3
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 199.5
		97.5% Chebyshev(Mean, Sd) UCL 215.7
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 247.5
95% Approximate Gamma UCL (Use when n >= 40)	177	
95% Adjusted Gamma UCL (Use when n < 40)	177.3	

Potential UCL to Use	Use 95% Approximate Gamma UCL 177

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

General UCL Statistics for Data Sets with Non-Detects: 2012 Total Soil

User Selected Options

From File	PRO_UCL.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic

General Statistics

Number of Valid Observations	20	Number of Distinct Observations	16

Raw Statistics		**Log-transformed Statistics**	
Minimum	0.46	Minimum of Log Data	-0.777
Maximum	1.8	Maximum of Log Data	0.588
Mean	1.033	Mean of log Data	-0.015
Geometric Mean	0.985	SD of log Data	0.319
Median	1		
SD	0.33		
Std. Error of Mean	0.0737		
Coefficient of Variation	0.319		
Skewness	0.827		

Relevant UCL Statistics

Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.942	Shapiro Wilk Test Statistic	0.976
Shapiro Wilk Critical Value	0.905	Shapiro Wilk Critical Value	0.905
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	1.16	95% H-UCL	1.188
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	1.36
95% Adjusted-CLT UCL (Chen-1995)	1.169	97.5% Chebyshev (MVUE) UCL	1.501
95% Modified-t UCL (Johnson-1978)	1.163	99% Chebyshev (MVUE) UCL	1.778

Gamma Distribution Test		**Data Distribution**
k star (bias corrected)	9.125	Data appear Normal at 5% Significance Level
Theta Star	0.113	
MLE of Mean	1.033	
MLE of Standard Deviation	0.342	
nu star	365	
Approximate Chi Square Value (.05)	321.7	**Nonparametric Statistics**
Adjusted Level of Significance	0.038	95% CLT UCL 1.154
Adjusted Chi Square Value	318.5	95% Jackknife UCL 1.16
		95% Standard Bootstrap UCL 1.149
Anderson-Darling Test Statistic	0.248	95% Bootstrap-t UCL 1.183
Anderson-Darling 5% Critical Value	0.742	95% Hall's Bootstrap UCL 1.186
Kolmogorov-Smirnov Test Statistic	0.129	95% Percentile Bootstrap UCL 1.156
Kolmogorov-Smirnov 5% Critical Value	0.194	95% BCA Bootstrap UCL 1.158
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 1.354
		97.5% Chebyshev(Mean, Sd) UCL 1.493
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 1.766
95% Approximate Gamma UCL (Use when n >= 40)	1.172	
95% Adjusted Gamma UCL (Use when n < 40)	1.184	

Potential UCL to Use	Use 95% Student's-t UCL 1.16

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Cobalt

General Statistics

Number of Valid Observations	20	Number of Distinct Observations	15

Raw Statistics

Minimum	3.5
Maximum	36
Mean	17.06
Geometric Mean	15.04
Median	15.5
SD	7.631
Std. Error of Mean	1.706
Coefficient of Variation	0.447
Skewness	0.385

Log-transformed Statistics

Minimum of Log Data	1.253
Maximum of Log Data	3.584
Mean of log Data	2.711
SD of log Data	0.573

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.939
Shapiro Wilk Critical Value	0.905

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.848
Shapiro Wilk Critical Value	0.905

Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	20.01

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	20.02
95% Modified-t UCL (Johnson-1978)	20.04

Assuming Lognormal Distribution

95% H-UCL	23.35
95% Chebyshev (MVUE) UCL	27.84
97.5% Chebyshev (MVUE) UCL	32.28
99% Chebyshev (MVUE) UCL	41.02

Gamma Distribution Test

k star (bias corrected)	3.541
Theta Star	4.818
MLE of Mean	17.06
MLE of Standard Deviation	9.066
nu star	141.6
Approximate Chi Square Value (.05)	115.1
Adjusted Level of Significance	0.038
Adjusted Chi Square Value	113.2
Anderson-Darling Test Statistic	0.952
Anderson-Darling 5% Critical Value	0.745
Kolmogorov-Smirnov Test Statistic	0.262
Kolmogorov-Smirnov 5% Critical Value	0.195

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL (Use when n >= 40)	20.99
95% Adjusted Gamma UCL (Use when n < 40)	21.34

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	19.87
95% Jackknife UCL	20.01
95% Standard Bootstrap UCL	19.78
95% Bootstrap-t UCL	20.27
95% Hall's Bootstrap UCL	20.49
95% Percentile Bootstrap UCL	19.88
95% BCA Bootstrap UCL	19.8
95% Chebyshev(Mean, Sd) UCL	24.5
97.5% Chebyshev(Mean, Sd) UCL	27.72
99% Chebyshev(Mean, Sd) UCL	34.04

Potential UCL to Use Use 95% Student's-t UCL 20.01

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Vanadium

General Statistics

Number of Valid Observations	20	Number of Distinct Observations	10

Raw Statistics

Minimum	110
Maximum	400
Mean	214.5
Geometric Mean	201.1
Median	180
SD	79.9
Std. Error of Mean	17.87
Coefficient of Variation	0.372
Skewness	0.696

Log-transformed Statistics

Minimum of Log Data	4.7
Maximum of Log Data	5.991
Mean of log Data	5.304
SD of log Data	0.369

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.929
Shapiro Wilk Critical Value	0.905

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.958
Shapiro Wilk Critical Value	0.905

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	245.4

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	246.9
95% Modified-t UCL (Johnson-1978)	245.9

Assuming Lognormal Distribution

95% H-UCL	252.9
95% Chebyshev (MVUE) UCL	293.2
97.5% Chebyshev (MVUE) UCL	327.3
99% Chebyshev (MVUE) UCL	394.2

Gamma Distribution Test

k star (bias corrected)	6.754
Theta Star	31.76
MLE of Mean	214.5
MLE of Standard Deviation	82.54
nu star	270.1
Approximate Chi Square Value (.05)	233.1
Adjusted Level of Significance	0.038
Adjusted Chi Square Value	230.4
Anderson-Darling Test Statistic	0.422
Anderson-Darling 5% Critical Value	0.743
Kolmogorov-Smirnov Test Statistic	0.19
Kolmogorov-Smirnov 5% Critical Value	0.194

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL (Use when n >= 40)	248.6
95% Adjusted Gamma UCL (Use when n < 40)	251.5

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	243.9
95% Jackknife UCL	245.4
95% Standard Bootstrap UCL	243.3
95% Bootstrap-t UCL	247.7
95% Hall's Bootstrap UCL	246.4
95% Percentile Bootstrap UCL	243
95% BCA Bootstrap UCL	246
95% Chebyshev(Mean, Sd) UCL	292.4
97.5% Chebyshev(Mean, Sd) UCL	326.1
99% Chebyshev(Mean, Sd) UCL	392.3

Potential UCL to Use

Use 95% Student's-t UCL 245.4

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

APPENDIX Q
CHEMICAL INTAKE EQUATIONS

Soil/Sediment

Incidental Ingestion of Soil/Sediment

The following equation is used in the calculation of a CDI (mg/kg/day) for a human receptor who incidentally ingests soil/sediment at the site:

$$CDI = \frac{Cs \times IR \times FI \times CF \times EF \times ED}{BW \times AT_c \text{ or } AT_{nc}}$$

Where:

Cs	=	chemical concentration in total soil/sediment (mg/kg)
IR	=	ingestion rate (mg/day)
FI	=	fraction of total soil/sediment ingested from the source (unitless)
CF	=	conversion factor (10^{-06} kg/mg)
EF	=	exposure frequency (days/yr)
ED	=	exposure duration (yrs)
BW	=	adult body weight (kg)
AT_c	=	averaging time carcinogens (days)
AT_{nc}	=	averaging time, noncarcinogens (days)

Dermal Contact with Soil/Sediment

The absorbed dose associated with the potential dermal contact of COPCs in soil/sediment was calculated using the following equation (USEPA, 1989):

$$DAD = \frac{Cs \times SA \times AF \times ABS \times EF \times ED \times CF}{BW \times AT}$$

Where:

DAD	=	Dermally Absorbed Dose, mg/kg-day
Cs	=	Chemical concentration in the total soil/sediment, mg/kg
AF	=	Adherence Factor, milligram per square centimeter day (mg/cm^2-d)
ABS	=	Absorbed fraction, unitless
CF	=	Conversion Factor, 10^{-06} mg/kg
SA	=	Surface Area of exposed skin, cm^2
EF	=	Exposure Frequency, days/year
ED	=	Exposure Duration, years
BW	=	average Body Weight, kg
AT	=	Averaging Time, days

Inhalation of Fugitive Dust/Volatiles from Soil

The daily intake resulting from the inhalation of COPCs adsorbed onto fugitive dust particulate and/or volatiles was estimated using the following equation (USEPA, 2009):

$$CDI = \frac{Ca \times ET \times EF \times ED}{AT}$$

Where:

CDI	=	Chronic Daily Intake, mg/kg-day
Ca	=	Chemical concentration in air as fugitive dust, milligrams per cubic meter (mg/m^3)
ET	=	Exposure Time, hours/day
EF	=	Exposure Frequency, days/year
ED	=	Exposure Duration, years
AT	=	Averaging Time, days

The air concentration (Ca) of a chemical in fugitive dust emissions was estimated from the following equation, adapted from Cowherd (1985).

$$Ca = Cs \times (1/PEF + 1/VF)$$

Where:

Ca	=	Chemical concentration in air as fugitive dust, mg/m^3
Cs	=	Concentration of chemical in the soil, mg/kg
PEF	=	Particulate Emission Factor, m^3/kg
VF	=	Volatilization Factor, m^3/kg

Volatilization factors used in this HHRA were calculated (USEPA, 2002).

Groundwater

Ingestion of Groundwater

The daily intake associated with the direct potential ingestion of the COPCs in groundwater under a drinking water scenario were calculated using the following equation (USEPA, 1989):

$$CDI = \frac{Cw \times IR \times EF \times ED}{BW \times AT}$$

Where:

CDI	=	Chronic Daily Intake, mg/kg-day
Cw	=	Chemical concentration in water, mg/L
IR	=	Ingestion Rate, L/day
EF	=	Exposure Frequency, days/year
ED	=	Exposure Duration, years
BW	=	average Body Weight, kg
AT	=	Averaging Time, days

Dermal Contact with Groundwater

The absorbed dose associated with potential dermal contact with COPCs in groundwater was calculated using the following equation (USEPA, 1989 and 2004):

$$CDI = \frac{DA_{event} \times EF \times ED \times CF \times SA}{BW \times AT}$$

Where:

CDI	=	Chronic Daily Intake, mg/kg-day
DA_{event}	=	Absorbed dose per event (mg/cm^2-event) (assume 1 event/day)
EF	=	Exposure Frequency, days/year
ED	=	Exposure Duration, years
CF	=	Conversion Factor, 1 L/1000 cm^3
SA	=	Surface Area of exposed skin, cm^2
BW	=	average Body Weight, kg
AT	=	Averaging Time, days

The following equations are used to calculate DA_{event} for organic compounds:

If $t_{event} \leq t^*$, then

$$DA_{event} = 2FA \times K_p \times C_w \times \sqrt{\frac{6\tau_{event} \times t_{event}}{\pi}}$$

If $t_{event} > t^*$, then

$$DA_{event} = FA \times K_p \times C_w \left[\frac{t_{event}}{1+B} + 2\tau_{event} \left(\frac{1+3B+3B^2}{(1+B)^2} \right) \right]$$

Where:

DA_{event}	=	Absorbed dose per event (mg/cm^2-event)
FA	=	Fraction absorbed (dimensionless)
K_p	=	Dermal permeability coefficient of compound in water (cm/hour)
Cw	=	Chemical concentration in water (mg/cm^3)
τ_{event}	=	Lag time per event (hour /event)
t_{event}	=	Event duration (hour /event) (assume 1 event/day)
t*	=	Time to reach steady-state (hour) = $2.4\tau_{event}$
B	=	Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis (ve) (dimensionless).

The following equation is used to calculate DA_{event} for inorganic and highly ionized organic chemicals:

$$DA_{event} = K_p \times C_w \times t_{event}$$

Where:

DA_{event}	=	Absorbed dose per event (mg/cm^2-event)
K_p	=	Dermal permeability coefficient of compound in water (cm/ hour)
C_w	=	Chemical concentration in water (mg/cm^3)
t_{event}	=	Event duration (hours/event) (assume 1 event/day)

<u>Surface Water</u>

Ingestion of Surface Water

The daily intake associated with the indirect potential ingestion of the COPCs in surface water under a wading scenario were calculated using the following equation (USEPA, 1989):

$$CDI = \frac{Cw \times IR \times ET \times EF \times ED}{BW \times AT}$$

Where:

CDI	=	Chronic Daily Intake, mg/kg-day
Cw	=	Chemical concentration in water, mg/L
IR	=	Ingestion Rate, L/day
ET	=	Exposure Time, hours/day
EF	=	Exposure Frequency, days/year
ED	=	Exposure Duration, years
BW	=	average Body Weight, kg
AT	=	Averaging Time, days

Dermal Contact with Surface Water

The absorbed dose associated with potential dermal contact with COPCs in surface water was calculated using the following equation (USEPA, 1989):

$$CDI = \frac{Cw \times K_p \times ET \times EF \times ED \times SA \times CF}{BW \times AT}$$

Where:

CDI	=	Chronic Daily Intake, mg/kg-day
Cw	=	Chemical concentration in water, mg/L
K_p	=	Dermal permeability coefficient of compound in water (cm/hour)
ET	=	Exposure Time, hours/day
EF	=	Exposure Frequency, days/year
ED	=	Exposure Duration, years
SA	=	Surface Area of exposed skin, cm^2
CF	=	Conversion Factor, 1 L/1000 cm^3
BW	=	average Body Weight, kg
AT	=	Averaging Time, days

APPENDIX R
RISK CALCULATION SPREADSHEETS

ADULT AND YOUTH TRESPASSERS - CURRENT AND FUTURE SCENARIOS
ACCIDENTAL INGESTION OF SOIL - SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
CORRECTIVE MEASURES STUDY REPORT - NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

CDI (mg/kg/d) = (C*IR*CF*FI*EF*ED)/(BW*AT)
ILCR = CDI*CSFo ILCR (MMOA chemicals) = (CDI*ADAF)*CSFo
HQ = CDI/RfDo

Parameter	Units	Description	16<=24	6<=16
CDI	mg/kg/d	Chronic daily intake	CS	CS
ILCR	NA	Incremental lifetime cancer risk	CS	CS
CSFo	1/(mg/kg/d)	Oral cancer slope factor	CS	CS
HQ	NA	Hazard quotient	CS	CS
RfDo	mg/kg/d	Oral reference dose	CS	CS
C	mg/kg	Concentration of chemical in soil	CS	CS
IR-S	mg/day	Ingestion rate of soil	100	100
CF	kg/mg	Conversion factor	1.00E-06	1.00E-06
FI	NA	Fraction of soil ingested from site	1	1
EF	days/year	Exposure frequency	52	52
ED	years	Exposure duration	8	11
BW	kg	Body weight	70	45
AT-C	days	Averaging time, carcinogens	25,550	25,550
AT-N	days	Averaging time, noncarcinogens	8,760	4,015
ADAF	NA	Age Dependent Adjustment Factors	1	3

		Age Adjusted CDIs	
		16<=24	6<=16
Parameter	C (mg/kg)	CDI (mg/kg/d)	CDI (mg/kg/d)
Benzo(a)anthracene	0.0130	3.0E-10	1.9E-09
Benzo(a)pyrene (BaP)	0.0414	9.6E-10	6.2E-09
Benzo(b)fluoranthene	0.297	6.9E-09	4.4E-08
Benzo(k)fluoranthene	0.290	6.7E-09	4.3E-08
Chrysene	0.465	1.1E-08	6.9E-08
Dibenz(a,h)anthracene	0.0920	2.1E-09	1.4E-08
Indeno(1,2,3-cd)pyrene	0.0288	6.7E-10	4.3E-09

				Adult						Youth					
				Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	CSFo 1/(mg/kg/d)	RfDo (mg/kg/d)	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Methyl Iodide	0.00369	NA	NA	2.6E-10	--	--	7.5E-10	--	--	1.8E-10	--	--	1.2E-09	--	--
Propionitrile (Ethyl Cyanide)	0.00810	NA	NA	5.7E-10	--	--	1.6E-09	--	--	4.0E-10	--	--	2.6E-09	--	--
Benzo(a)anthracene	0.0130	7.3E-01	NA	2.2E-09	1.6E-09	0.5%	2.6E-09	--	--	1.9E-09	1.4E-09	0.5%	4.1E-09	--	--
Benzo(a)pyrene (BaP)	0.0414	7.3E+00	NA	7.1E-09	5.2E-08	14.5%	8.4E-09	--	--	6.2E-09	4.5E-08	15.6%	1.3E-08	--	--
Benzo(b)fluoranthene	0.297	7.3E-01	NA	5.1E-08	3.7E-08	10.4%	6.0E-08	--	--	4.4E-08	3.2E-08	11.2%	9.4E-08	--	--
Benzo(k)fluoranthene	0.290	7.3E-02	NA	5.0E-08	3.7E-09	1.0%	5.9E-08	--	--	4.3E-08	3.2E-09	1.1%	9.2E-08	--	--
Chrysene	0.465	7.3E-03	NA	8.0E-08	5.9E-10	0.2%	9.5E-08	--	--	6.9E-08	5.1E-10	0.2%	1.5E-07	--	--
Dibenz(a,h)anthracene	0.0920	7.3E+00	NA	1.6E-08	1.2E-07	32.1%	1.9E-08	--	--	1.4E-08	1.0E-07	34.6%	2.9E-08	--	--
Indeno(1,2,3-cd)pyrene	0.0288	7.3E-01	NA	5.0E-09	3.6E-09	1.0%	5.9E-09	--	--	4.3E-09	3.1E-09	1.1%	9.1E-09	--	--
Antimony	1.14	NA	4.0E-04	8.0E-08	--	--	2.3E-07	5.8E-04	1.8%	5.7E-08	--	--	3.6E-07	9.0E-04	1.8%
Arsenic	1.39	1.5E+00	3.0E-04	9.7E-08	1.5E-07	40.4%	2.8E-07	9.4E-04	2.9%	6.9E-08	1.0E-07	35.8%	4.4E-07	1.5E-03	2.9%
Cobalt	29.8	NA	3.0E-04	2.1E-06	--	--	6.1E-06	2.0E-02	63.1%	1.5E-06	--	--	9.4E-06	3.1E-02	63.1%
Lead	537	NA	NA	3.7E-05	--	--	1.1E-04	--	--	2.7E-05	--	--	1.7E-04	--	--
Thallium	0.133	NA	1.0E-05	9.3E-09	--	--	2.7E-08	2.7E-03	8.5%	6.6E-09	--	--	4.2E-08	4.2E-03	8.5%
Vanadium	186	NA	5.0E-03	1.3E-05	--	--	3.8E-05	7.6E-03	23.6%	9.3E-06	--	--	5.9E-05	1.2E-02	23.6%
				Total ILCR:	3.6E-07	100.0%	Total HI:	3.2E-02	100.0%	Total ILCR:	2.9E-07	100.0%	Total HI:	5.0E-02	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
ADAF - Age Dependent Adjustment Factors
CS - Chemical Specific
MMOA - Mutagenic Mode of Action

Parameter (non-MMOA chemicals)	Adult	Youth
Exposure duration (ED)	24	11
Averaging time, noncarcinogens (AT-N)	8,760	4,015

ADULT AND YOUTH TRESPASSERS - CURRENT AND FUTURE SCENARIOS
DERMAL CONTACT WITH SOIL - SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
CORRECTIVE MEASURES STUDY REPORT - NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

DAD (mg/kg/d) = (C*CF*AF*ABS*SA*EF*ED)/(BW*AT)
ILCR = CDI*CSFd ILCR (MMOA chemicals) = (CDI*ADAF)*CSFo
HQ = CDI/RfDd

Parameter	Units	Description	16<=24	6<=16
DAD	mg/kg/d	Dermally absorbed dose	CS	CS
ILCR	NA	Incremental lifetime cancer risk	CS	CS
CSFd	1/(mg/kg/d)	Dermal cancer slope factor	CS	CS
HQ	NA	Hazard quotient	CS	CS
RfDd	mg/kg/d	Dermal reference dose	CS	CS
C	mg/kg	Concentration of chemical in soil	CS	CS
CF	kg/mg	Conversion factor	1.00E-06	1.00E-06
AF	mg/cm2	Soil to skin adherence factor	0.07	0.2
ABS	NA	Absorption fraction	CS	CS
SA	cm2/day	Skin surface area available for contact	5,700	3,200
EF	days/year	Exposure frequency	52	52
ED	years	Exposure duration	8	11
BW	kg	Body weight	70	45
AT-C	days	Averaging time, carcinogens	25,550	25,550
AT-N	days	Averaging time, noncarcinogens	8,760	4,015
ADAF	NA	Age Dependent Adjustment Factors	1	3

Parameter	C (mg/kg)	ABS	16<=24 DAD (mg/kg/d)	6<=16 DAD (mg/kg/d)
Benzo(a)anthracene	0.0130	1.3E-01	1.6E-10	1.6E-09
Benzo(a)pyrene (BaP)	0.0414	1.3E-01	5.0E-10	5.1E-09
Benzo(b)fluoranthene	0.297	1.3E-01	3.6E-09	3.7E-08
Benzo(k)fluoranthene	0.290	1.3E-01	3.5E-09	3.6E-08
Chrysene	0.465	1.3E-01	5.6E-09	5.8E-08
Dibenz(a,h)anthracene	0.0920	1.3E-01	1.1E-09	1.1E-08
Indeno(1,2,3-cd)pyrene	0.0288	1.3E-01	3.5E-10	3.6E-09

					Adult						Youth					
					Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	ABS	CSFd 1/(mg/kg/d)	RfDd (mg/kg/d)	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI
Methyl Iodide	0.00369	NA	NA	NA	1.0E-09	--	--	3.0E-09	--	--	1.2E-09	--	--	7.5E-09	--	--
Propionitrile (Ethyl Cyanide)	0.00810	NA	NA	NA	2.3E-09	--	--	6.6E-09	--	--	2.6E-09	--	--	1.6E-08	--	--
Benzo(a)anthracene	0.0130	1.3E-01	7.3E-01	NA	1.8E-09	1.3E-09	0.0%	1.4E-09	--	--	1.6E-09	1.2E-09	0.7%	3.4E-09	--	--
Benzo(a)pyrene (BaP)	0.0414	1.3E-01	7.3E+00	NA	5.6E-09	4.1E-08	0.6%	4.4E-09	--	--	5.1E-09	3.8E-08	21.5%	1.1E-08	--	--
Benzo(b)fluoranthene	0.297	1.3E-01	7.3E-01	NA	4.0E-08	3.0E-08	0.5%	3.1E-08	--	--	3.7E-08	2.7E-08	15.4%	7.8E-08	--	--
Benzo(k)fluoranthene	0.290	1.3E-01	7.3E-02	NA	4.0E-08	2.9E-09	0.0%	3.1E-08	--	--	3.6E-08	2.6E-09	1.5%	7.6E-08	--	--
Chrysene	0.465	1.3E-01	7.3E-03	NA	6.3E-08	4.6E-10	0.0%	4.9E-08	--	--	5.8E-08	4.2E-10	0.2%	1.2E-07	--	--
Dibenz(a,h)anthracene	0.0920	1.3E-01	7.3E+00	NA	1.3E-08	9.1E-08	1.4%	9.7E-09	--	--	1.1E-08	8.3E-08	47.8%	2.4E-08	--	--
Indeno(1,2,3-cd)pyrene	0.0288	1.3E-01	7.3E-01	NA	3.9E-09	2.9E-09	0.0%	3.0E-09	--	--	3.6E-09	2.6E-09	1.5%	7.6E-09	--	--
Antimony	1.14	1.0E-02	NA	6.0E-05	1.2E-06	--	--	9.3E-09	1.5E-04	1.2%	3.6E-09	--	--	2.3E-08	3.8E-04	1.2%
Arsenic	1.39	3.0E-02	1.5E+00	3.0E-04	4.2E-06	6.4E-06	97.4%	3.4E-08	1.1E-04	0.9%	1.3E-08	2.0E-08	11.4%	8.4E-08	2.8E-04	0.9%
Cobalt	29.8	1.0E-02	NA	3.0E-04	3.0E-05	--	--	2.4E-07	8.1E-04	6.3%	9.5E-08	--	--	6.0E-07	2.0E-03	6.3%
Lead	537	1.0E-02	NA	NA	5.5E-04	--	--	4.4E-06	--	--	1.7E-06	--	--	1.1E-05	--	--
Thallium	0.133	1.0E-02	NA	1.0E-05	1.4E-07	--	--	1.1E-09	1.1E-04	0.8%	4.2E-10	--	--	2.7E-09	2.7E-04	0.8%
Vanadium	186	1.0E-02	NA	1.3E-04	1.9E-04	--	--	1.5E-06	1.2E-02	90.8%	5.9E-07	--	--	3.8E-06	2.9E-02	90.8%
					Total ILCR:	6.5E-06	100.0%	Total HI:	1.3E-02	100.0%	Total ILCR:	1.7E-07	100.0%	Total HI:	3.2E-02	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
ADAF - Age Dependent Adjustment Factors
CS - Chemical Specific

Parameter (non-MMOA chemicals)	Adult	Youth
Exposure duration (ED)	24	11
Averaging time, noncarcinogens (AT-N)	8,760	4,015

ADULT AND YOUTH TRESPASSERS - CURRENT AND FUTURE SCENARIOS
INHALATION OF FUGITIVE DUSTS EMANATING FROM SOIL - SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
CORRECTIVE MEASURES STUDY REPORT - NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

EC (mg/m3) = (Ca*ET*EF*ED)/AT
Where: Ca = C/VF + C/PEF

ILCR = EC*IUR*1000 ug/mg ILCR (MMOA chemicals) = EC*ADAF*IUR*1000 ug/mg
HQ = EC/RfC

Parameter	Units	Description	16<=24	6<=16
EC	mg/m3	Exposure Concentration	CS	CS
ILCR	NA	Incremental lifetime cancer risk	CS	CS
IUR	1/(µg/m3)	Inhalation Unit Risk	CS	CS
HQ	NA	Hazard quotient	CS	CS
RfC	mg/kg/d	Inhalation Reference Concentration	CS	CS
Ca	mg/m3	Concentration of chemical in air as fugitive dusts	CS	CS
C	mg/kg	Concentration of chemical in soil	CS	CS
VF	m3/kg	Volatilization Factor	CS	CS
PEF	m3/kg	Particulate emission factor	1.36E+09	1.36E+09
ET	hours/day	Exposure time	2	2
EF	days/year	Exposure frequency	52	52
ED	years	Exposure duration	8	11
AT-C	hours	Averaging time, carcinogens	613200	613200
AT-N	hours	Averaging time, noncarcinogens	70080	96360
ADAF	NA	Age Dependent Adjustment Factors	1	3

		Age Adjusted ECs	
		16<=24	6<=16
Parameter	Ca (mg/m3)	EC (mg/m3)	EC (mg/m3)
Benzo(a)anthracene	9.6E-12	1.3E-14	5.3E-14
Benzo(a)pyrene (BaP)	3.0E-11	4.1E-14	1.7E-13
Benzo(b)fluoranthene	2.2E-10	3.0E-13	1.2E-12
Benzo(k)fluoranthene	2.1E-10	2.9E-13	1.2E-12
Chrysene	3.4E-10	4.6E-13	1.9E-12
Dibenz(a,h)anthracene	6.8E-11	9.2E-14	3.8E-13
Indeno(1,2,3-cd)pyrene	2.1E-11	2.9E-14	1.2E-13

						Adult						Youth					
						Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	VF (m3/kg)	Ca (mg/m3)	IUR 1/(µg/m3)	RfC (mg/m3)	EC (mg/m3)	ILCR	% Contrib. Total ILCR	EC (mg/m3)	HQ	% Contrib. HI	EC (mg/m3)	ILCR	% Contrib. Total ILCR	EC (mg/m3)	HQ	% Contrib. HI
Methyl Iodide	0.00369	NA	2.71E-12	NA	NA	1.1E-14	--	--	9.7E-14	--	--	5.1E-15	--	--	3.2E-14	--	--
Propionitrile (Ethyl Cyanide	0.00810	NA	5.96E-12	NA	NA	2.4E-14	--	--	2.1E-13	--	--	1.1E-14	--	--	7.1E-14	--	--
Benzo(a)anthracene	0.0130	NA	9.56E-12	1.1E-04	NA	6.6E-14	7.3E-15	0.0%	3.4E-13	--	--	5.3E-14	5.9E-15	0.0%	1.1E-13	--	--
Benzo(a)pyrene (BaP)	0.0414	NA	3.04E-11	1.1E-03	NA	2.1E-13	2.3E-13	0.0%	1.1E-12	--	--	1.7E-13	1.9E-13	0.0%	3.6E-13	--	--
Benzo(b)fluoranthene	0.297	NA	2.18E-10	1.1E-04	NA	1.5E-12	1.7E-13	0.0%	7.8E-12	--	--	1.2E-12	1.3E-13	0.0%	2.6E-12	--	--
Benzo(k)fluoranthene	0.290	NA	2.13E-10	1.1E-04	NA	1.5E-12	1.6E-13	0.0%	7.6E-12	--	--	1.2E-12	1.3E-13	0.0%	2.5E-12	--	--
Chrysene	0.465	NA	3.42E-10	1.1E-05	NA	2.4E-12	2.6E-14	0.0%	1.2E-11	--	--	1.9E-12	2.1E-14	0.0%	4.1E-12	--	--
Dibenz(a,h)anthracene	0.0920	NA	6.76E-11	1.2E-03	NA	4.7E-13	5.6E-13	0.1%	2.4E-12	--	--	3.8E-13	4.5E-13	0.1%	8.0E-13	--	--
Indeno(1,2,3-cd)pyrene	0.0288	NA	2.12E-11	1.1E-04	NA	1.5E-13	1.6E-14	0.0%	7.5E-13	--	--	1.2E-13	1.3E-14	0.0%	2.5E-13	--	--
Antimony	1.14	NA	8.38E-10	NA	NA	3.4E-12	--	--	3.0E-11	--	--	1.6E-12	--	--	1.0E-11	--	--
Arsenic	1.39	NA	1.02E-09	4.3E-03	1.5E-05	4.2E-12	1.8E-11	2.2%	3.6E-11	2.4E-06	1.3%	1.9E-12	8.2E-12	2.2%	1.2E-11	8.1E-07	1.3%
Cobalt	29.8	NA	2.19E-08	9.0E-03	6.0E-06	8.9E-11	8.0E-10	97.7%	7.8E-10	1.3E-04	71.8%	4.1E-11	3.7E-10	97.6%	2.6E-10	4.3E-05	71.8%
Lead	537	NA	3.95E-07	NA	NA	1.6E-09	--	--	1.4E-08	--	--	7.4E-10	--	--	4.7E-09	--	--
Thallium	0.133	NA	9.78E-11	NA	NA	4.0E-13	--	--	3.5E-12	--	--	1.8E-13	--	--	1.2E-12	--	--
Vanadium	186	NA	1.37E-07	NA	1.0E-04	5.6E-10	--	--	4.9E-09	4.9E-05	26.9%	2.6E-10	--	--	1.6E-09	1.6E-05	26.9%
						Total ILCR:	8.2E-10	100.0%	Total HI:	1.8E-04	100.0%	Total ILCR:	3.8E-10	100.0%	Total HI:	6.0E-05	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
ADAF - Age Dependent Adjustment Factors
CS - Chemical Specific

Parameter (non-MMOA chemicals)	Adult	Youth
Exposure duration (ED)	24	11
Averaging time, noncarcinogens (AT-N)	70,080	96,360

ADULT AND YOUTH TRESPASSERS - CURRENT AND FUTURE SCENARIOS
ACCIDENTAL INGESTION OF SURFACE WATER - SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
CORRECTIVE MEASURES STUDY REPORT - NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

CDI (mg/kg/d) = (C*IR*ET*EF*ED)/(BW*AT)
ILCR = CDI*CSFo
HQ = CDI/RfDo

Parameter	Units	Description	Adult	Youth	
CDI	mg/kg/d	Chronic daily intake	CS	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	CS	
CSFo	1/(mg/kg/d)	Oral cancer slope factor	CS	CS	
HQ	NA	Hazard quotient	CS	CS	
RfDo	mg/kg/d	Oral reference dose	CS	CS	
C	mg/L	Concentration of chemical in water	CS	CS	
IR-W	L/hour	Ingestion rate of water	0.005	0.005	
ET	hours/day	Exposure time	2	2	
EF	days/year	Exposure frequency	52	52	
ED	years	Exposure duration	24	11	
BW	kg	Body weight	70	45	
AT-C	days	Averaging time, carcinogens	25,550	25,550	
AT-N	days	Averaging time, noncarcinogens	8,760	4,015	

				Adult						Youth					
				Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
Parameter	C (mg/L)	CSFo 1/(mg/kg/d)	RfDo (mg/kg/d)	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Bromodichloromethane	0.00034	6.2E-02	2.0E-02	2.4E-09	1.5E-10	2.6%	6.9E-09	3.5E-07	0.5%	1.7E-09	1.0E-10	2.6%	1.1E-08	5.4E-07	0.5%
Chloroform	0.00120	3.1E-02	1.0E-02	8.4E-09	2.6E-10	4.6%	2.4E-08	2.4E-06	3.6%	6.0E-09	1.9E-10	4.6%	3.8E-08	3.8E-06	3.6%
Dibromochloromethane	0.00016	8.4E-02	2.0E-02	1.1E-09	9.4E-11	1.7%	3.3E-09	1.6E-07	0.2%	8.0E-10	6.7E-11	1.7%	5.1E-09	2.5E-07	0.2%
Arsenic	0.00049	1.5E+00	3.0E-04	3.4E-09	5.1E-09	91.1%	1.0E-08	3.3E-05	49.5%	2.4E-09	3.7E-09	91.1%	1.6E-08	5.2E-05	49.5%
Vanadium	0.00760	NA	5.0E-03	5.3E-08	--	--	1.5E-07	3.1E-05	46.1%	3.8E-08	--	--	2.4E-07	4.8E-05	46.1%
				Total ILCR:	5.6E-09	100.0%	Total HI:	6.7E-05	100.0%	Total ILCR:	4.0E-09	100.0%	Total HI:	1.0E-04	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT AND YOUTH TRESPASSERS - CURRENT AND FUTURE SCENARIOS
DERMAL CONTACT WITH SURFACE WATER - SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
CORRECTIVE MEASURES STUDY REPORT - NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

DAD (mg/kg/d) = (C*CF*Kp*SA*EF*ED*ET)/(BW*AT)

ILCR = CDI*CSFo Adj CSF Adj = CSF/AD
HQ = CDI/RfDo Adj RfD Adj = RfD*AD

Parameter	Units	Description	Adult	Youth	
DAD	mg/kg/d	Dermally absorbed dose	CS	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	CS	
CSFd	1/(mg/kg/d)	Dermal cancer slope factor	CS	CS	
HQ	NA	Hazard quotient	CS	CS	
RfDd	mg/kg/d	Dermal reference dose	CS	CS	
SA	cm2	Skin surface area available for contact	5,700	3,200	
EF	days/year	Exposure frequency	52	52	
ED	years	Exposure duration	24	11	
ET	hours/day	Exposure time	2.0	2.0	
BW	kg	Body weight	70	45	
AT-C	days	Averaging time, carcinogens	25,550	25,550	
AT-N	days	Averaging time, noncarcinogens	8,760	4,015	
C	mg/L	Concentration of chemical in water	CS	CS	
CF	L/cm3	Conversion factor	1.00E-03	1.00E-03	
Kp	cm/hour	Dermal permeability coefficient	CS	CS	
AD	NA	Adjustment for absorbed dose	CS	CS	

					Adult						Youth					
					Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
Parameter	C (mg/L)	Kp (cm/hour)	CSFd 1/(mg/kg/d)	RfDd (mg/kg/d)	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI
Bromodichloromethane	0.00034	4.02E-03 (61)	6.2E-02	2.0E-02	1.1E-08	6.7E-10	7.6%	3.2E-08	1.6E-06	0.1%	4.4E-09	2.7E-10	7.6%	2.8E-08	1.4E-06	0.1%
Chloroform	0.00120	6.83E-03 (61)	3.1E-02	1.0E-02	6.5E-08	2.0E-09	22.8%	1.9E-07	1.9E-05	1.3%	2.6E-08	8.1E-10	22.8%	1.7E-07	1.7E-05	1.3%
Dibromochloromethane	0.00016	2.89E-03 (61)	8.4E-02	2.0E-02	3.7E-09	3.1E-10	3.5%	1.1E-08	5.4E-07	0.0%	1.5E-09	1.2E-10	3.5%	9.4E-09	4.7E-07	0.0%
Arsenic	0.00049	1.00E-03 (61)	1.5E+00	3.0E-04	3.9E-09	5.8E-09	66.1%	1.1E-08	3.8E-05	2.7%	1.6E-09	2.3E-09	66.1%	9.9E-09	3.3E-05	2.7%
Vanadium	0.00760	1.00E-03 (61)	NA	1.3E-04	6.0E-08	--	--	1.8E-07	1.4E-03	95.8%	2.4E-08	--	--	1.5E-07	1.2E-03	95.8%
					Total ILCR:	8.9E-09	100.0%	Total HI:	1.4E-03	100.0%	Total ILCR:	3.5E-09	100.0%	Total HI:	1.2E-03	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

Kp value is derived from the USEPA RAGS E Guidance unless otherwise noted

ADULT AND YOUTH TRESPASSERS - CURRENT AND FUTURE SCENARIOS
ACCIDENTAL INGESTION OF SEDIMENT - SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
CORRECTIVE MEASURES STUDY REPORT - NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

CDI (mg/kg/d) = (C*IR*CF*FI*EF*ED)/(BW*AT)
ILCR = CDI*CSFo
HQ = CDI/RfDo

Parameter	Units	Description	Adult	Youth	
CDI	mg/kg/d	Chronic daily intake	CS	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	CS	
CSFo	1/(mg/kg/d)	Oral cancer slope factor	CS	CS	
HQ	NA	Hazard quotient	CS	CS	
RfDo	mg/kg/d	Oral reference dose	CS	CS	
C	mg/kg	Concentration of chemical in soil	CS	CS	
IR-S	mg/day	Ingestion rate of sediment	100	100	
CF	kg/mg	Conversion factor	1.00E-06	1.00E-06	
FI	NA	Fraction of soil ingested from site	1	1	
EF	days/year	Exposure frequency	52	52	
ED	years	Exposure duration	24	11	
BW	kg	Body weight	70	45	
AT-C	days	Averaging time, carcinogens	25,550	25,550	
AT-N	days	Averaging time, noncarcinogens	8,760	4,015	

				Adult						Youth					
				Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	CSFo 1/(mg/kg/d)	RfDo (mg/kg/d)	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Arsenic	1.50	1.5E+00	3.0E-04	1.0E-07	1.6E-07	100.0%	3.1E-07	1.0E-03	2.9%	7.5E-08	1.1E-07	100.0%	4.7E-07	1.6E-03	2.9%
Cobalt	31.9	NA	3.0E-04	2.2E-06	--	--	6.5E-06	2.2E-02	61.9%	1.6E-06	--	--	1.0E-05	3.4E-02	61.9%
Thallium	0.140	NA	1.0E-05	9.8E-09	--	--	2.8E-08	2.8E-03	8.2%	7.0E-09	--	--	4.4E-08	4.4E-03	8.2%
Vanadium	232	NA	5.0E-03	1.6E-05	--	--	4.7E-05	9.4E-03	27.0%	1.2E-05	--	--	7.3E-05	1.5E-02	27.0%
				Total ILCR:	1.6E-07	100.0%	Total HI:	3.5E-02	100.0%	Total ILCR:	1.1E-07	100.0%	Total HI:	5.4E-02	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT AND YOUTH TRESPASSERS - CURRENT AND FUTURE SCENARIOS
DERMAL CONTACT WITH SEDIMENT - SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
CORRECTIVE MEASURES STUDY REPORT - NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

DAD (mg/kg/d) = (C*CF*AF*ABS*SA*EF*ED)/(BW*AT)
ILCR = CDI*CSFd
HQ = CDI/RfDd

Parameter	Units	Description	Adult	Youth	
DAD	mg/kg/d	Dermally absorbed dose	CS	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	CS	
CSFd	1/(mg/kg/d)	Dermal cancer slope factor	CS	CS	
HQ	NA	Hazard quotient	CS	CS	
RfDd	mg/kg/d	Dermal reference dose	CS	CS	
C	mg/kg	Concentration of chemical in soil	CS	CS	
CF	kg/mg	Conversion factor	1.00E-06	1.00E-06	
AF	mg/cm2	Soil to skin adherence factor	0.3	0.3	
ABS	NA	Absorption fraction	CS	CS	
SA	cm2/day	Skin surface area available for contact	5,700	3,200	
EF	days/year	Exposure frequency	52	52	
ED	years	Exposure duration	24	11	
BW	kg	Body weight	70	45	
AT-C	days	Averaging time, carcinogens	25,550	25,550	
AT-N	days	Averaging time, noncarcinogens	8,760	4,015	

					Adult						Youth					
					Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	ABS	CSFd 1/(mg/kg/d)	RfDd (mg/kg/d)	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI
Arsenic	1.50	3.0E-02	1.5E+00	3.0E-04	5.4E-08	8.1E-08	100.0%	1.6E-07	5.2E-04	0.8%	2.1E-08	3.2E-08	100.0%	1.4E-07	4.6E-04	0.8%
Cobalt	31.9	1.0E-02	NA	3.0E-04	3.8E-07	--	--	1.1E-06	3.7E-03	5.5%	1.5E-07	--	--	9.7E-07	3.2E-03	5.5%
Thallium	0.140	1.0E-02	NA	1.0E-05	1.7E-09	--	--	4.9E-09	4.9E-04	0.7%	6.7E-10	--	--	4.3E-09	4.3E-04	0.7%
Vanadium	232	1.0E-02	NA	1.3E-04	2.8E-06	--	--	8.1E-06	6.2E-02	93.0%	1.1E-06	--	--	7.1E-06	5.4E-02	93.0%
					Total ILCR:	8.1E-08	100.0%	Total HI:	6.7E-02	100.0%	Total ILCR:	3.2E-08	100.0%	Total HI:	5.8E-02	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT ON-SITE WORKERS - CURRENT AND FUTURE SCENARIOS
ACCIDENTAL INGESTION OF SOIL - SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
CORRECTIVE MEASURES STUDY REPORT - NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

CDI (mg/kg/d) = (C*IR*CF*FI*EF*ED)/(BW*AT)
ILCR = CDI*CSFo
HQ = CDI/RfDo

Parameter	Units	Description	Adult	
CDI	mg/kg/d	Chronic daily intake	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	
CSFo	1/(mg/kg/d)	Oral cancer slope factor	CS	
HQ	NA	Hazard quotient	CS	
RfDo	mg/kg/d	Oral reference dose	CS	
C	mg/kg	Concentration of chemical in soil	CS	
IR-S	mg/day	Ingestion rate of soil	100	
CF	kg/mg	Conversion factor	1.00E-06	
FI	NA	Fraction of soil ingested from site	1	
EF	days/year	Exposure frequency	250	
ED	years	Exposure duration	25	
BW	kg	Body weight	70	
AT-C	days	Averaging time, carcinogens	25,550	
AT-N	days	Averaging time, noncarcinogens	9,125	

				Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	CSFo 1/(mg/kg/d)	RfDo (mg/kg/d)	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Methyl Iodide	0.00369	NA	NA	1.3E-09	--	--	3.6E-09	--	--
Propionitrile (Ethyl Cyanide)	0.00810	NA	NA	2.8E-09	--	--	7.9E-09	--	--
Benzo(a)anthracene	0.0130	7.3E-01	NA	4.5E-09	3.3E-09	0.3%	1.3E-08	--	--
Benzo(a)pyrene (BaP)	0.0414	7.3E+00	NA	1.4E-08	1.1E-07	9.1%	4.1E-08	--	--
Benzo(b)fluoranthene	0.297	7.3E-01	NA	1.0E-07	7.6E-08	6.5%	2.9E-07	--	--
Benzo(k)fluoranthene	0.290	7.3E-02	NA	1.0E-07	7.4E-09	0.6%	2.8E-07	--	--
Chrysene	0.465	7.3E-03	NA	1.6E-07	1.2E-09	0.1%	4.5E-07	--	--
Dibenz(a,h)anthracene	0.0920	7.3E+00	NA	3.2E-08	2.3E-07	20.2%	9.0E-08	--	--
Indeno(1,2,3-cd)pyrene	0.0288	7.3E-01	NA	1.0E-08	7.3E-09	0.6%	2.8E-08	--	--
Antimony	1.14	NA	4.0E-04	4.0E-07	--	--	1.1E-06	2.8E-03	1.8%
Arsenic	1.39	1.5E+00	3.0E-04	4.9E-07	7.3E-07	62.6%	1.4E-06	4.5E-03	2.9%
Cobalt	29.8	NA	3.0E-04	1.0E-05	--	--	2.9E-05	9.7E-02	63.1%
Lead	537	NA	NA	1.9E-04	--	--	5.3E-04	--	--
Thallium	0.133	NA	1.0E-05	4.6E-08	--	--	1.3E-07	1.3E-02	8.5%
Vanadium	186	NA	5.0E-03	6.5E-05	--	--	1.8E-04	3.6E-02	23.6%
				Total ILCR:	1.2E-06	100.0%	Total HI:	1.5E-01	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT ON-SITE WORKERS - CURRENT AND FUTURE SCENARIOS
DERMAL CONTACT WITH SOIL - SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
CORRECTIVE MEASURES STUDY REPORT - NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

DAD (mg/kg/d) = (C*CF*AF*ABS*SA*EF*ED)/(BW*AT)
ILCR = CDI*CSFd
HQ = CDI/RfDd

Parameter	Units	Description	Adult	
DAD	mg/kg/d	Dermally absorbed dose	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	
CSFd	1/(mg/kg/d)	Dermal cancer slope factor	CS	
HQ	NA	Hazard quotient	CS	
RfDd	mg/kg/d	Dermal reference dose	CS	
C	mg/kg	Concentration of chemical in soil	CS	
CF	kg/mg	Conversion factor	1.00E-06	
AF	mg/cm2	Soil to skin adherence factor	0.2	
ABS	NA	Absorption fraction	CS	
SA	cm2/day	Skin surface area available for contact	3,300	
EF	days/year	Exposure frequency	250	
ED	years	Exposure duration	25	
BW	kg	Body weight	70	
AT-C	days	Averaging time, carcinogens	25,550	
AT-N	days	Averaging time, noncarcinogens	9,125	

					Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	ABS	CSFd 1/(mg/kg/d)	RfDd (mg/kg/d)	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI
Methyl Iodide	0.00369	NA	NA	NA	8.5E-09	--	--	2.4E-08	--	--
Propionitrile (Ethyl Cyanide)	0.00810	NA	NA	NA	1.9E-08	--	--	5.2E-08	--	--
Benzo(a)anthracene	0.0130	1.3E-01	7.3E-01	NA	3.9E-09	2.8E-09	0.5%	1.1E-08	--	--
Benzo(a)pyrene (BaP)	0.0414	1.3E-01	7.3E+00	NA	1.2E-08	9.1E-08	17.5%	3.5E-08	--	--
Benzo(b)fluoranthene	0.297	1.3E-01	7.3E-01	NA	8.9E-08	6.5E-08	12.6%	2.5E-07	--	--
Benzo(k)fluoranthene	0.290	1.3E-01	7.3E-02	NA	8.7E-08	6.3E-09	1.2%	2.4E-07	--	--
Chrysene	0.465	1.3E-01	7.3E-03	NA	1.4E-07	1.0E-09	0.2%	3.9E-07	--	--
Dibenz(a,h)anthracene	0.0920	1.3E-01	7.3E+00	NA	2.8E-08	2.0E-07	38.9%	7.7E-08	--	--
Indeno(1,2,3-cd)pyrene	0.0288	1.3E-01	7.3E-01	NA	8.6E-09	6.3E-09	1.2%	2.4E-08	--	--
Antimony	1.14	1.0E-02	NA	6.0E-05	2.6E-08	--	--	7.4E-08	1.2E-03	1.2%
Arsenic	1.39	3.0E-02	1.5E+00	3.0E-04	9.6E-08	1.4E-07	27.9%	2.7E-07	9.0E-04	0.9%
Cobalt	29.8	1.0E-02	NA	3.0E-04	6.9E-07	--	--	1.9E-06	6.4E-03	6.3%
Lead	537	1.0E-02	NA	NA	1.2E-05	--	--	3.5E-05	--	--
Thallium	0.133	1.0E-02	NA	1.0E-05	3.1E-09	--	--	8.6E-09	8.6E-04	0.8%
Vanadium	186	1.0E-02	NA	1.3E-04	4.3E-06	--	--	1.2E-05	9.2E-02	90.8%
					Total ILCR:	5.2E-07	100.0%	Total HI:	1.0E-01	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT ON-SITE WORKERS - CURRENT AND FUTURE SCENARIOS
INHALATION OF FUGITIVE DUSTS EMANATING FROM SOIL - SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
CORRECTIVE MEASURES STUDY REPORT - NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

EC (mg/m3) = (Ca*ET*EF*ED)/AT
Where: Ca = C/VF + C/PEF

ILCR = EC*IUR*1000 ug/mg
HQ = EC/RfC

Parameter	Units	Description	Adult	
EC	mg/m3	Exposure Concentration	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	
IUR	1/(µg/m3)	Inhalation Unit Risk	CS	
HQ	NA	Hazard quotient	CS	
RfC	mg/m3	Inhalation Reference Concentration	CS	
Ca	mg/m3	Concentration of chemical in air as fugitive dusts	CS	
C	mg/kg	Concentration of chemical in soil	CS	
VF	m3/kg	Volatilization Factor	CS	
PEF	m3/kg	Particulate emission factor	1.36E+09	
ET	hours/day	Exposure time	8.0	
EF	days/year	Exposure frequency	250	
ED	years	Exposure duration	25	
AT-C	hours	Averaging time, carcinogens	613,200	
AT-N	hours	Averaging time, noncarcinogens	219,000	

						Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	VF (m3/kg)	Ca (mg/m3)	IUR 1/(µg/m3)	RfC (mg/m3)	EC (mg/m3)	ILCR	% Contrib. Total ILCR	EC (mg/m3)	HQ	% Contrib. HI
Methyl Iodide	0.00369	NA	2.71E-12	NA	NA	2.2E-13	--	--	6.2E-13	--	--
Propionitrile (Ethyl Cyanide)	0.00810	NA	5.96E-12	NA	NA	4.9E-13	--	--	1.4E-12	--	--
Benzo(a)anthracene	0.0130	1.8E+07	7.27E-10	1.1E-04	NA	5.9E-11	6.5E-12	0.0%	1.7E-10	--	--
Benzo(a)pyrene (BaP)	0.0414	3.5E+07	1.21E-09	1.1E-03	NA	9.8E-11	1.1E-10	0.6%	2.8E-10	--	--
Benzo(b)fluoranthene	0.297	2.1E+07	1.43E-08	1.1E-04	NA	1.2E-09	1.3E-10	0.8%	3.3E-09	--	--
Benzo(k)fluoranthene	0.290	4.5E+07	6.63E-09	1.1E-04	NA	5.4E-10	5.9E-11	0.3%	1.5E-09	--	--
Chrysene	0.465	2.7E+06	1.71E-07	1.1E-05	NA	1.4E-08	1.5E-10	0.9%	3.9E-08	--	--
Dibenz(a,h)anthracene	0.0920	8.7E+07	1.13E-09	1.2E-03	NA	9.2E-11	1.1E-10	0.7%	2.6E-10	--	--
Indeno(1,2,3-cd)pyrene	0.0288	8.2E+07	3.72E-10	1.1E-04	NA	3.0E-11	3.3E-12	0.0%	8.5E-11	--	--
Antimony	1.14	NA	8.38E-10	NA	NA	6.8E-11	--	--	1.9E-10	--	--
Arsenic	1.39	NA	1.02E-09	4.3E-03	1.5E-05	8.3E-11	3.6E-10	2.1%	2.3E-10	1.6E-05	1.3%
Cobalt	29.8	NA	2.19E-08	9.0E-03	6.0E-06	1.8E-09	1.6E-08	94.5%	5.0E-09	8.3E-04	71.8%
Lead	537	NA	3.95E-07	NA	NA	3.2E-08	--	--	9.0E-08	--	--
Thallium	0.133	NA	9.78E-11	NA	NA	8.0E-12	--	--	2.2E-11	--	--
Vanadium	186	NA	1.37E-07	NA	1.0E-04	1.1E-08	--	--	3.1E-08	3.1E-04	26.9%
						Total ILCR:	1.7E-08	100.0%	Total HI:	1.2E-03	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT ON-SITE WORKERS - CURRENT AND FUTURE SCENARIOS
ACCIDENTAL INGESTION OF SURFACE WATER - SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
CORRECTIVE MEASURES STUDY REPORT - NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

CDI (mg/kg/d) = (C*IR*ET*EF*ED)/(BW*AT)
ILCR = CDI*CSFo
HQ = CDI/RfDo

Parameter	Units	Description	Adult	
CDI	mg/kg/d	Chronic daily intake	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	
CSFo	1/(mg/kg/d)	Oral cancer slope factor	CS	
HQ	NA	Hazard quotient	CS	
RfDo	mg/kg/d	Oral reference dose	CS	
C	mg/L	Concentration of chemical in water	CS	
IR-W	L/hour	Ingestion rate of water	0.005	
ET	hours/day	Exposure time	2	
EF	days/year	Exposure frequency	250	
ED	years	Exposure duration	25	
BW	kg	Body weight	70	
AT-C	days	Averaging time, carcinogens	25,550	
AT-N	days	Averaging time, noncarcinogens	9,125	

				Carcinogens			Noncarcinogens		
Parameter	C (mg/L)	CSFo 1/(mg/kg/d)	RfDo (mg/kg/d)	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Bromodichloromethane	0.00034	6.2E-02	2.0E-02	1.2E-08	7.4E-10	2.6%	3.3E-08	1.7E-06	0.5%
Chloroform	0.00120	3.1E-02	1.0E-02	4.2E-08	1.3E-09	4.6%	1.2E-07	1.2E-05	3.6%
Dibromochloromethane	0.00016	8.4E-02	2.0E-02	5.6E-09	4.7E-10	1.7%	1.6E-08	7.8E-07	0.2%
Arsenic	0.00049	1.5E+00	3.0E-04	1.7E-08	2.6E-08	91.1%	4.8E-08	1.6E-04	49.5%
Vanadium	0.00760	NA	5.0E-03	2.7E-07	--	--	7.4E-07	1.5E-04	46.1%
				Total ILCR:	2.8E-08	100.0%	Total HI:	3.2E-04	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT ON-SITE WORKERS - CURRENT AND FUTURE SCENARIOS
DERMAL CONTACT WITH SURFACE WATER - SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
CORRECTIVE MEASURES STUDY REPORT - NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

DAD (mg/kg/d) = (C*CF*Kp*SA*EF*ED*ET)/(BW*AT)

ILCR = CDI*CSFo Adj CSF Adj = CSF/AD
HQ = CDI/RfDo Adj RfD Adj = RfD*AD

Parameter	Units	Description	Adult	
DAD	mg/kg/d	Dermally absorbed dose	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	
CSFd	1/(mg/kg/d)	Dermal cancer slope factor	CS	
HQ	NA	Hazard quotient	CS	
RfDd	mg/kg/d	Dermal reference dose	CS	
SA	cm2	Skin surface area available for contact	3,300	
EF	days/year	Exposure frequency	250	
ED	years	Exposure duration	25	
ET	hours/day	Exposure time	2.0	
BW	kg	Body weight	70	
AT-C	days	Averaging time, carcinogens	25,550	
AT-N	days	Averaging time, noncarcinogens	9,125	
C	mg/L	Concentration of chemical in water	CS	
CF	L/cm3	Conversion factor	1.00E-03	
Kp	cm/hour	Dermal permeability coefficient	CS	
AD	NA	Adjustment for absorbed dose	CS	

					Carcinogens			Noncarcinogens		
Parameter	C (mg/L)	Kp (cm/hour)	CSFd 1/(mg/kg/d)	RfDd (mg/kg/d)	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI
Bromodichloromethane	0.00034	4.02E-03 (61)	6.2E-02	2.0E-02	3.2E-08	2.0E-09	7.6%	8.8E-08	4.4E-06	0.1%
Chloroform	0.00120	6.83E-03 (61)	3.1E-02	1.0E-02	1.9E-07	5.9E-09	22.8%	5.3E-07	5.3E-05	1.3%
Dibromochloromethane	0.00016	2.89E-03 (61)	8.4E-02	2.0E-02	1.1E-08	9.0E-10	3.5%	3.0E-08	1.5E-06	0.0%
Arsenic	0.00049	1.00E-03 (61)	1.5E+00	3.0E-04	1.1E-08	1.7E-08	66.1%	3.2E-08	1.1E-04	2.7%
Vanadium	0.00760	1.00E-03 (61)	NA	1.3E-04	1.8E-07	--	--	4.9E-07	3.8E-03	95.8%
					Total ILCR:	2.6E-08	100.0%	Total HI:	3.9E-03	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

Kp value is derived from the USEPA RAGS E Guidance unless otherwise noted

ADULT ON-SITE WORKERS - CURRENT AND FUTURE SCENARIOS
ACCIDENTAL INGESTION OF SEDIMENT - SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
CORRECTIVE MEASURES STUDY REPORT - NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

CDI (mg/kg/d) = (C*IR*CF*FI*EF*ED)/(BW*AT)
ILCR = CDI*CSFo
HQ = CDI/RfDo

Parameter	Units	Description	Adult	
CDI	mg/kg/d	Chronic daily intake	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	
CSFo	1/(mg/kg/d)	Oral cancer slope factor	CS	
HQ	NA	Hazard quotient	CS	
RfDo	mg/kg/d	Oral reference dose	CS	
C	mg/kg	Concentration of chemical in soil	CS	
IR-S	mg/day	Ingestion rate of sediment	100	
CF	kg/mg	Conversion factor	1.00E-06	
FI	NA	Fraction of soil ingested from site	1	
EF	days/year	Exposure frequency	250	
ED	years	Exposure duration	25	
BW	kg	Body weight	70	
AT-C	days	Averaging time, carcinogens	25,550	
AT-N	days	Averaging time, noncarcinogens	9,125	

				Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	CSFo 1/(mg/kg/d)	RfDo (mg/kg/d)	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Arsenic	1.50	1.5E+00	3.0E-04	5.2E-07	7.9E-07	100.0%	1.5E-06	4.9E-03	2.9%
Cobalt	31.9	NA	3.0E-04	1.1E-05	--	--	3.1E-05	1.0E-01	61.9%
Thallium	0.140	NA	1.0E-05	4.9E-08	--	--	1.4E-07	1.4E-02	8.2%
Vanadium	232	NA	5.0E-03	8.1E-05	--	--	2.3E-04	4.5E-02	27.0%
				Total ILCR:	7.9E-07	100.0%	Total HI:	1.7E-01	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT ON-SITE WORKERS - CURRENT AND FUTURE SCENARIOS
DERMAL CONTACT WITH SEDIMENT - SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
CORRECTIVE MEASURES STUDY REPORT - NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

DAD (mg/kg/d) = (C*CF*AF*ABS*SA*EF*ED)/(BW*AT)
ILCR = CDI*CSFd
HQ = CDI/RfDd

Parameter	Units	Description	Adult	
DAD	mg/kg/d	Dermally absorbed dose	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	
CSFd	1/(mg/kg/d)	Dermal cancer slope factor	CS	
HQ	NA	Hazard quotient	CS	
RfDd	mg/kg/d	Dermal reference dose	CS	
C	mg/kg	Concentration of chemical in soil	CS	
CF	kg/mg	Conversion factor	1.00E-06	
AF	mg/cm2	Soil to skin adherence factor	0.3	
ABS	NA	Absorption fraction	CS	
SA	cm2/day	Skin surface area available for contact	3,300	
EF	days/year	Exposure frequency	250	
ED	years	Exposure duration	25	
BW	kg	Body weight	70	
AT-C	days	Averaging time, carcinogens	25,550	
AT-N	days	Averaging time, noncarcinogens	9,125	

					Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	ABS	CSFd 1/(mg/kg/d)	RfDd (mg/kg/d)	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI
Arsenic	1.50	3.0E-02	1.5E+00	3.0E-04	1.6E-07	2.3E-07	100.0%	4.4E-07	1.5E-03	0.8%
Cobalt	31.9	1.0E-02	NA	3.0E-04	1.1E-06	--	--	3.1E-06	1.0E-02	5.5%
Thallium	0.140	1.0E-02	NA	1.0E-05	4.8E-09	--	--	1.4E-08	1.4E-03	0.7%
Vanadium	232	1.0E-02	NA	1.3E-04	8.0E-06	--	--	2.2E-05	1.7E-01	93.0%
					Total ILCR:	2.3E-07	100.0%	Total HI:	1.9E-01	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIO
ACCIDENTAL INGESTION OF SOIL - SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
CORRECTIVE MEASURES STUDY REPORT - NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

CDI (mg/kg/d) = (C*IR*CF*FI*EF*ED)/(BW*AT)
ILCR = CDI*CSFo
HQ = CDI/RfDo

ILCR (MMOA chemicals) = (CDI*ADAF)*CSFo
CS - Chemical Specific

Parameter	Units	0<=2	2<=6	6<=16	16<=24
CDI	mg/kg/d	CS	CS	CS	CS
ILCR	NA	CS	CS	CS	CS
CSFo	1/(mg/kg/d)	CS	CS	CS	CS
HQ	NA	CS	CS	CS	CS
RfDo	mg/kg/d	CS	CS	CS	CS
C	mg/kg	CS	CS	CS	CS
IR-S	mg/day	200	200	100	100
CF	kg/mg	1.00E-06	1.00E-06	1.E-06	0.000001
FI	NA	1	1	1	1
EF	days/year	350	350	350	350
ED	years	2	4	10	8
BW	kg	15	15	45	70
AT-C	days	25550	25550	25550	25550
AT-N	days	730	1460	3650	2920
ADAF	NA	10	3	3	1

		Age Adjusted CDIs			
		16<=24	6<=16	2<=6	0<=2
Parameter	C (mg/kg)	CDI (mg/kg/d)	CDI (mg/kg/d)	CDI (mg/kg/d)	CDI (mg/kg/d)
Benzo(a)anthracene	0.0130	2.0E-09	1.2E-08	2.8E-08	4.7E-08
Benzo(a)pyrene (BaP)	0.0414	6.5E-09	3.8E-08	9.1E-08	1.5E-07
Benzo(b)fluoranthene	0.297	4.6E-08	2.7E-07	6.5E-07	1.1E-06
Benzo(k)fluoranthene	0.290	4.5E-08	2.6E-07	6.4E-07	1.1E-06
Chrysene	0.465	7.3E-08	4.2E-07	1.0E-06	1.7E-06
Dibenz(a,h)anthracene	0.0920	1.4E-08	8.4E-08	2.0E-07	3.4E-07
Indeno(1,2,3-cd)pyrene	0.0288	4.5E-09	2.6E-08	6.3E-08	1.1E-07

				Adult						Young Child					
				Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	CSFo 1/(mg/kg/d)	RfDo (mg/kg/d)	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Methyl Iodide	0.00369	NA	NA	1.7E-09	--	--	5.1E-09	--	--	4.0E-09	--	--	4.7E-08	--	--
Propionitrile (Ethyl Cyanide)	0.00810	NA	NA	3.8E-09	--	--	1.1E-08	--	--	8.9E-09	--	--	1.0E-07	--	--
Benzo(a)anthracene	0.0130	7.3E-01	NA	9.0E-08	6.6E-08	0.7%	1.8E-08	--	--	7.6E-08	5.5E-08	0.6%	1.7E-07	--	--
Benzo(a)pyrene (BaP)	0.0414	7.3E+00	NA	2.9E-07	2.1E-06	21.8%	5.7E-08	--	--	2.4E-07	1.8E-06	18.5%	5.3E-07	--	--
Benzo(b)fluoranthene	0.297	7.3E-01	NA	2.1E-06	1.5E-06	15.6%	4.1E-07	--	--	1.7E-06	1.3E-06	13.2%	3.8E-06	--	--
Benzo(k)fluoranthene	0.290	7.3E-02	NA	2.0E-06	1.5E-07	1.5%	4.0E-07	--	--	1.7E-06	1.2E-07	1.3%	3.7E-06	--	--
Chrysene	0.465	7.3E-03	NA	3.2E-06	2.3E-08	0.2%	6.4E-07	--	--	2.7E-06	2.0E-08	0.2%	5.9E-06	--	--
Dibenz(a,h)anthracene	0.0920	7.3E+00	NA	6.4E-07	4.6E-06	48.4%	1.3E-07	--	--	5.4E-07	3.9E-06	41.0%	1.2E-06	--	--
Indeno(1,2,3-cd)pyrene	0.0288	7.3E-01	NA	2.0E-07	1.5E-07	1.5%	3.9E-08	--	--	1.7E-07	1.2E-07	1.3%	3.7E-07	--	--
Antimony	1.14	NA	4.0E-04	5.4E-07	--	--	1.6E-06	3.9E-03	1.8%	1.2E-06	--	--	1.5E-05	3.6E-02	1.8%
Arsenic	1.39	1.5E+00	3.0E-04	6.5E-07	9.8E-07	10.2%	1.9E-06	6.3E-03	2.9%	1.5E-06	2.3E-06	23.9%	1.8E-05	5.9E-02	2.9%
Cobalt	29.8	NA	3.0E-04	1.4E-05	--	--	4.1E-05	1.4E-01	63.1%	3.3E-05	--	--	3.8E-04	1.3E+00	63.1%
Lead	537	NA	NA	2.5E-04	--	--	7.4E-04	--	--	5.9E-04	--	--	6.9E-03	--	--
Thallium	0.133	NA	1.0E-05	6.2E-08	--	--	1.8E-07	1.8E-02	8.5%	1.5E-07	--	--	1.7E-06	1.7E-01	8.5%
Vanadium	186	NA	5.0E-03	8.7E-05	--	--	2.5E-04	5.1E-02	23.6%	2.0E-04	--	--	2.4E-03	4.8E-01	23.6%
				Total ILCR:	9.6E-06	100.0%	Total HI:	2.2E-01	100.0%	Total ILCR:	9.6E-06	100.0%	Total HI:	2.0E+00	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
ADAF - Age Dependent Adjustment Factors
CS - Chemical Specific
MMOA - Mutagenic Mode of Action

Parameter (non-MMOA chemicals)	Adult	Young Child
Exposure duration (ED)	24	6
Averaging time, noncarcinogens (AT-N)	8,760	2,190

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIO
DERMAL CONTACT WITH SOIL - SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
CORRECTIVE MEASURES STUDY REPORT - NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

DAD (mg/kg/d) = (C*CF*AF*ABS*SA*EF*ED)/(BW*AT)
ILCR = CDI*CSFd
HQ = CDI/RfDd

ILCR (MMOA chemicals) = (DAD*ADAF)*CSFo
CS - Chemical Specific

Parameter	Units	0<=2	2<=6	6<=16	16<=24
DAD	mg/kg/d	CS	CS	CS	CS
ILCR	NA	CS	CS	CS	CS
CSFd	1/(mg/kg/d)	CS	CS	CS	CS
HQ	NA	CS	CS	CS	CS
RfDd	mg/kg/d	CS	CS	CS	CS
C	mg/kg	CS	CS	CS	CS
CF	kg/mg	1.00E-06	1.00E-06	1.00E-06	1.00E-06
AF	mg/cm2	0.2	0.2	0.07	0.07
ABS	NA	CS	CS	CS	CS
SA	cm2/day	2,800	2,800	3,200	5700
EF	days/year	350	350	350	350
ED	years	2	4	10	8
BW	kg	15	15	45	70
AT-C	days	25,550	25,550	25,550	25,550
AT-N	days	730	1,460	3,650	2,920
ADAF	NA	10	3	3	1

			Age Adjusted DADs			
			16<=24	6<=16	2<=6	0<=2
Parameter	C (mg/kg)	ABS	DAD (mg/kg/d)	DAD (mg/kg/d)	DAD (mg/kg/d)	DAD (mg/kg/d)
Benzo(a)anthracene	0.0130	1.3E-01	1.1E-09	3.5E-09	1.0E-08	1.7E-08
Benzo(a)pyrene (BaP)	0.0414	1.3E-01	3.4E-09	1.1E-08	3.3E-08	5.5E-08
Benzo(b)fluoranthene	0.297	1.3E-01	2.4E-08	7.9E-08	2.4E-07	3.9E-07
Benzo(k)fluoranthene	0.290	1.3E-01	2.4E-08	7.7E-08	2.3E-07	3.9E-07
Chrysene	0.465	1.3E-01	3.8E-08	1.2E-07	3.7E-07	6.2E-07
Dibenz(a,h)anthracene	0.0920	1.3E-01	7.5E-09	2.4E-08	7.3E-08	1.2E-07
Indeno(1,2,3-cd)pyrene	0.0288	1.3E-01	2.3E-09	7.7E-09	2.3E-08	3.8E-08

					Adult						Young Child					
					Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	ABS	CSFd 1/(mg/kg/d)	RfDd (mg/kg/d)	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI
Methyl Iodide	0.00369	NA	NA	NA	6.9E-09	--	--	2.0E-08	--	--	1.1E-08	--	--	1.3E-07	--	--
Propionitrile (Ethyl Cyanide)	0.00810	NA	NA	NA	1.5E-08	--	--	4.4E-08	--	--	2.5E-08	--	--	2.9E-07	--	--
Benzo(a)anthracene	0.0130	1.3E-01	7.3E-01	NA	3.2E-08	2.3E-08	0.7%	9.2E-09	--	--	2.8E-08	2.0E-08	0.7%	6.1E-08	--	--
Benzo(a)pyrene (BaP)	0.0414	1.3E-01	7.3E+00	NA	1.0E-07	7.5E-07	23.4%	2.9E-08	--	--	8.8E-08	6.4E-07	22.6%	1.9E-07	--	--
Benzo(b)fluoranthene	0.297	1.3E-01	7.3E-01	NA	7.3E-07	5.4E-07	16.8%	2.1E-07	--	--	6.3E-07	4.6E-07	16.2%	1.4E-06	--	--
Benzo(k)fluoranthene	0.290	1.3E-01	7.3E-02	NA	7.2E-07	5.2E-08	1.6%	2.1E-07	--	--	6.2E-07	4.5E-08	1.6%	1.3E-06	--	--
Chrysene	0.465	1.3E-01	7.3E-03	NA	1.2E-06	8.4E-09	0.3%	3.3E-07	--	--	9.9E-07	7.2E-09	0.3%	2.2E-06	--	--
Dibenz(a,h)anthracene	0.0920	1.3E-01	7.3E+00	NA	2.3E-07	1.7E-06	51.9%	6.5E-08	--	--	2.0E-07	1.4E-06	50.3%	4.3E-07	--	--
Indeno(1,2,3-cd)pyrene	0.0288	1.3E-01	7.3E-01	NA	7.1E-08	5.2E-08	1.6%	2.0E-08	--	--	6.1E-08	4.5E-08	1.6%	1.3E-07	--	--
Antimony	1.14	1.0E-02	NA	6.0E-05	2.1E-08	--	--	6.2E-08	1.0E-03	1.2%	3.5E-08	--	--	4.1E-07	6.8E-03	1.2%
Arsenic	1.39	3.0E-02	1.5E+00	3.0E-04	7.8E-08	1.2E-07	3.7%	2.3E-07	7.6E-04	0.9%	1.3E-07	1.9E-07	6.8%	1.5E-06	5.0E-03	0.9%
Cobalt	29.8	1.0E-02	NA	3.0E-04	5.6E-07	--	--	1.6E-06	5.4E-03	6.3%	9.1E-07	--	--	1.1E-05	3.6E-02	6.3%
Lead	537	1.0E-02	NA	NA	1.0E-05	--	--	2.9E-05	--	--	1.6E-05	--	--	1.9E-04	--	--
Thallium	0.133	1.0E-02	NA	1.0E-05	2.5E-09	--	--	7.3E-09	7.3E-04	0.8%	4.1E-09	--	--	4.8E-08	4.8E-03	0.8%
Vanadium	186	1.0E-02	NA	1.3E-04	3.5E-06	--	--	1.0E-05	7.8E-02	90.8%	5.7E-06	--	--	6.7E-05	5.1E-01	90.8%
					Total ILCR:	3.2E-06	100.0%	Total HI:	8.6E-02	100.0%	Total ILCR:	2.8E-06	100.0%	Total HI:	5.6E-01	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
ADAF - Age Dependent Adjustment Factors
CS - Chemical Specific
MMOA - Mutagenic Mode of Action

Parameter (non-MMOA chemicals)	Adult	Young Child
Exposure duration (ED)	24	6
Averaging time, noncarcinogens (AT-N)	8,760	2,190

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIO
INHALATION OF FUGITIVE DUSTS EMANATING FROM SOIL - SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
CORRECTIVE MEASURES STUDY REPORT - NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

EC (mg/m3) = (Ca*ET*EF*ED)/AT
Where: Ca = C/VF + C/PEF

ILCR = EC*IUR*1000 ug/mg
HQ = EC/RfC

ILCR (MMOA chemicals) = EC*ADAF*IUR*1000 ug/mg
CS - Chemical Specific

Parameter	Units	0<=2	2<=6	6<=16	16<=24
EC	mg/m3	CS	CS	CS	CS
ILCR	NA	CS	CS	CS	CS
IUR	1/(µg/m3)	CS	CS	CS	CS
HQ	NA	CS	CS	CS	CS
RfC	mg/m3	CS	CS	CS	CS
Ca	mg/m3	CS	CS	CS	CS
C	mg/kg	CS	CS	CS	CS
VF	m3/kg	CS	CS	CS	CS
PEF	m3/kg	1.36E+09	1.36E+09	1.36E+09	1.36E+09
ET	hours/day	24	24	24	24
EF	days/year	350	350	350	350
ED	years	2	4	10	8
AT-C	hours	613,200	613,200	613,200	613,200
AT-N	hours	17,520	35,040	87,600	70,080
ADAF	NA	10	3	3	1

		Age Adjusted ECs			
		16<=24	6<=16	2<=6	0<=2
Parameter	Ca (mg/m3)	EC (mg/m3)	EC (mg/m3)	EC (mg/m3)	EC (mg/m3)
Benzo(a)anthracene	9.6E-12	1.0E-12	3.9E-12	1.6E-12	2.6E-12
Benzo(a)pyrene (BaP)	3.0E-11	3.3E-12	1.3E-11	5.0E-12	8.3E-12
Benzo(b)fluoranthene	2.2E-10	2.4E-11	9.0E-11	3.6E-11	6.0E-11
Benzo(k)fluoranthene	2.1E-10	2.3E-11	8.8E-11	3.5E-11	5.8E-11
Chrysene	3.4E-10	3.7E-11	1.4E-10	5.6E-11	9.4E-11
Dibenz(a,h)anthracene	6.8E-11	7.4E-12	2.8E-11	1.1E-11	1.9E-11
Indeno(1,2,3-cd)pyrene	2.1E-11	2.3E-12	8.7E-12	3.5E-12	5.8E-12

						Adult						Young Child					
						Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	VF (m3/kg)	Ca (mg/m3)	IUR 1/(µg/m3)	RfC mg/m3	EC (mg/m3)	ILCR	% Contrib. Total ILCR	EC (mg/m3)	HQ	% Contrib. HI	EC (mg/m3)	ILCR	% Contrib. Total ILCR	EC (mg/m3)	HQ	% Contrib. HI
Methyl Iodide	0.00369	NA	2.71E-12	NA	NA	8.9E-13	--	--	2.6E-12	--	--	2.2E-13	--	--	2.6E-12	--	--
Propionitrile (Ethyl Cyanide	0.00810	NA	5.96E-12	NA	NA	2.0E-12	--	--	5.7E-12	--	--	4.9E-13	--	--	5.7E-12	--	--
Benzo(a)anthracene	0.0130	NA	9.56E-12	1.1E-04	NA	9.2E-12	1.0E-12	0.0%	9.2E-12	--	--	4.2E-12	4.6E-13	0.0%	9.2E-12	--	--
Benzo(a)pyrene (BaP)	0.0414	NA	3.04E-11	1.1E-03	NA	2.9E-11	3.2E-11	0.0%	2.9E-11	--	--	1.3E-11	1.5E-11	0.1%	2.9E-11	--	--
Benzo(b)fluoranthene	0.297	NA	2.18E-10	1.1E-04	NA	2.1E-10	2.3E-11	0.0%	2.1E-10	--	--	9.6E-11	1.1E-11	0.1%	2.1E-10	--	--
Benzo(k)fluoranthene	0.290	NA	2.13E-10	1.1E-04	NA	2.0E-10	2.2E-11	0.0%	2.0E-10	--	--	9.3E-11	1.0E-11	0.1%	2.0E-10	--	--
Chrysene	0.465	NA	3.42E-10	1.1E-05	NA	3.3E-10	3.6E-12	0.0%	3.3E-10	--	--	1.5E-10	1.6E-12	0.0%	3.3E-10	--	--
Dibenz(a,h)anthracene	0.0920	NA	6.76E-11	1.2E-03	NA	6.5E-11	7.8E-11	0.1%	6.5E-11	--	--	3.0E-11	3.6E-11	0.2%	6.5E-11	--	--
Indeno(1,2,3-cd)pyrene	0.0288	NA	2.12E-11	1.1E-04	NA	2.0E-11	2.2E-12	0.0%	2.0E-11	--	--	9.3E-12	1.0E-12	0.0%	2.0E-11	--	--
Antimony	1.14	NA	8.38E-10	NA	NA	2.8E-10	--	--	8.0E-10	--	--	6.9E-11	--	--	8.0E-10	--	--
Arsenic	1.39	NA	1.02E-09	4.3E-03	1.5E-05	3.4E-10	1.4E-09	2.2%	9.8E-10	6.5E-05	1.3%	8.4E-11	3.6E-10	2.2%	9.8E-10	6.5E-05	1.3%
Cobalt	29.8	NA	2.19E-08	9.0E-03	6.0E-06	7.2E-09	6.5E-08	97.6%	2.1E-08	3.5E-03	71.8%	1.8E-09	1.6E-08	97.4%	2.1E-08	3.5E-03	71.8%
Lead	537	NA	3.95E-07	NA	NA	1.3E-07	--	--	3.8E-07	--	--	3.2E-08	--	--	3.8E-07	--	--
Thallium	0.133	NA	9.78E-11	NA	NA	3.2E-11	--	--	9.4E-11	--	--	8.0E-12	--	--	9.4E-11	--	--
Vanadium	186	NA	1.37E-07	NA	1.0E-04	4.5E-08	--	--	1.3E-07	1.3E-03	26.9%	1.1E-08	--	--	1.3E-07	1.3E-03	26.9%
						Total ILCR:	6.6E-08	100.0%	Total HI:	4.9E-03	100.0%	Total ILCR:	1.7E-08	100.0%	Total HI:	4.9E-03	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.
ADAF - Age Dependent Adjustment Factors
CS - Chemical Specific
MMOA - Mutagenic Mode of Action

Parameter	Adult	Young Child
Exposure duration (ED)	24	6
Averaging time, noncarcinogens (AT-N)	210,240	52,560

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIO
INGESTION OF GROUNDWATER AS DRINKING WATER - SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
CORRECTIVE MEASURES STUDY REPORT - NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

CDI (mg/kg/d) = (C*IR*EF*ED)/(BW*AT)
ILCR = CDI*CSFo
HQ = CDI/RfDo

CS - Chemical Specific

Parameter	Units	Description	Adult	Young Child
CDI	mg/kg/d	Chronic daily intake	CS	CS
ILCR	NA	Incremental lifetime cancer risk	CS	CS
CSFo	1/(mg/kg/d)	Oral cancer slope factor	CS	CS
HQ	NA	Hazard quotient	CS	CS
RfDo	mg/kg/d	Oral reference dose	CS	CS
C	mg/L	Concentration of chemical in water	CS	CS
IR-W	L/day	Ingestion rate of water	2	1
EF	days/year	Exposure frequency	350	350
ED	years	Exposure duration	24	6
BW	kg	Body weight	70	15
AT-C	days	Averaging time, carcinogens	25,550	25,550
AT-N	days	Averaging time, noncarcinogens	8,760	2,190

				Adult						Young Child					
				Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
Parameter	C (mg/L)	CSFo 1/(mg/kg/d)	RfDo (mg/kg/d)	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Naphthalene	0.00130	NA	2.0E-02	1.2E-05	--	--	3.6E-05	1.8E-03	0.1%	7.1E-06	--	--	8.3E-05	4.2E-03	0.1%
Arsenic	0.00620	1.5E+00	3.0E-04	5.8E-05	8.7E-05	100.0%	1.7E-04	5.7E-01	25.7%	3.4E-05	5.1E-05	100.0%	4.0E-04	1.3E+00	25.7%
Cadmium	0.00071	NA	5.0E-04	6.7E-06	--	--	1.9E-05	3.9E-02	1.8%	3.9E-06	--	--	4.5E-05	9.1E-02	1.8%
Cobalt	0.00580	NA	3.0E-04	5.4E-05	--	--	1.6E-04	5.3E-01	24.0%	3.2E-05	--	--	3.7E-04	1.2E+00	24.0%
Selenium	0.0242	NA	5.0E-03	2.3E-04	--	--	6.6E-04	1.3E-01	6.0%	1.3E-04	--	--	1.5E-03	3.1E-01	6.0%
Vanadium	0.171	NA	5.0E-03	1.6E-03	--	--	4.7E-03	9.4E-01	42.5%	9.4E-04	--	--	1.1E-02	2.2E+00	42.5%
				Total ILCR:	8.7E-05	100.0%	Total HI:	2.2E+00	100.0%	Total ILCR:	5.1E-05	100.0%	Total HI:	5.1E+00	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIO
DERMAL CONTACT WITH GROUNDWATER - SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
CORRECTIVE MEASURES STUDY REPORT - NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

DAD (mg/kg/d) = (C*CF*Kp*SA*EF*ED*ET)/(BW*AT) — Inorganics
DAD (mg/kg/d) = (C*CF*(2*Kp*SQRT(6*tau*ET/pi))*SA*EF*ED)/(BW*AT) — ET ≤ t* (Organics)
DAD (mg/kg/d) = (C*CF*(Kp*(ET/(1+B)+2*tau*((1+3*B+B^2)/(1+B)^2))*SA*EF*ED)/(BW*AT) — ET > t* (Benzene & Vinyl Chloride)

ILCR = CDI*CSFo Adj
HQ = CDI/RfDo Adj

CSF Adj = CSF/AD
RfD Adj = RfD*AD

Parameter	Units	Description	Adult	Young Child	
DAD	mg/kg/d	Dermally absorbed dose	CS	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	CS	
CSFd	1/(mg/kg/d)	Dermal cancer slope factor	CS	CS	
HQ	NA	Hazard quotient	CS	CS	
RfDd	mg/kg/d	Dermal reference dose	CS	CS	
SA	cm2	Skin surface area available for contact	18,000	6,600	
EF	days/year	Exposure frequency	350	350	
ED	years	Exposure duration	24	6	
ET	hours/day	Exposure time	0.58	1.00	
BW	kg	Body weight	70	15	
AT-C	days	Averaging time, carcinogens	25,550	25,550	
AT-N	days	Averaging time, noncarcinogens	8,760	2,190	
C	mg/L	Concentration of chemical in water	CS	CS	
CF	L/cm3	Conversion factor	1.00E-03	1.00E-03	
Kp	cm/hour	Dermal permeability coefficient	CS	CS	
AD	NA	Adjustment for absorbed dose	CS	CS	

								Adult						Young Child					
								Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
Parameter	C (mg/L)	Kp (cm/hour)	tau (hours)	t* (hours)	B	CSFd 1/(mg/kg/d)	RfDd (mg/kg/d)	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI
Naphthalene	0.00130	4.66E-02 (61)	5.6E-01	1.3E+00	2.0E-01	NA	2.0E-02	8.1E-06	--	--	2.4E-05	1.2E-03	0.6%	4.5E-06	--	--	5.3E-05	2.6E-03	0.4%
Arsenic	0.00620	1.00E-03 (61)	NA	NA	NA	1.5E+00	3.0E-04	3.0E-07	4.6E-07	100.0%	8.9E-07	3.0E-03	1.5%	2.2E-07	3.4E-07	100.0%	2.6E-06	8.7E-03	1.5%
Cadmium	0.00071	1.00E-03 (61)	NA	NA	NA	NA	1.5E-05	3.5E-08	--	--	1.0E-07	6.8E-03	3.4%	2.6E-08	--	--	3.0E-07	2.0E-02	3.4%
Cobalt	0.00580	4.00E-04 (61)	NA	NA	NA	NA	3.0E-04	1.1E-07	--	--	3.3E-07	1.1E-03	0.6%	8.4E-08	--	--	9.8E-07	3.3E-03	0.6%
Selenium	0.0242	1.00E-03 (61)	NA	NA	NA	NA	5.0E-03	1.2E-06	--	--	3.5E-06	6.9E-04	0.3%	8.8E-07	--	--	1.0E-05	2.0E-03	0.3%
Vanadium	0.171	1.00E-03 (61)	NA	NA	NA	NA	1.3E-04	8.4E-06	--	--	2.4E-05	1.9E-01	93.7%	6.2E-06	--	--	7.2E-05	5.5E-01	93.8%
								Total ILCR:	4.6E-07	100.0%	Total HI:	2.0E-01	100.0%	Total ILCR:	3.4E-07	100.0%	Total HI:	5.9E-01	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

Kp, tau, t*, and B values are derived from the USEPA RAGS E Guidance unless otherwise noted

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIO
ACCIDENTAL INGESTION OF SURFACE WATER - SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
CORRECTIVE MEASURES STUDY REPORT - NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

CDI (mg/kg/d) = (C*IR*ET*EF*ED)/(BW*AT)
ILCR = CDI*CSFo
HQ = CDI/RfDo

CS - Chemical Specific

Parameter	Units	Description	Adult	Young Child
CDI	mg/kg/d	Chronic daily intake	CS	CS
ILCR	NA	Incremental lifetime cancer risk	CS	CS
CSFo	1/(mg/kg/d)	Oral cancer slope factor	CS	CS
HQ	NA	Hazard quotient	CS	CS
RfDo	mg/kg/d	Oral reference dose	CS	CS
C	mg/L	Concentration of chemical in water	CS	CS
IR-W	L/hour	Ingestion rate of water	0.005	0.005
ET	hours/day	Exposure time	2	2
EF	days/year	Exposure frequency	52	52
ED	years	Exposure duration	24	6
BW	kg	Body weight	70	15
AT-C	days	Averaging time, carcinogens	25,550	25,550
AT-N	days	Averaging time, noncarcinogens	8,760	2,190

				Adult						Young Child					
				Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
Parameter	C (mg/L)	CSFo 1/(mg/kg/d)	RfDo (mg/kg/d)	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Bromodichloromethane	0.00034	6.2E-02	2.0E-02	2.4E-09	1.5E-10	2.6%	6.9E-09	3.5E-07	0.5%	2.8E-09	1.7E-10	2.6%	3.2E-08	1.6E-06	0.5%
Chloroform	0.00120	3.1E-02	1.0E-02	8.4E-09	2.6E-10	4.6%	2.4E-08	2.4E-06	3.6%	9.8E-09	3.0E-10	4.6%	1.1E-07	1.1E-05	3.6%
Dibromochloromethane	0.00016	8.4E-02	2.0E-02	1.1E-09	9.4E-11	1.7%	3.3E-09	1.6E-07	0.2%	1.3E-09	1.1E-10	1.7%	1.5E-08	7.6E-07	0.2%
Arsenic	0.00049	1.5E+00	3.0E-04	3.4E-09	5.1E-09	91.1%	1.0E-08	3.3E-05	49.5%	4.0E-09	6.0E-09	91.1%	4.7E-08	1.6E-04	49.5%
Vanadium	0.00760	NA	5.0E-03	5.3E-08	--	--	1.5E-07	3.1E-05	46.1%	6.2E-08	--	--	7.2E-07	1.4E-04	46.1%
				Total ILCR:	5.6E-09	100.0%	Total HI:	6.7E-05	100.0%	Total ILCR:	6.6E-09	100.0%	Total HI:	3.1E-04	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIO
DERMAL CONTACT WITH SURFACE WATER - SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
CORRECTIVE MEASURES STUDY REPORT - NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

DAD (mg/kg/d) = (C*CF*Kp*SA*EF*ED*ET)/(BW*AT)

ILCR = CDI*CSFo Adj CSF Adj = CSF/AD CS - Chemical Specific
HQ = CDI/RfDo Adj RfD Adj = RfD*AD

Parameter	Units	Description	Adult	Young Child
DAD	mg/kg/d	Dermally absorbed dose	CS	CS
ILCR	NA	Incremental lifetime cancer risk	CS	CS
CSFd	1/(mg/kg/d)	Dermal cancer slope factor	CS	CS
HQ	NA	Hazard quotient	CS	CS
RfDd	mg/kg/d	Dermal reference dose	CS	CS
SA	cm2	Skin surface area available for contact	5,700	2,800
EF	days/year	Exposure frequency	52	52
ED	years	Exposure duration	24	6
ET	hours/day	Exposure time	2.0	2.0
BW	kg	Body weight	70	15
AT-C	days	Averaging time, carcinogens	25,550	25,550
AT-N	days	Averaging time, noncarcinogens	8,760	2,190
C	mg/L	Concentration of chemical in water	CS	CS
CF	L/cm3	Conversion factor	1.00E-03	1.00E-03
Kp	cm/hour	Dermal permeability coefficient	CS	CS
AD	NA	Adjustment for absorbed dose	CS	CS

					Adult						Young Child					
					Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
Parameter	C (mg/L)	Kp (cm/hour)	CSFd 1/(mg/kg/d)	RfDd (mg/kg/d)	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI
Bromodichloromethane	0.00034	4.02E-03 (61)	6.2E-02	2.0E-02	1.1E-08	6.7E-10	7.6%	3.2E-08	1.6E-06	0.1%	6.2E-09	3.9E-10	7.6%	7.3E-08	3.6E-06	0.1%
Chloroform	0.00120	6.83E-03 (61)	3.1E-02	1.0E-02	6.5E-08	2.0E-09	22.8%	1.9E-07	1.9E-05	1.3%	3.7E-08	1.2E-09	22.8%	4.4E-07	4.4E-05	1.3%
Dibromochloromethane	0.00016	2.89E-03 (61)	8.4E-02	2.0E-02	3.7E-09	3.1E-10	3.5%	1.1E-08	5.4E-07	0.0%	2.1E-09	1.8E-10	3.5%	2.5E-08	1.2E-06	0.0%
Arsenic	0.00049	1.00E-03 (61)	1.5E+00	3.0E-04	3.9E-09	5.8E-09	66.1%	1.1E-08	3.8E-05	2.7%	2.2E-09	3.4E-09	66.1%	2.6E-08	8.7E-05	2.7%
Vanadium	0.00760	1.00E-03 (61)	NA	1.3E-04	6.0E-08	--	--	1.8E-07	1.4E-03	95.8%	3.5E-08	--	--	4.0E-07	3.1E-03	95.8%
					Total ILCR:	8.9E-09	100.0%	Total HI:	1.4E-03	100.0%	Total ILCR:	5.1E-09	100.0%	Total HI:	3.2E-03	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

Kp value is derived from the USEPA RAGS E Guidance unless otherwise noted

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIO
ACCIDENTAL INGESTION OF SEDIMENT - SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
CORRECTIVE MEASURES STUDY REPORT - NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

CDI (mg/kg/d) = (C*IR*CF*FI*EF*ED)/(BW*AT)
ILCR = CDI*CSFo
HQ = CDI/RfDo

CS - Chemical Specific

Parameter	Units	Description	Adult	Young Child
CDI	mg/kg/d	Chronic daily intake	CS	CS
ILCR	NA	Incremental lifetime cancer risk	CS	CS
CSFo	1/(mg/kg/d)	Oral cancer slope factor	CS	CS
HQ	NA	Hazard quotient	CS	CS
RfDo	mg/kg/d	Oral reference dose	CS	CS
C	mg/kg	Concentration of chemical in soil	CS	CS
IR-S	mg/day	Ingestion rate of sediment	100	200
CF	kg/mg	Conversion factor	1.00E-06	1.00E-06
FI	NA	Fraction of soil ingested from site	1	1
EF	days/year	Exposure frequency	52	52
ED	years	Exposure duration	24	6
BW	kg	Body weight	70	15
AT-C	days	Averaging time, carcinogens	25,550	25,550
AT-N	days	Averaging time, noncarcinogens	8,760	2,190

				Adult						Young Child					
				Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	CSFo 1/(mg/kg/d)	RfDo (mg/kg/d)	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Arsenic	1.50	1.5E+00	3.0E-04	1.0E-07	1.6E-07	100.0%	3.1E-07	1.0E-03	2.9%	2.4E-07	3.7E-07	100.0%	2.8E-06	9.5E-03	2.9%
Cobalt	31.9	NA	3.0E-04	2.2E-06	--	--	6.5E-06	2.2E-02	61.9%	5.2E-06	--	--	6.1E-05	2.0E-01	61.9%
Thallium	0.140	NA	1.0E-05	9.8E-09	--	--	2.8E-08	2.8E-03	8.2%	2.3E-08	--	--	2.7E-07	2.7E-02	8.2%
Vanadium	232	NA	5.0E-03	1.6E-05	--	--	4.7E-05	9.4E-03	27.0%	3.8E-05	--	--	4.4E-04	8.8E-02	27.0%
				Total ILCR:	1.6E-07	100.0%	Total HI:	3.5E-02	100.0%	Total ILCR:	3.7E-07	100.0%	Total HI:	3.3E-01	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT AND YOUNG CHILD RESIDENTS - FUTURE SCENARIO
DERMAL CONTACT WITH SEDIMENT - SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
CORRECTIVE MEASURES STUDY REPORT - NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

DAD (mg/kg/d) = (C*CF*AF*ABS*SA*EF*ED)/(BW*AT)
ILCR = CDI*CSFd
HQ = CDI/RfDd

CS - Chemical Specific

Parameter	Units	Description	Adult	Young Child
DAD	mg/kg/d	Dermally absorbed dose	CS	CS
ILCR	NA	Incremental lifetime cancer risk	CS	CS
CSFd	1/(mg/kg/d)	Dermal cancer slope factor	CS	CS
HQ	NA	Hazard quotient	CS	CS
RfDd	mg/kg/d	Dermal reference dose	CS	CS
C	mg/kg	Concentration of chemical in soil	CS	CS
CF	kg/mg	Conversion factor	1.00E-06	1.00E-06
AF	mg/cm2	Soil to skin adherence factor	0.3	0.3
ABS	NA	Absorption fraction	CS	CS
SA	cm2/day	Skin surface area available for contact	5,700	2,800
EF	days/year	Exposure frequency	52	52
ED	years	Exposure duration	24	6
BW	kg	Body weight	70	15
AT-C	days	Averaging time, carcinogens	25,550	25,550
AT-N	days	Averaging time, noncarcinogens	8,760	2,190

					Adult						Young Child					
					Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	ABS	CSFd 1/(mg/kg/d)	RfDd (mg/kg/d)	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI
Arsenic	1.50	3.0E-02	1.5E+00	3.0E-04	5.4E-08	8.1E-08	100.0%	1.6E-07	5.2E-04	0.8%	3.1E-08	4.6E-08	100.0%	3.6E-07	1.2E-03	0.8%
Cobalt	31.9	1.0E-02	NA	3.0E-04	3.8E-07	--	--	1.1E-06	3.7E-03	5.5%	2.2E-07	--	--	2.5E-06	8.5E-03	5.5%
Thallium	0.140	1.0E-02	NA	1.0E-05	1.7E-09	--	--	4.9E-09	4.9E-04	0.7%	9.6E-10	--	--	1.1E-08	1.1E-03	0.7%
Vanadium	232	1.0E-02	NA	1.3E-04	2.8E-06	--	--	8.1E-06	6.2E-02	93.0%	1.6E-06	--	--	1.9E-05	1.4E-01	93.0%
					Total ILCR:	8.1E-08	100.0%	Total HI:	6.7E-02	100.0%	Total ILCR:	4.6E-08	100.0%	Total HI:	1.5E-01	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT INDUSTRIAL / COMMERCIAL WORKERS - FUTURE SCENARIO
ACCIDENTAL INGESTION OF SOIL - SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
CORRECTIVE MEASURES STUDY REPORT - NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

CDI (mg/kg/d) = (C*IR*CF*FI*EF*ED)/(BW*AT)
ILCR = CDI*CSFo
HQ = CDI/RfDo

Parameter	Units	Description	Adult	
CDI	mg/kg/d	Chronic daily intake	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	
CSFo	1/(mg/kg/d)	Oral cancer slope factor	CS	
HQ	NA	Hazard quotient	CS	
RfDo	mg/kg/d	Oral reference dose	CS	
C	mg/kg	Concentration of chemical in soil	CS	
IR-S	mg/day	Ingestion rate of soil	100	
CF	kg/mg	Conversion factor	1.00E-06	
FI	NA	Fraction of soil ingested from site	1	
EF	days/year	Exposure frequency	250	
ED	years	Exposure duration	25	
BW	kg	Body weight	70	
AT-C	days	Averaging time, carcinogens	25,550	
AT-N	days	Averaging time, noncarcinogens	9,125	

				Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	CSFo 1/(mg/kg/d)	RfDo (mg/kg/d)	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Methyl Iodide	0.00369	NA	NA	1.3E-09	--	--	3.6E-09	--	--
Propionitrile (Ethyl Cyanide)	0.00810	NA	NA	2.8E-09	--	--	7.9E-09	--	--
Benzo(a)anthracene	0.0130	7.3E-01	NA	4.5E-09	3.3E-09	0.3%	1.3E-08	--	--
Benzo(a)pyrene (BaP)	0.0414	7.3E+00	NA	1.4E-08	1.1E-07	9.1%	4.1E-08	--	--
Benzo(b)fluoranthene	0.297	7.3E-01	NA	1.0E-07	7.6E-08	6.5%	2.9E-07	--	--
Benzo(k)fluoranthene	0.290	7.3E-02	NA	1.0E-07	7.4E-09	0.6%	2.8E-07	--	--
Chrysene	0.465	7.3E-03	NA	1.6E-07	1.2E-09	0.1%	4.5E-07	--	--
Dibenz(a,h)anthracene	0.0920	7.3E+00	NA	3.2E-08	2.3E-07	20.2%	9.0E-08	--	--
Indeno(1,2,3-cd)pyrene	0.0288	7.3E-01	NA	1.0E-08	7.3E-09	0.6%	2.8E-08	--	--
Antimony	1.14	NA	4.0E-04	4.0E-07	--	--	1.1E-06	2.8E-03	1.8%
Arsenic	1.39	1.5E+00	3.0E-04	4.9E-07	7.3E-07	62.6%	1.4E-06	4.5E-03	2.9%
Cobalt	29.8	NA	3.0E-04	1.0E-05	--	--	2.9E-05	9.7E-02	63.1%
Lead	537	NA	NA	1.9E-04	--	--	5.3E-04	--	--
Thallium	0.133	NA	1.0E-05	4.6E-08	--	--	1.3E-07	1.3E-02	8.5%
Vanadium	186	NA	5.0E-03	6.5E-05	--	--	1.8E-04	3.6E-02	23.6%
				Total ILCR:	1.2E-06	100.0%	Total HI:	1.5E-01	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT INDUSTRIAL / COMMERCIAL WORKERS - FUTURE SCENARIO
DERMAL CONTACT WITH SOIL - SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
CORRECTIVE MEASURES STUDY REPORT - NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

DAD (mg/kg/d) = (C*CF*AF*ABS*SA*EF*ED)/(BW*AT)
ILCR = CDI*CSFd
HQ = CDI/RfDd

Parameter	Units	Description	Adult	
DAD	mg/kg/d	Dermally absorbed dose	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	
CSFd	1/(mg/kg/d)	Dermal cancer slope factor	CS	
HQ	NA	Hazard quotient	CS	
RfDd	mg/kg/d	Dermal reference dose	CS	
C	mg/kg	Concentration of chemical in soil	CS	
CF	kg/mg	Conversion factor	1.00E-06	
AF	mg/cm2	Soil to skin adherence factor	0.2	
ABS	NA	Absorption fraction	CS	
SA	cm2/day	Skin surface area available for contact	3,300	
EF	days/year	Exposure frequency	250	
ED	years	Exposure duration	25	
BW	kg	Body weight	70	
AT-C	days	Averaging time, carcinogens	25,550	
AT-N	days	Averaging time, noncarcinogens	9,125	

					Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	ABS	CSFd 1/(mg/kg/d)	RfDd (mg/kg/d)	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI
Methyl Iodide	0.00369	NA	NA	NA	8.5E-09	--	--	2.4E-08	--	--
Propionitrile (Ethyl Cyanide)	0.00810	NA	NA	NA	1.9E-08	--	--	5.2E-08	--	--
Benzo(a)anthracene	0.0130	1.3E-01	7.3E-01	NA	3.9E-09	2.8E-09	0.5%	1.1E-08	--	--
Benzo(a)pyrene (BaP)	0.0414	1.3E-01	7.3E+00	NA	1.2E-08	9.1E-08	17.5%	3.5E-08	--	--
Benzo(b)fluoranthene	0.297	1.3E-01	7.3E-01	NA	8.9E-08	6.5E-08	12.6%	2.5E-07	--	--
Benzo(k)fluoranthene	0.290	1.3E-01	7.3E-02	NA	8.7E-08	6.3E-09	1.2%	2.4E-07	--	--
Chrysene	0.465	1.3E-01	7.3E-03	NA	1.4E-07	1.0E-09	0.2%	3.9E-07	--	--
Dibenz(a,h)anthracene	0.0920	1.3E-01	7.3E+00	NA	2.8E-08	2.0E-07	38.9%	7.7E-08	--	--
Indeno(1,2,3-cd)pyrene	0.0288	1.3E-01	7.3E-01	NA	8.6E-09	6.3E-09	1.2%	2.4E-08	--	--
Antimony	1.14	1.0E-02	NA	6.0E-05	2.6E-08	--	--	7.4E-08	1.2E-03	1.2%
Arsenic	1.39	3.0E-02	1.5E+00	3.0E-04	9.6E-08	1.4E-07	27.9%	2.7E-07	9.0E-04	0.9%
Cobalt	29.8	1.0E-02	NA	3.0E-04	6.9E-07	--	--	1.9E-06	6.4E-03	6.3%
Lead	537	1.0E-02	NA	NA	1.2E-05	--	--	3.5E-05	--	--
Thallium	0.133	1.0E-02	NA	1.0E-05	3.1E-09	--	--	8.6E-09	8.6E-04	0.8%
Vanadium	186	1.0E-02	NA	1.3E-04	4.3E-06	--	--	1.2E-05	9.2E-02	90.8%
					Total ILCR:	5.2E-07	100.0%	Total HI:	1.0E-01	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT INDUSTRIAL / COMMERCIAL WORKERS - FUTURE SCENARIO
INHALATION OF FUGITIVE DUSTS EMANATING FROM SOIL - SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
CORRECTIVE MEASURES STUDY REPORT - NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

EC (mg/m3) = (Ca*ET*EF*ED)/AT
Where: Ca = C/VF + C/PEF

ILCR = EC*IUR*1000 ug/mg
HQ = EC/RfC

Parameter	Units	Description	Adult	
EC	mg/m3	Exposure Concentration	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	
IUR	1/(µg/m3)	Inhalation Unit Risk	CS	
HQ	NA	Hazard quotient	CS	
RfC	mg/m3	Inhalation Reference Concentration	CS	
Ca	mg/m3	Concentration of chemical in air as fugitive dusts	CS	
C	mg/kg	Concentration of chemical in soil	CS	
VF	m3/kg	Volatilization Factor	CS	
PEF	m3/kg	Particulate emission factor	1.36E+09	
ET	hours/day	Exposure time	8.0	
EF	days/year	Exposure frequency	250	
ED	years	Exposure duration	25	
AT-C	hours	Averaging time, carcinogens	613,200	
AT-N	hours	Averaging time, noncarcinogens	219,000	

						Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	VF (m3/kg)	Ca (mg/m3)	IUR 1/(µg/m3)	RfC (mg/m3)	EC (mg/m3)	ILCR	% Contrib. Total ILCR	EC (mg/m3)	HQ	% Contrib. HI
Methyl Iodide	0.00369	NA	2.71E-12	NA	NA	2.2E-13	--	--	6.2E-13	--	--
Propionitrile (Ethyl Cyanide)	0.00810	NA	5.96E-12	NA	NA	4.9E-13	--	--	1.4E-12	--	--
Benzo(a)anthracene	0.0130	NA	9.56E-12	1.1E-04	NA	7.8E-13	8.6E-14	0.0%	2.2E-12	--	--
Benzo(a)pyrene (BaP)	0.0414	NA	3.04E-11	1.1E-03	NA	2.5E-12	2.7E-12	0.0%	7.0E-12	--	--
Benzo(b)fluoranthene	0.297	NA	2.18E-10	1.1E-04	NA	1.8E-11	2.0E-12	0.0%	5.0E-11	--	--
Benzo(k)fluoranthene	0.290	NA	2.13E-10	1.1E-04	NA	1.7E-11	1.9E-12	0.0%	4.9E-11	--	--
Chrysene	0.465	NA	3.42E-10	1.1E-05	NA	2.8E-11	3.1E-13	0.0%	7.8E-11	--	--
Dibenz(a,h)anthracene	0.0920	NA	6.76E-11	1.2E-03	NA	5.5E-12	6.6E-12	0.0%	1.5E-11	--	--
Indeno(1,2,3-cd)pyrene	0.0288	NA	2.12E-11	1.1E-04	NA	1.7E-12	1.9E-13	0.0%	4.8E-12	--	--
Antimony	1.14	NA	8.38E-10	NA	NA	6.8E-11	--	--	1.9E-10	--	--
Arsenic	1.39	NA	1.02E-09	4.3E-03	1.5E-05	8.3E-11	3.6E-10	2.2%	2.3E-10	1.6E-05	1.3%
Cobalt	29.8	NA	2.19E-08	9.0E-03	6.0E-06	1.8E-09	1.6E-08	97.7%	5.0E-09	8.3E-04	71.8%
Lead	537	NA	3.95E-07	NA	NA	3.2E-08	--	--	9.0E-08	--	--
Thallium	0.133	NA	9.78E-11	NA	NA	8.0E-12	--	--	2.2E-11	--	--
Vanadium	186	NA	1.37E-07	NA	1.0E-04	1.1E-08	--	--	3.1E-08	3.1E-04	26.9%
						Total ILCR:	1.6E-08	100.0%	Total HI:	1.2E-03	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT INDUSTRIAL / COMMERCIAL WORKERS - FUTURE SCENARIO
INGESTION OF GROUNDWATER AS DRINKING WATER - SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
CORRECTIVE MEASURES STUDY REPORT - NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

CDI (mg/kg/d) = (C*IR*EF*ED)/(BW*AT)
ILCR = CDI*CSFo
HQ = CDI/RfDo

Parameter	Units	Description	Adult	
CDI	mg/kg/d	Chronic daily intake	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	
CSFo	1/(mg/kg/d)	Oral cancer slope factor	CS	
HQ	NA	Hazard quotient	CS	
RfDo	mg/kg/d	Oral reference dose	CS	
C	mg/L	Concentration of chemical in water	CS	
IR-W	L/day	Ingestion rate of water	2	
EF	days/year	Exposure frequency	250	
ED	years	Exposure duration	25	
BW	kg	Body weight	70	
AT-C	days	Averaging time, carcinogens	25,550	
AT-N	days	Averaging time, noncarcinogens	9,125	

				Carcinogens			Noncarcinogens		
Parameter	C (mg/L)	CSFo 1/(mg/kg/d)	RfDo (mg/kg/d)	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Naphthalene	0.00130	NA	2.0E-02	4.5E-06	--	--	1.3E-05	6.4E-04	0.1%
Arsenic	0.00620	1.5E+00	3.0E-04	2.2E-05	3.2E-05	100.0%	6.1E-05	2.0E-01	25.7%
Cadmium	0.00071	NA	5.0E-04	2.5E-06	--	--	6.9E-06	1.4E-02	1.8%
Cobalt	0.00580	NA	3.0E-04	2.0E-05	--	--	5.7E-05	1.9E-01	24.0%
Selenium	0.0242	NA	5.0E-03	8.5E-05	--	--	2.4E-04	4.7E-02	6.0%
Vanadium	0.171	NA	5.0E-03	6.0E-04	--	--	1.7E-03	3.3E-01	42.5%
				Total ILCR:	3.2E-05	100.0%	Total HI:	7.9E-01	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT CONSTRUCTION WORKERS - FUTURE SCENARIO
ACCIDENTAL INGESTION OF SOIL - SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
CORRECTIVE MEASURES STUDY REPORT - NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

CDI (mg/kg/d) = (C*IR*CF*FI*EF*ED)/(BW*AT)
ILCR = CDI*CSFo
HQ = CDI/RfDo

Parameter	Units	Description	Adult	
CDI	mg/kg/d	Chronic daily intake	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	
CSFo	1/(mg/kg/d)	Oral cancer slope factor	CS	
HQ	NA	Hazard quotient	CS	
RfDo	mg/kg/d	Oral reference dose	CS	
C	mg/kg	Concentration of chemical in soil	CS	
IR-S	mg/day	Ingestion rate of soil	330	
CF	kg/mg	Conversion factor	1.00E-06	
FI	NA	Fraction of soil ingested from site	1	
EF	days/year	Exposure frequency	250	
ED	years	Exposure duration	1	
BW	kg	Body weight	70	
AT-C	days	Averaging time, carcinogens	25,550	
AT-N	days	Averaging time, noncarcinogens	365	

				Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	CSFo 1/(mg/kg/d)	RfDo (mg/kg/d)	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Methyl Iodide	0.00369	NA	NA	1.7E-10	--	--	1.2E-08	--	--
Propionitrile (Ethyl Cyanide)	0.00810	NA	NA	3.7E-10	--	--	2.6E-08	--	--
Benzo(a)anthracene	0.0130	7.3E-01	NA	6.0E-10	4.4E-10	0.3%	4.2E-08	--	--
Benzo(a)pyrene (BaP)	0.0414	7.3E+00	NA	1.9E-09	1.4E-08	9.1%	1.3E-07	--	--
Benzo(b)fluoranthene	0.297	7.3E-01	NA	1.4E-08	1.0E-08	6.5%	9.6E-07	--	--
Benzo(k)fluoranthene	0.290	7.3E-02	NA	1.3E-08	9.8E-10	0.6%	9.4E-07	--	--
Chrysene	0.465	7.3E-03	NA	2.1E-08	1.6E-10	0.1%	1.5E-06	--	--
Dibenz(a,h)anthracene	0.0920	7.3E+00	NA	4.2E-09	3.1E-08	20.2%	3.0E-07	--	--
Indeno(1,2,3-cd)pyrene	0.0288	7.3E-01	NA	1.3E-09	9.7E-10	0.6%	9.3E-08	--	--
Antimony	1.14	NA	4.0E-04	5.3E-08	--	--	3.7E-06	9.2E-03	1.8%
Arsenic	1.39	1.5E+00	3.0E-04	6.4E-08	9.6E-08	62.6%	4.5E-06	1.5E-02	2.9%
Cobalt	29.8	NA	3.0E-04	1.4E-06	--	--	9.6E-05	3.2E-01	63.1%
Lead	537	NA	NA	2.5E-05	--	--	1.7E-03	--	--
Thallium	0.133	NA	1.0E-05	6.1E-09	--	--	4.3E-07	4.3E-02	8.5%
Vanadium	186	NA	5.0E-03	8.6E-06	--	--	6.0E-04	1.2E-01	23.6%
				Total ILCR:	1.5E-07	100.0%	Total HI:	5.1E-01	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT CONSTRUCTION WORKERS - FUTURE SCENARIO
DERMAL CONTACT WITH SOIL - SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
CORRECTIVE MEASURES STUDY REPORT - NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

DAD (mg/kg/d) = (C*CF*AF*ABS*SA*EF*ED)/(BW*AT)
ILCR = CDI*CSFd
HQ = CDI/RfDd

Parameter	Units	Description	Adult	
DAD	mg/kg/d	Dermally absorbed dose	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	
CSFd	1/(mg/kg/d)	Dermal cancer slope factor	CS	
HQ	NA	Hazard quotient	CS	
RfDd	mg/kg/d	Dermal reference dose	CS	
C	mg/kg	Concentration of chemical in soil	CS	
CF	kg/mg	Conversion factor	1.00E-06	
AF	mg/cm2	Soil to skin adherence factor	0.3	
ABS	NA	Absorption fraction	CS	
SA	cm2/day	Skin surface area available for contact	3,300	
EF	days/year	Exposure frequency	250	
ED	years	Exposure duration	1	
BW	kg	Body weight	70	
AT-C	days	Averaging time, carcinogens	25,550	
AT-N	days	Averaging time, noncarcinogens	365	

					Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	ABS	CSFd 1/(mg/kg/d)	RfDd (mg/kg/d)	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI
Methyl Iodide	0.00369	NA	NA	NA	5.1E-10	--	--	3.6E-08	--	--
Propionitrile (Ethyl Cyanide)	0.00810	NA	NA	NA	1.1E-09	--	--	7.8E-08	--	--
Benzo(a)anthracene	0.0130	1.3E-01	7.3E-01	NA	2.3E-10	1.7E-10	0.5%	1.6E-08	--	--
Benzo(a)pyrene (BaP)	0.0414	1.3E-01	7.3E+00	NA	7.4E-10	5.4E-09	17.5%	5.2E-08	--	--
Benzo(b)fluoranthene	0.297	1.3E-01	7.3E-01	NA	5.3E-09	3.9E-09	12.6%	3.7E-07	--	--
Benzo(k)fluoranthene	0.290	1.3E-01	7.3E-02	NA	5.2E-09	3.8E-10	1.2%	3.7E-07	--	--
Chrysene	0.465	1.3E-01	7.3E-03	NA	8.4E-09	6.1E-11	0.2%	5.9E-07	--	--
Dibenz(a,h)anthracene	0.0920	1.3E-01	7.3E+00	NA	1.7E-09	1.2E-08	38.9%	1.2E-07	--	--
Indeno(1,2,3-cd)pyrene	0.0288	1.3E-01	7.3E-01	NA	5.2E-10	3.8E-10	1.2%	3.6E-08	--	--
Antimony	1.14	1.0E-02	NA	6.0E-05	1.6E-09	--	--	1.1E-07	1.8E-03	1.2%
Arsenic	1.39	3.0E-02	1.5E+00	3.0E-04	5.8E-09	8.7E-09	27.9%	4.0E-07	1.3E-03	0.9%
Cobalt	29.8	1.0E-02	NA	3.0E-04	4.1E-08	--	--	2.9E-06	9.6E-03	6.3%
Lead	537	1.0E-02	NA	NA	7.4E-07	--	--	5.2E-05	--	--
Thallium	0.133	1.0E-02	NA	1.0E-05	1.8E-10	--	--	1.3E-08	1.3E-03	0.8%
Vanadium	186	1.0E-02	NA	1.3E-04	2.6E-07	--	--	1.8E-05	1.4E-01	90.8%
					Total ILCR:	3.1E-08	100.0%	Total HI:	1.5E-01	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT CONSTRUCTION WORKERS - FUTURE SCENARIO
INHALATION OF FUGITIVE DUSTS EMANATING FROM SOIL - SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
CORRECTIVE MEASURES STUDY REPORT - NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

EC (mg/m3) = (Ca*ET*EF*ED)/AT
Where: Ca = C/VF + C/PEF

ILCR = EC*IUR*1000 ug/mg
HQ = EC/RfC

Parameter	Units	Description	Adult	
EC	mg/m3	Exposure Concentration	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	
IUR	1/(µg/m3)	Inhalation Unit Risk	CS	
HQ	NA	Hazard quotient	CS	
RfC	mg/m3	Inhalation Reference Concentration	CS	
Ca	mg/m3	Concentration of chemical in air as fugitive dusts	CS	
C	mg/kg	Concentration of chemical in soil	CS	
VF	m3/kg	Volatilization Factor	CS	
PEF	m3/kg	Particulate emission factor	2.89E+06	
ET	hours/day	Exposure time	8.0	
EF	days/year	Exposure frequency	250	
ED	years	Exposure duration	1	
AT-C	hours	Averaging time, carcinogens	613,200	
AT-N	hours	Averaging time, noncarcinogens	8,760	

						Carcinogens			Noncarcinogens		
Parameter	C (mg/kg)	VF (m3/kg)	Ca (mg/m3)	IUR 1/(µg/m3)	RfC (mg/m3)	EC (mg/m3)	ILCR	% Contrib. Total ILCR	EC (mg/m3)	HQ	% Contrib. HI
Methyl Iodide	0.00369	NA	1.28E-09	NA	NA	4.2E-12	--	--	2.9E-10	--	--
Propionitrile (Ethyl Cyanide)	0.00810	NA	2.81E-09	NA	NA	9.2E-12	--	--	6.4E-10	--	--
Benzo(a)anthracene	0.0130	NA	4.51E-09	1.1E-04	NA	1.5E-11	1.6E-12	0.0%	1.0E-09	--	--
Benzo(a)pyrene (BaP)	0.0414	NA	1.43E-08	1.1E-03	NA	4.7E-11	5.1E-11	0.0%	3.3E-09	--	--
Benzo(b)fluoranthene	0.297	NA	1.03E-07	1.1E-04	NA	3.4E-10	3.7E-11	0.0%	2.4E-08	--	--
Benzo(k)fluoranthene	0.290	NA	1.01E-07	1.1E-04	NA	3.3E-10	3.6E-11	0.0%	2.3E-08	--	--
Chrysene	0.465	NA	1.61E-07	1.1E-05	NA	5.3E-10	5.8E-12	0.0%	3.7E-08	--	--
Dibenz(a,h)anthracene	0.0920	NA	3.19E-08	1.2E-03	NA	1.0E-10	1.2E-10	0.0%	7.3E-09	--	--
Indeno(1,2,3-cd)pyrene	0.0288	NA	9.98E-09	1.1E-04	NA	3.3E-11	3.6E-12	0.0%	2.3E-09	--	--
Antimony	1.14	NA	3.95E-07	NA	NA	1.3E-09	--	--	9.0E-08	--	--
Arsenic	1.39	NA	4.82E-07	4.3E-03	1.5E-05	1.6E-09	6.8E-09	2.2%	1.1E-07	7.3E-03	1.3%
Cobalt	29.8	NA	1.03E-05	9.0E-03	6.0E-06	3.4E-08	3.0E-07	97.7%	2.4E-06	3.9E-01	71.8%
Lead	537	NA	1.86E-04	NA	NA	6.1E-07	--	--	4.2E-05	--	--
Thallium	0.133	NA	4.61E-08	NA	NA	1.5E-10	--	--	1.1E-08	--	--
Vanadium	186	NA	6.45E-05	NA	1.0E-04	2.1E-07	--	--	1.5E-05	1.5E-01	26.9%
						Total ILCR:	3.1E-07	100.0%	Total HI:	5.5E-01	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT CONSTRUCTION WORKERS - FUTURE SCENARIO
INGESTION OF GROUNDWATER AS DRINKING WATER - SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
CORRECTIVE MEASURES STUDY REPORT - NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

CDI (mg/kg/d) = (C*IR*EF*ED)/(BW*AT)
ILCR = CDI*CSFo
HQ = CDI/RfDo

Parameter	Units	Description	Adult	
CDI	mg/kg/d	Chronic daily intake	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	
CSFo	1/(mg/kg/d)	Oral cancer slope factor	CS	
HQ	NA	Hazard quotient	CS	
RfDo	mg/kg/d	Oral reference dose	CS	
C	mg/L	Concentration of chemical in water	CS	
IR-W	L/day	Ingestion rate of water	0.02	
EF	days/year	Exposure frequency	50	
ED	years	Exposure duration	1	
BW	kg	Body weight	70	
AT-C	days	Averaging time, carcinogens	25,550	
AT-N	days	Averaging time, noncarcinogens	365	

				Carcinogens			Noncarcinogens		
Parameter	C (mg/L)	CSFo 1/(mg/kg/d)	RfDo (mg/kg/d)	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Naphthalene	0.00130	NA	2.0E-02	7.3E-10	--	--	5.1E-08	2.5E-06	0.1%
Arsenic	0.00620	1.5E+00	3.0E-04	3.5E-09	5.2E-09	100.0%	2.4E-07	8.1E-04	25.7%
Cadmium	0.00071	NA	5.0E-04	4.0E-10	--	--	2.8E-08	5.6E-05	1.8%
Cobalt	0.00580	NA	3.0E-04	3.2E-09	--	--	2.3E-07	7.6E-04	24.0%
Selenium	0.0242	NA	5.0E-03	1.4E-08	--	--	9.5E-07	1.9E-04	6.0%
Vanadium	0.171	NA	5.0E-03	9.6E-08	--	--	6.7E-06	1.3E-03	42.5%
				Total ILCR:	5.2E-09	100.0%	Total HI:	3.2E-03	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

ADULT CONSTRUCTION WORKERS - FUTURE SCENARIO
DERMAL CONTACT WITH GROUNDWATER - SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
CORRECTIVE MEASURES STUDY REPORT - NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

DAD (mg/kg/d) = (C*CF*Kp*SA*EF*ED*ET)/(BW*AT) — Inorganics — ILCR = CDI*CSFo Adj — CSF Adj = CSF/AD
DAD (mg/kg/d) = (C*CF*(2*Kp*SQRT(6*tau*ET/pi))*SA*EF*ED)/(BW*AT) — ET ≤ t* (Organics) — HQ = CDI/RfDo Adj — RfD Adj = RfD*AD
DAD (mg/kg/d) = (C*CF*(Kp*(ET/(1+B)+2*tau*((1+3*B+B^2)/(1+B)^2))*SA*EF*ED)/(BW*AT) — ET > t* (Benzene & Vinyl Chloride)

Parameter	Units	Description	Adult	
DAD	mg/kg/d	Dermally absorbed dose	CS	(Chemical Specific)
ILCR	NA	Incremental lifetime cancer risk	CS	
CSFd	1/(mg/kg/d)	Dermal cancer slope factor	CS	
HQ	NA	Hazard quotient	CS	
RfDd	mg/kg/d	Dermal reference dose	CS	
SA	cm2	Skin surface area available for contact	3,300	
EF	days/year	Exposure frequency	50	
ED	years	Exposure duration	1	
ET	hours/day	Exposure time	2.00	
BW	kg	Body weight	70	
AT-C	days	Averaging time, carcinogens	25,550	
AT-N	days	Averaging time, noncarcinogens	365	
C	mg/L	Concentration of chemical in water	CS	
CF	L/cm3	Conversion factor	1.00E-03	
Kp	cm/hour	Dermal permeability coefficient	CS	
AD	NA	Adjustment for absorbed dose	CS	

								Carcinogens			Noncarcinogens		
Parameter	C (mg/L)	Kp (cm/hour)	tau (hours)	t* (hours)	B	CSFd 1/(mg/kg/d)	RfDd (mg/kg/d)	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI
Naphthalene	0.00130	4.66E-02 (61)	5.6E-01	1.3E+00	2.0E-01	NA	2.0E-02	1.6E-08	--	--	1.2E-06	5.8E-05	0.3%
Arsenic	0.00620	1.00E-03 (61)	NA	NA	NA	1.5E+00	3.0E-04	1.1E-09	1.7E-09	100.0%	8.0E-08	2.7E-04	1.5%
Cadmium	0.00071	1.00E-03 (61)	NA	NA	NA	NA	1.5E-05	1.3E-10	--	--	9.2E-09	6.1E-04	3.4%
Cobalt	0.00580	4.00E-04 (61)	NA	NA	NA	NA	3.0E-04	4.3E-10	--	--	3.0E-08	1.0E-04	0.6%
Selenium	0.0242	1.00E-03 (61)	NA	NA	NA	NA	5.0E-03	4.5E-09	--	--	3.1E-07	6.3E-05	0.3%
Vanadium	0.171	1.00E-03 (61)	NA	NA	NA	NA	1.3E-04	3.2E-08	--	--	2.2E-06	1.7E-02	93.9%
								Total ILCR:	1.7E-09	100.0%	Total HI:	1.8E-02	100.0%

NOTES:
-- - Not applicable.
NA - Toxicity criterion not available.

Kp, tau, t*, and B values are derived from the USEPA RAGS E Guidance unless otherwise noted

PARTICULATE EMISSION FACTOR - CONSTRUCTION WORKERS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT - NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

$$PEF = Q/C_{sr} \times 1/F_D \times \left[\frac{T \times A_R}{556 \times (W/3)^{0.4} \times (365-p)/365 \times Sum(VKT)} \right]$$

$$Q/C_{sr} = A \times \exp\left((\ln A_S - B)^2/C\right)$$

Symbol	Definition (units)	Default	Reference
Q/C_{sr}	Inverse of a 1-h avg. air concentration along a straight road bisecting a 10.00624 acre square site (g/m2 -s/kg/m3)	15.2	USEPA 2002
A	Constant (unitless)	12.9351	USEPA 2002
A_S	Arial extent of site surface soil contamination (acres)	10.00624	Site-specific
B	Constant (unitless)	5.7383	USEPA 2002
C	Constant (unitless)	71.7711	USEPA 2002
F_D	Dispersion correction factor	0.185	USEPA 2002
T	Total time over which construction occurs (s)	7.20E+06	USEPA 2002
A_R	Surface area of contaminated road segment (m^2)	3,067	Site-specific
W	Mean vehicle weight (tons)	11	USEPA 2002
p	Number of days with at least 0.01 inches of precipitation (days/year)	120	USEPA 2002
Sum(VKT)	Sum of fleet vehicle kilometers traveled during the exposure duration (km)	1005	USEPA 2002
PEF	Particulate Emission Factor (m^3/kg)	2.89E+06	Site-specific

Q/C_{sr} Calculation

$\ln A_S$	2.303	
$(\ln A_S - B)^2$	11.8	
$(\ln A_S - B)^2/C$	0.164	
$e^{(\ln AS - B)2/C}$	1.18	
$A \times e^{(\ln AS - B)2/C}$	15.2	Q/C_{sr}

PEF Calculation

$Q/C_{sr} \times 1/F_D$	82	
$T \times A_R$	22,080,562,519	
$(W/3)^{0.4}$	1.68	
(365-p)/365	0.671	
$556 \times (W/3)^{0.4} \times (365-p)/365 \times Sum(VKT)$	630,700	
$T \times A_R/556 \times (W/3)^{0.4} \times (365-p)/365 \times Sum(VKT)$	35,010	
PEF	2,885,278	
10.00624 acres / 0.000247 acres / m2 =	40,511	m^2
sqrt (40511) / 1000 =	0.201	km

Assumptions

W assumptions: 10 - 2-ton cars and 10 - 20-ton trucks = 20 vehicles

Sum(VKT) assumptions:

Assume that the site is 10.00624 acres configured as a square with the unpaved road segment dividing the square evenly. The road length equals the square root of the 10.00624 acres (0.201 km). Assume that each vehicle travels the length of the road 1 time per day, 5 days per week, for a total of 12 months (1 year) = 20 vehicles x 0.201 km/day x 50 weeks/yr x 5 days/week = 1005 km

A_R assumptions:

Based on VKT, the road length is 201 m and assume the road width is 50 ft. (15.24).

Reference

USEPA 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

APPENDIX S
RAGS PART D TABLES

TABLE 1
SELECTION OF EXPOSURE PATHWAYS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current	Soil	Soil	Soil	On-Site Workers	Adult	Ingestion Dermal	Quantitative	Current landscaping, outdoor work-related activities for site.
				Industrial / Commercial Workers	Adult	Ingestion Dermal	NA	Not a current receptor.
				Construction Workers	Adult	Ingestion Dermal	NA	Not a current receptor.
				Trespassers	Adult and Youth	Ingestion Dermal	Quantitative	Current access of the site without permission
				Residents	Adult and Young Child	Ingestion Dermal	NA	Not a current receptor.
		Air	Fugitive Dusts	On-Site Workers	Adult	Inhalation	Quantitative	Current landscaping, outdoor work-related activities for site.
				Industrial / Commercial Workers	Adult	Inhalation	NA	Not a current receptor.
				Construction Workers	Adult	Inhalation	NA	Not a current receptor.
				Trespassers	Adult and Youth	Inhalation	Quantitative	Current access of the site without permission
				Residents	Adult and Young Child	Inhalation	NA	Not a current receptor.
	Total Soil	Total Soil	Total Soil	On-Site Workers	Adult	Ingestion Dermal	Quantitative	Current landscaping, outdoor work-related activities for site.
				Industrial / Commercial Workers	Adult	Ingestion Dermal	NA	Not a current receptor.
				Construction Workers	Adult	Ingestion Dermal	NA	Not a current receptor.
				Trespassers	Adult and Youth	Ingestion Dermal	Quantitative	Current access of the site without permission
				Residents	Adult and Young Child	Ingestion Dermal	NA	Not a current receptor.

TABLE 1
SELECTION OF EXPOSURE PATHWAYS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current (cont.)	Total Soil (cont.)	Air	Fugitive Dusts	On-Site Workers	Adult	Inhalation	Quantitative	Current landscaping, outdoor work-related activities for site.
				Industrial / Commercial Workers	Adult	Inhalation	NA	Not a current receptor.
				Construction Workers	Adult	Inhalation	NA	Not a current receptor.
				Trespassers	Adult and Youth	Inhalation	Quantitative	Current access of the site without permission
				Residents	Adult and Young Child	Inhalation	NA	Not a current receptor.
	Groundwater	Groundwater	Groundwater	On-Site Workers	Adult	Ingestion Dermal	NA	Not currently exposed to this medium.
				Industrial / Commercial Workers	Adult	Ingestion Dermal	NA	Not a current receptor.
				Construction Workers	Adult	Ingestion Dermal	NA	Not a current receptor.
				Trespassers	Adult and Youth	Ingestion Dermal	NA	Not currently exposed to this medium.
				Residents	Adult and Young Child	Ingestion Dermal	NA	Not a current receptor.
		Air	Volatile Emissions to Indoor Air	Industrial / Commercial Workers	Adult	Inhalation	NA	Not a current receptor.
				Residents	Adult	Inhalation	NA	Not a current receptor.
			Volatile Emissions to Trench Air	Construction Workers	Adult	Inhalation	NA	Not a current receptor.

TABLE 1
SELECTION OF EXPOSURE PATHWAYS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current (cont.)	Surface Water	Surface Water	Surface Water	On-Site Workers	Adult	Ingestion Dermal	Quantitative	Current landscaping, outdoor work-related activities for site.
				Industrial / Commercial Workers	Adult	Ingestion Dermal	NA	Not a current receptor.
				Construction Workers	Adult	Ingestion Dermal	NA	Not a current receptor.
				Trespassers	Adult and Youth	Ingestion Dermal	Quantitative	Current access of the site without permission
				Residents	Adult and Young Child	Ingestion Dermal	NA	Not a current receptor.
	Sediment	Sediment	Sediment	On-Site Workers	Adult	Ingestion Dermal	Quantitative	Current landscaping, outdoor work-related activities for site.
				Industrial / Commercial Workers	Adult	Ingestion Dermal	NA	Not a current receptor.
				Construction Workers	Adult	Ingestion Dermal	NA	Not a current receptor.
				Trespassers	Adult and Youth	Ingestion Dermal	Quantitative	Current access of the site without permission
				Residents	Adult and Young Child	Ingestion Dermal	NA	Not a current receptor.
Future	Soil	Soil	Soil	On-Site Workers	Adult	Ingestion Dermal	Quantitative	Future potential landscaping, outdoor work-related activities for site.
				Industrial / Commercial Workers	Adult	Ingestion Dermal	Quantitative	Future potential indoor workers walking around the site.
				Construction Workers	Adult	Ingestion Dermal	Quantitative	Future potential excavation or construction activities for development.
				Trespassers	Adult and Youth	Ingestion Dermal	Quantitative	Future potential access of the site without permission
				Residents	Adult and Young Child	Ingestion Dermal	Quantitative	Future potential residential development.

TABLE 1
SELECTION OF EXPOSURE PATHWAYS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future (cont.)	Soil (cont.)	Air	Fugitive Dusts	On-Site Workers	Adult	Inhalation	Quantitative	Future potential landscaping, outdoor work-related activities for site.
				Industrial / Commercial Workers	Adult	Inhalation	Quantitative	Future potential indoor workers walking around the site.
				Construction Workers	Adult	Inhalation	Quantitative	Future potential excavation or construction activities for development.
				Trespassers	Adult and Youth	Inhalation	Quantitative	Future potential access of the site without permission
				Residents	Adult and Young Child	Inhalation	Quantitative	Future potential residential development.
	Total Soil	Total Soil	Total Soil	On-Site Workers	Adult	Ingestion Dermal	Quantitative	Future potential landscaping, outdoor work-related activities for site.
				Industrial / Commercial Workers	Adult	Ingestion Dermal	Quantitative	Future potential indoor workers walking around the site.
				Construction Workers	Adult	Ingestion Dermal	Quantitative	Future potential excavation or construction activities for development.
				Trespassers	Adult and Youth	Ingestion Dermal	Quantitative	Future potential access of the site without permission
				Residents	Adult and Young Child	Ingestion Dermal	Quantitative	Future potential residential development.
		Air	Fugitive Dusts	On-Site Workers	Adult	Inhalation	Quantitative	Future potential landscaping, outdoor work-related activities for site.
				Industrial / Commercial Workers	Adult	Inhalation	Quantitative	Future potential indoor workers walking around the site.
				Construction Workers	Adult	Inhalation	Quantitative	Future potential excavation or construction activities for development.
				Trespassers	Adult and Youth	Inhalation	Quantitative	Future potential access of the site without permission
				Residents	Adult and Young Child	Inhalation	Quantitative	Future potential residential development.

TABLE 1
SELECTION OF EXPOSURE PATHWAYS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future (cont.)	Groundwater	Groundwater	Groundwater	On-Site Workers	Adult	Ingestion Dermal	NA	Not expected to be exposed to this medium.
				Industrial / Commercial Workers	Adult	Ingestion Dermal	Quantitative	Future potential indoor workers walking around the site.
				Construction Workers	Adult	Ingestion Dermal	Quantitative	Future potential excavation or construction activities for development.
				Trespassers	Adult and Youth	Ingestion Dermal	NA	Not expected to be exposed to this medium.
				Residents	Adult and Young Child	Ingestion Dermal	Quantitative	Future potential residential development.
		Air	Volatile Emissions to Indoor Air	Industrial / Commercial Workers	Adult	Inhalation	Quantitative	Future potential vapor intrusion into building.
				Residents	Adult	Inhalation	Quantitative	Future potential vapor intrusion into building and exposure from shower vapors.
			Volatile Emissions to Trench Air	Construction Workers	Adult	Inhalation	Quantitative	Future potential excavation or construction activities for development.
	Surface Water	Surface Water	Surface Water	On-Site Workers	Adult	Ingestion Dermal	Quantitative	Future potential landscaping, outdoor work-related activities for site.
				Industrial / Commercial Workers	Adult	Ingestion Dermal	NA	Not expected to be exposed to this medium.
				Construction Workers	Adult	Ingestion Dermal	NA	Not expected to be exposed to this medium.
				Trespassers	Adult and Youth	Ingestion Dermal	Quantitative	Future potential access of the site without permission
				Residents	Adult and Young Child	Ingestion Dermal	Quantitative	Future potential residential development.

TABLE 1
SELECTION OF EXPOSURE PATHWAYS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future (cont.)	Sediment	Sediment	Sediment	On-Site Workers	Adult	Ingestion Dermal	Quantitative	Future potential landscaping, outdoor work-related activities for site.
				Industrial / Commercial Workers	Adult	Ingestion Dermal	NA	Not expected to be exposed to this medium.
				Construction Workers	Adult	Ingestion Dermal	NA	Not expected to be exposed to this medium.
				Trespassers	Adult and Youth	Ingestion Dermal	Quantitative	Future potential access of the site without permission
				Residents	Adult and Young Child	Ingestion Dermal	Quantitative	Future potential residential development.

TABLE 2.1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN, COMBINED DATA
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier) (1)	Maximum Concentration (Qualifier) (1)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (2)	Background Value (3)	Screening Toxicity Value (4)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (5)
Surface Soil		**Volatile Organics (µg/kg)**													
	591-78-6	2-Hexanone (MBK)	4.8 J	4.8 J	µg/kg	59SB12-00	1/29	2.4U - 14UJ	4.8	ND	2.10E+04	N/A	N/A	NO	BSL
	67-64-1	Acetone	15 J	190	µg/kg	59SB21-00	17/29	7.9U - 17UJ	190	ND	6.10E+06	N/A	N/A	NO	BSL
	107-13-1	Acrylonitrile	3.4 J	3.4 J	µg/kg	59SB12-00	1/29	24UJ - 56U	3.4	ND	2.40E+02	N/A	N/A	NO	BSL
	71-43-2	Benzene	0.37 J	0.73 J	µg/kg	59SB15-00	3/29	0.71U - 5.6U	0.73	ND	1.10E+03	N/A	N/A	NO	BSL
	74-83-9	Bromomethane	2.4 J	6.3	µg/kg	59SB11-00	3/29	1.1U - 5.6UJ	6.3	ND	7.30E+02	N/A	N/A	NO	BSL
	75-15-0	Carbon Disulfide	0.52 J	1 J	µg/kg	59SB17-00	2/29	0.79U - 5.6U	1	ND	8.20E+04	N/A	N/A	NO	BSL
	74-87-3	Chloromethane	0.35 J	0.99 J	µg/kg	59SB11-00	5/29	1.4U - 5.6U	0.99	ND	1.20E+04	N/A	N/A	NO	BSL
	126-98-7	Methyl Acrylonitrile	3.3 J	3.3 J	µg/kg	59SB12-00	1/29	16UJ - 56U	3.3	ND	7.60E+02	N/A	N/A	NO	BSL
	74-88-4	Methyl Iodide	0.97 J	12	µg/kg	59SB11-00	4/29	1.3UJ - 5.6U	12	ND	N/A	N/A	N/A	YES	NSC
	107-12-0	Propionitrile (Ethyl Cyanide)	8.1 J	8.1 J	µg/kg	59SB08-00	1/11	19UJ - 28UJ	8.1	ND	N/A	N/A	N/A	YES	NSC
	000000-01-4	Xylene, m/p-	0.14 J	0.32 J	µg/kg	59SB02-00	3/19	8U - 11U	0.32	ND	6.30E+04 (12)	N/A	N/A	NO	BSL
	1330-20-7	Xylenes, total	0.14 J	0.32 J	µg/kg	59SB02-00	3/29	0.79U - 5.6U	0.32	ND	6.30E+04	N/A	N/A	NO	BSL
		Semivolatile Organics (µg/kg)													
	117-81-7	Bis(2-ethylhexyl) Phthalate (BEHP)	11 J	630 J	µg/kg	59SB01-00	11/29	7.5U - 210UJ	630	ND	3.50E+04	N/A	N/A	NO	BSL
	85-68-7	Butyl Benzyl Phthalate	170 J	170 J	µg/kg	59SB15-00	1/29	8.3U - 240U	170	ND	2.60E+05	N/A	N/A	NO	BSL
	132-64-9	Dibenzofuran	750	750	µg/kg	59SB04-00	1/29	8.3U - 240U	750	ND	7.80E+03	N/A	N/A	NO	BSL
		LLPAHs (µg/kg)													
	91-57-6	2-Methylnaphthalene	1.2 J	31 J	µg/kg	59SB04-00	4/29	4.1U - 46U	31	ND	2.30E+04	N/A	N/A	NO	BSL
	83-32-9	Acenaphthene	0.82 J	480	µg/kg	59SB04-00	3/29	4.1U - 46U	480	ND	3.40E+05	N/A	N/A	NO	BSL
	208-96-8	Acenaphthylene	1.7 J	27	µg/kg	59SB04-00	3/29	4.1U - 46U	27	ND	3.40E+05 (13)	N/A	N/A	NO	BSL
	120-12-7	Anthracene	0.57 J	690	µg/kg	59SB04-00	9/29	4.1U - 46U	690	ND	1.70E+06	N/A	N/A	NO	BSL
	56-55-3	Benzo(a)anthracene	0.72 J	84 J	µg/kg	59SB04-00	12/29	4.1U - 46U	84	ND	1.50E+02	N/A	N/A	YES	CHEM
	50-32-8	Benzo(a)pyrene (BaP)	0.8 J	390	µg/kg	59SB04-00	8/29	4.1U - 46U	390	ND	1.50E+01	N/A	N/A	YES	ASL
	205-99-2	Benzo(b)fluoranthene	0.86 J	750	µg/kg	59SB04-00	9/29	4.1U - 46U	750	ND	1.50E+02	N/A	N/A	YES	ASL
	191-24-2	Benzo(g,h,i)perylene	0.53 J	220	µg/kg	59SB04-00	7/29	4.1U - 46U	220	ND	1.70E+05 (8)	N/A	N/A	NO	BSL
	207-08-9	Benzo(k)fluoranthene	0.75 J	730	µg/kg	59SB04-00	9/29	4.1U - 46U	730	ND	1.50E+03	N/A	N/A	YES	CHEM
	218-01-9	Chrysene	0.77 J	1,200	µg/kg	59SB04-00	14/29	4.1U - 46U	1,200	ND	1.50E+04	N/A	N/A	YES	CHEM
	53-70-3	Dibenz(a,h)anthracene	0.92 J	92	µg/kg	59SB04-00	2/29	8.3U - 93U	92	ND	1.50E+01	N/A	N/A	YES	ASL
	206-44-0	Fluoranthene	1.8 J	4,600	µg/kg	59SB04-00	11/29	4.1U - 46U	4,600	ND	2.30E+05	N/A	N/A	NO	BSL
	86-73-7	Fluorene	0.63 J	580	µg/kg	59SB04-00	5/29	4.1U - 46U	580	ND	2.30E+05	N/A	N/A	NO	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	1.8 J	240	µg/kg	59SB04-00	5/29	4.1U - 46UJ	240	ND	1.50E+02	N/A	N/A	YES	ASL
	91-20-3	Naphthalene	0.92 J	2.2 J	µg/kg	59SB15-00	4/29	4.1U - 46U	2.2	ND	3.60E+03	N/A	N/A	NO	BSL
	85-01-8	Phenanthrene	1.5 J	7,000	µg/kg	59SB04-00	8/29	8.3U - 93U	7,000	ND	2.20E+05	N/A	N/A	NO	BSL
	129-00-0	Pyrene	1 J	3,000	µg/kg	59SB04-00	13/29	4.1U - 46U	3,000	ND	1.70E+05	N/A	N/A	NO	BSL
		Pesticides (µg/kg)													
	72-54-8	4,4'-DDD	0.6 J	8.1 J	µg/kg	59SB15-00	4/19	3.6U - 19UJ	8.1	ND	2.00E+03	N/A	N/A	NO	BSL
	72-55-9	4,4'-DDE	0.46 J	160	µg/kg	59SB15-00	10/19	3.6U - 19UJ	160	ND	1.40E+03	N/A	N/A	NO	BSL
	50-29-3	4,4'-DDT	0.66 J	160	µg/kg	59SB15-00	9/19	3.6U - 19UJ	160	ND	1.70E+03	N/A	N/A	NO	BSL
	319-85-7	BHC, beta-	0.47 J	9.2 NJ	µg/kg	59SB17-00	5/18	0.95U - 4.8UJ	9.2	ND	2.70E+02	N/A	N/A	NO	BSL
	5103-71-9	Chlordane, alpha-	0.25 J	1.9 J	µg/kg	59SB22-00	7/19	1.8U - 19U	1.9	ND	1.60E+03 (18)	N/A	N/A	NO	BSL
	5103-74-2	Chlordane, gamma-	0.57 J	3.5 J	µg/kg	59SB15-00	2/19	1.8U - 9.7UJ	3.5	ND	1.60E+03 (18)	N/A	N/A	NO	BSL
	1031-07-8	Endosulfan Sulfate	0.52 J	0.72 J	µg/kg	59SB04-00	3/19	3.6U - 37U	0.72	ND	3.70E+04 (10)	N/A	N/A	NO	BSL
	7421-93-4	Endrin Aldehyde	1.8 J	1.8 J	µg/kg	59SB09-00	1/12	3.6U - 37U	1.8	ND	1.80E+03 (11)	N/A	N/A	NO	BSL
	72-43-5	Methoxychlor	26 NJ	26 NJ	µg/kg	59SB11-00	1/19	18U - 190U	26	ND	3.10E+04	N/A	N/A	NO	BSL
		Metals (mg/kg)													
	7440-36-0	Antimony	0.17 J	8.5 J	mg/kg	59SB15-00	7/29	0.57U - 6.5UJ	8.5	2.46	3.10E+00	N/A	N/A	YES	ASL
	7440-38-2	Arsenic	0.29 J	5.5	mg/kg	59SB15-00	19/29	0.53U - 2.9U	5.5	2.70	6.10E-01	N/A	N/A	YES	ASL
	7440-39-3	Barium	24	267 J	mg/kg	59SB08-00	29/29	(6)	267	203	1.50E+03	N/A	N/A	NO	BSL

TABLE 2.1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN, COMBINED DATA
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier) (1)	Maximum Concentration (Qualifier) (1)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (2)	Background Value (3)	Screening Toxicity Value (4)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (5)
		Metals (mg/kg) (cont.)													
	7440-41-7	Beryllium	0.097	0.63 J	mg/kg	59SB24-00	26/29	2.8U - 2.9U	0.63	0.595	1.60E+01	N/A	N/A	NO	BSL
	7440-43-9	Cadmium	0.047 J	2.6	mg/kg	59SB15-00	28/29	2.9U - 2.9U	2.6	5.53	7.00E+00	N/A	N/A	NO	BSL
	7440-47-3	Chromium	5.3 J	150	mg/kg	59SB33-00	29/29	(6)	150	50.1	1.20E+04 (27)	N/A	N/A	NO	BSL
	7440-48-4	Cobalt	6 J	45.2	mg/kg	59SB14-00	29/29	(6)	45.2	23.6	2.30E+00	N/A	N/A	YES	ASL
	7440-50-8	Copper	24.8 J	291	mg/kg	59SB14-00	29/29	(6)	291	171	3.10E+02	N/A	N/A	NO	BSL
	7439-92-1	Lead	2.6 J	654 J	mg/kg	59SB09-00	19/19	(6)	654	10.9	4.00E+02	N/A	N/A	YES	ASL
	7439-97-6	Mercury	0.009 J	0.095	mg/kg	59SB12-00	19/29	0.0093U - 0.041U	0.095	0.111	1.00E+00	N/A	N/A	NO	BSL
	7440-02-0	Nickel	6.1	47	mg/kg	59SB33-00	29/29	(6)	47	12.7	1.50E+02	N/A	N/A	NO	BSL
	7782-49-2	Selenium	0.21 J	2.4 J	mg/kg	59SB20-00	17/29	0.29U - 16.3U	2.4	1.12	3.90E+01	N/A	N/A	NO	BSL
	7440-22-4	Silver	0.088 J	2.6	mg/kg	59SB09-00	8/29	0.057U - 3.3U	2.6	ND	3.90E+01	N/A	N/A	NO	BSL
	7440-28-0	Thallium	0.027 J	0.37 J	mg/kg	59SB20-00	9/29	0.029U - 3.3U	0.37	--	7.80E-02	N/A	N/A	YES	ASL
	7440-31-5	Tin	3 J	36.5	mg/kg	59SB09-00	12/29	2.9U - 6.3UJ	36.5	3.80	4.70E+03	N/A	N/A	NO	BSL
	7440-62-2	Vanadium	72.8 J	330	mg/kg	59SB33-00	29/29	(6)	330	259	3.90E+01	N/A	N/A	YES	ASL
	7440-66-6	Zinc	34.1 J	747	mg/kg	59SB15-00	29/29	(6)	747	117	2.30E+03	N/A	N/A	NO	BSL

(1) J - Analyte present - Reported value is estimated
NJ - Presumptive evidence for the presence of the material at an estimated value
U - Not detected
UJ - Reported quantitation limit is qualified as estimated

mg/kg = milligrams per kilogram
µg/kg = microgram per kilogram

Definitions: N/A = Not Applicable
ND = Not Detected
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered

(2) Maximum concentration used for screening
(3) Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds (Baker, 2013): Upper Limit of Mean (Mean+2 Std Dev)
(4) All non-carcinogenic criteria were divided by 10 to account for potential additive effects of chemicals
USEPA Regional Screening Levels, Residential Soil (May 2013)
(5) Rationale Codes
Selection Reason: Same chemical class (CHEM)
No Screening Criteria (NSC)
Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)
(6) No detection limits given; analyte detected in every sample.
(7) Value for **chlordane** used as a surrogate.
(8) Value for **pyrene** used as a surrogate.
(9) Value for **chromium VI** used as a surrogate.
(10) Value for **endosulfan** used as a surrogate.
(11) Value for **endrin** used as a surrogate.
(12) Value for **total** used as a surrogate.
(13) Value for **acenaphthene** used as a surrogate.
(27) Value for **chromium III** used as a surrogate.

TABLE 2.2
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN, 2012 CMS INVESTIGATION DATA
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Suface Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier) (1)	Maximum Concentration (Qualifier) (1)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (2)	Background Value (3)	Screening Toxicity Value (4)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (5)
Surface Soil		**Volatile Organics (µg/kg)**													
	67-64-1	Acetone	15 J	45 J	µg/kg	59SB32-00	4/10	7.9U - 11U	45	--	6.10E+06	N/A	N/A	NO	BSL
		Semivolatile Organics (µg/kg)													
	117-81-7	Bis(2-ethylhexyl) Phthalate (BEHP	11 J	78 J	µg/kg	59SB25-00	5/10	7.5U - 84U	78	--	3.50E+04	N/A	N/A	NO	BSL
		LLPAHs (µg/kg)													
	91-57-6	2-Methylnaphthalene	6.4 J	6.4 J	µg/kg	59SB31-00	1/10	4.1U - 46U	6.4	ND	2.30E+04	N/A	N/A	NO	BSL
	85-01-8	Phenanthrene	6 J	6 J	µg/kg	59SB31-00	1/10	8.3U - 93U	6	ND	2.20E+05	N/A	N/A	NO	BSL
		Metals (mg/kg)													
	7440-38-2	Arsenic	0.46	1.8	mg/kg	59SB24-00	10/10	(6)	1.8	2.70	6.10E-01	N/A	N/A	YES	ASL
	7440-39-3	Barium	24	210 J	mg/kg	59SB24-00	10/10	(6)	210	203	1.50E+03	N/A	N/A	NO	BSL
	7440-41-7	Beryllium	0.097	0.63 J	mg/kg	59SB24-00	10/10	(6)	0.63	0.595	1.60E+01	N/A	N/A	NO	BSL
	7440-43-9	Cadmium	0.047 J	0.47	mg/kg	59SB25-00	10/10	(6)	0.47	5.53	7.00E+00	N/A	N/A	NO	BSL
	7440-47-3	Chromium	32	150	mg/kg	59SB33-00	10/10	(6)	150	50.1	1.20E+04 (27)	N/A	N/A	NO	BSL
	7440-48-4	Cobalt	6 J	36 J	mg/kg	59SB26-00	10/10	(6)	36	23.6	2.30E+00	N/A	N/A	YES	ASL
	7440-50-8	Copper	50	260 J	mg/kg	59SB24-00	10/10	(6)	260	171	3.10E+02	N/A	N/A	NO	BSL
	7439-97-6	Mercury	0.014 J	0.069	mg/kg	59SB25-00	4/10	0.0093U - 0.012U	0.069	0.111	1.00E+00	N/A	N/A	NO	BSL
	7440-02-0	Nickel	15	47	mg/kg	59SB33-00	10/10	(6)	47	12.7	1.50E+02	N/A	N/A	NO	BSL
	7782-49-2	Selenium	0.47 J	1.2	mg/kg	59SB32-00	3/10	0.29U - 0.35U	1.2	1.12	3.90E+01	N/A	N/A	NO	BSL
	7440-22-4	Silver	0.088 J	0.35	mg/kg	59SB32-00	3/10	0.057U - 0.069U	0.35	ND	3.90E+01	N/A	N/A	NO	BSL
	7440-28-0	Thallium	0.039 J	0.073 J	mg/kg	59SB30-00	3/10	0.029U - 0.035U	0.073	--	7.80E-02	N/A	N/A	NO	BSL
	7440-31-5	Tin	8.3 J	8.3 J	mg/kg	59SB24-00	1/10	2.9U - 3.5U	8.3	3.80	4.70E+03	N/A	N/A	NO	BSL
	7440-62-2	Vanadium	110	330	mg/kg	59SB33-00	10/10	(6)	330	259	3.90E+01	N/A	N/A	YES	ASL
	7440-66-6	Zinc	42	100 J	mg/kg	59SB24-00	10/10	(6)	100	117	2.30E+03	N/A	N/A	NO	BSL

(1) J - Analyte present - Reported value is estimated
U - Not detected
(2) Maximum concentration used for screening

mg/kg = milligrams per kilogram
µg/kg = microgram per kilogram

Definitions: N/A = Not Applicable
ND = Not Detected
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered

(3) Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds (Baker, 2013): Upper Limit of Mean (Mean+2 Std Dev)
(4) All non-carcinogenic criteria were divided by 10 to account for potential additive effects of chemicals
USEPA Regional Screening Levels, Residential Soil (May 2013)
(5) Rationale Codes
Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)
(6) No detection limits given; analyte detected in every sample.
(27) Value for **chromium III** used as a surrogate.

TABLE 2.3
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN, COMBINED DATA
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Total Soil
Exposure Medium: Total Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier) (1)	Maximum Concentration (Qualifier) (1)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (2)	Background Value (3)	Screening Toxicity Value (4)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (5)
Total Soil		**Volatiles (µg/kg)**													
	591-78-6	2-Hexanone (MBK)	4.8 J	4.8 J	µg/kg	59SB12-00	1/85	2.4U - 15U	4.8	ND	2.10E+04	N/A	N/A	NO	BSL
	67-64-1	Acetone	14 J	190	µg/kg	59SB21-00	24/85	7.9U - 27U	190	ND	6.10E+06	N/A	N/A	NO	BSL
	107-13-1	Acrylonitrile	3.4 J	3.4 J	µg/kg	59SB12-00	1/85	24UJ - 60U	3.4	ND	2.40E+02	N/A	N/A	NO	BSL
	71-43-2	Benzene	0.37 J	0.73 J	µg/kg	59SB15-00	5/85	0.71U - 6U	0.73	ND	1.10E+03	N/A	N/A	NO	BSL
	75-25-2	Bromoform	35	35	µg/kg	59SB02-04	1/85	1.1U - 6U	35	ND	6.20E+04	N/A	N/A	NO	BSL
	74-83-9	Bromomethane	1.2 J	6.3	µg/kg	59SB11-00	6/85	1.1U - 6U	6.3	ND	7.30E+02	N/A	N/A	NO	BSL
	75-15-0	Carbon Disulfide	0.52 J	10	µg/kg	59SB06-03	7/85	0.79U - 6U	10	ND	8.20E+04	N/A	N/A	NO	BSL
	74-87-3	Chloromethane	0.35 J	1.1 J	µg/kg	59SB02-01	9/85	1.4U - 6U	1.1	ND	1.20E+04	N/A	N/A	NO	BSL
	124-48-1	Dibromochloromethane	0.9 J	0.9 J	µg/kg	59SB02-04	1/85	1.2U - 6U	0.9	ND	6.80E+02	N/A	N/A	NO	BSL
	126-98-7	Methyl Acrylonitrile	3.3 J	3.3 J	µg/kg	59SB12-00	1/85	16UJ - 60U	3.3	ND	7.60E+02	N/A	N/A	NO	BSL
	74-88-4	Methyl Iodide	0.97 J	30 J	µg/kg	59SB02-01	7/85	1.3UJ - 6U	30	ND	N/A	N/A	N/A	YES	NSC
	75-09-2	Methylene Chloride	7.2	7.2	µg/kg	59SB31-01	1/85	0.71U - 6U	7.2	ND	5.60E+04	N/A	N/A	NO	BSL
	107-12-0	Propionitrile (Ethyl Cyanide)	8.1 J	8.1 J	µg/kg	59SB08-00	1/21	19UJ - 37U	8.1	ND	N/A	N/A	N/A	YES	NSC
	000000-01-4	Xylene, m/p-	0.12 J	0.32 J	µg/kg	59SB02-00	15/65	7.8U - 12U	0.32	ND	6.30E+04 (12)	N/A	N/A	NO	BSL
	1330-20-7	Xylenes, total	0.12 J	0.32 J	µg/kg	59SB02-00	15/85	0.79U - 6U	0.32	ND	6.30E+04	N/A	N/A	NO	BSL
		Semivolatiles (µg/kg)													
	105-67-9	2,4-Dimethylphenol	17 J	17 J	µg/kg	59SB25-01	1/85	8.6U - 480U	17	ND	1.20E+05	N/A	N/A	NO	BSL
	117-81-7	Bis(2-ethylhexyl) Phthalate (B	8.5 J	630 J	µg/kg	59SB01-00	23/85	7.5U - 250U	630	ND	3.50E+04	N/A	N/A	NO	BSL
	85-68-7	Butyl Benzyl Phthalate	170 J	170 J	µg/kg	59SB15-00	1/85	7.6U - 250U	170	ND	2.60E+05	N/A	N/A	NO	BSL
	132-64-9	Dibenzofuran	750	750	µg/kg	59SB04-00	1/85	7.6U - 250U	750	ND	7.80E+03	N/A	N/A	NO	BSL
	117-84-0	Di-n-octyl Phthalate	55 J	55 J	µg/kg	59SB22-01	1/85	7.6U - 250U	55	ND	6.10E+04	N/A	N/A	NO	BSL
	608-93-5	Pentachlorobenzene	5.6 J	5.6 J	µg/kg	59SB24-01	1/85	3.7U - 250U	5.6	ND	4.90E+03	N/A	N/A	NO	BSL
		PAHs (µg/kg)													
	91-57-6	2-Methylnaphthalene	0.96 J	31 J	µg/kg	59SB04-00	6/85	3.7U - 46U	31	ND	2.30E+04	N/A	N/A	NO	BSL
	83-32-9	Acenaphthene	0.82 J	480	µg/kg	59SB04-00	5/85	3.7U - 46U	480	ND	3.40E+05	N/A	N/A	NO	BSL
	208-96-8	Acenaphthylene	0.61 J	27	µg/kg	59SB04-00	5/85	3.7U - 46U	27	ND	3.40E+05 (13)	N/A	N/A	NO	BSL
	120-12-7	Anthracene	0.57 J	690	µg/kg	59SB04-00	10/85	3.7U - 46U	690	ND	1.70E+06	N/A	N/A	NO	BSL
	56-55-3	Benzo(a)anthracene	0.63 J	84 J	µg/kg	59SB04-00	20/85	3.7U - 46U	84	ND	1.50E+02	N/A	N/A	YES	CHEM
	50-32-8	Benzo(a)pyrene (BaP)	0.8 J	390	µg/kg	59SB04-00	13/85	3.7U - 46U	390	ND	1.50E+01	N/A	N/A	YES	ASL
	205-99-2	Benzo(b)fluoranthene	0.64 J	750	µg/kg	59SB04-00	14/85	3.7U - 46U	750	ND	1.50E+02	N/A	N/A	YES	ASL
	191-24-2	Benzo(g,h,i)perylene	0.53 J	220	µg/kg	59SB04-00	10/85	3.7U - 46U	220	ND	1.70E+05 (8)	N/A	N/A	NO	BSL
	207-08-9	Benzo(k)fluoranthene	0.49 J	730	µg/kg	59SB04-00	14/85	3.7U - 46U	730	ND	1.50E+03	N/A	N/A	YES	CHEM
	218-01-9	Chrysene	0.77 J	1,200	µg/kg	59SB04-00	22/85	3.7U - 46U	1,200	ND	1.50E+04	N/A	N/A	YES	CHEM
	53-70-3	Dibenz(a,h)anthracene	0.39 J	92	µg/kg	59SB04-00	3/85	7.6U - 93U	92	ND	1.50E+01	N/A	N/A	YES	ASL
	206-44-0	Fluoranthene	1.7 J	4,600	µg/kg	59SB04-00	15/85	3.7U - 46U	4,600	ND	2.30E+05	N/A	N/A	NO	BSL
	86-73-7	Fluorene	0.63 J	580	µg/kg	59SB04-00	6/85	3.7U - 46U	580	ND	2.30E+05	N/A	N/A	NO	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	0.77 J	240	µg/kg	59SB04-00	8/85	3.7U - 46UJ	240	ND	1.50E+02	N/A	N/A	YES	ASL
	91-20-3	Naphthalene	0.92 J	2.2 J	µg/kg	59SB15-00	7/85	3.7U - 46U	2.2	ND	3.60E+03	N/A	N/A	NO	BSL
	85-01-8	Phenanthrene	1.5 J	7,000	µg/kg	59SB04-00	13/85	7.6U - 93U	7,000	ND	2.20E+05	N/A	N/A	NO	BSL
	129-00-0	Pyrene	0.92 J	3,000	µg/kg	59SB04-00	21/85	3.7U - 46U	3,000	ND	1.70E+05	N/A	N/A	NO	BSL
		Pesticides (µg/kg)													
	72-54-8	4,4'-DDD	0.39 J	8.1 J	µg/kg	59SB15-00	5/65	3.5U - 19UJ	8.1	ND	2.00E+03	N/A	N/A	NO	BSL
	72-55-9	4,4'-DDE	0.46 J	160	µg/kg	59SB15-00	16/65	3.5U - 19UJ	160	ND	1.40E+03	N/A	N/A	NO	BSL
	50-29-3	4,4'-DDT	0.63 J	160	µg/kg	59SB15-00	13/65	3.5U - 19UJ	160	ND	1.70E+03	N/A	N/A	NO	BSL
	319-85-7	BHC, beta-	0.47 J	12 NJ	µg/kg	59SB12-05	12/64	0.95U - 4.8UJ	12	ND	2.70E+02	N/A	N/A	NO	BSL
	319-86-8	BHC, delta-	0.27 J	0.27 J	µg/kg	59SB03-04	1/65	1.8U - 19U	0.27	ND	2.70E+02 (13)	N/A	N/A	NO	BSL
	5103-71-9	Chlordane, alpha-	0.25 J	8.4	µg/kg	59SB03-04	8/65	1.8U - 19U	8.4	ND	1.60E+03 (18)	N/A	N/A	NO	BSL
	5103-74-2	Chlordane, gamma-	0.57 J	3.5 J	µg/kg	59SB15-00	2/65	1.8U - 9.7UJ	3.5	ND	1.60E+03 (18)	N/A	N/A	NO	BSL

TABLE 2.3
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN, COMBINED DATA
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Total Soil
Exposure Medium: Total Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier) (1)	Maximum Concentration (Qualifier) (1)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (2)	Background Value (3)	Screening Toxicity Value (4)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (5)
		Pesticides (µg/kg) (cont.)													
	1031-07-8	Endosulfan Sulfate	0.52 J	0.72 J	µg/kg	59SB04-00	3/65	3.5U - 37U	0.72	ND	3.70E+04 (10)	N/A	N/A	NO	BSL
	72-20-8	Endrin	0.56 J	0.56 J	µg/kg	59SB04-01	1/65	3.5U - 37U	0.56	ND	1.80E+03	N/A	N/A	NO	BSL
	7421-93-4	Endrin Aldehyde	0.46 J	1.8 J	µg/kg	59SB09-00	4/56	3.5U - 37U	1.8	ND	1.80E+03 (11)	N/A	N/A	NO	BSL
	76-44-8	Heptachlor	0.22 J	0.22 J	µg/kg	59SB13-01	1/65	1.8U - 19U	0.22	ND	1.10E+02	N/A	N/A	NO	BSL
	72-43-5	Methoxychlor	26 NJ	26 NJ	µg/kg	59SB11-00	1/65	18U - 190U	26	ND	3.10E+04	N/A	N/A	NO	BSL
		Metals (mg/kg)													
	7440-36-0	Antimony	0.15 J	8.5 J	mg/kg	59SB15-00	15/85	0.55U - 7.3UJ	8.5	2.43	3.10E+00	N/A	N/A	YES	ASL
	7440-38-2	Arsenic	0.19 J	5.5	mg/kg	59SB15-00	42/85	0.53U - 3.6UJ	5.5	2.37	6.10E-01	N/A	N/A	YES	ASL
	7440-39-3	Barium	4.1 J	312	mg/kg	59SB19-05	67/67	(6)	312	233	1.50E+03	N/A	N/A	NO	BSL
	7440-41-7	Beryllium	0.075 J	0.96	mg/kg	59SB13-01	68/85	2.6U - 3.6U	0.96	0.717	1.60E+01	N/A	N/A	NO	BSL
	7440-43-9	Cadmium	0.016 J	5	mg/kg	59SB08-05	72/85	0.034U - 3.6U	5	0.655	7.00E+00	N/A	N/A	NO	BSL
	7440-47-3	Chromium	5.3 J	232 J	mg/kg	59SB16-05	84/85	7UJ - 7UJ	232	87.6	1.20E+04 (27)	N/A	N/A	NO	BSL
	7440-48-4	Cobalt	3.5 J	83.9 J	mg/kg	59SB02-04	85/85	(6)	83.9	51.9	2.30E+00	N/A	N/A	YES	ASL
	7440-50-8	Copper	5.1 J	291	mg/kg	59SB14-00	85/85	(6)	291	225	3.10E+02	N/A	N/A	NO	BSL
	7439-92-1	Lead	0.72 J	654 J	mg/kg	59SB09-00	49/63	2.7U - 3.6UJ	654	28.2	4.00E+02	N/A	N/A	YES	ASL
	7439-97-6	Mercury	0.005 J	0.15	mg/kg	59SB06-03	45/85	0.0091U - 0.048U	0.15	0.112	1.00E+00	N/A	N/A	NO	BSL
	7440-02-0	Nickel	4.7 J	47.3	mg/kg	59SB17-01	85/85	(6)	47.3	27.0	1.50E+02	N/A	N/A	NO	BSL
	7782-49-2	Selenium	0.2 J	2.9 J	mg/kg	59SB19-05	45/85	0.28U - 18.2UJ	2.9	1.85	3.90E+01	N/A	N/A	NO	BSL
	7440-22-4	Silver	0.088 J	2.6	mg/kg	59SB09-00	17/85	0.055U - 3.6U	2.6	--	3.90E+01	N/A	N/A	NO	BSL
	7440-28-0	Thallium	0.027 J	0.53 J	mg/kg	59SB18-02	21/85	0.028U - 3.6U	0.53	0.775	7.80E-02	N/A	N/A	YES	ASL
	7440-31-5	Tin	1.9 J	36.5	mg/kg	59SB09-00	33/85	2.8U - 7U	36.5	3.68	4.70E+03	N/A	N/A	NO	BSL
	7440-62-2	Vanadium	43.5 J	407	mg/kg	59SB12-05	85/85	(6)	407	367	3.90E+01	N/A	N/A	YES	ASL
	7440-66-6	Zinc	34.1 J	747	mg/kg	59SB15-00	85/85	(6)	747	113	2.30E+03	N/A	N/A	NO	BSL

(1) J - Analyte present - Reported value is estimated
NJ - Presumptive evidence for the presence of the material at an estimated value
U - Not detected
UJ - Reported quantitation limit is qualified as estimated

mg/kg = milligrams per kilogram
µg/kg = microgram per kilogram

Definitions: N/A = Not Applicable
ND = Not Detected
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered

(2) Maximum concentration used for screening
(3) Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds (Baker, 2013): Upper Limit of Mean (Mean+2 Std Dev)
(4) All non-carcinogenic criteria were divided by 10 to account for potential additive effects of chemicals
USEPA Regional Screening Levels, Residential Soil (May 2013)
(5) Rationale Codes
Selection Reason: Same chemical class (CHEM)
No Screening Criteria (NSC)
Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)
(6) No detection limits given; analyte detected in every sample.
(7) Value for **chlordane** used as a surrogate.
(8) Value for **pyrene** used as a surrogate.
(9) Value for **chromium VI** used as a surrogate.
(10) Value for **endosulfan** used as a surrogate.
(11) Value for **endrin** used as a surrogate.
(12) Value for **total** used as a surrogate.
(13) Value for **acenaphthene** used as a surrogate.
(27) Value for **chromium III** used as a surrogate.

TABLE 2.4
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN, 2012 CMS INVESTIGATION DATA
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Total Soil
Exposure Medium: Total Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier) (1)	Maximum Concentration (Qualifier) (1)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (2)	Background Value (3)	Screening Toxicity Value (4)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (5)
Total Soil		**Volatile Organics (µg/kg)**													
	67-64-1	Acetone	14 J	45 J	µg/kg	59SB32-00	7/20	7.9U - 15U	45	ND	6.10E+06	N/A	N/A	NO	BSL
	75-09-2	Methylene Chloride	7.2	7.2	µg/kg	59SB31-01	1/20	0.71U - 1.1U	7.2	ND	5.60E+04	N/A	N/A	NO	BSL
		Semivolatile Oganics (µg/kg)													
	105-67-9	2,4-Dimethylphenol	17 J	17 J	µg/kg	59SB25-01	1/20	8.6U - 110U	17	ND	1.20E+05	N/A	N/A	NO	BSL
	117-81-7	Bis(2-ethylhexyl) Phthalate (BEHP	8.5 J	78 J	µg/kg	59SB25-00	13/20	7.5U - 84U	78	ND	3.50E+04	N/A	N/A	NO	BSL
	608-93-5	Pentachlorobenzene	5.6 J	5.6 J	µg/kg	59SB24-01	1/20	3.7U - 46U	5.6	ND	4.90E+03	N/A	N/A	NO	BSL
		LLPAHs (µg/kg)													
	91-57-6	2-Methylnaphthalene	6.4 J	6.4 J	µg/kg	59SB31-00	1/20	3.7U - 46U	6.4	ND	2.30E+04	N/A	N/A	NO	BSL
	85-01-8	Phenanthrene	4.6 J	6 J	µg/kg	59SB31-00	2/20	7.6U - 93U	6	ND	2.20E+05	N/A	N/A	NO	BSL
		Metals (mg/kg)													
	7440-38-2	Arsenic	0.46	1.8	mg/kg	59SB24-00	20/20	(6)	1.8	1.59	6.10E-01	N/A	N/A	YES	ASL
	7440-39-3	Barium	24	210 J	mg/kg	59SB24-00	20/20	(6)	210	220	1.50E+03	N/A	N/A	NO	BSL
	7440-41-7	Beryllium	0.097	0.63 J	mg/kg	59SB24-00	20/20	(6)	0.63	0.596	1.60E+01	N/A	N/A	NO	BSL
	7440-43-9	Cadmium	0.016 J	0.47	mg/kg	59SB25-00	19/20	0.034U - 0.034U	0.47	0.539	7.00E+00	N/A	N/A	NO	BSL
	7440-47-3	Chromium	16	150	mg/kg	59SB33-00	20/20	(6)	150	114	1.20E+04 (27)	N/A	N/A	NO	BSL
	7440-48-4	Cobalt	3.5 J	36 J	mg/kg	59SB26-00	20/20	(6)	36	26.9	2.30E+00	N/A	N/A	YES	ASL
	7440-50-8	Copper	48	260 J	mg/kg	59SB24-00	20/20	(6)	260	246	3.10E+02	N/A	N/A	NO	BSL
	7439-97-6	Mercury	0.011 J	0.083	mg/kg	59SB29-01	8/20	0.0091U - 0.012U	0.083	0.108	1.00E+00	N/A	N/A	NO	BSL
	7440-02-0	Nickel	5.7	47	mg/kg	59SB33-00	20/20	(6)	47	24.7	1.50E+02	N/A	N/A	NO	BSL
	7782-49-2	Selenium	0.47 J	1.2	mg/kg	59SB32-00	7/20	0.28U - 0.35U	1.2	5.94	3.90E+01	N/A	N/A	NO	BSL
	7440-22-4	Silver	0.088 J	0.35	mg/kg	59SB32-00	4/20	0.055U - 0.07U	0.35	ND	3.90E+01	N/A	N/A	NO	BSL
	7440-28-0	Thallium	0.037 J	0.073 J	mg/kg	59SB30-00	4/20	0.028U - 0.035U	0.073	0.924	7.80E-02	N/A	N/A	NO	BSL
	7440-31-5	Tin	8.3 J	8.3 J	mg/kg	59SB24-00	1/20	2.8U - 3.6U	8.3	3.56	4.70E+03	N/A	N/A	NO	BSL
	7440-62-2	Vanadium	110	400	mg/kg	59SB33-01	20/20	(6)	400	434	3.90E+01	N/A	N/A	YES	ASL
	7440-66-6	Zinc	35	100 J	mg/kg	59SB24-00	20/20	(6)	100	88.1	2.30E+03	N/A	N/A	NO	BSL

(1) J - Analyte present - Reported value is estimated
U - Not detected
(2) Maximum concentration used for screening

mg/kg = milligrams per kilogram
µg/kg = microgram per kilogram

Definitions: N/A = Not Applicable
ND = Not Detected
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered

(3) Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds (Baker, 2013): Upper Limit of Mean (Mean+2 Std Dev)
(4) All non-carcinogenic criteria were divided by 10 to account for potential additive effects of chemicals
USEPA Regional Screening Levels, Residential Soil (May 2013)
(5) Rationale Codes
Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)
(6) No detection limits given; analyte detected in every sample.
(27) Value for **chromium III** used as a surrogate.

TABLE 2.5
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier) (1)	Maximum Concentration (Qualifier) (1)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (2)	Background Value (3)	Screening Toxicity Value (4)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (5)
Groundwater		**Volatile Organics (µg/L)**													
	71-43-2	Benzene	0.036 J	0.1 J	µg/L	59GW09	4/10	0.5U - 0.5U	0.1	ND	3.90E-01	5	MCL	NO	BSL
	75-15-0	Carbon Disulfide	0.05 J	0.15 J	µg/L	59GW09	3/10	0.5U - 0.5U	0.15	ND	7.20E+01	N/A		NO	BSL
		Semivolatile Organics (µg/L)													
	117-81-7	Bis(2-ethylhexyl) Phthalate (BEHP	2.4 J	2.4 J	µg/L	59GW05	1/10	5UJ - 5.3UJ	2.4	ND	4.80E+00	6	MCL	NO	BSL
		LLPAHs (µg/L)													
	91-20-3	Naphthalene	1.3 J	1.3 J	µg/L	59GW06	1/10	0.2UJ - 0.21UJ	1.3	ND	1.40E-01	N/A		YES	ASL
	85-01-8	Phenanthrene	0.054 J	0.054 J	µg/L	59GW10	1/10	0.2UJ - 0.21UJ	0.054	ND	3.00E+01	N/A		NO	BSL
	129-00-0	Pyrene	0.01 J	0.01 J	µg/L	59GW01, 59GW02	2/10	0.2UJ - 0.21UJ	0.01	ND	8.70E+00	N/A		NO	BSL
		Pesticides (µg/L)													
	5103-71-9	Chlordane, alpha-	0.016 NJ	0.016 NJ	µg/L	59GW04	1/10	0.05U - 0.056U	0.016	ND	1.90E-01 (18)	2	MCL (18)	NO	BSL
		Dissolved Metals (µg/L)													
	7440-36-0	Antimony	0.23 J	0.47 J	µg/L	59GW04	7/10	2U - 2U	0.47	ND	6.00E-01	6	MCL	NO	BSL
	7440-38-2	Arsenic	0.92 J	5.3	µg/L	59GW01	10/10	(6)	5.3	ND	4.50E-02	10	MCL	YES	ASL
	7440-39-3	Barium	4.6 J	45.7	µg/L	59GW06	10/10	(6)	45.7	ND	2.90E+02	2000	MCL	NO	BSL
	7440-43-9	Cadmium	0.1 J	0.55 J	µg/L	59GW01, 59GW06	4/10	1U - 1U	0.55	ND	6.90E-01	5	MCL	NO	BSL
	7440-47-3	Chromium	0.27 J	1.4 J	µg/L	59GW01	9/10	2U - 2U	1.4	ND	1.60E+03 (27)	100	MCL	NO	BSL
	7440-48-4	Cobalt	0.19 J	3.5	µg/L	59GW06	10/10	(6)	3.5	ND	4.70E-01	N/A		YES	ASL
	7440-50-8	Copper	2.3	19	µg/L	59GW01	10/10	(6)	19	ND	6.20E+01	1300	MCL	NO	BSL
	7440-02-0	Nickel	1.1	8.3	µg/L	59GW01	8/10	1U - 1U	8.3	ND	3.00E+01	N/A		NO	BSL
	7782-49-2	Selenium	0.6 J	23.8	µg/L	59GW01	10/10	(6)	23.8	ND	7.80E+00	50	MCL	YES	ASL
	7440-22-4	Silver	0.045 J	0.055 J	µg/L	59GW04	2/10	1U - 1U	0.055	ND	7.10E+00	N/A		NO	BSL
	7440-28-0	Thallium	0.084 J	0.39 J	µg/L	59GW01	5/10	1U - 1U	0.39	ND	2.00E+00 (25)	2	MCL	NO	BSL
	7440-62-2	Vanadium	9.5	179	µg/L	59GW10	10/10	(6)	179	ND	6.30E+00	N/A		YES	ASL
	7440-66-6	Zinc	2.6 J	13.4 J	µg/L	59GW01	7/9	2UJ - 2UJ	13.4	ND	4.70E+02	N/A		NO	BSL
		Total Metals (µg/L)													
	7440-36-0	Antimony	0.26 J	0.54 J	µg/L	59GW09	6/10	2U - 2U	0.54	12.2	6.00E-01	6	MCL	NO	BSL
	7440-38-2	Arsenic	0.94 J	6.2	µg/L	59GW01	10/10	(6)	6.2	18.9	4.50E-02	10	MCL	YES	ASL
	7440-39-3	Barium	6.5 J	49.1	µg/L	59GW06	10/10	(6)	49.1	686	2.90E+02	2000	MCL	NO	BSL
	7440-41-7	Beryllium	0.055 J	0.055 J	µg/L	59GW03	1/10	1U - 1U	0.055	2.21	1.60E+00	4	MCL	NO	BSL
	7440-43-9	Cadmium	0.069 J	0.71 J	µg/L	59GW01	7/10	1U - 1U	0.71	16.6	6.90E-01	5	MCL	YES	ASL
	7440-47-3	Chromium	0.46 J	5.5	µg/L	59GW03	10/10	(6)	5.5	162	1.60E+03 (27)	100	MCL	NO	BSL
	7440-48-4	Cobalt	0.3 J	5.8	µg/L	59GW03	10/10	(6)	5.8	633	4.70E-01	N/A		YES	ASL
	7440-50-8	Copper	3.9	21.3	µg/L	59GW01	10/10	(6)	21.3	324	6.20E+01	1300	MCL	NO	BSL
	7439-92-1	Lead	1.7	5	µg/L	59GW03	2/10	1U - 1U	5	26.2	1.50E+01 (25)	15	MCL	NO	BSL
	7440-02-0	Nickel	1.2	8	µg/L	59GW01	9/10	1U - 1U	8	95.7	3.00E+01	N/A		NO	BSL
	7782-49-2	Selenium	0.48 J	24.2	µg/L	59GW01	10/10	(6)	24.2	29.9	7.80E+00	50	MCL	YES	ASL
	7440-22-4	Silver	0.054 J	0.65 J	µg/L	59GW01	6/10	1UJ - 1UJ	0.65	18.3	7.10E+00	N/A		NO	BSL
	7440-28-0	Thallium	0.096 J	0.43 J	µg/L	59GW01	5/10	1U - 1U	0.43	ND	2.00E+00 (25)	2	MCL	NO	BSL
	7440-62-2	Vanadium	9.2	171	µg/L	59GW10	10/10	(6)	171	485	6.30E+00	N/A		YES	ASL

TABLE 2.5
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

(1) J - Analyte present - Reported value is estimated
NJ - Presumptive evidence for the presence of the material at an estimated value
U - Not detected
UJ - Reported quantitation limit is qualified as estimated

µg/L = microgram per liter

Definitions: N/A = Not Applicable
ND = Not Detected
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
COPC = Chemical of Potential Concern
MCL = Medium Contaminant Level

(2) Maximum concentration used for screening
(3) Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds (Baker, 2013): Upper Limit of Mean (Mean+2 Std Dev)
(4) All non-carcinogenic criteria were divided by 10 to account for potential additive effects of chemicals
USEPA Regional Screening Levels, Tapwater (May 2013)
(5) Rationale Codes
Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)
(6) No detection limits given; analyte detected in every sample.
(18) Value for **technical chlordane** used as a surrogate.
(25) Value for **MCL**
(27) Value for **chromium III** used as a surrogate.

TABLE 2.6
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier) (1)	Maximum Concentration (Qualifier) (1)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (2)	Background Value (3)	Screening Toxicity Value (4)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (5)
Surface Water		**Volatile Organics (µg/L)**													
	75-27-4	Bromodichloromethane	0.34 J	0.34 J	µg/L	59SW01	1/3	0.5U - 0.5U	0.34	ND	1.20E-01	N/A	N/A	YES	ASL
	75-15-0	Carbon Disulfide	0.021 J	0.021 J	µg/L	59SW03	1/3	0.5U - 0.5U	0.021	ND	7.20E+01	N/A	N/A	NO	BSL
	67-66-3	Chloroform	1.2	1.2	µg/L	59SW01	1/3	0.5U - 0.5U	1.2	ND	1.90E-01	N/A	N/A	YES	ASL
	124-48-1	Dibromochloromethane	0.16 J	0.16 J	µg/L	59SW01	1/3	0.5U - 0.5U	0.16	ND	1.50E-01	N/A	N/A	YES	ASL
		LLPAHs (µg/L)													
	206-44-0	Fluoranthene	0.017 J	0.019 J	µg/L	59SW02	2/3	0.2U - 0.2U	0.019	ND	6.30E+01	N/A	N/A	NO	BSL
	129-00-0	Pyrene	0.018 J	0.02 J	µg/L	59SW02	2/3	0.2U - 0.2U	0.02	ND	8.70E+00	N/A	N/A	NO	BSL
		Pesticides (µg/L)													
	72-55-9	4,4'-DDE	0.006 J	0.006 J	µg/L	59SW01	1/3	0.1U - 0.1U	0.006	ND	2.00E-01	N/A	N/A	NO	BSL
	50-29-3	4,4'-DDT	0.0065 J	0.0065 J	µg/L	59SW01	1/3	0.1U - 0.1U	0.0065	ND	2.00E-01	N/A	N/A	NO	BSL
		Dissolved Metals (µg/L)													
	7440-36-0	Antimony	0.23 J	0.23 J	µg/L	59SW02, 59SW03	2/3	2U - 2U	0.23	ND	6.00E-01	N/A	N/A	NO	BSL
	7440-38-2	Arsenic	0.4 J	0.52 J	µg/L	59SW01	3/3	(6)	0.52	ND	4.50E-02	N/A	N/A	YES	ASL
	7440-39-3	Barium	17.7	20.5	µg/L	59SW01	3/3	(6)	20.5	ND	2.90E+02	N/A	N/A	NO	BSL
	7440-47-3	Chromium	0.39 J	0.4 J	µg/L	59SW02	3/3	(6)	0.4	ND	1.60E+03 (27)	N/A	N/A	NO	BSL
	7440-48-4	Cobalt	0.061 J	0.084 J	µg/L	59SW01	3/3	(6)	0.084	ND	4.70E-01	N/A	N/A	NO	BSL
	7440-50-8	Copper	2.9	3.1	µg/L	59SW01	3/3	(6)	3.1	ND	6.20E+01	N/A	N/A	NO	BSL
	7782-49-2	Selenium	0.48 J	0.82 J	µg/L	59SW01	3/3	(6)	0.82	ND	7.80E+00	N/A	N/A	NO	BSL
	7440-62-2	Vanadium	6.1	6.3	µg/L	59SW01	3/3	(6)	6.3	ND	6.30E+00	N/A	N/A	YES	ASL
	7440-66-6	Zinc	2.2 J	5.5 J	µg/L	59SW01	3/3	(6)	5.5	ND	4.70E+02	N/A	N/A	NO	BSL
		Total Metals (µg/L)													
	7440-36-0	Antimony	0.23 J	0.26 J	µg/L	59SW02	2/3	2U - 2U	0.26	2.0	6.00E-01	N/A	N/A	NO	BSL
	7440-38-2	Arsenic	0.42 J	0.49 J	µg/L	59SW01	3/3	(6)	0.49	2.62	4.50E-02	N/A	N/A	YES	ASL
	7440-39-3	Barium	19.4	21.4	µg/L	59SW01	3/3	(6)	21.4	246	2.90E+02	N/A	N/A	NO	BSL
	7440-70-2	Calcium	18,900	18,900	µg/L	59SW01	1/1	(6)	18,900	ND	N/A	N/A	N/A	NO	NUT
	7440-47-3	Chromium	0.68 J	0.76 J	µg/L	59SW02	3/3	(6)	0.76	8.26	1.60E+03 (27)	N/A	N/A	NO	BSL
	7440-48-4	Cobalt	0.32 J	0.34 J	µg/L	59SW02, 59SW03	3/3	(6)	0.34	12.3	4.70E-01	N/A	N/A	NO	BSL
	7440-50-8	Copper	3.8	4	µg/L	59SW02, 59SW03	3/3	(6)	4	37.8	6.20E+01	N/A	N/A	NO	BSL
	7782-49-2	Selenium	0.47 J	0.75 J	µg/L	59SW01	3/3	(6)	0.75	1.10	7.80E+00	N/A	N/A	NO	BSL
	7440-62-2	Vanadium	7	7.6	µg/L	59SW02	3/3	(6)	7.6	36.8	6.30E+00	N/A	N/A	YES	ASL
	7440-66-6	Zinc	7.9 J	7.9 J	µg/L	59SW01	1/1	(6)	7.9	23.3	4.70E+02	N/A	N/A	NO	BSL

(1) J - Analyte present - Reported value is estima
U - Not detected
(2) Maximum concentration used for screening

µg/L = microgram per liter

Definitions: N/A = Not Applicable
ND = Not Detected
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered

(3) Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds (Baker, 2010): Upper Limit of Mean (Mean+2 Std Dev)
(4) All non-carcinogenic criteria were divided by 10 to account for potential additive effects of chemicals
USEPA Regional Screening Levels, Tapwater (May 2013)
(5) Rationale Codes
Selection Reason:
Deletion Reason: Above Screening Levels (ASL)
Essential Nutrient (NUT)
(6) No detection limits given; analyte detected in Below Screening Level (BSL)

(27) Value for **chromium III** used as a surrogate.

TABLE 2.7
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier) (1)	Maximum Concentration (Qualifier) (1)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (2)	Background Value (3)	Screening Toxicity Value (4)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (5)
Sediment		**Volatile Organics (µg/kg)**													
	67-64-1	Acetone	78	150 J	µg/kg	59SD02	2/2	(6)	150	ND	6.10E+06	N/A	N/A	NO	BSL
	75-15-0	Carbon Disulfide	2.3 J	2.3 J	µg/kg	59SD01	1/3	6.7U - 12UJ	2.3	ND	8.20E+04	N/A	N/A	NO	BSL
	000000-01-4	Xylene, m/p-	0.79 J	0.79 J	µg/kg	59SD01	1/3	13U - 24UJ	0.79	ND	6.30E+04 (12)	N/A	N/A	NO	BSL
	1330-20-7	Xylenes, total	0.79 J	0.79 J	µg/kg	59SD01	1/3	6.7U - 12UJ	0.79	ND	6.30E+04	N/A	N/A	NO	BSL
		Semivolatile Organics (µg/kg)													
	117-81-7	Bis(2-ethylhexyl) Phthalate (BEHP	110 J	730	µg/kg	59SD03	3/3	(6)	730	ND	3.50E+04	N/A	N/A	NO	BSL
	85-68-7	Butyl Benzyl Phthalate	63 J	63 J	µg/kg	59SD01	1/3	310U - 360UJ	63	ND	2.60E+05	N/A	N/A	NO	BSL
		LLPAHs (µg/kg)													
	91-57-6	2-Methylnaphthalene	4.4 J	4.4 J	µg/kg	59SD01	1/3	310U - 360UJ	4.4	ND	2.30E+04	N/A	N/A	NO	BSL
	208-96-8	Acenaphthylene	1.6 J	1.6 J	µg/kg	59SD01	1/3	310U - 360UJ	1.6	ND	3.40E+05 (13)	N/A	N/A	NO	BSL
	120-12-7	Anthracene	4.6 J	4.6 J	µg/kg	59SD01	1/3	310U - 360UJ	4.6	ND	1.70E+06	N/A	N/A	NO	BSL
	56-55-3	Benzo(a)anthracene	5 J	5 J	µg/kg	59SD01	1/3	310U - 360UJ	5	ND	1.50E+02	N/A	N/A	NO	BSL
	218-01-9	Chrysene	6.9 J	6.9 J	µg/kg	59SD01	1/3	310U - 360UJ	6.9	ND	1.50E+04	N/A	N/A	NO	BSL
	206-44-0	Fluoranthene	7.2 J	36 J	µg/kg	59SD03	2/3	360UJ - 360UJ	36	ND	2.30E+05	N/A	N/A	NO	BSL
	86-73-7	Fluorene	2.3 J	2.3 J	µg/kg	59SD01	1/3	310U - 360UJ	2.3	ND	2.30E+05	N/A	N/A	NO	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	8.3 J	8.3 J	µg/kg	59SD01	1/3	310U - 360UJ	8.3	ND	1.50E+02	N/A	N/A	NO	BSL
	85-01-8	Phenanthrene	6.3 J	6.3 J	µg/kg	59SD01	1/3	310U - 360UJ	6.3	ND	2.20E+05	N/A	N/A	NO	BSL
	129-00-0	Pyrene	8.8 J	41 J	µg/kg	59SD03	2/3	360UJ - 360UJ	41	ND	1.70E+05	N/A	N/A	NO	BSL
		Pesticides (µg/kg)													
	72-54-8	4,4'-DDD	1.6 J	5.9 J	µg/kg	59SD03	3/3	(6)	5.9	ND	2.00E+03	N/A	N/A	NO	BSL
	72-55-9	4,4'-DDE	32 J	160	µg/kg	59SD03	3/3	(6)	160	ND	1.40E+03	N/A	N/A	NO	BSL
	50-29-3	4,4'-DDT	1.3 J	1.3 J	µg/kg	59SD01	1/3	6U - 7UJ	1.3	ND	1.70E+03	N/A	N/A	NO	BSL
	309-00-2	Aldrin	0.66 J	0.66 J	µg/kg	59SD03	1/3	3.5UJ - 3.6UJ	0.66	ND	2.90E+01	N/A	N/A	NO	BSL
	5103-71-9	Chlordane, alpha-	2.1 NJ	25 NJ	µg/kg	59SD02	2/3	3.1U - 3.1U	25	ND	1.60E+03 (18)	N/A	N/A	NO	BSL
	5103-74-2	Chlordane, gamma-	18 J	31 J	µg/kg	59SD02	2/3	3.1U - 3.1U	31	ND	1.60E+03 (18)	N/A	N/A	NO	BSL
	60-57-1	Dieldrin	0.9 J	0.9 J	µg/kg	59SD01	1/3	6U - 7UJ	0.9	ND	3.00E+01	N/A	N/A	NO	BSL
	7421-93-4	Endrin Aldehyde	0.87 J	1.1 J	µg/kg	59SD01	2/3	6U - 6U	1.1	ND	1.80E+03 (11)	N/A	N/A	NO	BSL
	76-44-8	Heptachlor	1.2 J	1.2 J	µg/kg	59SD02	1/3	3.1U - 3.5UJ	1.2	ND	1.10E+02	N/A	N/A	NO	BSL
		Metals (mg/kg)													
	7440-36-0	Antimony	0.58 J	0.8 J	mg/kg	59SD02	2/3	2.1UJ - 2.1UJ	0.8	9.73	3.10E+00	N/A	N/A	NO	BSL
	7440-38-2	Arsenic	0.65 J	1.5	mg/kg	59SD03	3/3	(6)	1.5	6.38	6.10E-01	N/A	N/A	YES	ASL
	7440-39-3	Barium	81.6 J	164 J	mg/kg	59SD02	3/3	(6)	164	345	1.50E+03	N/A	N/A	NO	BSL
	7440-41-7	Beryllium	0.35 J	0.45 J	mg/kg	59SD02	3/3	(6)	0.45	1.05	1.60E+01	N/A	N/A	NO	BSL
	7440-43-9	Cadmium	0.69 J	0.99 J	mg/kg	59SD03	3/3	(6)	0.99	0.468	7.00E+00	N/A	N/A	NO	BSL
	7440-47-3	Chromium	37.3	42.1 J	mg/kg	59SD02	3/3	(6)	42.1	104	1.20E+04 (27)	N/A	N/A	NO	BSL
	7440-48-4	Cobalt	20.9 J	31.9 J	mg/kg	59SD02	3/3	(6)	31.9	92.6	2.30E+00	N/A	N/A	YES	ASL
	7440-50-8	Copper	36.2 J	187 J	mg/kg	59SD05	13/13	(6)	187	213	3.10E+02	N/A	N/A	NO	BSL
	7439-92-1	Lead	4.92 J	71.2 J	mg/kg	59SD01	11/11	(6)	71.2	41.6	4.00E+02	N/A	N/A	NO	BSL
	7439-97-6	Mercury	0.033 J	0.19	mg/kg	59SD03	3/3	(6)	0.19	0.237	1.00E+00	N/A	N/A	NO	BSL
	7440-02-0	Nickel	18.7 J	28.1	mg/kg	59SD03	3/3	(6)	28.1	31.6	1.50E+02	N/A	N/A	NO	BSL
	7782-49-2	Selenium	0.69 J	1 J	mg/kg	59SD02	3/3	(6)	1	4.71	3.90E+01	N/A	N/A	NO	BSL
	7440-22-4	Silver	0.17 J	0.23 J	mg/kg	59SD02	3/3	(6)	0.23	0.297	3.90E+01	N/A	N/A	NO	BSL
	7440-28-0	Thallium	0.053 J	0.14 J	mg/kg	59SD02	2/3	1UJ - 1UJ	0.14	ND	7.80E-02	N/A	N/A	YES	ASL
	7440-62-2	Vanadium	144 J	232 J	mg/kg	59SD02	3/3	(6)	232	473	3.90E+01	N/A	N/A	YES	ASL
	7440-66-6	Zinc	71.7 J	357 J	mg/kg	59SD05	13/13	(6)	357	177	2.30E+03	N/A	N/A	NO	BSL

TABLE 2.7
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

(1) J - Analyte present - Reported value is estimated
NJ - Presumptive evidence for the presence of the material at an estimated value
U - Not detected
UJ - Reported quantitation limit is qualified as estimated

mg/kg = milligrams per kilogram
µg/kg = microgram per kilogram

Definitions: N/A = Not Applicable
ND = Not Detected
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered

(2) Maximum concentration used for screening
(3) Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds (Baker, 2013): Upper Limit of Mean (Mean+2 Std Dev)
(4) All non-carcinogenic criteria were divided by 10 to account for potential additive effects of chemicals
USEPA Regional Screening Levels, Residential Soil (May 2013)
(5) Rationale Codes
Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)
(6) No detection limits given; analyte detected in every sample.
(7) Value for **chlordane** used as a surrogate.
(8) Value for **pyrene** used as a surrogate.
(9) Value for **chromium VI** used as a surrogate.
(10) Value for **endosulfan** used as a surrogate.
(11) Value for **endrin** used as a surrogate.
(12) Value for **total** used as a surrogate.
(13) Value for **acenaphthene** used as a surrogate.
(27) Value for **chromium III** used as a surrogate.

TABLE 3.1.RME
EXPOSURE POINT CONCENTRATION SUMMARY, COMBINED DATA
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution) (1)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic (2)	Rationale (ProUCL)
Surface Soil									
	Methyl Iodide	µg/kg	2.03	3.69 (NP)	12	0.00369	mg/kg	95% UCL (NP)	95% KM(Percentile Bootstrap) UCL
	Propionitrile (Ethyl Cyanide	µg/kg	11.8	Not Determined	8.1 J	0.00810	mg/kg	Max	Less than 4 detections
	Benzo(a)anthracene	µg/kg	9.55	13.0 (NP)	84 J	0.0130	mg/kg	95% UCL (NP)	95% KM(t) UCL
	Benzo(a)pyrene (BaP)	µg/kg	20.2	41.4 (NP)	390	0.0414	mg/kg	95% UCL (NP)	95% KM(t) UCL
	Benzo(b)fluoranthene	µg/kg	32.2	297 (NP)	750	0.297	mg/kg	95% UCL (NP)	99% KM(Chebyshev) UCL
	Benzo(k)fluoranthene	µg/kg	31.9	290 (NP)	730	0.290	mg/kg	95% UCL (NP)	99% KM(Chebyshev) UCL
	Chrysene	µg/kg	47.9	465 (NP)	1,200	0.465	mg/kg	95% UCL (NP)	99% KM(Chebyshev) UCL
	Dibenz(a,h)anthracene	µg/kg	10.6	Not Determined	92	0.0920	mg/kg	Max	Less than 4 detections
	Indeno(1,2,3-cd)pyrene	µg/kg	15.4	28.8 (NP)	240	0.0288	mg/kg	95% UCL (NP)	95% KM(t) UCL
	Antimony	mg/kg	1.25	1.14 (NP)	8.5 J	1.14	mg/kg	95% UCL (NP)	95% KM(t) UCL
	Arsenic	mg/kg	1.13	1.39 (NP)	5.5	1.39	mg/kg	95% UCL (NP)	95% KM(Percentile Bootstrap) UCL
	Cobalt	mg/kg	21.8	24.3 (N)	45.2	24.3	mg/kg	95% UCL (N)	95% Student's-t UCL
	Lead	mg/kg	83.0	537 (NP)	654 J	537	mg/kg	95% UCL (NP)	99% Chebyshev(Mean,Sd) UCL
	Thallium	mg/kg	0.401	0.0966 (NP)	0.37 J	0.0966	mg/kg	95% UCL (NP)	95% KM(% Bootstrap) UCL
	Vanadium	mg/kg	165	186 (N)	330	186	mg/kg	95% UCL (N)	95% Student's-t UCL

Notes:

UCL = Upper Confidence Level

(1) Distribution and 95% UCL were calculated by ProUCL for data sets with greater than 8 samples and greater than 4 detections.
(N) - Normal distribution and 95% UCL
(NP) - Non-parametric distribution and 95% UCL
(2) Exposure point concentration statistic will be the 95% UCL (as calculated by ProUCL) or the maximum detected.

TABLE 3.2.RME
EXPOSURE POINT CONCENTRATION SUMMARY, 2012 CMS INVESTIGATION DATA
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution) (1)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic (2)	Rationale (ProUCL)
Surface Soil									
	Arsenic	mg/kg	1.09	1.35 (N)	1.8	1.35	mg/kg	95% UCL (N)	95% Student's-t UCL
	Cobalt	mg/kg	20.1	24.8 (N)	36 J	24.8	mg/kg	95% UCL (N)	95% Student's-t UCL
	Vanadium	mg/kg	206	246 (N)	330	246	mg/kg	95% UCL (N)	95% Student's-t UCL

Notes:

UCL = Upper Confidence Level

(1) Distribution and 95% UCL were calculated by ProUCL for data sets with greater than 8 samples and greater than 4 detections.
(N) - Normal distribution and 95% UCL
(2) Exposure point concentration statistic will be the 95% UCL (as calculated by ProUCL) or the maximum detected.

TABLE 3.3.RME
EXPOSURE POINT CONCENTRATION SUMMARY, COMBINE DATA
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Total Soil
Exposure Medium: Total Soil

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution) (1)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic (2)	Rationale (ProUCL)
Total Soil									
	Methyl Iodide	µg/kg	2.38	3.13 (NP)	30 J	0.00313	mg/kg	95% UCL (NP)	95% KM(BCA) UCL
	Propionitrile (Ethyl Cyanide	µg/kg	12.5	Not Determined	8.1 J	0.00810	mg/kg	Max	Less than 4 detections
	Benzo(a)anthracene	µg/kg	6.11	5.63 (NP)	84 J	0.00563	mg/kg	95% UCL (NP)	95% KM(BCA) UCL
	Benzo(a)pyrene (BaP)	µg/kg	9.71	27.7 (NP)	390	0.0277	mg/kg	95% UCL (NP)	95% KM(Chebyshev) UCL
	Benzo(b)fluoranthene	µg/kg	13.8	50.8 (NP)	750	0.0508	mg/kg	95% UCL (NP)	95% KM(Chebyshev) UCL
	Benzo(k)fluoranthene	µg/kg	13.7	66.4 (NP)	730	0.0664	mg/kg	95% UCL (NP)	97.5% KM(Chebyshev) UCL
	Chrysene	µg/kg	19.4	79.7 (NP)	1,200	0.0797	mg/kg	95% UCL (NP)	95% KM(Chebyshev) UCL
	Dibenz(a,h)anthracene	µg/kg	6.86	Not Determined	92	0.0920	mg/kg	Max	Less than 4 detections
	Indeno(1,2,3-cd)pyrene	µg/kg	8.16	25.0 (NP)	240	0.0250	mg/kg	95% UCL (NP)	97.5% KM(Chebyshev) UCL
	Antimony	mg/kg	1.62	0.730 (NP)	8.5 J	0.730	mg/kg	95% UCL (NP)	95% KM(BCA) UCL
	Arsenic	mg/kg	1.11	1.01 (NP)	5.5	1.01	mg/kg	95% UCL (NP)	95% KM(t) UCL
	Cobalt	mg/kg	23.6	29.8 (NP)	83.9 J	29.8	mg/kg	95% UCL (NP)	95% Chebyshev(Mean, Sd) UCL
	Lead	mg/kg	29.8	92.1 (NP)	654 J	92.1	mg/kg	95% UCL (NP)	95% KM(Chebyshev) UCL
	Thallium	mg/kg	0.665	0.133 (NP)	0.53 J	0.133	mg/kg	95% UCL (NP)	95% KM(BCA) UCL
	Vanadium	mg/kg	162	177 (G)	407	177	mg/kg	95% UCL (G)	95% Approximate Gamma UCL

Notes:

UCL = Upper Confidence Level

(1) Distribution and 95% UCL were calculated by ProUCL for data sets with greater than 8 samples and greater than 4 detections.
(NP) - Non-parametric distribution and 95% UCL
(G) - Gamma distribution and 95% UCL
(2) Exposure point concentration statistic will be the 95% UCL (as calculated by ProUCL) or the maximum detected.

TABLE 3.4.RME
EXPOSURE POINT CONCENTRATION SUMMARY, 2012 CMS INVESTIGATION DATA
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Total Soil
Exposure Medium: Total Soil

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution) (1)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic (2)	Rationale (ProUCL)
Total Soil									
	Arsenic	mg/kg	1.03	1.16 (N)	1.8	1.16	mg/kg	95% UCL (N)	95% Student's-t UCL
	Cobalt	mg/kg	17.1	20.0 (N)	36 J	20.0	mg/kg	95% UCL (N)	95% Student's-t UCL
	Vanadium	mg/kg	215	245 (N)	400	245	mg/kg	95% UCL (N)	95% Student's-t UCL

Notes:

UCL = Upper Confidence Level

(1) Distribution and 95% UCL were calculated by ProUCL for data sets with greater than 8 samples and greater than 4 detections.
(N) - Normal distribution and 95% UCL
(2) Exposure point concentration statistic will be the 95% UCL (as calculated by ProUCL) or the maximum detected.

TABLE 3.5.RME
EXPOSURE POINT CONCENTRATION SUMMARY, COMBINED DATA
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Soil
Exposure Medium: Soil

Exposure Point Soil	Chemical of Potential Concern	Exposure Point Concentration			
		Value	Units	Statistic (2)	Rationale (ProUCL)
SS	Methyl Iodide	0.00369	mg/kg	95% UCL (NP)	95% KM(Percentile Bootstrap) UCL
SS	Propionitrile (Ethyl Cyanide	0.00810	mg/kg	Max	Less than 4 detections
SS	Benzo(a)anthracene	0.0130	mg/kg	95% UCL (NP)	95% KM(t) UCL
SS	Benzo(a)pyrene (BaP)	0.0414	mg/kg	95% UCL (NP)	95% KM(t) UCL
SS	Benzo(b)fluoranthene	0.297	mg/kg	95% UCL (NP)	99% KM(Chebyshev) UCL
SS	Benzo(k)fluoranthene	0.290	mg/kg	95% UCL (NP)	99% KM(Chebyshev) UCL
SS	Chrysene	0.465	mg/kg	95% UCL (NP)	99% KM(Chebyshev) UCL
SS	Dibenz(a,h)anthracene	0.0920	mg/kg	Max	Less than 4 detections
SS	Indeno(1,2,3-cd)pyrene	0.0288	mg/kg	95% UCL (NP)	95% KM(t) UCL
SS	Antimony	1.14	mg/kg	95% UCL (NP)	95% KM(t) UCL
SS	Arsenic	1.39	mg/kg	95% UCL (NP)	95% KM(Percentile Bootstrap) UCL
TS	Cobalt	29.8	mg/kg	95% UCL (NP)	95% Chebyshev(Mean, Sd) UCL
SS	Lead	537	mg/kg	95% UCL (NP)	99% Chebyshev(Mean,Sd) UCL
TS	Thallium	0.133	mg/kg	95% UCL (NP)	95% KM(BCA) UCL
SS	Vanadium	186	mg/kg	95% UCL (N)	95% Student's-t UCL

Notes:

UCL = Upper Confidence Level

(1) Distribution and 95% UCL were calculated by ProUCL for data sets with greater than 8 samples and greater than 4 detections.
(2) Exposure point concentration statistic will be the 95% UCL (as calculated by ProUCL) or the maximum detected.

TABLE 3.6.RME
EXPOSURE POINT CONCENTRATION SUMMARY, 2012 CMS INVESTIGATION DATA
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Soil
Exposure Medium: Soil

Exposure Point Soil	Chemical of Potential Concern	Exposure Point Concentration			
		Value	Units	Statistic (2)	Rationale (ProUCL)
SS	Arsenic	1.35	mg/kg	95% UCL (N)	95% Student's-t UCL
SS	Cobalt	24.8	mg/kg	95% UCL (N)	95% Student's-t UCL
SS	Vanadium	246	mg/kg	95% UCL (N)	95% Student's-t UCL

Notes:

UCL = Upper Confidence Level

(1) Distribution and 95% UCL were calculated by ProUCL for data sets with greater than 8 samples and greater than 4 de
(2) Exposure point concentration statistic will be the 95% UCL (as calculated by ProUCL) or the maximum detected.

TABLE 3.7.RME
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution) (1)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic (2)	Rationale
Groundwater									
	Naphthalene	µg/L	0.221	Not Determined	1.3 J	0.00130	mg/L	Max	Conservative Estimate
	Arsenic	µg/L	3.21	Not Determined	6.2	0.00620	mg/L	Max	Conservative Estimate
	Cadmium	µg/L	0.360	Not Determined	0.71 J	0.00071	mg/L	Max	Conservative Estimate
	Cobalt	µg/L	2.31	Not Determined	5.8	0.00580	mg/L	Max	Conservative Estimate
	Selenium	µg/L	10.2	Not Determined	24.2	0.0242	mg/L	Max	Conservative Estimate
	Vanadium	µg/L	63.3	Not Determined	171	0.171	mg/L	Max	Conservative Estimate

Notes:

UCL = Upper Confidence Level

(1) Distribution and 95% UCL were not calculated because we are using the maximum as a conservative estimate
(2) Exposure point concentration statistic will be the 95% UCL (as calculated by ProUCL) or the maximum detected.

TABLE 3.8.RME
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution) (1)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic (2)	Rationale (ProUCL)
Surface Water									
	Bromodichloromethane	µg/L	0.280	Not Determined	0.34 J	0.00034	mg/kg	Max	Less than 8 samples
	Chloroform	µg/L	0.567	Not Determined	1.2	0.00120	mg/kg	Max	Less than 8 samples
	Dibromochloromethane	µg/L	0.220	Not Determined	0.16 J	0.00016	mg/kg	Max	Less than 8 samples
	Arsenic	µg/L	0.450	Not Determined	0.49 J	0.00049	mg/kg	Max	Less than 8 samples
	Vanadium	µg/L	7.30	Not Determined	7.6	0.00760	mg/kg	Max	Less than 8 samples

Notes:

UCL = Upper Confidence Level

(1) Distribution and 95% UCL were not determined because data sets contained less than 8 samples or less than 4 detections.
(2) Exposure point concentration statistic will be the 95% UCL (as calculated by ProUCL) or the maximum detected.

TABLE 3.9.RME
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution) (1)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic (2)	Rationale (ProUCL)
Sediment									
	Arsenic	mg/kg	1.04	Not Determined	1.5	1.50	mg/kg	Max	Less than 8 samples
	Cobalt	mg/kg	25.1	Not Determined	31.9 J	31.9	mg/kg	Max	Less than 8 samples
	Thallium	mg/kg	0.231	Not Determined	0.14 J	0.140	mg/kg	Max	Less than 8 samples
	Vanadium	mg/kg	177	Not Determined	232 J	232	mg/kg	Max	Less than 8 samples

Notes:

UCL = Upper Confidence Level

(1) Distribution and 95% UCL were not determined because data sets contained less than 8 samples or less than 4 detections.
(2) Exposure point concentration statistic will be the 95% UCL (as calculated by ProUCL) or the maximum detected.

TABLE 4.1.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion									Chronic Daily Intake (CDI) Equations
	Current and Future Trespassers	Adult	Soil	C	Contaminant Concentration in Soil	Chemical Specific	mg/kg	Chemical Specific	
				IR-S	Ingestion Rate of Soil	100	mg/day	USEPA, 1991	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				FI	Fraction Ingested from Source	1	NA	Prof Judge (2)	CDI (mg/kg-day) =
				EF	Exposure Frequency	52	days/year	Prof Judge (3)	C x IR x CF x Fi x EF x ED x 1/BW x 1/AT
				ED	Exposure Duration	24	years	USEPA, 1991	
				BW	Body Weight	70	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
		Youth	Soil	C	Contaminant Concentration in Soil	Chemical Specific	mg/kg	Chemical Specific	
				IR-S	Ingestion Rate of Soil	100	mg/day	USEPA, 1991	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				FI	Fraction Ingested from Source	1	NA	Prof Judge (2)	CDI (mg/kg-day) =
				EF	Exposure Frequency	52	days/year	Prof Judge (3)	C x IR x CF x Fi x EF x ED x 1/BW x 1/AT
				ED	Exposure Duration	11	years	USEPA, 1991	
				BW	Body Weight	45	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	4,015	days	USEPA, 1989	
	Current and Future On-Site Workers	Adult	Soil	C	Contaminant Concentration in Soil	Chemical Specific	mg/kg	Chemical Specific	
				IR-S	Ingestion Rate of Soil	100	mg/day	USEPA, 2002	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				FI	Fraction Ingested from Source	1	NA	Prof Judge (2)	CDI (mg/kg-day) =
				EF	Exposure Frequency	250	days/year	USEPA, 2004	C x IR x CF x Fi x EF x ED x 1/BW x 1/AT
				ED	Exposure Duration	25	years	USEPA, 2004	
				BW	Body Weight	70	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	USEPA, 1989	
	Future Residents	Adult	Soil	C	Contaminant Concentration in Soil	Chemical Specific	mg/kg	Chemical Specific	
				IR-S	Ingestion Rate of Soil	100	mg/day	USEPA, 1991	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				FI	Fraction Ingested from Source	1	NA	Prof Judge (2)	CDI (mg/kg-day) =
				EF	Exposure Frequency	350	days/year	USEPA, 2004	C x IR x CF x Fi x EF x ED x 1/BW x 1/AT
				ED	Exposure Duration	24	years	USEPA, 1991	(17)
				BW	Body Weight	70	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	

TABLE 4.1.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
		Young Child	Soil	C	Contaminant Concentration in Soil	Chemical Specific	mg/kg	Chemical Specific	
				IR-S	Ingestion Rate of Soil	200	mg/day	USEPA, 1991	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				FI	Fraction Ingested from Source	1	NA	Prof Judge (2)	CDI (mg/kg-day) =
				EF	Exposure Frequency	350	days/year	USEPA, 2004	C x IR x CF x Fi x EF x ED x 1/BW x 1/AT
				ED	Exposure Duration	6	years	USEPA, 1991	(17)
				BW	Body Weight	15	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	
	Future Industrial / Commercial Workers	Adult	Soil	C	Contaminant Concentration in Soil	Chemical Specific	mg/kg	Chemical Specific	
				IR-S	Ingestion Rate of Soil	100	mg/day	USEPA, 2002	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				FI	Fraction Ingested from Source	1	NA	Prof Judge (2)	CDI (mg/kg-day) =
				EF	Exposure Frequency	250	days/year	USEPA, 2004	C x IR x CF x Fi x EF x ED x 1/BW x 1/AT
				ED	Exposure Duration	25	years	USEPA, 2004	
				BW	Body Weight	70	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	USEPA, 1989	
	Future Construction Workers	Adult	Soil	C	Contaminant Concentration in Soil	Chemical Specific	mg/kg	Chemical Specific	
				IR-S	Ingestion Rate of Soil	330	mg/day	USEPA, 2002	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				FI	Fraction Ingested from Source	1	NA	Prof Judge (2)	CDI (mg/kg-day) =
				EF	Exposure Frequency	250	days/year	USEPA, 2004	C x IR x CF x Fi x EF x ED x 1/BW x 1/AT
				ED	Exposure Duration	1	years	Prof Judge (5)	
				BW	Body Weight	70	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	
Dermal									Dermally Adjusted Dose (DAD) Equations
	Current and Future On-Site Workers	Adult	Soil	C	Contaminant Concentration in Soil	Chemical Specific	mg/kg	Chemical Specific	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				SA	Surface Area Available for Contact	3,300	cm2/day	USEPA, 2004	
				AF	Soil to Skin Adherence Factor	0.2	mg/cm2	USEPA, 2004	DAD (mg/kg-day) =
				ABS	Absorption Factor	CS	NA	USEPA, 2004	C x CF x SA x AF x ABS x EF x ED x
				EF	Exposure Frequency	250	days/year	USEPA, 2004	1/BW x1/AT
				ED	Exposure Duration	25	years	USEPA, 2004	
				BW	Body Weight	70	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	USEPA, 1989	

TABLE 4.1.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
	Future Industrial / Commercial Workers	Adult	Soil	C	Contaminant Concentration in Soil	Chemical Specific	mg/kg	Chemical Specific	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				SA	Surface Area Available for Contact	3,300	cm2/day	USEPA, 2004	
				AF	Soil to Skin Adherence Factor	0.2	mg/cm2	USEPA, 2004	DAD (mg/kg-day) =
				ABS	Absorption Factor	CS	NA	USEPA, 2004	C x CF x SA x AF x ABS x EF x ED x
				EF	Exposure Frequency	250	days/year	USEPA, 2004	1/BW x1/AT
				ED	Exposure Duration	25	years	USEPA, 2004	
				BW	Body Weight	70	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	USEPA, 1989	
	Future Construction Workers	Adult	Soil	C	Contaminant Concentration in Soil	Chemical Specific	mg/kg	Chemical Specific	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				SA	Surface Area Available for Contact	3,300	cm2/day	USEPA, 2004	
				AF	Soil to Skin Adherence Factor	0.3	mg/cm2	USEPA, 2002	DAD (mg/kg-day) =
				ABS	Absorption Factor	CS	NA	USEPA, 2004	C x CF x SA x AF x ABS x EF x ED x
				EF	Exposure Frequency	250	days/year	USEPA, 2004	1/BW x1/AT
				ED	Exposure Duration	1	years	Prof Judge (5)	
				BW	Body Weight	70	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	
	Current and Future Trespassers	Adult	Soil	C	Contaminant Concentration in Soil	Chemical Specific	mg/kg	Chemical Specific	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				SA	Surface Area Available for Contact	5,700	cm2/day	USEPA, 2004	
				AF	Soil to Skin Adherence Factor	0.07	mg/cm2	USEPA, 2004	DAD (mg/kg-day) =
				ABS	Absorption Factor	CS	NA	USEPA, 2004	C x CF x SA x AF x ABS x EF x ED x
				EF	Exposure Frequency	52	days/year	Prof Judge (3)	1/BW x1/AT
				ED	Exposure Duration	24	years	USEPA, 1991	
				BW	Body Weight	70	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
		Youth	Soil	C	Contaminant Concentration in Soil	Chemical Specific	mg/kg	Chemical Specific	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				SA	Surface Area Available for Contact	3,200	cm2/day	USEPA, 1997	
				AF	Soil to Skin Adherence Factor	0.2	mg/cm2	USEPA, 2004	DAD (mg/kg-day) =
				ABS	Absorption Factor	CS	NA	USEPA, 2004	C x CF x SA x AF x ABS x EF x ED x
				EF	Exposure Frequency	52	days/year	Prof Judge (3)	1/BW x1/AT
				ED	Exposure Duration	11	years	USEPA, 1991	
				BW	Body Weight	45	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	4,015	days	USEPA, 1989	

TABLE 4.1.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
	Future Residents	Adult	Soil	C	Contaminant Concentration in Soil	Chemical Specific	mg/kg	Chemical Specific	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				SA	Surface Area Available for Contact	5,700	cm2/day	USEPA, 2004	
				AF	Soil to Skin Adherence Factor	0.07	mg/cm2	USEPA, 2004	DAD (mg/kg-day) =
				ABS	Absorption Factor	CS	NA	USEPA, 2004	C x CF x SA x AF x ABS x EF x ED x
				EF	Exposure Frequency	350	days/year	USEPA, 2004	1/BW x1/AT
				ED	Exposure Duration	24	years	USEPA, 1991	(17)
				BW	Body Weight	70	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
		Young Child	Soil	C	Contaminant Concentration in Soil	Chemical Specific	mg/kg	Chemical Specific	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				SA	Surface Area Available for Contact	2,800	cm2/day	USEPA, 2004	
				AF	Soil to Skin Adherence Factor	0.2	mg/cm2	USEPA, 2004	DAD (mg/kg-day) =
				ABS	Absorption Factor	CS	NA	USEPA, 2004	C x CF x SA x AF x ABS x EF x ED x
				EF	Exposure Frequency	350	days/year	USEPA, 2004	1/BW x1/AT
				ED	Exposure Duration	6	years	USEPA, 1991	(17)
				BW	Body Weight	15	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	

Notes

ADAFs - Age-Dependent Adjustment Factors
Chemical Specific - See Table 3.1
MMOA - Mutagenic Mode of Action
NA - Not Applicable
Prof Judge - Professional Judgment

(2) Conservative assumption of 100% ingested from source
(3) Assumes individuals trespass on site 1 day/week. This value represents the default value for NAPR but may be revised based on site-specific factors such as accessibility and attractiveness to trespassers
(5) Assumes a construction period of 1 year.
(17) ADAFs are incorporated into the equation to adjust cancer risk for receptors whose exposure includes early life for chemicals that have been determined to be carcinogenic via MMOA. The following ADAFs are used: 10 for age 0 to 2 years 3 for age 2 to 16 years, and no adjustment for ages 16 and up (USEPA, 2005).

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USEPA, 2004: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005
USEPA, 2005. Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. EPA/630/R-03/003F. March 2005

TABLE 4.1a.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Surface Soil
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation									Exposure Concentration (EC) Equations
	Current and Future Trespassers	Adult	Fugitive dust	Ca	Contaminant Concentration in Air	Chemical Specific	mg/m3	Chemical Specific	
				ET	Exposure Time	2	hours/day	USEPA, 1997 (6)	
				EF	Exposure Frequency	52	days/year	Prof Judge (3)	
				ED	Exposure Duration	24	years	USEPA, 1991	EC (mg/m3) =
				PEF	Particulate Emission Factor	1.36E+09	m3/kg	USEPA, 2002	(Ca*ET*EF*ED)/AT
				AT-C	Averaging Time (Cancer)	613,200	hours	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	210,240	hours	USEPA, 1989	
		Youth	Fugitive dust	Ca	Contaminant Concentration in Air	Chemical Specific	mg/m3	Chemical Specific	
				ET	Exposure Time	2	hours/day	USEPA, 1997 (6)	
				EF	Exposure Frequency	52	days/year	Prof Judge (3)	
				ED	Exposure Duration	11	years	USEPA, 1991	EC (mg/m3) =
				PEF	Particulate Emission Factor	1.36E+09	m3/kg	USEPA, 2002	(Ca*ET*EF*ED)/AT
				AT-C	Averaging Time (Cancer)	613,200	hours	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	96,360	hours	USEPA, 1989	
	Current and Future On-Site Workers	Adult	Fugitive dust	Ca	Contaminant Concentration in Air	Chemical Specific	mg/m3	Chemical Specific	
				ET	Exposure Time	8	hours/day	Prof Judge (7)	
				EF	Exposure Frequency	250	days/year	USEPA, 2004	
				ED	Exposure Duration	25	years	USEPA, 2004	EC (mg/m3) =
				PEF	Particulate Emission Factor	1.36E+09	m3/kg	USEPA, 2002	(Ca*ET*EF*ED)/AT
				AT-C	Averaging Time (Cancer)	613,200	hours	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	219,000	hours	USEPA, 1989	
	Future Residents	Adult	Fugitive dust	Ca	Contaminant Concentration in Air	Chemical Specific	mg/m3	Chemical Specific	
				ET	Exposure Time	24	hours/day	Prof Judge (8)	
				EF	Exposure Frequency	350	days/year	USEPA, 2004	
				ED	Exposure Duration	24	years	USEPA, 1991	EC (mg/m3) =
				PEF	Particulate Emission Factor	1.36E+09	m3/kg	USEPA, 2002	(Ca*ET*EF*ED)/AT
				AT-C	Averaging Time (Cancer)	613,200	hours	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	210,240	hours	USEPA, 1989	
		Young Child	Fugitive dust	Ca	Contaminant Concentration in Air	Chemical Specific	mg/m3	Chemical Specific	
				ET	Exposure Time	24	hours/day	Prof Judge (8)	
				EF	Exposure Frequency	350	days/year	USEPA, 2004	
				ED	Exposure Duration	6	years	USEPA, 1991	EC (mg/m3) =
				PEF	Particulate Emission Factor	1.36E+09	m3/kg	USEPA, 2002	(Ca*ET*EF*ED)/AT
				AT-C	Averaging Time (Cancer)	613,200	hours	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	52,560	hours	USEPA, 1989	

TABLE 4.1a.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Surface Soil
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
	Future Industrial / Commercial Workers	Adult	Fugitive dust	Ca	Contaminant Concentration in Air	Chemical Specific	mg/m3	Chemical Specific	
				ET	Exposure Time	8	hours/day	Prof Judge (7)	
				EF	Exposure Frequency	250	days/year	USEPA, 2004	
				ED	Exposure Duration	25	years	USEPA, 2004	EC (mg/m3) =
				PEF	Particulate Emission Factor	1.36E+09	m3/kg	USEPA, 2002	(Ca*ET*EF*ED)/AT
				AT-C	Averaging Time (Cancer)	613,200	hours	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	219,000	hours	USEPA, 1989	
	Future Construction Workers	Adult	Fugitive dust	Ca	Contaminant Concentration in Air	Chemical Specific	mg/m3	Chemical Specific	
				ET	Exposure Time	8	hours/day	Prof Judge (7)	
				EF	Exposure Frequency	250	days/year	USEPA, 2004	
				ED	Exposure Duration	1	years	Prof Judge (5)	EC (mg/m3) =
				PEF	Particulate Emission Factor	2.89E+06	m3/kg	USEPA, 2002	(Ca*ET*EF*ED)/AT
				AT-C	Averaging Time (Cancer)	613,200	hours	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	hours	USEPA, 1989	

Notes

Chemical Specific - See Table 3.1

Prof Judge - Professional Judgment

(5) Assumes a construction period of 1 year.
(6) Recommended outdoor activity factor for adults.
(7) Assumes an 8 hour work day.
(8) Conservatively assumes receptor remains at residence 24 hours/day.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002
USEPA, 1991: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual Supplemental Guidance: Standard Default Exposure Factors
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2002. Draft Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24
USEPA, 2004: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005

TABLE 4.2.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Total Soil
Exposure Medium: Total Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion									Chronic Daily Intake (CDI) Equations
	Current and Future Trespassers	Adult	Total Soil	C	Contaminant Concentration in Soil	Chemical Specific	mg/kg	Chemical Specific	
				IR-S	Ingestion Rate of Soil	100	mg/day	USEPA, 1991	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				FI	Fraction Ingested from Source	1	NA	Prof Judge (2)	CDI (mg/kg-day) =
				EF	Exposure Frequency	52	days/year	Prof Judge (3)	C x IR x CF x Fi x EF x ED x 1/BW x 1/AT
				ED	Exposure Duration	24	years	USEPA, 1991	
				BW	Body Weight	70	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
		Youth	Total Soil	C	Contaminant Concentration in Soil	Chemical Specific	mg/kg	Chemical Specific	
				IR-S	Ingestion Rate of Soil	100	mg/day	USEPA, 1991	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				FI	Fraction Ingested from Source	1	NA	Prof Judge (2)	CDI (mg/kg-day) =
				EF	Exposure Frequency	52	days/year	Prof Judge (3)	C x IR x CF x Fi x EF x ED x 1/BW x 1/AT
				ED	Exposure Duration	11	years	USEPA, 1991	
				BW	Body Weight	45	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	4,015	days	USEPA, 1989	
	Current and Future On-Site Workers	Adult	Total Soil	C	Contaminant Concentration in Soil	Chemical Specific	mg/kg	Chemical Specific	
				IR-S	Ingestion Rate of Soil	100	mg/day	USEPA, 2002	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				FI	Fraction Ingested from Source	1	NA	Prof Judge (2)	CDI (mg/kg-day) =
				EF	Exposure Frequency	250	days/year	USEPA, 2004	C x IR x CF x Fi x EF x ED x 1/BW x 1/AT
				ED	Exposure Duration	25	years	USEPA, 2004	
				BW	Body Weight	70	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	USEPA, 1989	
	Future Residents	Adult	Total Soil	C	Contaminant Concentration in Soil	Chemical Specific	mg/kg	Chemical Specific	
				IR-S	Ingestion Rate of Soil	100	mg/day	USEPA, 1991	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				FI	Fraction Ingested from Source	1	NA	Prof Judge (2)	CDI (mg/kg-day) =
				EF	Exposure Frequency	350	days/year	USEPA, 2004	C x IR x CF x Fi x EF x ED x 1/BW x 1/AT
				ED	Exposure Duration	24	years	USEPA, 1991	(17)
				BW	Body Weight	70	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	

TABLE 4.2.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Total Soil
Exposure Medium: Total Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
		Young Child	Total Soil	C	Contaminant Concentration in Soil	Chemical Specific	mg/kg	Chemical Specific	
				IR-S	Ingestion Rate of Soil	200	mg/day	USEPA, 1991	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				FI	Fraction Ingested from Source	1	NA	Prof Judge (2)	CDI (mg/kg-day) =
				EF	Exposure Frequency	350	days/year	USEPA, 2004	C x IR x CF x Fi x EF x ED x 1/BW x 1/AT
				ED	Exposure Duration	6	years	USEPA, 1991	(17)
				BW	Body Weight	15	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	
	Future Industrial / Commercial Workers	Adult	Total Soil	C	Contaminant Concentration in Soil	Chemical Specific	mg/kg	Chemical Specific	
				IR-S	Ingestion Rate of Soil	100	mg/day	USEPA, 2002	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				FI	Fraction Ingested from Source	1	NA	Prof Judge (2)	CDI (mg/kg-day) =
				EF	Exposure Frequency	250	days/year	USEPA, 2004	C x IR x CF x Fi x EF x ED x 1/BW x 1/AT
				ED	Exposure Duration	25	years	USEPA, 2004	
				BW	Body Weight	70	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	USEPA, 1989	
	Future Construction Workers	Adult	Total Soil	C	Contaminant Concentration in Soil	Chemical Specific	mg/kg	Chemical Specific	
				IR-S	Ingestion Rate of Soil	330	mg/day	USEPA, 2002	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				FI	Fraction Ingested from Source	1	NA	Prof Judge (2)	CDI (mg/kg-day) =
				EF	Exposure Frequency	250	days/year	USEPA, 2004	C x IR x CF x Fi x EF x ED x 1/BW x 1/AT
				ED	Exposure Duration	1	years	Prof Judge (5)	
				BW	Body Weight	70	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	
Dermal									Dermally Adjusted Dose (DAD) Equations
	Current and Future Trespassers	Adult	Total Soil	C	Contaminant Concentration in Soil	Chemical Specific	mg/kg	Chemical Specific	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				SA	Surface Area Available for Contact	5,700	cm2/day	USEPA, 2004	
				AF	Soil to Skin Adherence Factor	0.07	mg/cm2	USEPA, 2004	DAD (mg/kg-day) =
				ABS	Absorption Factor	CS	NA	USEPA, 2004	C x CF x SA x AF x ABS x EF x ED x
				EF	Exposure Frequency	52	days/year	Prof Judge (3)	1/BW x1/AT
				ED	Exposure Duration	24	years	USEPA, 1991	
				BW	Body Weight	70	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	

TABLE 4.2.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Total Soil
Exposure Medium: Total Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
		Youth	Total Soil	C	Contaminant Concentration in Soil	Chemical Specific	mg/kg	Chemical Specific	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				SA	Surface Area Available for Contact	3,200	cm2/day	USEPA, 1997	
				AF	Soil to Skin Adherence Factor	0.2	mg/cm2	USEPA, 2004	DAD (mg/kg-day) =
				ABS	Absorption Factor	CS	NA	USEPA, 2004	C x CF x SA x AF x ABS x EF x ED x
				EF	Exposure Frequency	52	days/year	Prof Judge (3)	1/BW x1/AT
				ED	Exposure Duration	11	years	USEPA, 1991	
				BW	Body Weight	45	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	4,015	days	USEPA, 1989	
	Current and Future On-Site Workers	Adult	Total Soil	C	Contaminant Concentration in Soil	Chemical Specific	mg/kg	Chemical Specific	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				SA	Surface Area Available for Contact	3,300	cm2/day	USEPA, 2004	
				AF	Soil to Skin Adherence Factor	0.2	mg/cm2	USEPA, 2004	DAD (mg/kg-day) =
				ABS	Absorption Factor	CS	NA	USEPA, 2004	C x CF x SA x AF x ABS x EF x ED x
				EF	Exposure Frequency	250	days/year	USEPA, 2004	1/BW x1/AT
				ED	Exposure Duration	25	years	USEPA, 2004	
				BW	Body Weight	70	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	USEPA, 1989	
	Future Residents	Adult	Total Soil	C	Contaminant Concentration in Soil	Chemical Specific	mg/kg	Chemical Specific	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				SA	Surface Area Available for Contact	5,700	cm2/day	USEPA, 2004	
				AF	Soil to Skin Adherence Factor	0.07	mg/cm2	USEPA, 2004	DAD (mg/kg-day) =
				ABS	Absorption Factor	CS	NA	USEPA, 2004	C x CF x SA x AF x ABS x EF x ED x
				EF	Exposure Frequency	350	days/year	USEPA, 2004	1/BW x1/AT
				ED	Exposure Duration	24	years	USEPA, 1991	(17)
				BW	Body Weight	70	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
		Young Child	Total Soil	C	Contaminant Concentration in Soil	Chemical Specific	mg/kg	Chemical Specific	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				SA	Surface Area Available for Contact	2,800	cm2/day	USEPA, 2004	
				AF	Soil to Skin Adherence Factor	0.2	mg/cm2	USEPA, 2004	DAD (mg/kg-day) =
				ABS	Absorption Factor	CS	NA	USEPA, 2004	C x CF x SA x AF x ABS x EF x ED x
				EF	Exposure Frequency	350	days/year	USEPA, 2004	1/BW x1/AT
				ED	Exposure Duration	6	years	USEPA, 1991	(17)
				BW	Body Weight	15	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	

TABLE 4.2.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Total Soil
Exposure Medium: Total Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
	Future Industrial / Commercial Workers	Adult	Total Soil	C	Contaminant Concentration in Soil	Chemical Specific	mg/kg	Chemical Specific	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				SA	Surface Area Available for Contact	3,300	cm2/day	USEPA, 2004	
				AF	Soil to Skin Adherence Factor	0.2	mg/cm2	USEPA, 2004	DAD (mg/kg-day) =
				ABS	Absorption Factor	CS	NA	USEPA, 2004	C x CF x SA x AF x ABS x EF x ED x
				EF	Exposure Frequency	250	days/year	USEPA, 2004	1/BW x1/AT
				ED	Exposure Duration	25	years	USEPA, 2004	
				BW	Body Weight	70	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	USEPA, 1989	
	Future Construction Workers	Adult	Total Soil	C	Contaminant Concentration in Soil	Chemical Specific	mg/kg	Chemical Specific	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				SA	Surface Area Available for Contact	3,300	cm2/day	USEPA, 2004	
				AF	Soil to Skin Adherence Factor	0.3	mg/cm2	USEPA, 2002	DAD (mg/kg-day) =
				ABS	Absorption Factor	CS	NA	USEPA, 2004	C x CF x SA x AF x ABS x EF x ED x
				EF	Exposure Frequency	250	days/year	USEPA, 2004	1/BW x1/AT
				ED	Exposure Duration	1	years	Prof Judge (5)	
				BW	Body Weight	70	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	

Notes

ADAFs - Age-Dependent Adjustment Factors
Chemical Specific - See Table 3.2
MMOA - Mutagenic Mode of Action
NA - Not Applicable
Prof Judge - Professional Judgment

(2) Conservative assumption of 100% ingested from source
(3) Assumes individuals trespass on site 1 day/week. This value represents the default value for NAPR but may be revised based on site-specific factors such as accessibility and attractiveness to trespassers
(5) Assumes a construction period of 1 year.
(17) ADAFs are incorporated into the equation to adjust cancer risk for receptors whose exposure includes early life for chemicals that have been determined to be carcinogenic via MMOA. The following ADAFs are used: 10 for age 0 to 2 years
3 for age 2 to 16 years, and no adjustment for ages 16 and up (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002
USEPA, 1991: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual Supplemental Guidance: Standard Default Exposure Factors
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2002. Draft Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24
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TABLE 4.2a.RME
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NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Total Soil
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation									Exposure Concentration (EC) Equations
	Current and Future Trespassers	Adult	Fugitive dust	Ca	Contaminant Concentration in Air	Chemical Specific	mg/m3	Chemical Specific	
				ET	Exposure Time	2	hours/day	USEPA, 1997 (6)	
				EF	Exposure Frequency	52	days/year	Prof Judge (3)	
				ED	Exposure Duration	24	years	USEPA, 1991	EC (mg/m3) =
				PEF	Particulate Emission Factor	1.36E+09	m3/kg	USEPA, 2002	(Ca*ET*EF*ED)/AT
				AT-C	Averaging Time (Cancer)	613,200	hours	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	210,240	hours	USEPA, 1989	
		Youth	Fugitive dust	Ca	Contaminant Concentration in Air	Chemical Specific	mg/m3	Chemical Specific	
				ET	Exposure Time	2	hours/day	USEPA, 1997 (6)	
				EF	Exposure Frequency	52	days/year	Prof Judge (3)	
				ED	Exposure Duration	11	years	USEPA, 1991	EC (mg/m3) =
				PEF	Particulate Emission Factor	1.36E+09	m3/kg	USEPA, 2002	(Ca*ET*EF*ED)/AT
				AT-C	Averaging Time (Cancer)	613,200	hours	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	96,360	hours	USEPA, 1989	
	Current and Future On-Site Workers	Adult	Fugitive dust	Ca	Contaminant Concentration in Air	Chemical Specific	mg/m3	Chemical Specific	
				ET	Exposure Time	8	hours/day	Prof Judge (7)	
				EF	Exposure Frequency	250	days/year	USEPA, 2004	
				ED	Exposure Duration	25	years	USEPA, 2004	EC (mg/m3) =
				PEF	Particulate Emission Factor	1.36E+09	m3/kg	USEPA, 2002	(Ca*ET*EF*ED)/AT
				AT-C	Averaging Time (Cancer)	613,200	hours	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	219,000	hours	USEPA, 1989	
	Future Residents	Adult	Fugitive dust	Ca	Contaminant Concentration in Air	Chemical Specific	mg/m3	Chemical Specific	
				ET	Exposure Time	24	hours/day	Prof Judge (8)	
				EF	Exposure Frequency	350	days/year	USEPA, 2004	
				ED	Exposure Duration	24	years	USEPA, 1991	EC (mg/m3) =
				PEF	Particulate Emission Factor	1.36E+09	m3/kg	USEPA, 2002	(Ca*ET*EF*ED)/AT
				AT-C	Averaging Time (Cancer)	613,200	hours	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	210,240	hours	USEPA, 1989	
		Young Child	Fugitive dust	Ca	Contaminant Concentration in Air	Chemical Specific	mg/m3	Chemical Specific	
				ET	Exposure Time	24	hours/day	Prof Judge (8)	
				EF	Exposure Frequency	350	days/year	USEPA, 2004	
				ED	Exposure Duration	6	years	USEPA, 1991	EC (mg/m3) =
				PEF	Particulate Emission Factor	1.36E+09	m3/kg	USEPA, 2002	(Ca*ET*EF*ED)/AT
				AT-C	Averaging Time (Cancer)	613,200	hours	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	52,560	hours	USEPA, 1989	

TABLE 4.2a.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Total Soil
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
	Future Industrial / Commercial Workers	Adult	Fugitive dust	Ca	Contaminant Concentration in Air	Chemical Specific	mg/m3	Chemical Specific	
				ET	Exposure Time	8	hours/day	Prof Judge (7)	
				EF	Exposure Frequency	250	days/year	USEPA, 2004	
				ED	Exposure Duration	25	years	USEPA, 2004	EC (mg/m3) =
				PEF	Particulate Emission Factor	1.36E+09	m3/kg	USEPA, 2002	(Ca*ET*EF*ED)/AT
				AT-C	Averaging Time (Cancer)	613,200	hours	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	219,000	hours	USEPA, 1989	
	Future Construction Workers	Adult	Fugitive dust	Ca	Contaminant Concentration in Air	Chemical Specific	mg/m3	Chemical Specific	
				ET	Exposure Time	8	hours/day	Prof Judge (7)	
				EF	Exposure Frequency	250	days/year	USEPA, 2004	
				ED	Exposure Duration	1	years	Prof Judge (5)	EC (mg/m3) =
				PEF	Particulate Emission Factor	2.89E+06	m3/kg	USEPA, 2002	(Ca*ET*EF*ED)/AT
				AT-C	Averaging Time (Cancer)	613,200	hours	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	hours	USEPA, 1989	

Notes

Chemical Specific - See Table 3.2
Prof Judge - Professional Judgment

(3) Assumes individuals trespass on site 1 day/week. This value represents the default value for NAPR but may be revised based on site-specific factors such as accessibility and attractiveness to trespassers
(5) Assumes a construction period of 1 year.
(6) Recommended outdoor activity factor for adults.
(7) Assumes an 8 hour work day.
(8) Conservatively assumes receptor remains at residence 24 hours/day.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002
USEPA, 1991: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual Supplemental Guidance: Standard Default Exposure Factors
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2002. Draft Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24
USEPA, 2004: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005

TABLE 4.3.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion									Chronic Daily Intake (CDI) Equations
	Future Residents	Adult	Groundwater	C	Contaminant Concentration in Groundwater	Chemical Specific	mg/L	Chemical Specific	
				IR-W	Ingestion Rate of Groundwater	2	L/hour	USEPA, 1993	
				EF	Exposure Frequency	350	days/year	USEPA, 2004	CDI (mg/kg-day) =
				ED	Exposure Duration	24	years	USEPA, 1991	C x IR-W x EF x ED x 1/BW x 1/AT
				BW	Body Weight	70	kg	USEPA, 1997	(17)
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
		Young Child	Groundwater	C	Contaminant Concentration in Groundwater	Chemical Specific	mg/L	Chemical Specific	
				IR-W	Ingestion Rate of Groundwater	1	L/hour	USEPA, 1989	
				EF	Exposure Frequency	350	days/year	USEPA, 2004	CDI (mg/kg-day) =
				ED	Exposure Duration	6	years	USEPA, 1991	C x IR-W x EF x ED x 1/BW x 1/AT
				BW	Body Weight	15	kg	USEPA, 1997	(17)
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	
	Future Industrial / Commercial Workers	Adult	Groundwater	C	Contaminant Concentration in Groundwater	Chemical Specific	mg/L	Chemical Specific	
				IR-W	Ingestion Rate of Groundwater	1	L/hour	USEPA, 1991	
				EF	Exposure Frequency	250	days/year	USEPA, 2004	CDI (mg/kg-day) =
				ED	Exposure Duration	25	years	USEPA, 2004	C x IR-W x EF x ED x 1/BW x 1/AT
				BW	Body Weight	70	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	USEPA, 1989	
	Future Construction Workers	Adult	Groundwater	C	Contaminant Concentration in Groundwater	Chemical Specific	mg/L	Chemical Specific	
				IR-W	Ingestion Rate of Groundwater	0.02	L/hour	VDEQ, 2009	
				EF	Exposure Frequency	50	days/year	Prof Judge (12)	CDI (mg/kg-day) =
				ED	Exposure Duration	1	years	Prof Judge (5)	C x IR-W x EF x ED x 1/BW x 1/AT
				BW	Body Weight	70	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	

TABLE 4.3.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal									Dermally Adjusted Dose (DAD) Equations
	Future Residents	Adult	Groundwater	C	Contaminant Concentration in Groundwater	Chemical Specific	mg/L	Chemical Specific	
				CF	Conversion Factor	1.00E-03	L/cm3	USEPA, 1989	DAD (mg/kg-day) =
				SA	Surface Area Available for Contact	18,000	cm2	USEPA, 2004	
				PC	Permeability Constant	Chemical Specific	cm/hour	USEPA, 2004	Inorganics
				tau	Lag Time	Chemical Specific	hour	USEPA, 2004	(C*CF*Kp*SA*EF*ED*ET)/(BW*AT
				t*	Time to Reach Steady State	Chemical Specific	hour	USEPA, 2004	
				B	Permeability Coefficient of a Compound	Chemical Specific	NA	USEPA, 2004	Organics: ET <= t*
				ET	Exposure Time	0.58	hours/day	USEPA, 2004	(C*CF*(2*Kp*SQRT(6*tau*ET/pi))*SA*EF*ED)/(BW*AT
				EF	Exposure Frequency	350	days/year	USEPA, 2004	
				ED	Exposure Duration	24	years	USEPA, 1991	Organics: ET > t*
				BW	Body Weight	70	kg	USEPA, 1997	(C*CF*(Kp*(ET/(1+B)+2*tau*((1+3*B)/(1+B)))*SA*EF*ED)/(BW*AT
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	(17)
		Young Child	Groundwater	C	Contaminant Concentration in Groundwater	Chemical Specific	mg/L	Chemical Specific	
				CF	Conversion Factor	1.00E-03	L/cm3	USEPA, 1989	DAD (mg/kg-day) =
				SA	Surface Area Available for Contact	6,600	cm2	USEPA, 2004	
				PC	Permeability Constant	Chemical Specific	cm/hour	USEPA, 2004	Inorganics
				tau	Lag Time	Chemical Specific	hour	USEPA, 2004	(C*CF*Kp*SA*EF*ED*ET)/(BW*AT
				t*	Time to Reach Steady State	Chemical Specific	hour	USEPA, 2004	
				B	Permeability Coefficient of a Compound	Chemical Specific	NA	USEPA, 2004	Organics: ET <= t*
				ET	Exposure Time	1	hours/day	USEPA, 2004	(C*CF*(2*Kp*SQRT(6*tau*ET/pi))*SA*EF*ED)/(BW*AT
				EF	Exposure Frequency	350	days/year	USEPA, 2004	
				ED	Exposure Duration	6	years	USEPA, 1991	Organics: ET > t*
				BW	Body Weight	15	kg	USEPA, 1997	(C*CF*(Kp*(ET/(1+B)+2*tau*((1+3*B)/(1+B)))*SA*EF*ED)/(BW*AT
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	(17)
	Future Construction Workers	Adult	Groundwater	C	Contaminant Concentration in Groundwater	Chemical Specific	mg/L	Chemical Specific	
				CF	Conversion Factor	1.00E-03	L/cm3	USEPA, 1989	DAD (mg/kg-day) =
				SA	Surface Area Available for Contact	3,300	cm2	USEPA, 2004	
				PC	Permeability Constant	Chemical Specific	cm/hour	USEPA, 2004	Inorganics
				tau	Lag Time	Chemical Specific	hour	USEPA, 2004	(C*CF*Kp*SA*EF*ED*ET)/(BW*AT
				t*	Time to Reach Steady State	Chemical Specific	hour	USEPA, 2004	
				B	Permeability Coefficient of a Compound	Chemical Specific	NA	USEPA, 2004	Organics: ET <= t*
				ET	Exposure Time	2	hours/day	Prof Judge (13)	(C*CF*(2*Kp*SQRT(6*tau*ET/pi))*SA*EF*ED)/(BW*AT
				EF	Exposure Frequency	50	days/year	Prof Judge (12)	
				ED	Exposure Duration	1	years	Prof Judge (5)	Organics: ET > t*
				BW	Body Weight	70	kg	USEPA, 1997	(C*CF*(Kp*(ET/(1+B)+2*tau*((1+3*B)/(1+B)))*SA*EF*ED)/(BW*AT
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	

TABLE 4.3.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Notes

ADAFs - Age-Dependent Adjustment Factors
Chemical Specific - See Table 3.3
MMOA - Mutagenic Mode of Action
NA - Not Applicable
Prof Judge - Professional Judgment

(5) Assumes a construction period of 1 year.
(7) Assumes an 8 hour work day.
(12) Assumes 20% of time spent in trench.
(13) Assumes 2 hours/event in trench.
(17) ADAFs are incorporated into the equation to adjust cancer risk for receptors whose exposure includes early life for chemicals that have been determined to be carcinogenic via MMOA. The following ADAFs are used: 10 for age 0 to 2 years, 3 for age 2 to 16 years, and no adjustment for ages 16 and up (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002
USEPA, 1991: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual Supplemental Guidance: Standard Default Exposure Factors
USEPA, 1993: "Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure." November, 1993
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2004: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005
USEPA, 2005. Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. EPA/630/R-03/003F. March 2005

TABLE 4.3a.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Future Residents	Adult	Water Vapors from Showerhead						Exposure Concentration (EC) Equations
				Ca	Contaminant Concentration in Air	Chemical Specific	mg/m3	Chemical Specific	
				ET	Exposure Time	0.58	hours/day	USEPA, 2004	
				EF	Exposure Frequency	350	days/year	USEPA, 2004	EC (mg/m3) =
				ED	Exposure Duration	24	years	USEPA, 1991	(Ca*ET*EF*ED)/AT
				AT-C	Averaging Time (Cancer)	613,200	hours	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	210,240	hours	USEPA, 1989	
	Future Construction Workers	Adult	Water Vapors in Trench						
				Ca	Contaminant Concentration in Air	Chemical Specific	mg/m3	Chemical Specific	
				ET	Exposure Time	2	hours/day	Prof Judge (13)	EC (mg/m3) =
				EF	Exposure Frequency	50	days/year	Prof Judge (12)	(Ca*ET*EF*ED)/AT
				ED	Exposure Duration	1	years	Prof Judge (5)	
				AT-C	Averaging Time (Cancer)	613,200	hours	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	hours	USEPA, 1989	

Notes

Chemical Specific - See Table 3.3
Prof Judge - Professional Judgment

(5) Assumes a construction period of 1 year.
(12) Assumes 20% of time spent in trench.
(13) Assumes 2 hours/event in trench.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002
USEPA, 1991: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual Supplemental Guidance: Standard Default Exposure Factors
USEPA, 2004: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005

TABLE 4.4.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion									Chronic Daily Intake (CDI) Equations
	Current and Future Trespassers	Adult	Surface Water	C	Contaminant Concentration in Surface Water	Chemical Specific	mg/L	Chemical Specific	
				IR-W	Ingestion Rate of Groundwater	0.005	L/hour	USEPA, 1989 (16)	
				EF	Exposure Frequency	52	days/year	Prof Judge (3)	CDI (mg/kg-day) =
				ED	Exposure Duration	24	years	USEPA, 1991	C x IR-W x EF x ED x 1/BW x 1/AT
				BW	Body Weight	70	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
		Youth	Surface Water	C	Contaminant Concentration in Surface Water	Chemical Specific	mg/L	Chemical Specific	
				IR-W	Ingestion Rate of Groundwater	0.005	L/hour	USEPA, 1989 (16)	
				EF	Exposure Frequency	52	days/year	Prof Judge (3)	CDI (mg/kg-day) =
				ED	Exposure Duration	11	years	USEPA, 1991	C x IR-W x EF x ED x 1/BW x 1/AT
				BW	Body Weight	45	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	4,015	days	USEPA, 1989	
	Current and Future On-Site Workers	Adult	Surface Water	C	Contaminant Concentration in Surface Water	Chemical Specific	mg/L	Chemical Specific	
				IR-W	Ingestion Rate of Groundwater	0.005	L/hour	VDEQ, 2010 (15)	
				EF	Exposure Frequency	250	days/year	USEPA, 2004	CDI (mg/kg-day) =
				ED	Exposure Duration	25	years	USEPA, 2004	C x IR-W x EF x ED x 1/BW x 1/AT
				BW	Body Weight	70	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	USEPA, 1989	
	Future Residents	Adult	Surface Water	C	Contaminant Concentration in Surface Water	Chemical Specific	mg/L	Chemical Specific	
				IR-W	Ingestion Rate of Groundwater	0.005	L/hour	USEPA, 1989 (16)	
				EF	Exposure Frequency	52	days/year	Prof Judge (3)	CDI (mg/kg-day) =
				ED	Exposure Duration	24	years	USEPA, 1991	C x IR-W x EF x ED x 1/BW x 1/AT
				BW	Body Weight	70	kg	USEPA, 1997	(17)
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
		Young Child	Surface Water	C	Contaminant Concentration in Surface Water	Chemical Specific	mg/L	Chemical Specific	
				IR-W	Ingestion Rate of Groundwater	0.005	L/hour	USEPA, 1989 (16)	
				EF	Exposure Frequency	52	days/year	Prof Judge (3)	CDI (mg/kg-day) =
				ED	Exposure Duration	6	years	USEPA, 1991	C x IR-W x EF x ED x 1/BW x 1/AT
				BW	Body Weight	15	kg	USEPA, 1997	(17)
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	

TABLE 4.4.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal									Dermally Adjusted Dose (DAD) Equations
	Current and Future Trespassers	Adult	Surface Water	C	Contaminant Concentration in Surface Water	Chemical Specific	mg/L	Chemical Specific	
				CF	Conversion Factor	1.00E-03	L/cm3	USEPA, 1989	
				SA	Surface Area Available for Contact	5,700	cm2	Prof Judge	
				PC	Permeability Constant	Chemical Specific	cm/hour	USEPA, 2004	DAD (mg/kg-day) =
				ET	Exposure Time	2	hours/day	USEPA, 1997 (6)	C x CF x SA x PC x ET x EF x ED x
				EF	Exposure Frequency	52	days/year	Prof Judge (3)	1/BW x1/AT
				ED	Exposure Duration	24	years	USEPA, 1991	
				BW	Body Weight	70	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
		Youth	Surface Water	C	Contaminant Concentration in Surface Water	Chemical Specific	mg/L	Chemical Specific	
				CF	Conversion Factor	1.00E-03	L/cm3	USEPA, 1989	
				SA	Surface Area Available for Contact	3,200	cm2	USEPA, 2004	
				PC	Permeability Constant	Chemical Specific	cm/hour	USEPA, 2004	DAD (mg/kg-day) =
				ET	Exposure Time	2	hours/day	USEPA, 1997 (6)	C x CF x SA x PC x ET x EF x ED x
				EF	Exposure Frequency	52	days/year	Prof Judge (3)	1/BW x1/AT
				ED	Exposure Duration	11	years	USEPA, 1991	
				BW	Body Weight	45	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	4,015	days	USEPA, 1989	
	Current and Future On-Site Workers	Adult	Surface Water	C	Contaminant Concentration in Surface Water	Chemical Specific	mg/L	Chemical Specific	
				CF	Conversion Factor	1.00E-03	L/cm3	USEPA, 1989	
				SA	Surface Area Available for Contact	3,300	cm2	USEPA, 2004	
				PC	Permeability Constant	Chemical Specific	cm/hour	USEPA, 2004	DAD (mg/kg-day) =
				ET	Exposure Time	2	hours/day	USEPA, 1997 (6)	C x CF x SA x PC x ET x EF x ED x
				EF	Exposure Frequency	250	days/year	USEPA, 2004	1/BW x1/AT
				ED	Exposure Duration	25	years	USEPA, 2004	
				BW	Body Weight	70	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	USEPA, 1989	
	Future Residents	Adult	Surface Water	C	Contaminant Concentration in Surface Water	Chemical Specific	mg/L	Chemical Specific	
				CF	Conversion Factor	1.00E-03	L/cm3	USEPA, 1989	
				SA	Surface Area Available for Contact	5,700	cm2	USEPA, 2004	
				PC	Permeability Constant	Chemical Specific	cm/hour	USEPA, 2004	DAD (mg/kg-day) =
				ET	Exposure Time	2	hours/day	USEPA, 1997 (6)	C x CF x SA x PC x ET x EF x ED x
				EF	Exposure Frequency	52	days/year	Prof Judge (3)	1/BW x1/AT
				ED	Exposure Duration	24	years	USEPA, 1991	(17)
				BW	Body Weight	70	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	

TABLE 4.4.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
		Young Child	Surface Water	C	Contaminant Concentration in Surface Water	Chemical Specific	mg/L	Chemical Specific	
				CF	Conversion Factor	1.00E-03	L/cm3	USEPA, 1989	
				SA	Surface Area Available for Contact	2,800	cm2	USEPA, 2004	
				PC	Permeability Constant	Chemical Specific	cm/hour	USEPA, 2004	DAD (mg/kg-day) =
				ET	Exposure Time	2	hours/day	USEPA, 1997 (6)	C x CF x SA x PC x ET x EF x ED x
				EF	Exposure Frequency	52	days/year	Prof Judge (3)	1/BW x1/AT
				ED	Exposure Duration	6	years	USEPA, 1991	(17)
				BW	Body Weight	15	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	

Notes

ADAFs - Age-Dependent Adjustment Factors
Chemical Specific - See Table 3.4
MMOA - Mutagenic Mode of Action
Prof Judge - Professional Judgment

(3) Assumes individuals trespass on site 1 day/week. This value represents the default value for NAPR but may be revised based on site-specific factors such as accessibility and attractiveness to trespassers
(6) Recommended outdoor activity factor for adults
(15) Ingestion rate for wading assumes one order of magnitude less than the USEPA default ingestion rate for swimming
(16) Ingestion rate for swimming
(17) ADAFs are incorporated into the equation to adjust cancer risk for receptors whose exposure includes early life for chemicals that have been determined to be carcinogenic via MMOA. The following ADAFs are used: 10 for age 0 to 2 years, 3 for age 2 to 16 years, and no adjustment for ages 16 and up (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002
USEPA, 1991: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual Supplemental Guidance: Standard Default Exposure Factors
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2004: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005
USEPA, 2005. Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. EPA/630/R-03/003F. March 2005

TABLE 4.5.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion									Chronic Daily Intake (CDI) Equations
	Current and Future Trespassers	Adult	Sediment	C	Contaminant Concentration in Sediment	Chemical Specific	mg/kg	Chemical Specific	
				IR-S	Ingestion Rate of Sediment	100	mg/day	USEPA, 1991	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				FI	Fraction Ingested from Source	1	NA	Prof Judge (2)	CDI (mg/kg-day) =
				EF	Exposure Frequency	52	days/year	Prof Judge (3)	C x IR x CF x Fi x EF x ED x 1/BW x 1/AT
				ED	Exposure Duration	24	years	USEPA, 1991	
				BW	Body Weight	70	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
		Youth	Sediment	C	Contaminant Concentration in Sediment	Chemical Specific	mg/kg	Chemical Specific	
				IR-S	Ingestion Rate of Sediment	100	mg/day	USEPA, 1991	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				FI	Fraction Ingested from Source	1	NA	Prof Judge (2)	CDI (mg/kg-day) =
				EF	Exposure Frequency	52	days/year	Prof Judge (3)	C x IR x CF x Fi x EF x ED x 1/BW x 1/AT
				ED	Exposure Duration	11	years	USEPA, 1991	
				BW	Body Weight	45	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	4,015	days	USEPA, 1989	
	Current and Future On-Site Workers	Adult	Sediment	C	Contaminant Concentration in Sediment	Chemical Specific	mg/kg	Chemical Specific	
				IR-S	Ingestion Rate of Sediment	100	mg/day	USEPA, 2002	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				FI	Fraction Ingested from Source	1	NA	Prof Judge (2)	CDI (mg/kg-day) =
				EF	Exposure Frequency	250	days/year	USEPA, 2004	C x IR x CF x Fi x EF x ED x 1/BW x 1/AT
				ED	Exposure Duration	25	years	USEPA, 2004	
				BW	Body Weight	70	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	USEPA, 1989	
	Future Residents	Adult	Sediment	C	Contaminant Concentration in Sediment	Chemical Specific	mg/kg	Chemical Specific	
				IR-S	Ingestion Rate of Sediment	100	mg/day	USEPA, 1991	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				FI	Fraction Ingested from Source	1	NA	Prof Judge (2)	CDI (mg/kg-day) =
				EF	Exposure Frequency	52	days/year	Prof Judge (3)	C x IR x CF x Fi x EF x ED x 1/BW x 1/AT
				ED	Exposure Duration	24	years	USEPA, 1991	(17)
				BW	Body Weight	70	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	

TABLE 4.5.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
		Young Child	Sediment	C	Contaminant Concentration in Sediment	Chemical Specific	mg/kg	Chemical Specific	
				IR-S	Ingestion Rate of Sediment	200	mg/day	USEPA, 1991	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				FI	Fraction Ingested from Source	1	NA	Prof Judge (2)	CDI (mg/kg-day) =
				EF	Exposure Frequency	52	days/year	Prof Judge (3)	C x IR x CF x Fi x EF x ED x 1/BW x 1/AT
				ED	Exposure Duration	6	years	USEPA, 1991	(17)
				BW	Body Weight	15	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	
Dermal									Dermally Adjusted Dose (DAD) Equations
	Current and Future Trespassers	Adult	Sediment	C	Contaminant Concentration in Sediment	Chemical Specific	mg/kg	Chemical Specific	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				SA	Surface Area Available for Contact	5,700	cm2/day	USEPA, 2004	
				AF	Sediment to Skin Adherence Factor	0.3	mg/cm2	VDEQ, 2013	DAD (mg/kg-day) =
				ABS	Absorption Factor	CS	NA	USEPA, 2004	C x CF x SA x AF x ABS x EF x ED x
				EF	Exposure Frequency	52	days/year	Prof Judge (3)	1/BW x1/AT
				ED	Exposure Duration	24	years	USEPA, 1991	
				BW	Body Weight	70	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
		Youth	Sediment	C	Contaminant Concentration in Sediment	Chemical Specific	mg/kg	Chemical Specific	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				SA	Surface Area Available for Contact	3,200	cm2/day	USEPA, 1997	
				AF	Sediment to Skin Adherence Factor	0.3	mg/cm2	VDEQ, 2013	DAD (mg/kg-day) =
				ABS	Absorption Factor	CS	NA	USEPA, 2004	C x CF x SA x AF x ABS x EF x ED x
				EF	Exposure Frequency	52	days/year	Prof Judge (3)	1/BW x1/AT
				ED	Exposure Duration	11	years	USEPA, 1991	
				BW	Body Weight	45	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	4,015	days	USEPA, 1989	

TABLE 4.5.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
	Current and Future On-Site Workers	Adult	Sediment	C	Contaminant Concentration in Sediment	Chemical Specific	mg/kg	Chemical Specific	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				SA	Surface Area Available for Contact	3,300	cm2/day	USEPA, 2004	
				AF	Sediment to Skin Adherence Factor	0.3	mg/cm2	VDEQ, 2013	DAD (mg/kg-day) =
				ABS	Absorption Factor	CS	NA	USEPA, 2004	C x CF x SA x AF x ABS x EF x ED x
				EF	Exposure Frequency	250	days/year	USEPA, 2004	1/BW x1/AT
				ED	Exposure Duration	25	years	USEPA, 2004	
				BW	Body Weight	70	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	USEPA, 1989	
	Future Residents	Adult	Sediment	C	Contaminant Concentration in Sediment	Chemical Specific	mg/kg	Chemical Specific	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				SA	Surface Area Available for Contact	5,700	cm2/day	USEPA, 2004	
				AF	Sediment to Skin Adherence Factor	0.3	mg/cm2	VDEQ, 2013	DAD (mg/kg-day) =
				ABS	Absorption Factor	CS	NA	USEPA, 2004	C x CF x SA x AF x ABS x EF x ED x
				EF	Exposure Frequency	52	days/year	Prof Judge (3)	1/BW x1/AT
				ED	Exposure Duration	24	years	USEPA, 1991	(17)
				BW	Body Weight	70	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
		Young Child	Sediment	C	Contaminant Concentration in Sediment	Chemical Specific	mg/kg	Chemical Specific	
				CF	Conversion Factor	1.00E-06	kg/mg	USEPA, 1989	
				SA	Surface Area Available for Contact	2,800	cm2/day	USEPA, 2004	
				AF	Sediment to Skin Adherence Factor	0.3	mg/cm2	VDEQ, 2013	DAD (mg/kg-day) =
				ABS	Absorption Factor	CS	NA	USEPA, 2004	C x CF x SA x AF x ABS x EF x ED x
				EF	Exposure Frequency	52	days/year	Prof Judge (3)	1/BW x1/AT
				ED	Exposure Duration	6	years	USEPA, 1991	(17)
				BW	Body Weight	15	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	

TABLE 4.5.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Sediment
Exposure Medium: Sediment

Notes

ADAFs - Age-Dependent Adjustment Factors
Chemical Specific - See Table 3.5
MMOA - Mutagenic Mode of Action
NA - Not Applicable
Prof Judge - Professional Judgment

(2) Conservative assumption of 100% ingested from source.
(3) Assumes individuals trespass on site 1 day/week. This value represents the default value for NAPR but may be revised based on site-specific factors such as accessibility and attractiveness to trespassers
(17) ADAFs are incorporated into the equation to adjust cancer risk for receptors whose exposure includes early life for chemicals that have been determined to be carcinogenic via MMOA. The following ADAFs are used: 10 for age 0 to 2 years, 3 for a

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002
USEPA, 1991: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual Supplemental Guidance: Standard Default Exposure Factors.
USEPA, 1997: Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa
USEPA, 2002. Draft Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24
USEPA, 2004: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005.
USEPA, 2005. Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. EPA/630/R-03/003F. March 2005.

TABLE 5.1
NON-CANCER TOXICITY DATA -- ORAL/DERMAL
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal (1)	Absorbed RfD for Dermal (2)		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD:Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Date(s)
Bromodichloromethane	Chronic	2.00E-02	mg/kg/day	100%	2.00E-02	mg/kg/day	Kidney	1000/1	IRIS	1/2/2011
Chloroform	Chronic	1.00E-02	mg/kg/day	100%	1.00E-02	mg/kg/day	Liver	1000/1	IRIS	8/28/2010
Dibromochloromethane	Chronic	2.00E-02	mg/kg/day	100%	2.00E-02	mg/kg/day	Liver	1000/1	IRIS	1/2/2011
Methyl Iodide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Propionitrile (Ethyl Cyanide)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene (BaP)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenz(a,h)anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	Chronic	2.00E-02	mg/kg/day	100%	2.00E-02	mg/kg/day	Whole Body	3000/1	IRIS	7/30/2010
Antimony	Chronic	4.00E-04	mg/kg/day	15%	6.00E-05	mg/kg/day	Whole Body, CVS	1000/1	IRIS	11/22/2010
Arsenic	Chronic	3.00E-04	mg/kg/day	100%	3.00E-04	mg/kg/day	Skin / CVS	3/1	IRIS	4/3/2011
Cadmium	Chronic	1.00E-03	mg/kg/day	3%	3.00E-05	mg/kg/day	Kidney	10/1	IRIS	11/22/2010
Cobalt	Chronic	3.00E-04	mg/kg/day	100%	3.00E-04	mg/kg/day	CVS	10/1	PPRTV	3/16/2001
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	Chronic	5.00E-03	mg/kg/day	100%	5.00E-03	mg/kg/day	Skin	3/1	IRIS	1/2/2011
Thallium	Chronic	1.00E-05	mg/kg/day	100%	1.00E-05	mg/kg/day	Liver / CVS / Skin	3000/1	PPRTV Appendix	3/29/1999
Vanadium	Chronic	5.00E-03	mg/kg/day	3%	1.30E-04	mg/kg/day	GIS / Kidney	100/1	Lookup	7/1/1997

Notes:

(1) Refer to RAGS, Part E
(2) Adjusted dermal RfD = Oral RfD * Adj Factor

NA = Not Applicable / Not Available

Target Organ Abbreviations:
CVS = Cardiovascular System
GIS = Gastrointestinal System

Sources:
IRIS = Integrated Risk Information System
PPRTV = Provisional Peer Reviewed Toxicity Values

TABLE 5.2
NON-CANCER TOXICITY DATA -- INHALATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Extrapolated RfD		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC : Target Organ(s)	
		Value	Units	Value	Units			Source(s)	Date(s)
Bromodichloromethane	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform	NA	9.80E-02	mg/m3	NA	NA	NA	NA	ATSDR	NA
Dibromochloromethane	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Iodide	NA	NA	NA	NA	NA	NA	NA	NA	NA
Propionitrile (Ethyl Cyanide)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene (BaP)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenz(a,h)anthracene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	Chronic	3.00E-03	mg/m3	NA	NA	RsS	3000/1	IRIS	7/30/2010
Antimony	NA	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	Chronic	1.50E-05	mg/m3	NA	NA	NA	NA	Cal EPA	NA
Cadmium	Chronic	1.00E-05	mg/m3	NA	NA	Kidney	1/1	ATSDR	3/4/1999
Cobalt	Chronic	6.00E-06	mg/m3	NA	NA	RsS	NA	PPRTV	3/16/2001
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	2.00E-02	mg/m3	NA	NA	NA	NA	Cal EPA	NA
Thallium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	Chronic	1.00E-04	mg/m3	NA	NA	NA	NA	ATSDR	NA

Notes:

NA = Not Applicable / Not Available

Target Organ Abbreviations:
RsS = Respiratory System

Sources:
IRIS = Integrated Risk Information System
PPRTV = Provisional Peer Reviewed Toxicity Values
ATSDR = Agency for Toxic Substances and Disease Registry
Cal EPA = California Environmental Protection Agency

TABLE 6.1
CANCER TOXICITY DATA -- ORAL/DERMAL
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal (1)	Absorbed Cancer Slope Factor for Dermal (2)		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units		Value	Units		Source(s)	Date(s)
Bromodichloromethane	6.20E-02	1 / (mg/kg/day)	100%	6.20E-02	1 / (mg/kg/day)	B2	IRIS	1/2/2011
Chloroform	3.10E-02	1 / (mg/kg/day)	100%	3.10E-02	1 / (mg/kg/day)	B2	Cal EPA	5/31/2007
Dibromochloromethane	8.40E-02	1 / (mg/kg/day)	100%	8.40E-02	1 / (mg/kg/day)	C	IRIS	1/2/2011
Methyl Iodide	NA	NA	NA	NA	NA	NA	NA	NA
Propionitrile (Ethyl Cyanide)	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	7.30E-01	1 / (mg/kg/day)	100%	7.30E-01	1 / (mg/kg/day)	B2	ECAO	4/26/2000
Benzo(a)pyrene (BaP)	7.30E+00	1 / (mg/kg/day)	100%	7.30E+00	1 / (mg/kg/day)	B2	IRIS	11/1/2010
Benzo(b)fluoranthene	7.30E-01	1 / (mg/kg/day)	100%	7.30E-01	1 / (mg/kg/day)	B2	ECAO	4/26/2000
Benzo(k)fluoranthene	7.30E-02	1 / (mg/kg/day)	100%	7.30E-02	1 / (mg/kg/day)	B2	ECAO	4/26/2000
Chrysene	7.30E-03	1 / (mg/kg/day)	100%	7.30E-03	1 / (mg/kg/day)	B2	ECAO	4/26/2000
Dibenz(a,h)anthracene	7.30E+00	1 / (mg/kg/day)	100%	7.30E+00	1 / (mg/kg/day)	B2	ECAO	4/26/2000
Indeno(1,2,3-cd)pyrene	7.30E-01	1 / (mg/kg/day)	100%	7.30E-01	1 / (mg/kg/day)	B2	ECAO	4/26/2000
Naphthalene	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	1.50E+00	1 / (mg/kg/day)	100%	1.50E+00	1 / (mg/kg/day)	A	IRIS	4/3/2011
Cadmium	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt	NA	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

(1) Refer to RAGS, Part E
(2) Adjusted dermal CSF = Oral CSF / Adj Factor

NA = Not Applicable / Not Available

Sources:
IRIS = Integrated Risk Information System
Cal EPA = California Environmental Protection Agency
ECAO = Environmental Criteria and Assessment Office

EPA Group:
A - Human carcinogen
B1 - Probable human carcinogen - indicates that limited human data are available
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans
C - Possible human carcinogen
D - Not classifiable as a human carcinogen
E - Evidence of noncarcinogenicity

Weight of Evidence:
Known/Likely (EPA classes A, B1, B2, C)
Cannot be Determined (EPA class D)
Not Likely (EPA class E)

TABLE 6.2
CANCER TOXICITY DATA -- INHALATION
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor		Weight of Evidence/ Cancer Guideline Description	Unit Risk : Inhalation CSF	
	Value	Units	Value	Units		Source(s)	Date(s)
Bromodichloromethane	3.70E-05	1/(µg/m3)	NA	NA	D	Cal EPA	NA
Chloroform	2.30E-05	1/(µg/m3)	NA	NA	B2	IRIS	8/28/2010
Dibromochloromethane	2.70E-05	1/(µg/m3)	NA	NA	D	Cal EPA	NA
Methyl Iodide	NA	NA	NA	NA	NA	NA	NA
Propionitrile (Ethyl Cyanide)	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	1.10E-04	1/(µg/m3)	NA	NA	D	Cal EPA	NA
Benzo(a)pyrene (BaP)	1.10E-03	1/(µg/m3)	NA	NA	B2	Cal EPA	4/26/2000
Benzo(b)fluoranthene	1.10E-04	1/(µg/m3)	NA	NA	B2	Cal EPA	NA
Benzo(k)fluoranthene	1.10E-04	1/(µg/m3)	NA	NA	B2	Cal EPA	NA
Chrysene	1.10E-05	1/(µg/m3)	NA	NA	B2	Cal EPA	9/20/2002
Dibenz(a,h)anthracene	1.20E-03	1/(µg/m3)	NA	NA	D	Cal EPA	NA
Indeno(1,2,3-cd)pyrene	1.10E-04	1/(µg/m3)	NA	NA	B2	Cal EPA	9/20/2002
Naphthalene	3.40E-05	1/(µg/m3)	NA	NA	C	Cal EPA	2/28/2007
Antimony	NA	NA	NA	NA	NA	NA	NA
Arsenic	4.30E-03	1/(µg/m3)	NA	NA	A	IRIS	4/3/2011
Cadmium	1.80E-03	1/(µg/m3)	NA	NA	B1	IRIS	11/22/2010
Cobalt	9.00E-03	1/(µg/m3)	NA	NA	D	PPRTV	3/16/2001
Lead	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA
Thallium	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA

Notes:

EPA Group:
- A - Human carcinogen
- B1 - Probable human carcinogen - indicates that limited human data are available
- B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans
- C - Possible human carcinogen
- D - Not classifiable as a human carcinogen
- E - Evidence of noncarcinogenicity

Sources:

IRIS = Integrated Risk Information System
PPRTV = Provisional Peer Reviewed Toxicity Values
Cal EPA = California Environmental Protection Agency

NA = Not Applicable / Not Available

Weight of Evidence:
- Known/Likely (EPA classes A, B1, B2, C)
- Cannot be Determined (EPA class D)
- Not Likely (EPA class E)

TABLE 7.1.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Receptor Population: Trespassers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Soil	Ingestion													
				Methyl Iodide	0.00369	mg/kg	2.6E-10	mg/kg-day	NA	--	--	7.5E-10	mg/kg-day	NA	--	--
				Propionitrile (Ethyl Cyanide)	0.00810	mg/kg	5.7E-10	mg/kg-day	NA	--	--	1.6E-09	mg/kg-day	NA	--	--
				Benzo(a)anthracene	0.0130	mg/kg	2.2E-09	mg/kg-day	7.3E-01	1/(mg/kg-day)	1.6E-09	2.6E-09	mg/kg-day	NA	--	--
				Benzo(a)pyrene (BaP)	0.0414	mg/kg	7.1E-09	mg/kg-day	7.3E+00	1/(mg/kg-day)	5.2E-08	8.4E-09	mg/kg-day	NA	--	--
				Benzo(b)fluoranthene	0.297	mg/kg	5.1E-08	mg/kg-day	7.3E-01	1/(mg/kg-day)	3.7E-08	6.0E-08	mg/kg-day	NA	--	--
				Benzo(k)fluoranthene	0.290	mg/kg	5.0E-08	mg/kg-day	7.3E-02	1/(mg/kg-day)	3.7E-09	5.9E-08	mg/kg-day	NA	--	--
				Chrysene	0.465	mg/kg	8.0E-08	mg/kg-day	7.3E-03	1/(mg/kg-day)	5.9E-10	9.5E-08	mg/kg-day	NA	--	--
				Dibenz(a,h)anthracene	0.0920	mg/kg	1.6E-08	mg/kg-day	7.3E+00	1/(mg/kg-day)	1.2E-07	1.9E-08	mg/kg-day	NA	--	--
				Indeno(1,2,3-cd)pyrene	0.0288	mg/kg	5.0E-09	mg/kg-day	7.3E-01	1/(mg/kg-day)	3.6E-09	5.9E-09	mg/kg-day	NA	--	--
				Antimony	1.14	mg/kg	8.0E-08	mg/kg-day	NA	--	--	2.3E-07	mg/kg-day	4.0E-04	mg/kg-day	5.8E-04
				Arsenic	1.39	mg/kg	9.7E-08	mg/kg-day	1.5E+00	1/(mg/kg-day)	1.5E-07	2.8E-07	mg/kg-day	3.0E-04	mg/kg-day	9.4E-04
				Cobalt	29.8	mg/kg	2.1E-06	mg/kg-day	NA	--	--	6.1E-06	mg/kg-day	3.0E-04	mg/kg-day	2.0E-02
				Lead	537	mg/kg	3.7E-05	mg/kg-day	NA	--	--	1.1E-04	mg/kg-day	NA	--	--
				Thallium	0.133	mg/kg	9.3E-09	mg/kg-day	NA	--	--	2.7E-08	mg/kg-day	1.0E-05	mg/kg-day	2.7E-03
				Vanadium	186	mg/kg	1.3E-05	mg/kg-day	NA	--	--	3.8E-05	mg/kg-day	5.0E-03	mg/kg-day	7.6E-03
			Ingestion Total								3.6E-07					3.2E-02
			Dermal													
				Methyl Iodide	0.00369	mg/kg	1.0E-09	mg/kg-day	NA	--	--	3.0E-09	mg/kg-day	NA	--	--
				Propionitrile (Ethyl Cyanide)	0.00810	mg/kg	2.3E-09	mg/kg-day	NA	--	--	6.6E-09	mg/kg-day	NA	--	--
				Benzo(a)anthracene	0.0130	mg/kg	1.8E-09	mg/kg-day	7.3E-01	1/(mg/kg-day)	1.3E-09	1.4E-09	mg/kg-day	NA	--	--
				Benzo(a)pyrene (BaP)	0.0414	mg/kg	5.6E-09	mg/kg-day	7.3E+00	1/(mg/kg-day)	4.1E-08	4.4E-09	mg/kg-day	NA	--	--
				Benzo(b)fluoranthene	0.297	mg/kg	4.0E-08	mg/kg-day	7.3E-01	1/(mg/kg-day)	3.0E-08	3.1E-08	mg/kg-day	NA	--	--
				Benzo(k)fluoranthene	0.290	mg/kg	4.0E-08	mg/kg-day	7.3E-02	1/(mg/kg-day)	2.9E-09	3.1E-08	mg/kg-day	NA	--	--
				Chrysene	0.465	mg/kg	6.3E-08	mg/kg-day	7.3E-03	1/(mg/kg-day)	4.6E-10	4.9E-08	mg/kg-day	NA	--	--
				Dibenz(a,h)anthracene	0.0920	mg/kg	1.3E-08	mg/kg-day	7.3E+00	1/(mg/kg-day)	9.1E-08	9.7E-09	mg/kg-day	NA	--	--
				Indeno(1,2,3-cd)pyrene	0.0288	mg/kg	3.9E-09	mg/kg-day	7.3E-01	1/(mg/kg-day)	2.9E-09	3.0E-09	mg/kg-day	NA	--	--
				Antimony	1.14	mg/kg	1.2E-06	mg/kg-day	NA	--	--	9.3E-09	mg/kg-day	6.0E-05	mg/kg-day	1.5E-04
				Arsenic	1.39	mg/kg	4.2E-06	mg/kg-day	1.5E+00	1/(mg/kg-day)	6.4E-06	3.4E-08	mg/kg-day	3.0E-04	mg/kg-day	1.1E-04
				Cobalt	29.8	mg/kg	3.0E-05	mg/kg-day	NA	--	--	2.4E-07	mg/kg-day	3.0E-04	mg/kg-day	8.1E-04
				Lead	537	mg/kg	5.5E-04	mg/kg-day	NA	--	--	4.4E-06	mg/kg-day	NA	--	--
				Thallium	0.133	mg/kg	1.4E-07	mg/kg-day	NA	--	--	1.1E-09	mg/kg-day	1.0E-05	mg/kg-day	1.1E-04
				Vanadium	186	mg/kg	1.9E-04	mg/kg-day	NA	--	--	1.5E-06	mg/kg-day	1.3E-04	mg/kg-day	1.2E-02
			Dermal Total								6.5E-06					1.3E-02
		Exposure Point Total									6.9E-06					4.5E-02
	Exposure Medium Total										6.9E-06					4.5E-02

TABLE 7.1.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Receptor Population: Trespassers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
	Air	Fugative Dust	Inhalation													
				Methyl Iodide	0.00369	mg/kg	1.1E-14	mg/m3	NA	--	--	9.7E-14	mg/m3	NA	--	--
				Propionitrile (Ethyl Cyanide)	0.00810	mg/kg	2.4E-14	mg/m3	NA	--	--	2.1E-13	mg/m3	NA	--	--
				Benzo(a)anthracene	0.0130	mg/kg	6.6E-14	mg/m3	1.1E-04	1/(µg/m3)	7.3E-15	3.4E-13	mg/m3	NA	--	--
				Benzo(a)pyrene (BaP)	0.0414	mg/kg	2.1E-13	mg/m3	1.1E-03	1/(µg/m3)	2.3E-13	1.1E-12	mg/m3	NA	--	--
				Benzo(b)fluoranthene	0.297	mg/kg	1.5E-12	mg/m3	1.1E-04	1/(µg/m3)	1.7E-13	7.8E-12	mg/m3	NA	--	--
				Benzo(k)fluoranthene	0.290	mg/kg	1.5E-12	mg/m3	1.1E-04	1/(µg/m3)	1.6E-13	7.6E-12	mg/m3	NA	--	--
				Chrysene	0.465	mg/kg	2.4E-12	mg/m3	1.1E-05	1/(µg/m3)	2.6E-14	1.2E-11	mg/m3	NA	--	--
				Dibenz(a,h)anthracene	0.0920	mg/kg	4.7E-13	mg/m3	1.2E-03	1/(µg/m3)	5.6E-13	2.4E-12	mg/m3	NA	--	--
				Indeno(1,2,3-cd)pyrene	0.0288	mg/kg	1.5E-13	mg/m3	1.1E-04	1/(µg/m3)	1.6E-14	7.5E-13	mg/m3	NA	--	--
				Antimony	1.14	mg/kg	3.4E-12	mg/m3	NA	--	--	3.0E-11	mg/m3	NA	--	--
				Arsenic	1.39	mg/kg	4.2E-12	mg/m3	4.3E-03	1/(µg/m3)	1.8E-11	3.6E-11	mg/m3	1.5E-05	mg/m3	2.4E-06
				Cobalt	29.8	mg/kg	8.9E-11	mg/m3	9.0E-03	1/(µg/m3)	8.0E-10	7.8E-10	mg/m3	6.0E-06	mg/m3	1.3E-04
				Lead	537	mg/kg	1.6E-09	mg/m3	NA	--	--	1.4E-08	mg/m3	NA	--	--
				Thallium	0.133	mg/kg	4.0E-13	mg/m3	NA	--	--	3.5E-12	mg/m3	NA	--	--
				Vanadium	186	mg/kg	5.6E-10	mg/m3	NA	--	--	4.9E-09	mg/m3	1.0E-04	mg/m3	4.9E-05
			Inhalation Total								8.2E-10					1.8E-04
		Exposure Point Total									8.2E-10					1.8E-04
	Exposure Medium Total										8.2E-10					1.8E-04
Soil Total											6.9E-06					4.5E-02
Surface Water	Surface Water	Surface Water	Ingestion													
				Bromodichloromethane	0.00034	mg/kg	2.4E-09	mg/kg-day	6.2E-02	1/(mg/kg-day)	1.5E-10	6.9E-09	mg/kg-day	2.0E-02	mg/kg-day	3.5E-07
				Chloroform	0.00120	mg/kg	8.4E-09	mg/kg-day	3.1E-02	1/(mg/kg-day)	2.6E-10	2.4E-08	mg/kg-day	1.0E-02	mg/kg-day	2.4E-06
				Dibromochloromethane	0.00016	mg/kg	1.1E-09	mg/kg-day	8.4E-02	1/(mg/kg-day)	9.4E-11	3.3E-09	mg/kg-day	2.0E-02	mg/kg-day	1.6E-07
				Arsenic	0.00049	mg/kg	3.4E-09	mg/kg-day	1.5E+00	1/(mg/kg-day)	5.1E-09	1.0E-08	mg/kg-day	3.0E-04	mg/kg-day	3.3E-05
				Vanadium	0.00760	mg/kg	5.3E-08	mg/kg-day	NA	--	--	1.5E-07	mg/kg-day	5.0E-03	mg/kg-day	3.1E-05
			Ingestion Total								5.6E-09					6.7E-05
			Dermal													
				Bromodichloromethane	0.00034	mg/kg	1.1E-08	mg/kg-day	6.2E-02	1/(mg/kg-day)	6.7E-10	3.2E-08	mg/kg-day	2.0E-02	mg/kg-day	1.6E-06
				Chloroform	0.00120	mg/kg	6.5E-08	mg/kg-day	3.1E-02	1/(mg/kg-day)	2.0E-09	1.9E-07	mg/kg-day	1.0E-02	mg/kg-day	1.9E-05
				Dibromochloromethane	0.00016	mg/kg	3.7E-09	mg/kg-day	8.4E-02	1/(mg/kg-day)	3.1E-10	1.1E-08	mg/kg-day	2.0E-02	mg/kg-day	5.4E-07
				Arsenic	0.00049	mg/kg	3.9E-09	mg/kg-day	1.5E+00	1/(mg/kg-day)	5.8E-09	1.1E-08	mg/kg-day	3.0E-04	mg/kg-day	3.8E-05
				Vanadium	0.00760	mg/kg	6.0E-08	mg/kg-day	NA	--	--	1.8E-07	mg/kg-day	1.3E-04	mg/kg-day	1.4E-03
			Dermal Total								8.9E-09					1.4E-03
		Exposure Point Total									1.4E-08					1.5E-03
	Exposure Medium Total										1.4E-08					1.5E-03
Surface Water Total											1.4E-08					1.5E-03

TABLE 7.1.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Receptor Population: Trespassers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Sediment	Sediment	Sediment	Ingestion													
				Arsenic	1.50	mg/kg	1.0E-07	mg/kg-day	1.5E+00	1/(mg/kg-day)	1.6E-07	3.1E-07	mg/kg-day	3.0E-04	mg/kg-day	1.0E-03
				Cobalt	31.9	mg/kg	2.2E-06	mg/kg-day	NA	--	--	6.5E-06	mg/kg-day	3.0E-04	mg/kg-day	2.2E-02
				Thallium	0.140	mg/kg	9.8E-09	mg/kg-day	NA	--	--	2.8E-08	mg/kg-day	1.0E-05	mg/kg-day	2.8E-03
				Vanadium	232	mg/kg	1.6E-05	mg/kg-day	NA	--	--	4.7E-05	mg/kg-day	5.0E-03	mg/kg-day	9.4E-03
			Ingestion Total								1.6E-07					3.5E-02
			Dermal													
				Arsenic	1.50	mg/kg	5.4E-08	mg/kg-day	1.5E+00	1/(mg/kg-day)	8.1E-08	1.6E-07	mg/kg-day	3.0E-04	mg/kg-day	5.2E-04
				Cobalt	31.9	mg/kg	3.8E-07	mg/kg-day	NA	--	--	1.1E-06	mg/kg-day	3.0E-04	mg/kg-day	3.7E-03
				Thallium	0.140	mg/kg	1.7E-09	mg/kg-day	NA	--	--	4.9E-09	mg/kg-day	1.0E-05	mg/kg-day	4.9E-04
				Vanadium	232	mg/kg	2.8E-06	mg/kg-day	NA	--	--	8.1E-06	mg/kg-day	1.3E-04	mg/kg-day	6.2E-02
			Dermal Total								8.1E-08					6.7E-02
		Exposure Point Total									2.4E-07					1.0E-01
	Exposure Medium Total										2.4E-07					1.0E-01
Sediment Total											2.4E-07					1.0E-01
										Total of Receptor Risks Across All Media	7.1E-06	Total of Receptor Hazards Across All Media				1.5E-01

TABLE 7.2.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Receptor Population: Trespassers
Receptor Age: Youth

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Soil	Ingestion													
				Methyl Iodide	0.00369	mg/kg	1.8E-10	mg/kg-day	NA	--	--	1.2E-09	mg/kg-day	NA	--	--
				Propionitrile (Ethyl Cyanide	0.00810	mg/kg	4.0E-10	mg/kg-day	NA	--	--	2.6E-09	mg/kg-day	NA	--	--
				Benzo(a)anthracene	0.0130	mg/kg	1.9E-09	mg/kg-day	7.3E-01	1/(mg/kg-day)	1.4E-09	4.1E-09	mg/kg-day	NA	--	--
				Benzo(a)pyrene (BaP)	0.0414	mg/kg	6.2E-09	mg/kg-day	7.3E+00	1/(mg/kg-day)	4.5E-08	1.3E-08	mg/kg-day	NA	--	--
				Benzo(b)fluoranthene	0.297	mg/kg	4.4E-08	mg/kg-day	7.3E-01	1/(mg/kg-day)	3.2E-08	9.4E-08	mg/kg-day	NA	--	--
				Benzo(k)fluoranthene	0.290	mg/kg	4.3E-08	mg/kg-day	7.3E-02	1/(mg/kg-day)	3.2E-09	9.2E-08	mg/kg-day	NA	--	--
				Chrysene	0.465	mg/kg	6.9E-08	mg/kg-day	7.3E-03	1/(mg/kg-day)	5.1E-10	1.5E-07	mg/kg-day	NA	--	--
				Dibenz(a,h)anthracene	0.0920	mg/kg	1.4E-08	mg/kg-day	7.3E+00	1/(mg/kg-day)	1.0E-07	2.9E-08	mg/kg-day	NA	--	--
				Indeno(1,2,3-cd)pyrene	0.0288	mg/kg	4.3E-09	mg/kg-day	7.3E-01	1/(mg/kg-day)	3.1E-09	9.1E-09	mg/kg-day	NA	--	--
				Antimony	1.14	mg/kg	5.7E-08	mg/kg-day	NA	--	--	3.6E-07	mg/kg-day	4.0E-04	mg/kg-day	9.0E-04
				Arsenic	1.39	mg/kg	6.9E-08	mg/kg-day	1.5E+00	1/(mg/kg-day)	1.0E-07	4.4E-07	mg/kg-day	3.0E-04	mg/kg-day	1.5E-03
				Cobalt	29.8	mg/kg	1.5E-06	mg/kg-day	NA	--	--	9.4E-06	mg/kg-day	3.0E-04	mg/kg-day	3.1E-02
				Lead	537	mg/kg	2.7E-05	mg/kg-day	NA	--	--	1.7E-04	mg/kg-day	NA	--	--
				Thallium	0.133	mg/kg	6.6E-09	mg/kg-day	NA	--	--	4.2E-08	mg/kg-day	1.0E-05	mg/kg-day	4.2E-03
				Vanadium	186	mg/kg	9.3E-06	mg/kg-day	NA	--	--	5.9E-05	mg/kg-day	5.0E-03	mg/kg-day	1.2E-02
			Ingestion Total								2.9E-07					5.0E-02
			Dermal													
				Methyl Iodide	0.00369	mg/kg	1.2E-09	mg/kg-day	NA	--	--	7.5E-09	mg/kg-day	NA	--	--
				Propionitrile (Ethyl Cyanide	0.00810	mg/kg	2.6E-09	mg/kg-day	NA	--	--	1.6E-08	mg/kg-day	NA	--	--
				Benzo(a)anthracene	0.0130	mg/kg	1.6E-09	mg/kg-day	7.3E-01	1/(mg/kg-day)	1.2E-09	3.4E-09	mg/kg-day	NA	--	--
				Benzo(a)pyrene (BaP)	0.0414	mg/kg	5.1E-09	mg/kg-day	7.3E+00	1/(mg/kg-day)	3.8E-08	1.1E-08	mg/kg-day	NA	--	--
				Benzo(b)fluoranthene	0.297	mg/kg	3.7E-08	mg/kg-day	7.3E-01	1/(mg/kg-day)	2.7E-08	7.8E-08	mg/kg-day	NA	--	--
				Benzo(k)fluoranthene	0.290	mg/kg	3.6E-08	mg/kg-day	7.3E-02	1/(mg/kg-day)	2.6E-09	7.6E-08	mg/kg-day	NA	--	--
				Chrysene	0.465	mg/kg	5.8E-08	mg/kg-day	7.3E-03	1/(mg/kg-day)	4.2E-10	1.2E-07	mg/kg-day	NA	--	--
				Dibenz(a,h)anthracene	0.0920	mg/kg	1.1E-08	mg/kg-day	7.3E+00	1/(mg/kg-day)	8.3E-08	2.4E-08	mg/kg-day	NA	--	--
				Indeno(1,2,3-cd)pyrene	0.0288	mg/kg	3.6E-09	mg/kg-day	7.3E-01	1/(mg/kg-day)	2.6E-09	7.6E-09	mg/kg-day	NA	--	--
				Antimony	1.14	mg/kg	3.6E-09	mg/kg-day	NA	--	--	2.3E-08	mg/kg-day	6.0E-05	mg/kg-day	3.8E-04
				Arsenic	1.39	mg/kg	1.3E-08	mg/kg-day	1.5E+00	1/(mg/kg-day)	2.0E-08	8.4E-08	mg/kg-day	3.0E-04	mg/kg-day	2.8E-04
				Cobalt	29.8	mg/kg	9.5E-08	mg/kg-day	NA	--	--	6.0E-07	mg/kg-day	3.0E-04	mg/kg-day	2.0E-03
				Lead	537	mg/kg	1.7E-06	mg/kg-day	NA	--	--	1.1E-05	mg/kg-day	NA	--	--
				Thallium	0.133	mg/kg	4.2E-10	mg/kg-day	NA	--	--	2.7E-09	mg/kg-day	1.0E-05	mg/kg-day	2.7E-04
				Vanadium	186	mg/kg	5.9E-07	mg/kg-day	NA	--	--	3.8E-06	mg/kg-day	1.3E-04	mg/kg-day	2.9E-02
			Dermal Total								1.7E-07					3.2E-02
		Exposure Point Total									4.6E-07					8.2E-02
	Exposure Medium Total										4.6E-07					8.2E-02

TABLE 7.2.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Receptor Population: Trespassers
Receptor Age: Youth

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
	Air	Fugative Dust	Inhalation													
				Methyl Iodide	0.00369	mg/kg	5.1E-15	mg/m3	NA	--	--	3.2E-14	mg/m3	NA	--	--
				Propionitrile (Ethyl Cyanide	0.00810	mg/kg	1.1E-14	mg/m3	NA	--	--	7.1E-14	mg/m3	NA	--	--
				Benzo(a)anthracene	0.0130	mg/kg	5.3E-14	mg/m3	1.1E-04	1/(µg/m3)	5.9E-15	1.1E-13	mg/m3	NA	--	--
				Benzo(a)pyrene (BaP)	0.0414	mg/kg	1.7E-13	mg/m3	1.1E-03	1/(µg/m3)	1.9E-13	3.6E-13	mg/m3	NA	--	--
				Benzo(b)fluoranthene	0.297	mg/kg	1.2E-12	mg/m3	1.1E-04	1/(µg/m3)	1.3E-13	2.6E-12	mg/m3	NA	--	--
				Benzo(k)fluoranthene	0.290	mg/kg	1.2E-12	mg/m3	1.1E-04	1/(µg/m3)	1.3E-13	2.5E-12	mg/m3	NA	--	--
				Chrysene	0.465	mg/kg	1.9E-12	mg/m3	1.1E-05	1/(µg/m3)	2.1E-14	4.1E-12	mg/m3	NA	--	--
				Dibenz(a,h)anthracene	0.0920	mg/kg	3.8E-13	mg/m3	1.2E-03	1/(µg/m3)	4.5E-13	8.0E-13	mg/m3	NA	--	--
				Indeno(1,2,3-cd)pyrene	0.0288	mg/kg	1.2E-13	mg/m3	1.1E-04	1/(µg/m3)	1.3E-14	2.5E-13	mg/m3	NA	--	--
				Antimony	1.14	mg/kg	1.6E-12	mg/m3	NA	--	--	1.0E-11	mg/m3	NA	--	--
				Arsenic	1.39	mg/kg	1.9E-12	mg/m3	4.3E-03	1/(µg/m3)	8.2E-12	1.2E-11	mg/m3	1.5E-05	mg/m3	8.1E-07
				Cobalt	29.8	mg/kg	4.1E-11	mg/m3	9.0E-03	1/(µg/m3)	3.7E-10	2.6E-10	mg/m3	6.0E-06	mg/m3	4.3E-05
				Lead	537	mg/kg	7.4E-10	mg/m3	NA	--	--	4.7E-09	mg/m3	NA	--	--
				Thallium	0.133	mg/kg	1.8E-13	mg/m3	NA	--	--	1.2E-12	mg/m3	NA	--	--
				Vanadium	186	mg/kg	2.6E-10	mg/m3	NA	--	--	1.6E-09	mg/m3	1.0E-04	mg/m3	1.6E-05
			Inhalation Total								3.8E-10					6.0E-05
		Exposure Point Total									3.8E-10					6.0E-05
	Exposure Medium Total										3.8E-10					6.0E-05
Soil Total											4.6E-07					8.2E-02
Surface Water	Surface Water	Surface Water	Ingestion													
				Bromodichloromethane	0.00034	mg/kg	1.7E-09	mg/kg-day	6.2E-02	1/(mg/kg-day)	1.0E-10	1.1E-08	mg/kg-day	2.0E-02	mg/kg-day	5.4E-07
				Chloroform	0.00120	mg/kg	6.0E-09	mg/kg-day	3.1E-02	1/(mg/kg-day)	1.9E-10	3.8E-08	mg/kg-day	1.0E-02	mg/kg-day	3.8E-06
				Dibromochloromethane	0.00016	mg/kg	8.0E-10	mg/kg-day	8.4E-02	1/(mg/kg-day)	6.7E-11	5.1E-09	mg/kg-day	2.0E-02	mg/kg-day	2.5E-07
				Arsenic	0.00049	mg/kg	2.4E-09	mg/kg-day	1.5E+00	1/(mg/kg-day)	3.7E-09	1.6E-08	mg/kg-day	3.0E-04	mg/kg-day	5.2E-05
				Vanadium	0.00760	mg/kg	3.8E-08	mg/kg-day	NA	--	--	2.4E-07	mg/kg-day	5.0E-03	mg/kg-day	4.8E-05
			Ingestion Total								4.0E-09					1.0E-04
			Dermal													
				Bromodichloromethane	0.00034	mg/kg	4.4E-09	mg/kg-day	6.2E-02	1/(mg/kg-day)	2.7E-10	2.8E-08	mg/kg-day	2.0E-02	mg/kg-day	1.4E-06
				Chloroform	0.00120	mg/kg	2.6E-08	mg/kg-day	3.1E-02	1/(mg/kg-day)	8.1E-10	1.7E-07	mg/kg-day	1.0E-02	mg/kg-day	1.7E-05
				Dibromochloromethane	0.00016	mg/kg	1.5E-09	mg/kg-day	8.4E-02	1/(mg/kg-day)	1.2E-10	9.4E-09	mg/kg-day	2.0E-02	mg/kg-day	4.7E-07
				Arsenic	0.00049	mg/kg	1.6E-09	mg/kg-day	1.5E+00	1/(mg/kg-day)	2.3E-09	9.9E-09	mg/kg-day	3.0E-04	mg/kg-day	3.3E-05
				Vanadium	0.00760	mg/kg	2.4E-08	mg/kg-day	NA	--	--	1.5E-07	mg/kg-day	1.3E-04	mg/kg-day	1.2E-03
			Dermal Total								3.5E-09					1.2E-03
		Exposure Point Total									7.6E-09					1.3E-03
	Exposure Medium Total										7.6E-09					1.3E-03
Surface Water Total											7.6E-09					1.3E-03

TABLE 7.2.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Receptor Population: Trespassers
Receptor Age: Youth

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Sediment	Sediment	Sediment	Ingestion													
				Arsenic	1.50	mg/kg	7.5E-08	mg/kg-day	1.5E+00	1/(mg/kg-day)	1.1E-07	4.7E-07	mg/kg-day	3.0E-04	mg/kg-day	1.6E-03
				Cobalt	31.9	mg/kg	1.6E-06	mg/kg-day	NA	--	--	1.0E-05	mg/kg-day	3.0E-04	mg/kg-day	3.4E-02
				Thallium	0.140	mg/kg	7.0E-09	mg/kg-day	NA	--	--	4.4E-08	mg/kg-day	1.0E-05	mg/kg-day	4.4E-03
				Vanadium	232	mg/kg	1.2E-05	mg/kg-day	NA	--	--	7.3E-05	mg/kg-day	5.0E-03	mg/kg-day	1.5E-02
			Ingestion Total								1.1E-07					5.4E-02
			Dermal													
				Arsenic	1.50	mg/kg	2.1E-08	mg/kg-day	1.5E+00	1/(mg/kg-day)	3.2E-08	1.4E-07	mg/kg-day	3.0E-04	mg/kg-day	4.6E-04
				Cobalt	31.9	mg/kg	1.5E-07	mg/kg-day	NA	--	--	9.7E-07	mg/kg-day	3.0E-04	mg/kg-day	3.2E-03
				Thallium	0.140	mg/kg	6.7E-10	mg/kg-day	NA	--	--	4.3E-09	mg/kg-day	1.0E-05	mg/kg-day	4.3E-04
				Vanadium	232	mg/kg	1.1E-06	mg/kg-day	NA	--	--	7.1E-06	mg/kg-day	1.3E-04	mg/kg-day	5.4E-02
			Dermal Total								3.2E-08					5.8E-02
		Exposure Point Total									1.4E-07					1.1E-01
	Exposure Medium Total										1.4E-07					1.1E-01
Sediment Total											1.4E-07					1.1E-01
Total of Receptor Risks Across All Media											6.2E-07	Total of Receptor Hazards Across All Media				2.0E-01

TABLE 7.3.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Receptor Population: On-Site Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Soil	Ingestion													
				Methyl Iodide	0.00369	mg/kg	1.3E-09	mg/kg-day	NA	--	--	3.6E-09	mg/kg-day	NA	--	--
				Propionitrile (Ethyl Cyanide	0.00810	mg/kg	2.8E-09	mg/kg-day	NA	--	--	7.9E-09	mg/kg-day	NA	--	--
				Benzo(a)anthracene	0.0130	mg/kg	4.5E-09	mg/kg-day	7.3E-01	1/(mg/kg-day)	3.3E-09	1.3E-08	mg/kg-day	NA	--	--
				Benzo(a)pyrene (BaP)	0.0414	mg/kg	1.4E-08	mg/kg-day	7.3E+00	1/(mg/kg-day)	1.1E-07	4.1E-08	mg/kg-day	NA	--	--
				Benzo(b)fluoranthene	0.297	mg/kg	1.0E-07	mg/kg-day	7.3E-01	1/(mg/kg-day)	7.6E-08	2.9E-07	mg/kg-day	NA	--	--
				Benzo(k)fluoranthene	0.290	mg/kg	1.0E-07	mg/kg-day	7.3E-02	1/(mg/kg-day)	7.4E-09	2.8E-07	mg/kg-day	NA	--	--
				Chrysene	0.465	mg/kg	1.6E-07	mg/kg-day	7.3E-03	1/(mg/kg-day)	1.2E-09	4.5E-07	mg/kg-day	NA	--	--
				Dibenz(a,h)anthracene	0.0920	mg/kg	3.2E-08	mg/kg-day	7.3E+00	1/(mg/kg-day)	2.3E-07	9.0E-08	mg/kg-day	NA	--	--
				Indeno(1,2,3-cd)pyrene	0.0288	mg/kg	1.0E-08	mg/kg-day	7.3E-01	1/(mg/kg-day)	7.3E-09	2.8E-08	mg/kg-day	NA	--	--
				Antimony	1.14	mg/kg	4.0E-07	mg/kg-day	NA	--	--	1.1E-06	mg/kg-day	4.0E-04	mg/kg-day	2.8E-03
				Arsenic	1.39	mg/kg	4.9E-07	mg/kg-day	1.5E+00	1/(mg/kg-day)	7.3E-07	1.4E-06	mg/kg-day	3.0E-04	mg/kg-day	4.5E-03
				Cobalt	29.8	mg/kg	1.0E-05	mg/kg-day	NA	--	--	2.9E-05	mg/kg-day	3.0E-04	mg/kg-day	9.7E-02
				Lead	537	mg/kg	1.9E-04	mg/kg-day	NA	--	--	5.3E-04	mg/kg-day	NA	--	--
				Thallium	0.133	mg/kg	4.6E-08	mg/kg-day	NA	--	--	1.3E-07	mg/kg-day	1.0E-05	mg/kg-day	1.3E-02
				Vanadium	186	mg/kg	6.5E-05	mg/kg-day	NA	--	--	1.8E-04	mg/kg-day	5.0E-03	mg/kg-day	3.6E-02
			Ingestion Total								1.2E-06					1.5E-01
			Dermal													
				Methyl Iodide	0.00369	mg/kg	8.5E-09	mg/kg-day	NA	--	--	2.4E-08	mg/kg-day	NA	--	--
				Propionitrile (Ethyl Cyanide	0.00810	mg/kg	1.9E-08	mg/kg-day	NA	--	--	5.2E-08	mg/kg-day	NA	--	--
				Benzo(a)anthracene	0.0130	mg/kg	3.9E-09	mg/kg-day	7.3E-01	1/(mg/kg-day)	2.8E-09	1.1E-08	mg/kg-day	NA	--	--
				Benzo(a)pyrene (BaP)	0.0414	mg/kg	1.2E-08	mg/kg-day	7.3E+00	1/(mg/kg-day)	9.1E-08	3.5E-08	mg/kg-day	NA	--	--
				Benzo(b)fluoranthene	0.297	mg/kg	8.9E-08	mg/kg-day	7.3E-01	1/(mg/kg-day)	6.5E-08	2.5E-07	mg/kg-day	NA	--	--
				Benzo(k)fluoranthene	0.290	mg/kg	8.7E-08	mg/kg-day	7.3E-02	1/(mg/kg-day)	6.3E-09	2.4E-07	mg/kg-day	NA	--	--
				Chrysene	0.465	mg/kg	1.4E-07	mg/kg-day	7.3E-03	1/(mg/kg-day)	1.0E-09	3.9E-07	mg/kg-day	NA	--	--
				Dibenz(a,h)anthracene	0.0920	mg/kg	2.8E-08	mg/kg-day	7.3E+00	1/(mg/kg-day)	2.0E-07	7.7E-08	mg/kg-day	NA	--	--
				Indeno(1,2,3-cd)pyrene	0.0288	mg/kg	8.6E-09	mg/kg-day	7.3E-01	1/(mg/kg-day)	6.3E-09	2.4E-08	mg/kg-day	NA	--	--
				Antimony	1.14	mg/kg	2.6E-08	mg/kg-day	NA	--	--	7.4E-08	mg/kg-day	6.0E-05	mg/kg-day	1.2E-03
				Arsenic	1.39	mg/kg	9.6E-08	mg/kg-day	1.5E+00	1/(mg/kg-day)	1.4E-07	2.7E-07	mg/kg-day	3.0E-04	mg/kg-day	9.0E-04
				Cobalt	29.8	mg/kg	6.9E-07	mg/kg-day	NA	--	--	1.9E-06	mg/kg-day	3.0E-04	mg/kg-day	6.4E-03
				Lead	537	mg/kg	1.2E-05	mg/kg-day	NA	--	--	3.5E-05	mg/kg-day	NA	--	--
				Thallium	0.133	mg/kg	3.1E-09	mg/kg-day	NA	--	--	8.6E-09	mg/kg-day	1.0E-05	mg/kg-day	8.6E-04
				Vanadium	186	mg/kg	4.3E-06	mg/kg-day	NA	--	--	1.2E-05	mg/kg-day	1.3E-04	mg/kg-day	9.2E-02
			Dermal Total								5.2E-07					1.0E-01
		Exposure Point Total									1.7E-06					2.6E-01
	Exposure Medium Total										1.7E-06					2.6E-01

TABLE 7.3.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Receptor Population: On-Site Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
	Air	Fugative Dust	Inhalation													
				Methyl Iodide	0.00369	mg/kg	2.2E-13	mg/m3	NA	--	--	6.2E-13	mg/m3	NA	--	--
				Propionitrile (Ethyl Cyanide	0.00810	mg/kg	4.9E-13	mg/m3	NA	--	--	1.4E-12	mg/m3	NA	--	--
				Benzo(a)anthracene	0.0130	mg/kg	5.9E-11	mg/m3	1.1E-04	1/(µg/m3)	6.5E-12	1.7E-10	mg/m3	NA	--	--
				Benzo(a)pyrene (BaP)	0.0414	mg/kg	9.8E-11	mg/m3	1.1E-03	1/(µg/m3)	1.1E-10	2.8E-10	mg/m3	NA	--	--
				Benzo(b)fluoranthene	0.297	mg/kg	1.2E-09	mg/m3	1.1E-04	1/(µg/m3)	1.3E-10	3.3E-09	mg/m3	NA	--	--
				Benzo(k)fluoranthene	0.290	mg/kg	5.4E-10	mg/m3	1.1E-04	1/(µg/m3)	5.9E-11	1.5E-09	mg/m3	NA	--	--
				Chrysene	0.465	mg/kg	1.4E-08	mg/m3	1.1E-05	1/(µg/m3)	1.5E-10	3.9E-08	mg/m3	NA	--	--
				Dibenz(a,h)anthracene	0.0920	mg/kg	9.2E-11	mg/m3	1.2E-03	1/(µg/m3)	1.1E-10	2.6E-10	mg/m3	NA	--	--
				Indeno(1,2,3-cd)pyrene	0.0288	mg/kg	3.0E-11	mg/m3	1.1E-04	1/(µg/m3)	3.3E-12	8.5E-11	mg/m3	NA	--	--
				Antimony	1.14	mg/kg	6.8E-11	mg/m3	NA	--	--	1.9E-10	mg/m3	NA	--	--
				Arsenic	1.39	mg/kg	8.3E-11	mg/m3	4.3E-03	1/(µg/m3)	3.6E-10	2.3E-10	mg/m3	1.5E-05	mg/m3	1.6E-05
				Cobalt	29.8	mg/kg	1.8E-09	mg/m3	9.0E-03	1/(µg/m3)	1.6E-08	5.0E-09	mg/m3	6.0E-06	mg/m3	8.3E-04
				Lead	537	mg/kg	3.2E-08	mg/m3	NA	--	--	9.0E-08	mg/m3	NA	--	--
				Thallium	0.133	mg/kg	8.0E-12	mg/m3	NA	--	--	2.2E-11	mg/m3	NA	--	--
				Vanadium	186	mg/kg	1.1E-08	mg/m3	NA	--	--	3.1E-08	mg/m3	1.0E-04	mg/m3	3.1E-04
			Inhalation Total								1.7E-08					1.2E-03
		Exposure Point Total									1.7E-08					1.2E-03
	Exposure Medium Total										1.7E-08					1.2E-03
Soil Total											1.7E-06					2.6E-01
Surface Water	Surface Water	Surface Water	Ingestion													
				Bromodichloromethane	0.00034	mg/kg	1.2E-08	mg/kg-day	6.2E-02	1/(mg/kg-day)	7.4E-10	3.3E-08	mg/kg-day	2.0E-02	mg/kg-day	1.7E-06
				Chloroform	0.00120	mg/kg	4.2E-08	mg/kg-day	3.1E-02	1/(mg/kg-day)	1.3E-09	1.2E-07	mg/kg-day	1.0E-02	mg/kg-day	1.2E-05
				Dibromochloromethane	0.00016	mg/kg	5.6E-09	mg/kg-day	8.4E-02	1/(mg/kg-day)	4.7E-10	1.6E-08	mg/kg-day	2.0E-02	mg/kg-day	7.8E-07
				Arsenic	0.00049	mg/kg	1.7E-08	mg/kg-day	1.5E+00	1/(mg/kg-day)	2.6E-08	4.8E-08	mg/kg-day	3.0E-04	mg/kg-day	1.6E-04
				Vanadium	0.00760	mg/kg	2.7E-07	mg/kg-day	NA	--	--	7.4E-07	mg/kg-day	5.0E-03	mg/kg-day	1.5E-04
			Ingestion Total								2.8E-08					3.2E-04
			Dermal													
				Bromodichloromethane	0.00034	mg/kg	3.2E-08	mg/kg-day	6.2E-02	1/(mg/kg-day)	2.0E-09	8.8E-08	mg/kg-day	2.0E-02	mg/kg-day	4.4E-06
				Chloroform	0.00120	mg/kg	1.9E-07	mg/kg-day	3.1E-02	1/(mg/kg-day)	5.9E-09	5.3E-07	mg/kg-day	1.0E-02	mg/kg-day	5.3E-05
				Dibromochloromethane	0.00016	mg/kg	1.1E-08	mg/kg-day	8.4E-02	1/(mg/kg-day)	9.0E-10	3.0E-08	mg/kg-day	2.0E-02	mg/kg-day	1.5E-06
				Arsenic	0.00049	mg/kg	1.1E-08	mg/kg-day	1.5E+00	1/(mg/kg-day)	1.7E-08	3.2E-08	mg/kg-day	3.0E-04	mg/kg-day	1.1E-04
				Vanadium	0.00760	mg/kg	1.8E-07	mg/kg-day	NA	--	--	4.9E-07	mg/kg-day	1.3E-04	mg/kg-day	3.8E-03
			Dermal Total								2.6E-08					3.9E-03
		Exposure Point Total									5.4E-08					4.3E-03
	Exposure Medium Total										5.4E-08					4.3E-03
Surface Water Total											5.4E-08					4.3E-03

TABLE 7.3.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Receptor Population: On-Site Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Sediment	Sediment	Sediment	Ingestion													
				Arsenic	1.50	mg/kg	5.2E-07	mg/kg-day	1.5E+00	1/(mg/kg-day)	7.9E-07	1.5E-06	mg/kg-day	3.0E-04	mg/kg-day	4.9E-03
				Cobalt	31.9	mg/kg	1.1E-05	mg/kg-day	NA	--	--	3.1E-05	mg/kg-day	3.0E-04	mg/kg-day	1.0E-01
				Thallium	0.140	mg/kg	4.9E-08	mg/kg-day	NA	--	--	1.4E-07	mg/kg-day	1.0E-05	mg/kg-day	1.4E-02
				Vanadium	232	mg/kg	8.1E-05	mg/kg-day	NA	--	--	2.3E-04	mg/kg-day	5.0E-03	mg/kg-day	4.5E-02
			Ingestion Total								7.9E-07					1.7E-01
			Dermal													
				Arsenic	1.50	mg/kg	1.6E-07	mg/kg-day	1.5E+00	1/(mg/kg-day)	2.3E-07	4.4E-07	mg/kg-day	3.0E-04	mg/kg-day	1.5E-03
				Cobalt	31.9	mg/kg	1.1E-06	mg/kg-day	NA	--	--	3.1E-06	mg/kg-day	3.0E-04	mg/kg-day	1.0E-02
				Thallium	0.140	mg/kg	4.8E-09	mg/kg-day	NA	--	--	1.4E-08	mg/kg-day	1.0E-05	mg/kg-day	1.4E-03
				Vanadium	232	mg/kg	8.0E-06	mg/kg-day	NA	--	--	2.2E-05	mg/kg-day	1.3E-04	mg/kg-day	1.7E-01
			Dermal Total								2.3E-07					1.9E-01
		Exposure Point Total									1.0E-06					3.5E-01
	Exposure Medium Total										1.0E-06					3.5E-01
Sediment Total											1.0E-06					3.5E-01
										Total of Receptor Risks Across All Media	2.8E-06	Total of Receptor Hazards Across All Media				6.2E-01

TABLE 7.4.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Soil	Ingestion													
				Methyl Iodide	0.00369	mg/kg	1.7E-09	mg/kg-day	NA	--	--	5.1E-09	mg/kg-day	NA	--	--
				Propionitrile (Ethyl Cyanide	0.00810	mg/kg	3.8E-09	mg/kg-day	NA	--	--	1.1E-08	mg/kg-day	NA	--	--
				Benzo(a)anthracene	0.0130	mg/kg	9.0E-08	mg/kg-day	7.3E-01	1/(mg/kg-day)	6.6E-08	1.8E-08	mg/kg-day	NA	--	--
				Benzo(a)pyrene (BaP)	0.0414	mg/kg	2.9E-07	mg/kg-day	7.3E+00	1/(mg/kg-day)	2.1E-06	5.7E-08	mg/kg-day	NA	--	--
				Benzo(b)fluoranthene	0.297	mg/kg	2.1E-06	mg/kg-day	7.3E-01	1/(mg/kg-day)	1.5E-06	4.1E-07	mg/kg-day	NA	--	--
				Benzo(k)fluoranthene	0.290	mg/kg	2.0E-06	mg/kg-day	7.3E-02	1/(mg/kg-day)	1.5E-07	4.0E-07	mg/kg-day	NA	--	--
				Chrysene	0.465	mg/kg	3.2E-06	mg/kg-day	7.3E-03	1/(mg/kg-day)	2.3E-08	6.4E-07	mg/kg-day	NA	--	--
				Dibenz(a,h)anthracene	0.0920	mg/kg	6.4E-07	mg/kg-day	7.3E+00	1/(mg/kg-day)	4.6E-06	1.3E-07	mg/kg-day	NA	--	--
				Indeno(1,2,3-cd)pyrene	0.0288	mg/kg	2.0E-07	mg/kg-day	7.3E-01	1/(mg/kg-day)	1.5E-07	3.9E-08	mg/kg-day	NA	--	--
				Antimony	1.14	mg/kg	5.4E-07	mg/kg-day	NA	--	--	1.6E-06	mg/kg-day	4.0E-04	mg/kg-day	3.9E-03
				Arsenic	1.39	mg/kg	6.5E-07	mg/kg-day	1.5E+00	1/(mg/kg-day)	9.8E-07	1.9E-06	mg/kg-day	3.0E-04	mg/kg-day	6.3E-03
				Cobalt	29.8	mg/kg	1.4E-05	mg/kg-day	NA	--	--	4.1E-05	mg/kg-day	3.0E-04	mg/kg-day	1.4E-01
				Lead	537	mg/kg	2.5E-04	mg/kg-day	NA	--	--	7.4E-04	mg/kg-day	NA	--	--
				Thallium	0.133	mg/kg	6.2E-08	mg/kg-day	NA	--	--	1.8E-07	mg/kg-day	1.0E-05	mg/kg-day	1.8E-02
				Vanadium	186	mg/kg	8.7E-05	mg/kg-day	NA	--	--	2.5E-04	mg/kg-day	5.0E-03	mg/kg-day	5.1E-02
			Ingestion Total								9.6E-06					2.2E-01
			Dermal													
				Methyl Iodide	0.00369	mg/kg	6.9E-09	mg/kg-day	NA	--	--	2.0E-08	mg/kg-day	NA	--	--
				Propionitrile (Ethyl Cyanide	0.00810	mg/kg	1.5E-08	mg/kg-day	NA	--	--	4.4E-08	mg/kg-day	NA	--	--
				Benzo(a)anthracene	0.0130	mg/kg	3.2E-08	mg/kg-day	7.3E-01	1/(mg/kg-day)	2.3E-08	9.2E-09	mg/kg-day	NA	--	--
				Benzo(a)pyrene (BaP)	0.0414	mg/kg	1.0E-07	mg/kg-day	7.3E+00	1/(mg/kg-day)	7.5E-07	2.9E-08	mg/kg-day	NA	--	--
				Benzo(b)fluoranthene	0.297	mg/kg	7.3E-07	mg/kg-day	7.3E-01	1/(mg/kg-day)	5.4E-07	2.1E-07	mg/kg-day	NA	--	--
				Benzo(k)fluoranthene	0.290	mg/kg	7.2E-07	mg/kg-day	7.3E-02	1/(mg/kg-day)	5.2E-08	2.1E-07	mg/kg-day	NA	--	--
				Chrysene	0.465	mg/kg	1.2E-06	mg/kg-day	7.3E-03	1/(mg/kg-day)	8.4E-09	3.3E-07	mg/kg-day	NA	--	--
				Dibenz(a,h)anthracene	0.0920	mg/kg	2.3E-07	mg/kg-day	7.3E+00	1/(mg/kg-day)	1.7E-06	6.5E-08	mg/kg-day	NA	--	--
				Indeno(1,2,3-cd)pyrene	0.0288	mg/kg	7.1E-08	mg/kg-day	7.3E-01	1/(mg/kg-day)	5.2E-08	2.0E-08	mg/kg-day	NA	--	--
				Antimony	1.14	mg/kg	2.1E-08	mg/kg-day	NA	--	--	6.2E-08	mg/kg-day	6.0E-05	mg/kg-day	1.0E-03
				Arsenic	1.39	mg/kg	7.8E-08	mg/kg-day	1.5E+00	1/(mg/kg-day)	1.2E-07	2.3E-07	mg/kg-day	3.0E-04	mg/kg-day	7.6E-04
				Cobalt	29.8	mg/kg	5.6E-07	mg/kg-day	NA	--	--	1.6E-06	mg/kg-day	3.0E-04	mg/kg-day	5.4E-03
				Lead	537	mg/kg	1.0E-05	mg/kg-day	NA	--	--	2.9E-05	mg/kg-day	NA	--	--
				Thallium	0.133	mg/kg	2.5E-09	mg/kg-day	NA	--	--	7.3E-09	mg/kg-day	1.0E-05	mg/kg-day	7.3E-04
				Vanadium	186	mg/kg	3.5E-06	mg/kg-day	NA	--	--	1.0E-05	mg/kg-day	1.3E-04	mg/kg-day	7.8E-02
			Dermal Total								3.2E-06					8.6E-02
		Exposure Point Total									1.3E-05					3.0E-01
	Exposure Medium Total										1.3E-05					3.0E-01

TABLE 7.4.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
	Air	Fugative Dust	Inhalation													
				Methyl Iodide	0.00369	mg/kg	3.0E-13	mg/m3	NA	--	--	2.6E-12	mg/m3	NA	--	--
				Propionitrile (Ethyl Cyanide	0.00810	mg/kg	6.5E-13	mg/m3	NA	--	--	5.7E-12	mg/m3	NA	--	--
				Benzo(a)anthracene	0.0130	mg/kg	9.2E-12	mg/m3	1.1E-04	1/(µg/m3)	1.0E-12	9.2E-12	mg/m3	NA	--	--
				Benzo(a)pyrene (BaP)	0.0414	mg/kg	2.9E-11	mg/m3	1.1E-03	1/(µg/m3)	3.2E-11	2.9E-11	mg/m3	NA	--	--
				Benzo(b)fluoranthene	0.297	mg/kg	2.1E-10	mg/m3	1.1E-04	1/(µg/m3)	2.3E-11	2.1E-10	mg/m3	NA	--	--
				Benzo(k)fluoranthene	0.290	mg/kg	2.0E-10	mg/m3	1.1E-04	1/(µg/m3)	2.2E-11	2.0E-10	mg/m3	NA	--	--
				Chrysene	0.465	mg/kg	3.3E-10	mg/m3	1.1E-05	1/(µg/m3)	3.6E-12	3.3E-10	mg/m3	NA	--	--
				Dibenz(a,h)anthracene	0.0920	mg/kg	6.5E-11	mg/m3	1.2E-03	1/(µg/m3)	7.8E-11	6.5E-11	mg/m3	NA	--	--
				Indeno(1,2,3-cd)pyrene	0.0288	mg/kg	2.0E-11	mg/m3	1.1E-04	1/(µg/m3)	2.2E-12	2.0E-11	mg/m3	NA	--	--
				Antimony	1.14	mg/kg	9.2E-11	mg/m3	NA	--	--	8.0E-10	mg/m3	NA	--	--
				Arsenic	1.39	mg/kg	1.1E-10	mg/m3	4.3E-03	1/(µg/m3)	4.8E-10	9.8E-10	mg/m3	1.5E-05	mg/m3	6.5E-05
				Cobalt	29.8	mg/kg	2.4E-09	mg/m3	9.0E-03	1/(µg/m3)	2.2E-08	2.1E-08	mg/m3	6.0E-06	mg/m3	3.5E-03
				Lead	537	mg/kg	4.3E-08	mg/m3	NA	--	--	3.8E-07	mg/m3	NA	--	--
				Thallium	0.133	mg/kg	1.1E-11	mg/m3	NA	--	--	9.4E-11	mg/m3	NA	--	--
				Vanadium	186	mg/kg	1.5E-08	mg/m3	NA	--	--	1.3E-07	mg/m3	1.0E-04	mg/m3	1.3E-03
			Inhalation Total								2.2E-08					4.9E-03
		Exposure Point Total									2.2E-08					4.9E-03
	Exposure Medium Total										2.2E-08					4.9E-03
Soil Total											1.3E-05					3.1E-01
Groundwater	Groundwater	Tap	Ingestion													
				Naphthalene	0.00130	mg/L	1.2E-05	mg/kg-day	NA	--	--	3.6E-05	mg/kg-day	2.0E-02	mg/kg-day	1.8E-03
				Arsenic	0.00620	mg/L	5.8E-05	mg/kg-day	1.5E+00	1/(mg/kg-day)	8.7E-05	1.7E-04	mg/kg-day	3.0E-04	mg/kg-day	5.7E-01
				Cadmium	0.00071	mg/L	6.7E-06	mg/kg-day	NA	--	--	1.9E-05	mg/kg-day	5.0E-04	mg/kg-day	3.9E-02
				Cobalt	0.00580	mg/L	5.4E-05	mg/kg-day	NA	--	--	1.6E-04	mg/kg-day	3.0E-04	mg/kg-day	5.3E-01
				Selenium	0.0242	mg/L	2.3E-04	mg/kg-day	NA	--	--	6.6E-04	mg/kg-day	5.0E-03	mg/kg-day	1.3E-01
				Vanadium	0.171	mg/L	1.6E-03	mg/kg-day	NA	--	--	4.7E-03	mg/kg-day	5.0E-03	mg/kg-day	9.4E-01
			Ingestion Total								8.7E-05					**2.2E+00**
			Dermal													
				Naphthalene	0.00130	mg/L	8.1E-06	mg/kg-day	NA	--	--	2.4E-05	mg/kg-day	2.0E-02	mg/kg-day	1.2E-03
				Arsenic	0.00620	mg/L	3.0E-07	mg/kg-day	1.5E+00	1/(mg/kg-day)	4.6E-07	8.9E-07	mg/kg-day	3.0E-04	mg/kg-day	3.0E-03
				Cadmium	0.00071	mg/L	3.5E-08	mg/kg-day	NA	--	--	1.0E-07	mg/kg-day	1.5E-05	mg/kg-day	6.8E-03
				Cobalt	0.00580	mg/L	1.1E-07	mg/kg-day	NA	--	--	3.3E-07	mg/kg-day	3.0E-04	mg/kg-day	1.1E-03
				Selenium	0.0242	mg/L	1.2E-06	mg/kg-day	NA	--	--	3.5E-06	mg/kg-day	5.0E-03	mg/kg-day	6.9E-04
				Vanadium	0.171	mg/L	8.4E-06	mg/kg-day	NA	--	--	2.4E-05	mg/kg-day	1.3E-04	mg/kg-day	1.9E-01
			Dermal Total								4.6E-07					2.0E-01
		Exposure Point Total									8.8E-05					**2.4E+00**
	Exposure Medium Total										8.8E-05					**2.4E+00**
Groundwater Total											8.8E-05					**2.4E+00**

TABLE 7.4.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Water	Surface Water	Surface Water	Ingestion													
				Bromodichloromethane	0.00034	mg/kg	2.4E-09	mg/kg-day	6.2E-02	1/(mg/kg-day)	1.5E-10	6.9E-09	mg/kg-day	2.0E-02	mg/kg-day	3.5E-07
				Chloroform	0.00120	mg/kg	8.4E-09	mg/kg-day	3.1E-02	1/(mg/kg-day)	2.6E-10	2.4E-08	mg/kg-day	1.0E-02	mg/kg-day	2.4E-06
				Dibromochloromethane	0.00016	mg/kg	1.1E-09	mg/kg-day	8.4E-02	1/(mg/kg-day)	9.4E-11	3.3E-09	mg/kg-day	2.0E-02	mg/kg-day	1.6E-07
				Arsenic	0.00049	mg/kg	3.4E-09	mg/kg-day	1.5E+00	1/(mg/kg-day)	5.1E-09	1.0E-08	mg/kg-day	3.0E-04	mg/kg-day	3.3E-05
				Vanadium	0.00760	mg/kg	5.3E-08	mg/kg-day	NA	--	--	1.5E-07	mg/kg-day	5.0E-03	mg/kg-day	3.1E-05
			Ingestion Total								5.6E-09					6.7E-05
			Dermal													
				Bromodichloromethane	0.00034	mg/kg	1.1E-08	mg/kg-day	6.2E-02	1/(mg/kg-day)	6.7E-10	3.2E-08	mg/kg-day	2.0E-02	mg/kg-day	1.6E-06
				Chloroform	0.00120	mg/kg	6.5E-08	mg/kg-day	3.1E-02	1/(mg/kg-day)	2.0E-09	1.9E-07	mg/kg-day	1.0E-02	mg/kg-day	1.9E-05
				Dibromochloromethane	0.00016	mg/kg	3.7E-09	mg/kg-day	8.4E-02	1/(mg/kg-day)	3.1E-10	1.1E-08	mg/kg-day	2.0E-02	mg/kg-day	5.4E-07
				Arsenic	0.00049	mg/kg	3.9E-09	mg/kg-day	1.5E+00	1/(mg/kg-day)	5.8E-09	1.1E-08	mg/kg-day	3.0E-04	mg/kg-day	3.8E-05
				Vanadium	0.00760	mg/kg	6.0E-08	mg/kg-day	NA	--	--	1.8E-07	mg/kg-day	1.3E-04	mg/kg-day	1.4E-03
			Dermal Total								8.9E-09					1.4E-03
		Exposure Point Total									1.4E-08					1.5E-03
	Exposure Medium Total										1.4E-08					1.5E-03
Surface Water Total											1.4E-08					1.5E-03
Sediment	Sediment	Sediment	Ingestion													
				Arsenic	1.50	mg/kg	1.0E-07	mg/kg-day	1.5E+00	1/(mg/kg-day)	1.6E-07	3.1E-07	mg/kg-day	3.0E-04	mg/kg-day	1.0E-03
				Cobalt	31.9	mg/kg	2.2E-06	mg/kg-day	NA	--	--	6.5E-06	mg/kg-day	3.0E-04	mg/kg-day	2.2E-02
				Thallium	0.140	mg/kg	9.8E-09	mg/kg-day	NA	--	--	2.8E-08	mg/kg-day	1.0E-05	mg/kg-day	2.8E-03
				Vanadium	232	mg/kg	1.6E-05	mg/kg-day	NA	--	--	4.7E-05	mg/kg-day	5.0E-03	mg/kg-day	9.4E-03
			Ingestion Total								1.6E-07					3.5E-02
			Dermal													
				Arsenic	1.50	mg/kg	5.4E-08	mg/kg-day	1.5E+00	1/(mg/kg-day)	8.1E-08	1.6E-07	mg/kg-day	3.0E-04	mg/kg-day	5.2E-04
				Cobalt	31.9	mg/kg	3.8E-07	mg/kg-day	NA	--	--	1.1E-06	mg/kg-day	3.0E-04	mg/kg-day	3.7E-03
				Thallium	0.140	mg/kg	1.7E-09	mg/kg-day	NA	--	--	4.9E-09	mg/kg-day	1.0E-05	mg/kg-day	4.9E-04
				Vanadium	232	mg/kg	2.8E-06	mg/kg-day	NA	--	--	8.1E-06	mg/kg-day	1.3E-04	mg/kg-day	6.2E-02
			Dermal Total								8.1E-08					6.7E-02
		Exposure Point Total									2.4E-07					1.0E-01
	Exposure Medium Total										2.4E-07					1.0E-01
Sediment Total											2.4E-07					1.0E-01
										Total of Receptor Risks Across All Media	**1.0E-04**				Total of Receptor Hazards Across All Media	**2.8E+00**

TABLE 7.5.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Young Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Soil	Ingestion													
				Methyl Iodide	0.00369	mg/kg	4.0E-09	mg/kg-day	NA	--	--	4.7E-08	mg/kg-day	NA	--	--
				Propionitrile (Ethyl Cyanide	0.00810	mg/kg	8.9E-09	mg/kg-day	NA	--	--	1.0E-07	mg/kg-day	NA	--	--
				Benzo(a)anthracene	0.0130	mg/kg	7.6E-08	mg/kg-day	7.3E-01	1/(mg/kg-day)	5.5E-08	1.7E-07	mg/kg-day	NA	--	--
				Benzo(a)pyrene (BaP)	0.0414	mg/kg	2.4E-07	mg/kg-day	7.3E+00	1/(mg/kg-day)	1.8E-06	5.3E-07	mg/kg-day	NA	--	--
				Benzo(b)fluoranthene	0.297	mg/kg	1.7E-06	mg/kg-day	7.3E-01	1/(mg/kg-day)	1.3E-06	3.8E-06	mg/kg-day	NA	--	--
				Benzo(k)fluoranthene	0.290	mg/kg	1.7E-06	mg/kg-day	7.3E-02	1/(mg/kg-day)	1.2E-07	3.7E-06	mg/kg-day	NA	--	--
				Chrysene	0.465	mg/kg	2.7E-06	mg/kg-day	7.3E-03	1/(mg/kg-day)	2.0E-08	5.9E-06	mg/kg-day	NA	--	--
				Dibenz(a,h)anthracene	0.0920	mg/kg	5.4E-07	mg/kg-day	7.3E+00	1/(mg/kg-day)	3.9E-06	1.2E-06	mg/kg-day	NA	--	--
				Indeno(1,2,3-cd)pyrene	0.0288	mg/kg	1.7E-07	mg/kg-day	7.3E-01	1/(mg/kg-day)	1.2E-07	3.7E-07	mg/kg-day	NA	--	--
				Antimony	1.14	mg/kg	1.2E-06	mg/kg-day	NA	--	--	1.5E-05	mg/kg-day	4.0E-04	mg/kg-day	3.6E-02
				Arsenic	1.39	mg/kg	1.5E-06	mg/kg-day	1.5E+00	1/(mg/kg-day)	2.3E-06	1.8E-05	mg/kg-day	3.0E-04	mg/kg-day	5.9E-02
				Cobalt	29.8	mg/kg	3.3E-05	mg/kg-day	NA	--	--	3.8E-04	mg/kg-day	3.0E-04	mg/kg-day	**1.3E+00**
				Lead	537	mg/kg	5.9E-04	mg/kg-day	NA	--	--	6.9E-03	mg/kg-day	NA	--	--
				Thallium	0.133	mg/kg	1.5E-07	mg/kg-day	NA	--	--	1.7E-06	mg/kg-day	1.0E-05	mg/kg-day	1.7E-01
				Vanadium	186	mg/kg	2.0E-04	mg/kg-day	NA	--	--	2.4E-03	mg/kg-day	5.0E-03	mg/kg-day	4.8E-01
			Ingestion Total								9.6E-06					**2.0E+00**
			Dermal													
				Methyl Iodide	0.00369	mg/kg	1.1E-08	mg/kg-day	NA	--	--	1.3E-07	mg/kg-day	NA	--	--
				Propionitrile (Ethyl Cyanide	0.00810	mg/kg	2.5E-08	mg/kg-day	NA	--	--	2.9E-07	mg/kg-day	NA	--	--
				Benzo(a)anthracene	0.0130	mg/kg	2.8E-08	mg/kg-day	7.3E-01	1/(mg/kg-day)	2.0E-08	6.1E-08	mg/kg-day	NA	--	--
				Benzo(a)pyrene (BaP)	0.0414	mg/kg	8.8E-08	mg/kg-day	7.3E+00	1/(mg/kg-day)	6.4E-07	1.9E-07	mg/kg-day	NA	--	--
				Benzo(b)fluoranthene	0.297	mg/kg	6.3E-07	mg/kg-day	7.3E-01	1/(mg/kg-day)	4.6E-07	1.4E-06	mg/kg-day	NA	--	--
				Benzo(k)fluoranthene	0.290	mg/kg	6.2E-07	mg/kg-day	7.3E-02	1/(mg/kg-day)	4.5E-08	1.3E-06	mg/kg-day	NA	--	--
				Chrysene	0.465	mg/kg	9.9E-07	mg/kg-day	7.3E-03	1/(mg/kg-day)	7.2E-09	2.2E-06	mg/kg-day	NA	--	--
				Dibenz(a,h)anthracene	0.0920	mg/kg	2.0E-07	mg/kg-day	7.3E+00	1/(mg/kg-day)	1.4E-06	4.3E-07	mg/kg-day	NA	--	--
				Indeno(1,2,3-cd)pyrene	0.0288	mg/kg	6.1E-08	mg/kg-day	7.3E-01	1/(mg/kg-day)	4.5E-08	1.3E-07	mg/kg-day	NA	--	--
				Antimony	1.14	mg/kg	3.5E-08	mg/kg-day	NA	--	--	4.1E-07	mg/kg-day	6.0E-05	mg/kg-day	6.8E-03
				Arsenic	1.39	mg/kg	1.3E-07	mg/kg-day	1.5E+00	1/(mg/kg-day)	1.9E-07	1.5E-06	mg/kg-day	3.0E-04	mg/kg-day	5.0E-03
				Cobalt	29.8	mg/kg	9.1E-07	mg/kg-day	NA	--	--	1.1E-05	mg/kg-day	3.0E-04	mg/kg-day	3.6E-02
				Lead	537	mg/kg	1.6E-05	mg/kg-day	NA	--	--	1.9E-04	mg/kg-day	NA	--	--
				Thallium	0.133	mg/kg	4.1E-09	mg/kg-day	NA	--	--	4.8E-08	mg/kg-day	1.0E-05	mg/kg-day	4.8E-03
				Vanadium	186	mg/kg	5.7E-06	mg/kg-day	NA	--	--	6.7E-05	mg/kg-day	1.3E-04	mg/kg-day	5.1E-01
			Dermal Total								2.8E-06					5.6E-01
		Exposure Point Total									1.2E-05					**2.6E+00**
	Exposure Medium Total										1.2E-05					**2.6E+00**

TABLE 7.5.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Young Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
	Air	Fugative Dust	Inhalation													
				Methyl Iodide	0.00369	mg/kg	7.4E-14	mg/m3	NA	--	--	2.6E-12	mg/m3	NA	--	--
				Propionitrile (Ethyl Cyanide	0.00810	mg/kg	1.6E-13	mg/m3	NA	--	--	5.7E-12	mg/m3	NA	--	--
				Benzo(a)anthracene	0.0130	mg/kg	4.2E-12	mg/m3	1.1E-04	1/(µg/m3)	4.6E-13	9.2E-12	mg/m3	NA	--	--
				Benzo(a)pyrene (BaP)	0.0414	mg/kg	1.3E-11	mg/m3	1.1E-03	1/(µg/m3)	1.5E-11	2.9E-11	mg/m3	NA	--	--
				Benzo(b)fluoranthene	0.297	mg/kg	9.6E-11	mg/m3	1.1E-04	1/(µg/m3)	1.1E-11	2.1E-10	mg/m3	NA	--	--
				Benzo(k)fluoranthene	0.290	mg/kg	9.3E-11	mg/m3	1.1E-04	1/(µg/m3)	1.0E-11	2.0E-10	mg/m3	NA	--	--
				Chrysene	0.465	mg/kg	1.5E-10	mg/m3	1.1E-05	1/(µg/m3)	1.6E-12	3.3E-10	mg/m3	NA	--	--
				Dibenz(a,h)anthracene	0.0920	mg/kg	3.0E-11	mg/m3	1.2E-03	1/(µg/m3)	3.6E-11	6.5E-11	mg/m3	NA	--	--
				Indeno(1,2,3-cd)pyrene	0.0288	mg/kg	9.3E-12	mg/m3	1.1E-04	1/(µg/m3)	1.0E-12	2.0E-11	mg/m3	NA	--	--
				Antimony	1.14	mg/kg	2.3E-11	mg/m3	NA	--	--	8.0E-10	mg/m3	NA	--	--
				Arsenic	1.39	mg/kg	2.8E-11	mg/m3	4.3E-03	1/(µg/m3)	1.2E-10	9.8E-10	mg/m3	1.5E-05	mg/m3	6.5E-05
				Cobalt	29.8	mg/kg	6.0E-10	mg/m3	9.0E-03	1/(µg/m3)	5.4E-09	2.1E-08	mg/m3	6.0E-06	mg/m3	3.5E-03
				Lead	537	mg/kg	1.1E-08	mg/m3	NA	--	--	3.8E-07	mg/m3	NA	--	--
				Thallium	0.133	mg/kg	2.7E-12	mg/m3	NA	--	--	9.4E-11	mg/m3	NA	--	--
				Vanadium	186	mg/kg	3.7E-09	mg/m3	NA	--	--	1.3E-07	mg/m3	1.0E-04	mg/m3	1.3E-03
			Inhalation Total								5.6E-09					4.9E-03
		Exposure Point Total									5.6E-09					4.9E-03
	Exposure Medium Total										5.6E-09					4.9E-03
Soil Total											1.2E-05					**2.6E+00**
Groundwater	Groundwater	Tap	Ingestion													
				Naphthalene	0.00130	mg/L	7.1E-06	mg/kg-day	NA	--	--	8.3E-05	mg/kg-day	2.0E-02	mg/kg-day	4.2E-03
				Arsenic	0.00620	mg/L	3.4E-05	mg/kg-day	1.5E+00	1/(mg/kg-day)	5.1E-05	4.0E-04	mg/kg-day	3.0E-04	mg/kg-day	**1.3E+00**
				Cadmium	0.00071	mg/L	3.9E-06	mg/kg-day	NA	--	--	4.5E-05	mg/kg-day	5.0E-04	mg/kg-day	9.1E-02
				Cobalt	0.00580	mg/L	3.2E-05	mg/kg-day	NA	--	--	3.7E-04	mg/kg-day	3.0E-04	mg/kg-day	**1.2E+00**
				Selenium	0.0242	mg/L	1.3E-04	mg/kg-day	NA	--	--	1.5E-03	mg/kg-day	5.0E-03	mg/kg-day	3.1E-01
				Vanadium	0.171	mg/L	9.4E-04	mg/kg-day	NA	--	--	1.1E-02	mg/kg-day	5.0E-03	mg/kg-day	**2.2E+00**
			Ingestion Total								5.1E-05					**5.1E+00**
			Dermal													
				Naphthalene	0.00130	mg/L	4.5E-06	mg/kg-day	NA	--	--	5.3E-05	mg/kg-day	2.0E-02	mg/kg-day	2.6E-03
				Arsenic	0.00620	mg/L	2.2E-07	mg/kg-day	1.5E+00	1/(mg/kg-day)	3.4E-07	2.6E-06	mg/kg-day	3.0E-04	mg/kg-day	8.7E-03
				Cadmium	0.00071	mg/L	2.6E-08	mg/kg-day	NA	--	--	3.0E-07	mg/kg-day	1.5E-05	mg/kg-day	2.0E-02
				Cobalt	0.00580	mg/L	8.4E-08	mg/kg-day	NA	--	--	9.8E-07	mg/kg-day	3.0E-04	mg/kg-day	3.3E-03
				Selenium	0.0242	mg/L	8.8E-07	mg/kg-day	NA	--	--	1.0E-05	mg/kg-day	5.0E-03	mg/kg-day	2.0E-03
				Vanadium	0.171	mg/L	6.2E-06	mg/kg-day	NA	--	--	7.2E-05	mg/kg-day	1.3E-04	mg/kg-day	5.5E-01
			Dermal Total								3.4E-07					5.9E-01
		Exposure Point Total									5.1E-05					**5.7E+00**
	Exposure Medium Total										5.1E-05					**5.7E+00**
Groundwater Total											5.1E-05					**5.7E+00**

TABLE 7.5.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Young Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Water	Surface Water	Surface Water	Ingestion													
				Bromodichloromethane	0.00034	mg/kg	2.8E-09	mg/kg-day	6.2E-02	1/(mg/kg-day)	1.7E-10	3.2E-08	mg/kg-day	2.0E-02	mg/kg-day	1.6E-06
				Chloroform	0.00120	mg/kg	9.8E-09	mg/kg-day	3.1E-02	1/(mg/kg-day)	3.0E-10	1.1E-07	mg/kg-day	1.0E-02	mg/kg-day	1.1E-05
				Dibromochloromethane	0.00016	mg/kg	1.3E-09	mg/kg-day	8.4E-02	1/(mg/kg-day)	1.1E-10	1.5E-08	mg/kg-day	2.0E-02	mg/kg-day	7.6E-07
				Arsenic	0.00049	mg/kg	4.0E-09	mg/kg-day	1.5E+00	1/(mg/kg-day)	6.0E-09	4.7E-08	mg/kg-day	3.0E-04	mg/kg-day	1.6E-04
				Vanadium	0.00760	mg/kg	6.2E-08	mg/kg-day	NA	--	--	7.2E-07	mg/kg-day	5.0E-03	mg/kg-day	1.4E-04
			Ingestion Total								6.6E-09					3.1E-04
			Dermal													
				Bromodichloromethane	0.00034	mg/kg	6.2E-09	mg/kg-day	6.2E-02	1/(mg/kg-day)	3.9E-10	7.3E-08	mg/kg-day	2.0E-02	mg/kg-day	3.6E-06
				Chloroform	0.00120	mg/kg	3.7E-08	mg/kg-day	3.1E-02	1/(mg/kg-day)	1.2E-09	4.4E-07	mg/kg-day	1.0E-02	mg/kg-day	4.4E-05
				Dibromochloromethane	0.00016	mg/kg	2.1E-09	mg/kg-day	8.4E-02	1/(mg/kg-day)	1.8E-10	2.5E-08	mg/kg-day	2.0E-02	mg/kg-day	1.2E-06
				Arsenic	0.00049	mg/kg	2.2E-09	mg/kg-day	1.5E+00	1/(mg/kg-day)	3.4E-09	2.6E-08	mg/kg-day	3.0E-04	mg/kg-day	8.7E-05
				Vanadium	0.00760	mg/kg	3.5E-08	mg/kg-day	NA	--	--	4.0E-07	mg/kg-day	1.3E-04	mg/kg-day	3.1E-03
			Dermal Total								5.1E-09					3.2E-03
		Exposure Point Total									1.2E-08					3.6E-03
	Exposure Medium Total										1.2E-08					3.6E-03
Surface Water Total											1.2E-08					3.6E-03
Sediment	Sediment	Sediment	Ingestion													
				Arsenic	1.50	mg/kg	2.4E-07	mg/kg-day	1.5E+00	1/(mg/kg-day)	3.7E-07	2.8E-06	mg/kg-day	3.0E-04	mg/kg-day	9.5E-03
				Cobalt	31.9	mg/kg	5.2E-06	mg/kg-day	NA	--	--	6.1E-05	mg/kg-day	3.0E-04	mg/kg-day	2.0E-01
				Thallium	0.140	mg/kg	2.3E-08	mg/kg-day	NA	--	--	2.7E-07	mg/kg-day	1.0E-05	mg/kg-day	2.7E-02
				Vanadium	232	mg/kg	3.8E-05	mg/kg-day	NA	--	--	4.4E-04	mg/kg-day	5.0E-03	mg/kg-day	8.8E-02
			Ingestion Total								3.7E-07					3.3E-01
			Dermal													
				Arsenic	1.50	mg/kg	3.1E-08	mg/kg-day	1.5E+00	1/(mg/kg-day)	4.6E-08	3.6E-07	mg/kg-day	3.0E-04	mg/kg-day	1.2E-03
				Cobalt	31.9	mg/kg	2.2E-07	mg/kg-day	NA	--	--	2.5E-06	mg/kg-day	3.0E-04	mg/kg-day	8.5E-03
				Thallium	0.140	mg/kg	9.6E-10	mg/kg-day	NA	--	--	1.1E-08	mg/kg-day	1.0E-05	mg/kg-day	1.1E-03
				Vanadium	232	mg/kg	1.6E-06	mg/kg-day	NA	--	--	1.9E-05	mg/kg-day	1.3E-04	mg/kg-day	1.4E-01
			Dermal Total								4.6E-08					1.5E-01
		Exposure Point Total									4.1E-07					4.8E-01
	Exposure Medium Total										4.1E-07					4.8E-01
Sediment Total											4.1E-07					4.8E-01
										Total of Receptor Risks Across All Media	6.4E-05	Total of Receptor Hazards Across All Media				**8.8E+00**

TABLE 7.6.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Industrial / Commercial Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Soil	Ingestion													
				Methyl Iodide	0.00369	mg/kg	1.3E-09	mg/kg-day	NA	--	--	3.6E-09	mg/kg-day	NA	--	--
				Propionitrile (Ethyl Cyanide	0.00810	mg/kg	2.8E-09	mg/kg-day	NA	--	--	7.9E-09	mg/kg-day	NA	--	--
				Benzo(a)anthracene	0.0130	mg/kg	4.5E-09	mg/kg-day	7.3E-01	1/(mg/kg-day)	3.3E-09	1.3E-08	mg/kg-day	NA	--	--
				Benzo(a)pyrene (BaP)	0.0414	mg/kg	1.4E-08	mg/kg-day	7.3E+00	1/(mg/kg-day)	1.1E-07	4.1E-08	mg/kg-day	NA	--	--
				Benzo(b)fluoranthene	0.297	mg/kg	1.0E-07	mg/kg-day	7.3E-01	1/(mg/kg-day)	7.6E-08	2.9E-07	mg/kg-day	NA	--	--
				Benzo(k)fluoranthene	0.290	mg/kg	1.0E-07	mg/kg-day	7.3E-02	1/(mg/kg-day)	7.4E-09	2.8E-07	mg/kg-day	NA	--	--
				Chrysene	0.465	mg/kg	1.6E-07	mg/kg-day	7.3E-03	1/(mg/kg-day)	1.2E-09	4.5E-07	mg/kg-day	NA	--	--
				Dibenz(a,h)anthracene	0.0920	mg/kg	3.2E-08	mg/kg-day	7.3E+00	1/(mg/kg-day)	2.3E-07	9.0E-08	mg/kg-day	NA	--	--
				Indeno(1,2,3-cd)pyrene	0.0288	mg/kg	1.0E-08	mg/kg-day	7.3E-01	1/(mg/kg-day)	7.3E-09	2.8E-08	mg/kg-day	NA	--	--
				Antimony	1.14	mg/kg	4.0E-07	mg/kg-day	NA	--	--	1.1E-06	mg/kg-day	4.0E-04	mg/kg-day	2.8E-03
				Arsenic	1.39	mg/kg	4.9E-07	mg/kg-day	1.5E+00	1/(mg/kg-day)	7.3E-07	1.4E-06	mg/kg-day	3.0E-04	mg/kg-day	4.5E-03
				Cobalt	29.8	mg/kg	1.0E-05	mg/kg-day	NA	--	--	2.9E-05	mg/kg-day	3.0E-04	mg/kg-day	9.7E-02
				Lead	537	mg/kg	1.9E-04	mg/kg-day	NA	--	--	5.3E-04	mg/kg-day	NA	--	--
				Thallium	0.133	mg/kg	4.6E-08	mg/kg-day	NA	--	--	1.3E-07	mg/kg-day	1.0E-05	mg/kg-day	1.3E-02
				Vanadium	186	mg/kg	6.5E-05	mg/kg-day	NA	--	--	1.8E-04	mg/kg-day	5.0E-03	mg/kg-day	3.6E-02
			Ingestion Total								1.2E-06					1.5E-01
			Dermal													
				Methyl Iodide	0.00369	mg/kg	8.5E-09	mg/kg-day	NA	--	--	2.4E-08	mg/kg-day	NA	--	--
				Propionitrile (Ethyl Cyanide	0.00810	mg/kg	1.9E-08	mg/kg-day	NA	--	--	5.2E-08	mg/kg-day	NA	--	--
				Benzo(a)anthracene	0.0130	mg/kg	3.9E-09	mg/kg-day	7.3E-01	1/(mg/kg-day)	2.8E-09	1.1E-08	mg/kg-day	NA	--	--
				Benzo(a)pyrene (BaP)	0.0414	mg/kg	1.2E-08	mg/kg-day	7.3E+00	1/(mg/kg-day)	9.1E-08	3.5E-08	mg/kg-day	NA	--	--
				Benzo(b)fluoranthene	0.297	mg/kg	8.9E-08	mg/kg-day	7.3E-01	1/(mg/kg-day)	6.5E-08	2.5E-07	mg/kg-day	NA	--	--
				Benzo(k)fluoranthene	0.290	mg/kg	8.7E-08	mg/kg-day	7.3E-02	1/(mg/kg-day)	6.3E-09	2.4E-07	mg/kg-day	NA	--	--
				Chrysene	0.465	mg/kg	1.4E-07	mg/kg-day	7.3E-03	1/(mg/kg-day)	1.0E-09	3.9E-07	mg/kg-day	NA	--	--
				Dibenz(a,h)anthracene	0.0920	mg/kg	2.8E-08	mg/kg-day	7.3E+00	1/(mg/kg-day)	2.0E-07	7.7E-08	mg/kg-day	NA	--	--
				Indeno(1,2,3-cd)pyrene	0.0288	mg/kg	8.6E-09	mg/kg-day	7.3E-01	1/(mg/kg-day)	6.3E-09	2.4E-08	mg/kg-day	NA	--	--
				Antimony	1.14	mg/kg	2.6E-08	mg/kg-day	NA	--	--	7.4E-08	mg/kg-day	6.0E-05	mg/kg-day	1.2E-03
				Arsenic	1.39	mg/kg	9.6E-08	mg/kg-day	1.5E+00	1/(mg/kg-day)	1.4E-07	2.7E-07	mg/kg-day	3.0E-04	mg/kg-day	9.0E-04
				Cobalt	29.8	mg/kg	6.9E-07	mg/kg-day	NA	--	--	1.9E-06	mg/kg-day	3.0E-04	mg/kg-day	6.4E-03
				Lead	537	mg/kg	1.2E-05	mg/kg-day	NA	--	--	3.5E-05	mg/kg-day	NA	--	--
				Thallium	0.133	mg/kg	3.1E-09	mg/kg-day	NA	--	--	8.6E-09	mg/kg-day	1.0E-05	mg/kg-day	8.6E-04
				Vanadium	186	mg/kg	4.3E-06	mg/kg-day	NA	--	--	1.2E-05	mg/kg-day	1.3E-04	mg/kg-day	9.2E-02
			Dermal Total								5.2E-07					1.0E-01
		Exposure Point Total									1.7E-06					2.6E-01
	Exposure Medium Total										1.7E-06					2.6E-01

TABLE 7.6.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Industrial / Commercial Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
	Air	Fugative Dust	Inhalation													
				Methyl Iodide	0.00369	mg/kg	2.2E-13	mg/m3	NA	--	--	6.2E-13	mg/m3	NA	--	--
				Propionitrile (Ethyl Cyanide	0.00810	mg/kg	4.9E-13	mg/m3	NA	--	--	1.4E-12	mg/m3	NA	--	--
				Benzo(a)anthracene	0.0130	mg/kg	7.8E-13	mg/m3	1.1E-04	1/(µg/m3)	8.6E-14	2.2E-12	mg/m3	NA	--	--
				Benzo(a)pyrene (BaP)	0.0414	mg/kg	2.5E-12	mg/m3	1.1E-03	1/(µg/m3)	2.7E-12	7.0E-12	mg/m3	NA	--	--
				Benzo(b)fluoranthene	0.297	mg/kg	1.8E-11	mg/m3	1.1E-04	1/(µg/m3)	2.0E-12	5.0E-11	mg/m3	NA	--	--
				Benzo(k)fluoranthene	0.290	mg/kg	1.7E-11	mg/m3	1.1E-04	1/(µg/m3)	1.9E-12	4.9E-11	mg/m3	NA	--	--
				Chrysene	0.465	mg/kg	2.8E-11	mg/m3	1.1E-05	1/(µg/m3)	3.1E-13	7.8E-11	mg/m3	NA	--	--
				Dibenz(a,h)anthracene	0.0920	mg/kg	5.5E-12	mg/m3	1.2E-03	1/(µg/m3)	6.6E-12	1.5E-11	mg/m3	NA	--	--
				Indeno(1,2,3-cd)pyrene	0.0288	mg/kg	1.7E-12	mg/m3	1.1E-04	1/(µg/m3)	1.9E-13	4.8E-12	mg/m3	NA	--	--
				Antimony	1.14	mg/kg	6.8E-11	mg/m3	NA	--	--	1.9E-10	mg/m3	NA	--	--
				Arsenic	1.39	mg/kg	8.3E-11	mg/m3	4.3E-03	1/(µg/m3)	3.6E-10	2.3E-10	mg/m3	1.5E-05	mg/m3	1.6E-05
				Cobalt	29.8	mg/kg	1.8E-09	mg/m3	9.0E-03	1/(µg/m3)	1.6E-08	5.0E-09	mg/m3	6.0E-06	mg/m3	8.3E-04
				Lead	537	mg/kg	3.2E-08	mg/m3	NA	--	--	9.0E-08	mg/m3	NA	--	--
				Thallium	0.133	mg/kg	8.0E-12	mg/m3	NA	--	--	2.2E-11	mg/m3	NA	--	--
				Vanadium	186	mg/kg	1.1E-08	mg/m3	NA	--	--	3.1E-08	mg/m3	1.0E-04	mg/m3	3.1E-04
			Inhalation Total								1.6E-08					1.2E-03
		Exposure Point Total									1.6E-08					1.2E-03
	Exposure Medium Total										1.6E-08					1.2E-03
Soil Total											1.7E-06					2.6E-01
Groundwater	Groundwater	Tap	Ingestion													
				Naphthalene	0.00130	mg/L	4.5E-06	mg/kg-day	NA	--	--	1.3E-05	mg/kg-day	2.0E-02	mg/kg-day	6.4E-04
				Arsenic	0.00620	mg/L	2.2E-05	mg/kg-day	1.5E+00	1/(mg/kg-day)	3.2E-05	6.1E-05	mg/kg-day	3.0E-04	mg/kg-day	2.0E-01
				Cadmium	0.00071	mg/L	2.5E-06	mg/kg-day	NA	--	--	6.9E-06	mg/kg-day	5.0E-04	mg/kg-day	1.4E-02
				Cobalt	0.00580	mg/L	2.0E-05	mg/kg-day	NA	--	--	5.7E-05	mg/kg-day	3.0E-04	mg/kg-day	1.9E-01
				Selenium	0.0242	mg/L	8.5E-05	mg/kg-day	NA	--	--	2.4E-04	mg/kg-day	5.0E-03	mg/kg-day	4.7E-02
				Vanadium	0.171	mg/L	6.0E-04	mg/kg-day	NA	--	--	1.7E-03	mg/kg-day	5.0E-03	mg/kg-day	3.3E-01
			Ingestion Total								3.2E-05					7.9E-01
		Exposure Point Total									3.2E-05					7.9E-01
	Exposure Medium Total										3.2E-05					7.9E-01
Groundwater Total											3.2E-05					7.9E-01
										Total of Receptor Risks Across All Media	3.4E-05	Total of Receptor Hazards Across All Media				**1.0E+00**

TABLE 7.7.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARD
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING ARE/
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICC

Scenario Timeframe: Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Soil	Ingestion													
				Methyl Iodide	0.00369	mg/kg	1.7E-10	mg/kg-day	NA	--	--	1.2E-08	mg/kg-day	NA	--	--
				Propionitrile (Ethyl Cyanid	0.00810	mg/kg	3.7E-10	mg/kg-day	NA	--	--	2.6E-08	mg/kg-day	NA	--	--
				Benzo(a)anthracene	0.0130	mg/kg	6.0E-10	mg/kg-day	7.3E-01	1/(mg/kg-day)	4.4E-10	4.2E-08	mg/kg-day	NA	--	--
				Benzo(a)pyrene (BaP)	0.0414	mg/kg	1.9E-09	mg/kg-day	7.3E+00	1/(mg/kg-day)	1.4E-08	1.3E-07	mg/kg-day	NA	--	--
				Benzo(b)fluoranthene	0.297	mg/kg	1.4E-08	mg/kg-day	7.3E-01	1/(mg/kg-day)	1.0E-08	9.6E-07	mg/kg-day	NA	--	--
				Benzo(k)fluoranthene	0.290	mg/kg	1.3E-08	mg/kg-day	7.3E-02	1/(mg/kg-day)	9.8E-10	9.4E-07	mg/kg-day	NA	--	--
				Chrysene	0.465	mg/kg	2.1E-08	mg/kg-day	7.3E-03	1/(mg/kg-day)	1.6E-10	1.5E-06	mg/kg-day	NA	--	--
				Dibenz(a,h)anthracene	0.0920	mg/kg	4.2E-09	mg/kg-day	7.3E+00	1/(mg/kg-day)	3.1E-08	3.0E-07	mg/kg-day	NA	--	--
				Indeno(1,2,3-cd)pyrene	0.0288	mg/kg	1.3E-09	mg/kg-day	7.3E-01	1/(mg/kg-day)	9.7E-10	9.3E-08	mg/kg-day	NA	--	--
				Antimony	1.14	mg/kg	5.3E-08	mg/kg-day	NA	--	--	3.7E-06	mg/kg-day	4.0E-04	mg/kg-day	9.2E-03
				Arsenic	1.39	mg/kg	6.4E-08	mg/kg-day	1.5E+00	1/(mg/kg-day)	9.6E-08	4.5E-06	mg/kg-day	3.0E-04	mg/kg-day	1.5E-02
				Cobalt	29.8	mg/kg	1.4E-06	mg/kg-day	NA	--	--	9.6E-05	mg/kg-day	3.0E-04	mg/kg-day	3.2E-01
				Lead	537	mg/kg	2.5E-05	mg/kg-day	NA	--	--	1.7E-03	mg/kg-day	NA	--	--
				Thallium	0.133	mg/kg	6.1E-09	mg/kg-day	NA	--	--	4.3E-07	mg/kg-day	1.0E-05	mg/kg-day	4.3E-02
				Vanadium	186	mg/kg	8.6E-06	mg/kg-day	NA	--	--	6.0E-04	mg/kg-day	5.0E-03	mg/kg-day	1.2E-01
			Ingestion Total								1.5E-07					5.1E-01
			Dermal													
				Methyl Iodide	0.00369	mg/kg	5.1E-10	mg/kg-day	NA	--	--	3.6E-08	mg/kg-day	NA	--	--
				Propionitrile (Ethyl Cyanid	0.00810	mg/kg	1.1E-09	mg/kg-day	NA	--	--	7.8E-08	mg/kg-day	NA	--	--
				Benzo(a)anthracene	0.0130	mg/kg	2.3E-10	mg/kg-day	7.3E-01	1/(mg/kg-day)	1.7E-10	1.6E-08	mg/kg-day	NA	--	--
				Benzo(a)pyrene (BaP)	0.0414	mg/kg	7.4E-10	mg/kg-day	7.3E+00	1/(mg/kg-day)	5.4E-09	5.2E-08	mg/kg-day	NA	--	--
				Benzo(b)fluoranthene	0.297	mg/kg	5.3E-09	mg/kg-day	7.3E-01	1/(mg/kg-day)	3.9E-09	3.7E-07	mg/kg-day	NA	--	--
				Benzo(k)fluoranthene	0.290	mg/kg	5.2E-09	mg/kg-day	7.3E-02	1/(mg/kg-day)	3.8E-10	3.7E-07	mg/kg-day	NA	--	--
				Chrysene	0.465	mg/kg	8.4E-09	mg/kg-day	7.3E-03	1/(mg/kg-day)	6.1E-11	5.9E-07	mg/kg-day	NA	--	--
				Dibenz(a,h)anthracene	0.0920	mg/kg	1.7E-09	mg/kg-day	7.3E+00	1/(mg/kg-day)	1.2E-08	1.2E-07	mg/kg-day	NA	--	--
				Indeno(1,2,3-cd)pyrene	0.0288	mg/kg	5.2E-10	mg/kg-day	7.3E-01	1/(mg/kg-day)	3.8E-10	3.6E-08	mg/kg-day	NA	--	--
				Antimony	1.14	mg/kg	1.6E-09	mg/kg-day	NA	--	--	1.1E-07	mg/kg-day	6.0E-05	mg/kg-day	1.8E-03
				Arsenic	1.39	mg/kg	5.8E-09	mg/kg-day	1.5E+00	1/(mg/kg-day)	8.7E-09	4.0E-07	mg/kg-day	3.0E-04	mg/kg-day	1.3E-03
				Cobalt	29.8	mg/kg	4.1E-08	mg/kg-day	NA	--	--	2.9E-06	mg/kg-day	3.0E-04	mg/kg-day	9.6E-03
				Lead	537	mg/kg	7.4E-07	mg/kg-day	NA	--	--	5.2E-05	mg/kg-day	NA	--	--
				Thallium	0.133	mg/kg	1.8E-10	mg/kg-day	NA	--	--	1.3E-08	mg/kg-day	1.0E-05	mg/kg-day	1.3E-03
				Vanadium	186	mg/kg	2.6E-07	mg/kg-day	NA	--	--	1.8E-05	mg/kg-day	1.3E-04	mg/kg-day	1.4E-01
			Dermal Total								3.1E-08					1.5E-01
		Exposure Point Total									1.8E-07					6.6E-01
	Exposure Medium Total										1.8E-07					6.6E-01

TABLE 7.7.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARD
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
	Air	Fugative Dust	Inhalation													
				Methyl Iodide	0.00369	mg/kg	4.2E-12	mg/m3	NA	--	--	2.9E-10	mg/m3	NA	--	--
				Propionitrile (Ethyl Cyanid	0.00810	mg/kg	9.2E-12	mg/m3	NA	--	--	6.4E-10	mg/m3	NA	--	--
				Benzo(a)anthracene	0.0130	mg/kg	1.5E-11	mg/m3	1.1E-04	1/(µg/m3)	1.6E-12	1.0E-09	mg/m3	NA	--	--
				Benzo(a)pyrene (BaP)	0.0414	mg/kg	4.7E-11	mg/m3	1.1E-03	1/(µg/m3)	5.1E-11	3.3E-09	mg/m3	NA	--	--
				Benzo(b)fluoranthene	0.297	mg/kg	3.4E-10	mg/m3	1.1E-04	1/(µg/m3)	3.7E-11	2.4E-08	mg/m3	NA	--	--
				Benzo(k)fluoranthene	0.290	mg/kg	3.3E-10	mg/m3	1.1E-04	1/(µg/m3)	3.6E-11	2.3E-08	mg/m3	NA	--	--
				Chrysene	0.465	mg/kg	5.3E-10	mg/m3	1.1E-05	1/(µg/m3)	5.8E-12	3.7E-08	mg/m3	NA	--	--
				Dibenz(a,h)anthracene	0.0920	mg/kg	1.0E-10	mg/m3	1.2E-03	1/(µg/m3)	1.2E-10	7.3E-09	mg/m3	NA	--	--
				Indeno(1,2,3-cd)pyrene	0.0288	mg/kg	3.3E-11	mg/m3	1.1E-04	1/(µg/m3)	3.6E-12	2.3E-09	mg/m3	NA	--	--
				Antimony	1.14	mg/kg	1.3E-09	mg/m3	NA	--	--	9.0E-08	mg/m3	NA	--	--
				Arsenic	1.39	mg/kg	1.6E-09	mg/m3	4.3E-03	1/(µg/m3)	6.8E-09	1.1E-07	mg/m3	1.5E-05	mg/m3	7.3E-03
				Cobalt	29.8	mg/kg	3.4E-08	mg/m3	9.0E-03	1/(µg/m3)	3.0E-07	2.4E-06	mg/m3	6.0E-06	mg/m3	3.9E-01
				Lead	537	mg/kg	6.1E-07	mg/m3	NA	--	--	4.2E-05	mg/m3	NA	--	--
				Thallium	0.133	mg/kg	1.5E-10	mg/m3	NA	--	--	1.1E-08	mg/m3	NA	--	--
				Vanadium	186	mg/kg	2.1E-07	mg/m3	NA	--	--	1.5E-05	mg/m3	1.0E-04	mg/m3	1.5E-01
			Inhalation Total								3.1E-07					5.5E-01
		Exposure Point Total									3.1E-07					5.5E-01
	Exposure Medium Total										3.1E-07					5.5E-01
Soil Total											4.9E-07					**1.2E+00**
Groundwater	Groundwater	Tap	Ingestion													
				Naphthalene	0.00130	mg/L	7.3E-10	mg/kg-day	NA	--	--	5.1E-08	mg/kg-day	2.0E-02	mg/kg-day	2.5E-06
				Arsenic	0.00620	mg/L	3.5E-09	mg/kg-day	1.5E+00	1/(mg/kg-day)	5.2E-09	2.4E-07	mg/kg-day	3.0E-04	mg/kg-day	8.1E-04
				Cadmium	0.00071	mg/L	4.0E-10	mg/kg-day	NA	--	--	2.8E-08	mg/kg-day	5.0E-04	mg/kg-day	5.6E-05
				Cobalt	0.00580	mg/L	3.2E-09	mg/kg-day	NA	--	--	2.3E-07	mg/kg-day	3.0E-04	mg/kg-day	7.6E-04
				Selenium	0.0242	mg/L	1.4E-08	mg/kg-day	NA	--	--	9.5E-07	mg/kg-day	5.0E-03	mg/kg-day	1.9E-04
				Vanadium	0.171	mg/L	9.6E-08	mg/kg-day	NA	--	--	6.7E-06	mg/kg-day	5.0E-03	mg/kg-day	1.3E-03
			Ingestion Total								5.2E-09					3.2E-03
			Dermal													
				Naphthalene	0.00130	mg/L	1.6E-08	mg/kg-day	NA	--	--	1.2E-06	mg/kg-day	2.0E-02	mg/kg-day	5.8E-05
				Arsenic	0.00620	mg/L	1.1E-09	mg/kg-day	1.5E+00	1/(mg/kg-day)	1.7E-09	8.0E-08	mg/kg-day	3.0E-04	mg/kg-day	2.7E-04
				Cadmium	0.00071	mg/L	1.3E-10	mg/kg-day	NA	--	--	9.2E-09	mg/kg-day	1.5E-05	mg/kg-day	6.1E-04
				Cobalt	0.00580	mg/L	4.3E-10	mg/kg-day	NA	--	--	3.0E-08	mg/kg-day	3.0E-04	mg/kg-day	1.0E-04
				Selenium	0.0242	mg/L	4.5E-09	mg/kg-day	NA	--	--	3.1E-07	mg/kg-day	5.0E-03	mg/kg-day	6.3E-05
				Vanadium	0.171	mg/L	3.2E-08	mg/kg-day	NA	--	--	2.2E-06	mg/kg-day	1.3E-04	mg/kg-day	1.7E-02
			Dermal Total								1.7E-09					1.8E-02
		Exposure Point Total									6.9E-09					2.1E-02
	Exposure Medium Total										6.9E-09					2.1E-02
Groundwater Total											6.9E-09					2.1E-02
										Total of Receptor Risks Across All Media	5.0E-07	Total of Receptor Hazards Across All Media				**1.2E+00**

TABLE 8.1.RME
CALCULATION OF RADIATION CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe:	
Receptor Population:	
Receptor Age:	

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF / Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD / RfC		Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
			Total													
NOT APPLICABLE																
			Total													
		Exposure Point Total														
	Exposure Medium Total															
			Total													
		Exposure Point Total														
	Exposure Medium Total															
Total																
Total of Receptor Risks Across All Media												Total of Receptor Hazards Across All Media				

TABLE 9.1.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Receptor Population: Trespassers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Soil											
			Methyl Iodide	--	--	--	--	--	NA	--	--	--	--
			Propionitrile (Ethyl Cyanide)	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)anthracene	1.6E-09	--	1.3E-09	--	2.9E-09	NA	--	--	--	--
			Benzo(a)pyrene (BaP)	5.2E-08	--	4.1E-08	--	9.3E-08	NA	--	--	--	--
			Benzo(b)fluoranthene	3.7E-08	--	3.0E-08	--	6.7E-08	NA	--	--	--	--
			Benzo(k)fluoranthene	3.7E-09	--	2.9E-09	--	6.5E-09	NA	--	--	--	--
			Chrysene	5.9E-10	--	4.6E-10	--	1.0E-09	NA	--	--	--	--
			Dibenz(a,h)anthracene	1.2E-07	--	9.1E-08	--	2.1E-07	NA	--	--	--	--
			Indeno(1,2,3-cd)pyrene	3.6E-09	--	2.9E-09	--	6.5E-09	NA	--	--	--	--
			Antimony	--	--	--	--	--	Whole Body, CVS	<0.01	--	<0.01	<0.01
			Arsenic	1.5E-07	--	6.4E-06	--	6.5E-06	Skin / CVS	<0.01	--	<0.01	<0.01
			Cobalt	--	--	--	--	--	CVS	0.02	--	<0.01	0.02
			Lead	--	--	--	--	--	NA	--	--	--	--
			Thallium	--	--	--	--	--	Liver / CVS / Skin	<0.01	--	<0.01	<0.01
			Vanadium	--	--	--	--	--	GIS / Kidney	<0.01	--	0.01	0.02
			Chemical Total	3.6E-07	--	6.5E-06	--	6.9E-06		0.03	--	0.01	0.04
		Exposure Point Total						6.9E-06					0.04
	Exposure Medium Total							6.9E-06					0.04
	Air	Fugative Dust											
			Methyl Iodide	--	--	--	--	--	NA	--	--	--	--
			Propionitrile (Ethyl Cyanide)	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)anthracene	--	7.3E-15	--	--	7.3E-15	NA	--	--	--	--
			Benzo(a)pyrene (BaP)	--	2.3E-13	--	--	2.3E-13	NA	--	--	--	--
			Benzo(b)fluoranthene	--	1.7E-13	--	--	1.7E-13	NA	--	--	--	--
			Benzo(k)fluoranthene	--	1.6E-13	--	--	1.6E-13	NA	--	--	--	--
			Chrysene	--	2.6E-14	--	--	2.6E-14	NA	--	--	--	--
			Dibenz(a,h)anthracene	--	5.6E-13	--	--	5.6E-13	NA	--	--	--	--
			Indeno(1,2,3-cd)pyrene	--	1.6E-14	--	--	1.6E-14	NA	--	--	--	--
			Antimony	--	--	--	--	--	NA	--	--	--	--
			Arsenic	--	1.8E-11	--	--	1.8E-11	NA	--	<0.01	--	<0.01
			Cobalt	--	8.0E-10	--	--	8.0E-10	RsS	--	<0.01	--	<0.01
			Lead	--	--	--	--	--	NA	--	--	--	--
			Thallium	--	--	--	--	--	NA	--	--	--	--
			Vanadium	--	--	--	--	--	NA	--	<0.01	--	<0.01
			Chemical Total	--	8.2E-10	--	--	8.2E-10		--	<0.01	--	<0.01
		Exposure Point Total						8.2E-10					<0.01
	Exposure Medium Total							8.2E-10					<0.01
Soil Total								**6.89E-06**					**0.04**

TABLE 9.1.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Receptor Population: Trespassers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Water	Surface Water	Surface Water	Bromodichloromethane	1.5E-10	--	6.7E-10	--	8.2E-10	Kidney	<0.01	--	<0.01	<0.01
			Chloroform	2.6E-10	--	2.0E-09	--	2.3E-09	Liver	<0.01	--	<0.01	<0.01
			Dibromochloromethane	9.4E-11	--	3.1E-10	--	4.0E-10	Liver	<0.01	--	<0.01	<0.01
			Arsenic	5.1E-09	--	5.8E-09	--	1.1E-08	Skin / CVS	<0.01	--	<0.01	<0.01
			Vanadium	--	--	--	--	--	GIS / Kidney	<0.01	--	<0.01	<0.01
			Chemical Total	5.6E-09	--	8.9E-09	--	1.4E-08		<0.01	--	<0.01	<0.01
		Exposure Point Total						1.4E-08					<0.01
	Exposure Medium Total							1.4E-08					<0.01
Surface Water Total								**1.45E-08**					**<0.01**
Sediment	Sediment	Sediment	Arsenic	1.6E-07	--	8.1E-08	--	2.4E-07	Skin / CVS	<0.01	--	<0.01	<0.01
			Cobalt	--	--	--	--	--	CVS	0.02	--	<0.01	0.03
			Thallium	--	--	--	--	--	Liver / CVS / Skin	<0.01	--	<0.01	<0.01
			Vanadium	--	--	--	--	--	GIS / Kidney	<0.01	--	0.06	0.07
			Chemical Total	1.6E-07	--	8.1E-08	--	2.4E-07		0.03	--	0.07	0.10
		Exposure Point Total						2.4E-07					0.10
	Exposure Medium Total							2.4E-07					0.10
Sediment Total								**2.38E-07**					**0.10**
Adult Trespassers Total								**7.14E-06**					**0.15**

Total Risk Across Soil	6.9E-06	Total Hazard Index Across Soil	0.04
Total Risk Across Surface Water	1.4E-08	l Hazard Index Across Surface Water	0.0
Total Risk Across Sediment	2.4E-07	Total Hazard Index Across Sediment	0.10
Total Risk Across All Media and All Exposure Routes	7.1E-06	oss All Media and All Exposure Routes	0.15

Notes:

Target Organ Abbreviations:
CVS = Cardiovascular System
GIS = Gastrointestinal System
RsS = Respiratory System

	Inhalation	Oral/Dermal	Total
Whole Body HI =		<0.01	<0.01
Gastrointestinal System HI =		0.09	0.09
Cardiovascular System HI =		0.06	0.06
Skin HI =		<0.01	<0.01
Kidney HI =		0.09	0.09
Liver HI =		<0.01	<0.01
Respiratory System HI =	<0.01		<0.01

TABLE 9.2.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Receptor Population: Trespassers
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Soil											
			Methyl Iodide	--	--	--	--	--	NA	--	--	--	--
			Propionitrile (Ethyl Cyanide)	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)anthracene	1.4E-09	--	1.2E-09	--	2.6E-09	NA	--	--	--	--
			Benzo(a)pyrene (BaP)	4.5E-08	--	3.8E-08	--	8.3E-08	NA	--	--	--	--
			Benzo(b)fluoranthene	3.2E-08	--	2.7E-08	--	5.9E-08	NA	--	--	--	--
			Benzo(k)fluoranthene	3.2E-09	--	2.6E-09	--	5.8E-09	NA	--	--	--	--
			Chrysene	5.1E-10	--	4.2E-10	--	9.3E-10	NA	--	--	--	--
			Dibenz(a,h)anthracene	1.0E-07	--	8.3E-08	--	1.8E-07	NA	--	--	--	--
			Indeno(1,2,3-cd)pyrene	3.1E-09	--	2.6E-09	--	5.7E-09	NA	--	--	--	--
			Antimony	--	--	--	--	--	Whole Body, CVS	<0.01	--	<0.01	<0.01
			Arsenic	1.0E-07	--	2.0E-08	--	1.2E-07	Skin / CVS	<0.01	--	<0.01	<0.01
			Cobalt	--	--	--	--	--	CVS	0.03	--	<0.01	0.03
			Lead	--	--	--	--	--	NA	--	--	--	--
			Thallium	--	--	--	--	--	Liver / CVS / Skin	<0.01	--	<0.01	<0.01
			Vanadium	--	--	--	--	--	GIS / Kidney	0.01	--	0.03	0.04
			Chemical Total	2.9E-07	--	1.7E-07	--	4.6E-07		0.05	--	0.03	0.08
		Exposure Point Total						4.6E-07					0.08
	Exposure Medium Total							4.6E-07					0.08
	Air	Fugative Dust											
			Methyl Iodide	--	--	--	--	--	NA	--	--	--	--
			Propionitrile (Ethyl Cyanide)	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)anthracene	--	5.9E-15	--	--	5.9E-15	NA	--	--	--	--
			Benzo(a)pyrene (BaP)	--	1.9E-13	--	--	1.9E-13	NA	--	--	--	--
			Benzo(b)fluoranthene	--	1.3E-13	--	--	1.3E-13	NA	--	--	--	--
			Benzo(k)fluoranthene	--	1.3E-13	--	--	1.3E-13	NA	--	--	--	--
			Chrysene	--	2.1E-14	--	--	2.1E-14	NA	--	--	--	--
			Dibenz(a,h)anthracene	--	4.5E-13	--	--	4.5E-13	NA	--	--	--	--
			Indeno(1,2,3-cd)pyrene	--	1.3E-14	--	--	1.3E-14	NA	--	--	--	--
			Antimony	--	--	--	--	--	NA	--	--	--	--
			Arsenic	--	8.2E-12	--	--	8.2E-12	NA	--	<0.01	--	<0.01
			Cobalt	--	3.7E-10	--	--	3.7E-10	RsS	--	<0.01	--	<0.01
			Lead	--	--	--	--	--	NA	--	--	--	--
			Thallium	--	--	--	--	--	NA	--	--	--	--
			Vanadium	--	--	--	--	--	NA	--	<0.01	--	<0.01
			Chemical Total	--	3.8E-10	--	--	3.8E-10		--	<0.01	--	<0.01
		Exposure Point Total						3.8E-10					<0.01
	Exposure Medium Total							3.8E-10					<0.01
Soil Total								**4.65E-07**					**0.08**

TABLE 9.2.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Receptor Population: Trespassers
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Water	Surface Water	Surface Water											
			Bromodichloromethane	1.0E-10	--	2.7E-10	--	3.7E-10	Kidney	<0.01	--	<0.01	<0.01
			Chloroform	1.9E-10	--	8.1E-10	--	9.9E-10	Liver	<0.01	--	<0.01	<0.01
			Dibromochloromethane	6.7E-11	--	1.2E-10	--	1.9E-10	Liver	<0.01	--	<0.01	<0.01
			Arsenic	3.7E-09	--	2.3E-09	--	6.0E-09	Skin / CVS	<0.01	--	<0.01	<0.01
			Vanadium	--	--	--	--	--	GIS / Kidney	<0.01	--	<0.01	<0.01
			Chemical Total	4.0E-09	--	3.5E-09	--	7.6E-09		<0.01	--	<0.01	<0.01
		Exposure Point Total						7.6E-09					<0.01
	Exposure Medium Total							7.6E-09					<0.01
Surface Water Total								**7.56E-09**					**<0.01**
Sediment	Sediment	Sediment											
			Arsenic	1.1E-07	--	3.2E-08	--	1.4E-07	Skin / CVS	<0.01	--	<0.01	<0.01
			Cobalt	--	--	--	--	--	CVS	0.03	--	<0.01	0.04
			Thallium	--	--	--	--	--	Liver / CVS / Skin	<0.01	--	<0.01	<0.01
			Vanadium	--	--	--	--	--	GIS / Kidney	0.01	--	0.05	0.07
			Chemical Total	1.1E-07	--	3.2E-08	--	1.4E-07		0.05	--	0.06	0.11
		Exposure Point Total						1.4E-07					0.11
	Exposure Medium Total							1.4E-07					0.11
Sediment Total								**1.44E-07**					**0.11**
Youth Trespassers Total								**6.16E-07**					**0.20**

Total Risk Across Soil	4.6E-07	Total Hazard Index Across Soil	0.08
Total Risk Across Surface Water	7.6E-09	l Hazard Index Across Surface Water	0.0
Total Risk Across Sediment	1.4E-07	Total Hazard Index Across Sediment	0.11
Total Risk Across All Media and All Exposure Routes	6.2E-07	oss All Media and All Exposure Routes	0.20

Notes:

Target Organ Abbreviations:
CVS = Cardiovascular System
GIS = Gastrointestinal System
RsS = Respiratory System

	Inhalation	Oral/Dermal	Total
Whole Body HI =		<0.01	<0.01
Gastrointestinal System HI =		0.11	0.11
Cardiovascular System HI =		0.08	0.08
Skin HI =		0.01	0.01
Kidney HI =		0.11	0.11
Liver HI =		<0.01	<0.01
Respiratory System HI =	<0.01		<0.01

TABLE 9.3.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Receptor Population: On-Site Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Soil											
			Methyl Iodide	--	--	--	--	--	NA	--	--	--	--
			Propionitrile (Ethyl Cyanide)	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)anthracene	3.3E-09	--	2.8E-09	--	6.2E-09	NA	--	--	--	--
			Benzo(a)pyrene (BaP)	1.1E-07	--	9.1E-08	--	2.0E-07	NA	--	--	--	--
			Benzo(b)fluoranthene	7.6E-08	--	6.5E-08	--	1.4E-07	NA	--	--	--	--
			Benzo(k)fluoranthene	7.4E-09	--	6.3E-09	--	1.4E-08	NA	--	--	--	--
			Chrysene	1.2E-09	--	1.0E-09	--	2.2E-09	NA	--	--	--	--
			Dibenz(a,h)anthracene	2.3E-07	--	2.0E-07	--	4.4E-07	NA	--	--	--	--
			Indeno(1,2,3-cd)pyrene	7.3E-09	--	6.3E-09	--	1.4E-08	NA	--	--	--	--
			Antimony	--	--	--	--	--	Whole Body, CVS	<0.01	--	<0.01	<0.01
			Arsenic	7.3E-07	--	1.4E-07	--	8.7E-07	Skin / CVS	<0.01	--	<0.01	<0.01
			Cobalt	--	--	--	--	--	CVS	0.10	--	<0.01	0.10
			Lead	--	--	--	--	--	NA	--	--	--	--
			Thallium	--	--	--	--	--	Liver / CVS / Skin	0.01	--	<0.01	0.01
			Vanadium	--	--	--	--	--	GIS / Kidney	0.04	--	0.09	0.13
			Chemical Total	1.2E-06	--	5.2E-07	--	1.7E-06		0.15	--	0.10	0.26
		Exposure Point Total						1.7E-06					0.26
	Exposure Medium Total							1.7E-06					0.26
	Air	Fugative Dust											
			Methyl Iodide	--	--	--	--	--	NA	--	--	--	--
			Propionitrile (Ethyl Cyanide)	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)anthracene	--	6.5E-12	--	--	6.5E-12	NA	--	--	--	--
			Benzo(a)pyrene (BaP)	--	1.1E-10	--	--	1.1E-10	NA	--	--	--	--
			Benzo(b)fluoranthene	--	1.3E-10	--	--	1.3E-10	NA	--	--	--	--
			Benzo(k)fluoranthene	--	5.9E-11	--	--	5.9E-11	NA	--	--	--	--
			Chrysene	--	1.5E-10	--	--	1.5E-10	NA	--	--	--	--
			Dibenz(a,h)anthracene	--	1.1E-10	--	--	1.1E-10	NA	--	--	--	--
			Indeno(1,2,3-cd)pyrene	--	3.3E-12	--	--	3.3E-12	NA	--	--	--	--
			Antimony	--	--	--	--	--	NA	--	--	--	--
			Arsenic	--	3.6E-10	--	--	3.6E-10	NA	--	<0.01	--	<0.01
			Cobalt	--	1.6E-08	--	--	1.6E-08	RsS	--	<0.01	--	<0.01
			Lead	--	--	--	--	--	NA	--	--	--	--
			Thallium	--	--	--	--	--	NA	--	--	--	--
			Vanadium	--	--	--	--	--	NA	--	<0.01	--	<0.01
			Chemical Total	--	1.7E-08	--	--	1.7E-08		--	<0.01	--	<0.01
		Exposure Point Total						1.7E-08					<0.01
	Exposure Medium Total							1.7E-08					<0.01
Soil Total								**1.70E-06**					**0.26**

TABLE 9.3.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Receptor Population: On-Site Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Water	Surface Water	Surface Water	Bromodichloromethane	7.4E-10	--	2.0E-09	--	2.7E-09	Kidney	<0.01	--	<0.01	<0.01
			Chloroform	1.3E-09	--	5.9E-09	--	7.2E-09	Liver	<0.01	--	<0.01	<0.01
			Dibromochloromethane	4.7E-10	--	9.0E-10	--	1.4E-09	Liver	<0.01	--	<0.01	<0.01
			Arsenic	2.6E-08	--	1.7E-08	--	4.3E-08	Skin / CVS	<0.01	--	<0.01	<0.01
			Vanadium	--	--	--	--	--	GIS / Kidney	<0.01	--	<0.01	<0.01
			Chemical Total	2.8E-08	--	2.6E-08	--	5.4E-08		<0.01	--	<0.01	<0.01
		Exposure Point Total						5.4E-08					<0.01
	Exposure Medium Total							5.4E-08					<0.01
Surface Water Total								**5.39E-08**					**<0.01**
Sediment	Sediment	Sediment	Arsenic	7.9E-07	--	2.3E-07	--	1.0E-06	Skin / CVS	<0.01	--	<0.01	<0.01
			Cobalt	--	--	--	--	--	CVS	0.10	--	0.01	0.11
			Thallium	--	--	--	--	--	Liver / CVS / Skin	0.01	--	<0.01	0.02
			Vanadium	--	--	--	--	--	GIS / Kidney	0.05	--	0.17	0.22
			Chemical Total	7.9E-07	--	2.3E-07	--	1.0E-06		0.17	--	0.19	0.35
		Exposure Point Total						1.0E-06					0.35
	Exposure Medium Total							1.0E-06					0.35
Sediment Total								**1.02E-06**					**0.35**
On-Site Workers Total								**2.77E-06**					**0.62**

Total Risk Across Soil	1.7E-06	Total Hazard Index Across Soil	0.26
Total Risk Across Surface Water	5.4E-08	l Hazard Index Across Surface Water	0.0
Total Risk Across Sediment	1.0E-06	Total Hazard Index Across Sediment	0.35
Total Risk Across All Media and All Exposure Routes	2.8E-06	oss All Media and All Exposure Routes	0.62

Notes:

Target Organ Abbreviations:
CVS = Cardiovascular System
GIS = Gastrointestinal System
RsS = Respiratory System

	Inhalation	Oral/Dermal	Total
Whole Body HI =		<0.01	<0.01
Gastrointestinal System HI =		0.35	0.35
Cardiovascular System HI =		0.26	0.26
Skin HI =		0.04	0.04
Kidney HI =		0.35	0.35
Liver HI =		0.03	0.03
Respiratory System HI =	<0.01		<0.01

TABLE 9.4.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Soil											
			Methyl Iodide	--	--	--	--	--	NA	--	--	--	--
			Propionitrile (Ethyl Cyanide)	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)anthracene	6.6E-08	--	2.3E-08	--	8.9E-08	NA	--	--	--	--
			Benzo(a)pyrene (BaP)	2.1E-06	--	7.5E-07	--	2.8E-06	NA	--	--	--	--
			Benzo(b)fluoranthene	1.5E-06	--	5.4E-07	--	2.0E-06	NA	--	--	--	--
			Benzo(k)fluoranthene	1.5E-07	--	5.2E-08	--	2.0E-07	NA	--	--	--	--
			Chrysene	2.3E-08	--	8.4E-09	--	3.2E-08	NA	--	--	--	--
			Dibenz(a,h)anthracene	4.6E-06	--	1.7E-06	--	6.3E-06	NA	--	--	--	--
			Indeno(1,2,3-cd)pyrene	1.5E-07	--	5.2E-08	--	2.0E-07	NA	--	--	--	--
			Antimony	--	--	--	--	--	Whole Body, CVS	<0.01	--	<0.01	<0.01
			Arsenic	9.8E-07	--	1.2E-07	--	1.1E-06	Skin / CVS	<0.01	--	<0.01	<0.01
			Cobalt	--	--	--	--	--	CVS	0.14	--	<0.01	0.14
			Lead	--	--	--	--	--	NA	--	--	--	--
			Thallium	--	--	--	--	--	Liver / CVS / Skin	0.02	--	<0.01	0.02
			Vanadium	--	--	--	--	--	GIS / Kidney	0.05	--	0.08	0.13
			Chemical Total	9.6E-06	--	3.2E-06	--	1.3E-05		0.22	--	0.09	0.30
		Exposure Point Total						1.3E-05					0.30
	Exposure Medium Total							1.3E-05					0.30
	Air	Fugative Dust											
			Methyl Iodide	--	--	--	--	--	NA	--	--	--	--
			Propionitrile (Ethyl Cyanide)	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)anthracene	--	1.0E-12	--	--	1.0E-12	NA	--	--	--	--
			Benzo(a)pyrene (BaP)	--	3.2E-11	--	--	3.2E-11	NA	--	--	--	--
			Benzo(b)fluoranthene	--	2.3E-11	--	--	2.3E-11	NA	--	--	--	--
			Benzo(k)fluoranthene	--	2.2E-11	--	--	2.2E-11	NA	--	--	--	--
			Chrysene	--	3.6E-12	--	--	3.6E-12	NA	--	--	--	--
			Dibenz(a,h)anthracene	--	7.8E-11	--	--	7.8E-11	NA	--	--	--	--
			Indeno(1,2,3-cd)pyrene	--	2.2E-12	--	--	2.2E-12	NA	--	--	--	--
			Antimony	--	--	--	--	--	NA	--	--	--	--
			Arsenic	--	4.8E-10	--	--	4.8E-10	NA	--	<0.01	--	<0.01
			Cobalt	--	2.2E-08	--	--	2.2E-08	RsS	--	<0.01	--	<0.01
			Lead	--	--	--	--	--	NA	--	--	--	--
			Thallium	--	--	--	--	--	NA	--	--	--	--
			Vanadium	--	--	--	--	--	NA	--	<0.01	--	<0.01
			Chemical Total	--	2.2E-08	--	--	2.2E-08		--	<0.01	--	<0.01
		Exposure Point Total						2.2E-08					<0.01
	Exposure Medium Total							2.2E-08					<0.01
Soil Total								**1.28E-05**					**0.31**

TABLE 9.4.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Tap											
			Naphthalene	--	--	--	--	--	Whole Body	<0.01	--	<0.01	<0.01
			Arsenic	8.7E-05	--	4.6E-07	--	8.8E-05	Skin / CVS	0.57	--	<0.01	0.57
			Cadmium	--	--	--	--	--	Kidney	0.04	--	<0.01	0.05
			Cobalt	--	--	--	--	--	CVS	0.53	--	<0.01	0.53
			Selenium	--	--	--	--	--	Skin	0.13	--	<0.01	0.13
			Vanadium	--	--	--	--	--	GIS / Kidney	0.94	--	0.19	**1.13**
			Chemical Total	8.7E-05	--	4.6E-07	--	8.8E-05		2.21	--	0.20	**2.41**
		Exposure Point Total						8.8E-05					**2.41**
	Exposure Medium Total							8.8E-05					**2.41**
Groundwater Total								**8.78E-05**					**2.41**
Surface Water	Surface Water	Surface Water											
			Bromodichloromethane	1.5E-10	--	6.7E-10	--	8.2E-10	Kidney	<0.01	--	<0.01	<0.01
			Chloroform	2.6E-10	--	2.0E-09	--	2.3E-09	Liver	<0.01	--	<0.01	<0.01
			Dibromochloromethane	9.4E-11	--	3.1E-10	--	4.0E-10	Liver	<0.01	--	<0.01	<0.01
			Arsenic	5.1E-09	--	5.8E-09	--	1.1E-08	Skin / CVS	<0.01	--	<0.01	<0.01
			Vanadium	--	--	--	--	--	GIS / Kidney	<0.01	--	<0.01	<0.01
			Chemical Total	5.6E-09	--	8.9E-09	--	1.4E-08		<0.01	--	<0.01	<0.01
		Exposure Point Total						1.4E-08					<0.01
	Exposure Medium Total							1.4E-08					<0.01
Surface Water Total								**1.45E-08**					**<0.01**
Sediment	Sediment	Sediment											
			Arsenic	1.6E-07	--	8.1E-08	--	2.4E-07	Skin / CVS	<0.01	--	<0.01	<0.01
			Cobalt	--	--	--	--	--	CVS	0.02	--	<0.01	0.03
			Thallium	--	--	--	--	--	Liver / CVS / Skin	<0.01	--	<0.01	<0.01
			Vanadium	--	--	--	--	--	GIS / Kidney	<0.01	--	0.06	0.07
			Chemical Total	1.6E-07	--	8.1E-08	--	2.4E-07		0.03	--	0.07	0.10
		Exposure Point Total						2.4E-07					0.10
	Exposure Medium Total							2.4E-07					0.10
Sediment Total								**2.38E-07**					**0.10**

TABLE 9.4.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Adult Residents Total								**1.01E-04**					**2.82**

Total Risk Across Soil	1.3E-05	Total Hazard Index Across Soil	0.31
Total Risk Across Groundwater	8.8E-05	tal Hazard Index Across Groundwater	**2.4**
Total Risk Across Surface Water	1.4E-08	l Hazard Index Across Surface Water	0.0
Total Risk Across Sediment	2.4E-07	Total Hazard Index Across Sediment	0.10
Total Risk Across All Media and All Exposure Routes	**1.0E-04**	oss All Media and All Exposure Routes	**2.8**

Notes:

Target Organ Abbreviations:
CVS = Cardiovascular System
GIS = Gastrointestinal System
RsS = Respiratory System

	Inhalation	Oral/Dermal	Total
Whole Body HI =		<0.01	<0.01
Gastrointestinal System HI =		**1.3**	**1.3**
Cardiovascular System HI =		**1.3**	**1.3**
Skin HI =		0.73	0.73
Kidney HI =		**1.4**	**1.4**
Liver HI =		0.02	0.02
Respiratory System HI =	<0.01		<0.01

TABLE 9.4.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total

TABLE 9.5.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Young Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Soil											
			Methyl Iodide	--	--	--	--	--	NA	--	--	--	--
			Propionitrile (Ethyl Cyanide)	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)anthracene	5.5E-08	--	2.0E-08	--	7.6E-08	NA	--	--	--	--
			Benzo(a)pyrene (BaP)	1.8E-06	--	6.4E-07	--	2.4E-06	NA	--	--	--	--
			Benzo(b)fluoranthene	1.3E-06	--	4.6E-07	--	1.7E-06	NA	--	--	--	--
			Benzo(k)fluoranthene	1.2E-07	--	4.5E-08	--	1.7E-07	NA	--	--	--	--
			Chrysene	2.0E-08	--	7.2E-09	--	2.7E-08	NA	--	--	--	--
			Dibenz(a,h)anthracene	3.9E-06	--	1.4E-06	--	5.4E-06	NA	--	--	--	--
			Indeno(1,2,3-cd)pyrene	1.2E-07	--	4.5E-08	--	1.7E-07	NA	--	--	--	--
			Antimony	--	--	--	--	--	Whole Body, CVS	0.04	--	<0.01	0.04
			Arsenic	2.3E-06	--	1.9E-07	--	2.5E-06	Skin / CVS	0.06	--	<0.01	0.06
			Cobalt	--	--	--	--	--	CVS	1.27	--	0.04	**1.31**
			Lead	--	--	--	--	--	NA	--	--	--	--
			Thallium	--	--	--	--	--	Liver / CVS / Skin	0.17	--	<0.01	0.17
			Vanadium	--	--	--	--	--	GIS / Kidney	0.48	--	0.51	0.99
			Chemical Total	9.6E-06	--	2.8E-06	--	1.2E-05		2.01	--	0.56	**2.58**
		Exposure Point Total						1.2E-05					**2.58**
	Exposure Medium Total							1.2E-05					**2.58**
	Air	Fugative Dust											
			Methyl Iodide	--	--	--	--	--	NA	--	--	--	--
			Propionitrile (Ethyl Cyanide)	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)anthracene	--	4.6E-13	--	--	4.6E-13	NA	--	--	--	--
			Benzo(a)pyrene (BaP)	--	1.5E-11	--	--	1.5E-11	NA	--	--	--	--
			Benzo(b)fluoranthene	--	1.1E-11	--	--	1.1E-11	NA	--	--	--	--
			Benzo(k)fluoranthene	--	1.0E-11	--	--	1.0E-11	NA	--	--	--	--
			Chrysene	--	1.6E-12	--	--	1.6E-12	NA	--	--	--	--
			Dibenz(a,h)anthracene	--	3.6E-11	--	--	3.6E-11	NA	--	--	--	--
			Indeno(1,2,3-cd)pyrene	--	1.0E-12	--	--	1.0E-12	NA	--	--	--	--
			Antimony	--	--	--	--	--	NA	--	--	--	--
			Arsenic	--	1.2E-10	--	--	1.2E-10	NA	--	<0.01	--	<0.01
			Cobalt	--	5.4E-09	--	--	5.4E-09	RsS	--	<0.01	--	<0.01
			Lead	--	--	--	--	--	NA	--	--	--	--
			Thallium	--	--	--	--	--	NA	--	--	--	--
			Vanadium	--	--	--	--	--	NA	--	<0.01	--	<0.01
			Chemical Total	--	5.6E-09	--	--	5.6E-09		--	<0.01	--	<0.01
		Exposure Point Total						5.6E-09					<0.01
	Exposure Medium Total							5.6E-09					<0.01
Soil Total								**1.24E-05**					**2.58**

TABLE 9.5.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Young Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Tap											
			Naphthalene	--	--	--	--	--	Whole Body	<0.01	--	<0.01	<0.01
			Arsenic	5.1E-05	--	3.4E-07	--	5.1E-05	Skin / CVS	1.32	--	<0.01	**1.33**
			Cadmium	--	--	--	--	--	Kidney	0.09	--	0.02	0.11
			Cobalt	--	--	--	--	--	CVS	1.24	--	<0.01	**1.24**
			Selenium	--	--	--	--	--	Skin	0.31	--	<0.01	0.31
			Vanadium	--	--	--	--	--	GIS / Kidney	2.19	--	0.55	**2.74**
			Chemical Total	5.1E-05	--	3.4E-07	--	5.1E-05		5.15	--	0.59	**5.74**
		Exposure Point Total						5.1E-05					**5.74**
	Exposure Medium Total							5.1E-05					**5.74**
Groundwater Total								**5.13E-05**					**5.74**
Surface Water	Surface Water	Surface Water											
			Bromodichloromethane	1.7E-10	--	3.9E-10	--	5.6E-10	Kidney	<0.01	--	<0.01	<0.01
			Chloroform	3.0E-10	--	1.2E-09	--	1.5E-09	Liver	<0.01	--	<0.01	<0.01
			Dibromochloromethane	1.1E-10	--	1.8E-10	--	2.9E-10	Liver	<0.01	--	<0.01	<0.01
			Arsenic	6.0E-09	--	3.4E-09	--	9.3E-09	Skin / CVS	<0.01	--	<0.01	<0.01
			Vanadium	--	--	--	--	--	GIS / Kidney	<0.01	--	<0.01	<0.01
			Chemical Total	6.6E-09	--	5.1E-09	--	1.2E-08		<0.01	--	<0.01	<0.01
		Exposure Point Total						1.2E-08					<0.01
	Exposure Medium Total							1.2E-08					<0.01
Surface Water Total								**1.16E-08**					**<0.01**
Sediment	Sediment	Sediment											
			Arsenic	3.7E-07	--	4.6E-08	--	4.1E-07	Skin / CVS	<0.01	--	<0.01	0.01
			Cobalt	--	--	--	--	--	CVS	0.20	--	<0.01	0.21
			Thallium	--	--	--	--	--	Liver / CVS / Skin	0.03	--	<0.01	0.03
			Vanadium	--	--	--	--	--	GIS / Kidney	0.09	--	0.14	0.23
			Chemical Total	3.7E-07	--	4.6E-08	--	4.1E-07		0.33	--	0.15	0.48
		Exposure Point Total						4.1E-07					0.48
	Exposure Medium Total							4.1E-07					0.48
Sediment Total								**4.12E-07**					**0.48**

TABLE 9.5.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Young Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Young Child Residents Total								**6.41E-05**					**8.80**

Total Risk Across Soil	1.2E-05	Total Hazard Index Across Soil	**2.6**
Total Risk Across Groundwater	5.1E-05	tal Hazard Index Across Groundwater	**5.7**
Total Risk Across Surface Water	1.2E-08	l Hazard Index Across Surface Water	0.0
Total Risk Across Sediment	4.1E-07	Total Hazard Index Across Sediment	0.48
Total Risk Across All Media and All Exposure Routes	6.4E-05	oss All Media and All Exposure Routes	**8.8**

Notes:

Target Organ Abbreviations:
CVS = Cardiovascular System
GIS = Gastrointestinal System
RsS = Respiratory System

	Inhalation	Oral/Dermal	Total
Whole Body HI =		0.05	0.05
Gastrointestinal System HI =		**4.0**	**4.0**
Cardiovascular System HI =		**4.4**	**4.4**
Skin HI =		**1.9**	**1.9**
Kidney HI =		**4.1**	**4.1**
Liver HI =		0.20	0.20
Respiratory System HI =	<0.01		<0.01

TABLE 9.6.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Industrial / Commercial Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Soil											
			Methyl Iodide	--	--	--	--	--	NA	--	--	--	--
			Propionitrile (Ethyl Cyanide)	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)anthracene	3.3E-09	--	2.8E-09	--	6.2E-09	NA	--	--	--	--
			Benzo(a)pyrene (BaP)	1.1E-07	--	9.1E-08	--	2.0E-07	NA	--	--	--	--
			Benzo(b)fluoranthene	7.6E-08	--	6.5E-08	--	1.4E-07	NA	--	--	--	--
			Benzo(k)fluoranthene	7.4E-09	--	6.3E-09	--	1.4E-08	NA	--	--	--	--
			Chrysene	1.2E-09	--	1.0E-09	--	2.2E-09	NA	--	--	--	--
			Dibenz(a,h)anthracene	2.3E-07	--	2.0E-07	--	4.4E-07	NA	--	--	--	--
			Indeno(1,2,3-cd)pyrene	7.3E-09	--	6.3E-09	--	1.4E-08	NA	--	--	--	--
			Antimony	--	--	--	--	--	Whole Body, CVS	<0.01	--	<0.01	<0.01
			Arsenic	7.3E-07	--	1.4E-07	--	8.7E-07	Skin / CVS	<0.01	--	<0.01	<0.01
			Cobalt	--	--	--	--	--	CVS	0.10	--	<0.01	0.10
			Lead	--	--	--	--	--	NA	--	--	--	--
			Thallium	--	--	--	--	--	Liver / CVS / Skin	0.01	--	<0.01	0.01
			Vanadium	--	--	--	--	--	GIS / Kidney	0.04	--	0.09	0.13
			Chemical Total	1.2E-06	--	5.2E-07	--	1.7E-06		0.15	--	0.10	0.26
		Exposure Point Total						1.7E-06					0.26
	Exposure Medium Total							1.7E-06					0.26
	Air	Fugative Dust											
			Methyl Iodide	--	--	--	--	--	NA	--	--	--	--
			Propionitrile (Ethyl Cyanide)	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)anthracene	--	8.6E-14	--	--	8.6E-14	NA	--	--	--	--
			Benzo(a)pyrene (BaP)	--	2.7E-12	--	--	2.7E-12	NA	--	--	--	--
			Benzo(b)fluoranthene	--	2.0E-12	--	--	2.0E-12	NA	--	--	--	--
			Benzo(k)fluoranthene	--	1.9E-12	--	--	1.9E-12	NA	--	--	--	--
			Chrysene	--	3.1E-13	--	--	3.1E-13	NA	--	--	--	--
			Dibenz(a,h)anthracene	--	6.6E-12	--	--	6.6E-12	NA	--	--	--	--
			Indeno(1,2,3-cd)pyrene	--	1.9E-13	--	--	1.9E-13	NA	--	--	--	--
			Antimony	--	--	--	--	--	NA	--	--	--	--
			Arsenic	--	3.6E-10	--	--	3.6E-10	NA	--	<0.01	--	<0.01
			Cobalt	--	1.6E-08	--	--	1.6E-08	RsS	--	<0.01	--	<0.01
			Lead	--	--	--	--	--	NA	--	--	--	--
			Thallium	--	--	--	--	--	NA	--	--	--	--
			Vanadium	--	--	--	--	--	NA	--	<0.01	--	<0.01
			Chemical Total	--	1.6E-08	--	--	1.6E-08		--	<0.01	--	<0.01
		Exposure Point Total						1.6E-08					<0.01
	Exposure Medium Total							1.6E-08					<0.01
Soil Total								**1.70E-06**					**0.26**

TABLE 9.6.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Industrial / Commercial Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Tap	Naphthalene	--	--	--	--	0.0E+00	Whole Body	<0.01	--	--	<0.01
			Arsenic	3.2E-05	--	--	--	3.2E-05	Skin / CVS	0.20	--	--	0.20
			Cadmium	--	--	--	--	0.0E+00	Kidney	0.01	--	--	0.01
			Cobalt	--	--	--	--	0.0E+00	CVS	0.19	--	--	0.19
			Selenium	--	--	--	--	0.0E+00	Skin	0.05	--	--	0.05
			Vanadium	--	--	--	--	0.0E+00	GIS / Kidney	0.33	--	--	0.33
			Chemical Total	3.2E-05	--	--	--	3.2E-05		0.79	--	--	0.79
		Exposure Point Total						3.2E-05					0.79
	Exposure Medium Total							3.2E-05					0.79
Groundwater Total								**3.25E-05**					**0.79**
Industrial / Commercial Workers Total								**3.42E-05**					**1.04**

Total Risk Across Soil	1.7E-06	Total Hazard Index Across Soil	0.26
Total Risk Across Groundwater	3.2E-05	tal Hazard Index Across Groundwater	0.79
Total Risk Across All Media and All Exposure Routes	3.4E-05	oss All Media and All Exposure Routes	**1.0**

Notes:

Target Organ Abbreviations:
CVS = Cardiovascular System
GIS = Gastrointestinal System
RsS = Respiratory System

	Inhalation	Oral/Dermal	Total
Whole Body HI =		<0.01	<0.01
Gastrointestinal System HI =		0.46	0.46
Cardiovascular System HI =		0.52	0.52
Skin HI =		0.27	0.27
Kidney HI =		0.48	0.48
Liver HI =		0.01	0.01
Respiratory System HI =	<0.01		<0.01

TABLE 9.7.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Soil											
			Methyl Iodide	--	--	--	--	--	NA	--	--	--	--
			Propionitrile (Ethyl Cyanide)	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)anthracene	4.4E-10	--	1.7E-10	--	6.1E-10	NA	--	--	--	--
			Benzo(a)pyrene (BaP)	1.4E-08	--	5.4E-09	--	1.9E-08	NA	--	--	--	--
			Benzo(b)fluoranthene	1.0E-08	--	3.9E-09	--	1.4E-08	NA	--	--	--	--
			Benzo(k)fluoranthene	9.8E-10	--	3.8E-10	--	1.4E-09	NA	--	--	--	--
			Chrysene	1.6E-10	--	6.1E-11	--	2.2E-10	NA	--	--	--	--
			Dibenz(a,h)anthracene	3.1E-08	--	1.2E-08	--	4.3E-08	NA	--	--	--	--
			Indeno(1,2,3-cd)pyrene	9.7E-10	--	3.8E-10	--	1.3E-09	NA	--	--	--	--
			Antimony	--	--	--	--	--	Whole Body, CVS	<0.01	--	<0.01	0.01
			Arsenic	9.6E-08	--	8.7E-09	--	1.0E-07	Skin / CVS	0.01	--	<0.01	0.02
			Cobalt	--	--	--	--	--	CVS	0.32	--	<0.01	0.33
			Lead	--	--	--	--	--	NA	--	--	--	--
			Thallium	--	--	--	--	--	Liver / CVS / Skin	0.04	--	<0.01	0.04
			Vanadium	--	--	--	--	--	GIS / Kidney	0.12	--	0.14	0.26
			Chemical Total	1.5E-07	--	3.1E-08	--	1.8E-07		0.51	--	0.15	0.66
		Exposure Point Total						1.8E-07					0.66
	Exposure Medium Total							1.8E-07					0.66
	Air	Fugative Dust											
			Methyl Iodide	--	--	--	--	--	NA	--	--	--	--
			Propionitrile (Ethyl Cyanide)	--	--	--	--	--	NA	--	--	--	--
			Benzo(a)anthracene	--	1.6E-12	--	--	1.6E-12	NA	--	--	--	--
			Benzo(a)pyrene (BaP)	--	5.1E-11	--	--	5.1E-11	NA	--	--	--	--
			Benzo(b)fluoranthene	--	3.7E-11	--	--	3.7E-11	NA	--	--	--	--
			Benzo(k)fluoranthene	--	3.6E-11	--	--	3.6E-11	NA	--	--	--	--
			Chrysene	--	5.8E-12	--	--	5.8E-12	NA	--	--	--	--
			Dibenz(a,h)anthracene	--	1.2E-10	--	--	1.2E-10	NA	--	--	--	--
			Indeno(1,2,3-cd)pyrene	--	3.6E-12	--	--	3.6E-12	NA	--	--	--	--
			Antimony	--	--	--	--	--	NA	--	--	--	--
			Arsenic	--	6.8E-09	--	--	6.8E-09	NA	--	<0.01	--	<0.01
			Cobalt	--	3.0E-07	--	--	3.0E-07	RsS	--	0.39	--	0.39
			Lead	--	--	--	--	--	NA	--	--	--	--
			Thallium	--	--	--	--	--	NA	--	--	--	--
			Vanadium	--	--	--	--	--	NA	--	0.15	--	0.15
			Chemical Total	--	3.1E-07	--	--	3.1E-07		--	0.55	--	0.55
		Exposure Point Total						3.1E-07					0.55
	Exposure Medium Total							3.1E-07					0.55
Soil Total								**4.95E-07**					**1.21**

TABLE 9.7.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Tap	Naphthalene	--	--	--	--	--	Whole Body	<0.01	--	<0.01	<0.01
			Arsenic	5.2E-09	--	1.7E-09	--	6.9E-09	Skin / CVS	<0.01	--	<0.01	<0.01
			Cadmium	--	--	--	--	--	Kidney	<0.01	--	<0.01	<0.01
			Cobalt	--	--	--	--	--	CVS	<0.01	--	<0.01	<0.01
			Selenium	--	--	--	--	--	Skin	<0.01	--	<0.01	<0.01
			Vanadium	--	--	--	--	--	GIS / Kidney	<0.01	--	0.02	0.02
			Chemical Total	5.2E-09	--	1.7E-09	--	6.9E-09		<0.01	--	0.02	0.02
		Exposure Point Total						6.9E-09					0.02
	Exposure Medium Total							6.9E-09					0.02
Groundwater Total								**6.92E-09**					**0.02**
Construction Workers Total								**5.02E-07**					**1.23**

Total Risk Across Soil	4.9E-07	Total Hazard Index Across Soil	**1.2**
Total Risk Across Groundwater	6.9E-09	tal Hazard Index Across Groundwater	0.02
Total Risk Across All Media and All Exposure Routes	5.0E-07	oss All Media and All Exposure Routes	**1.2**

Notes:

Target Organ Abbreviations:
CVS = Cardiovascular System
GIS = Gastrointestinal System
RsS = Respiratory System

	Inhalation	Oral/Dermal	Total
Whole Body HI =		0.01	0.01
Gastrointestinal System HI =		0.28	0.28
Cardiovascular System HI =		0.40	0.40
Skin HI =		0.06	0.06
Kidney HI =		0.28	0.28
Liver HI =		0.04	0.04
Respiratory System HI =	0.39		0.39

TABLE 10.1.RME
RISK ASSESSMENT SUMMARY
REASONABLE MAXIMUM EXPOSURE
SWMU 59 - FORMER VEHICLE MAINTENANCE AND REFUELING AREA
CORRECTIVE MEASURES STUDY REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Young Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Soil	Cobalt	--	--	--	--	--	CVS	1.27	--	0.04	**1.31**
			Chemical Total	--	--	--	--	--		1.27	--	0.04	**1.31**
		Exposure Point Total						--					**1.31**
	Exposure Medium Total							--					**1.31**
Soil Total								**--**					**1.31**
Groundwater	Groundwater	Tap	Arsenic	5.1E-05	--	3.4E-07	--	5.1E-05	Skin / CVS	1.32	--	<0.01	**1.33**
			Cobalt	--	--	--	--	--	CVS	1.24	--	<0.01	**1.24**
			Vanadium	--	--	--	--	--	GIS / Kidney	2.19	--	0.55	**2.74**
			Chemical Total	5.1E-05	--	3.4E-07	--	5.1E-05		4.74	--	0.57	**5.31**
		Exposure Point Total						5.1E-05					**5.31**
	Exposure Medium Total							5.1E-05					**5.31**
Groundwater Total								**5.13E-05**					**5.31**
Young Child Residents Total								**5.13E-05**					**6.62**

Total Risk Across Soil	--	Total Hazard Index Across Soil	**1.3**
Total Risk Across Groundwater	5.1E-05	tal Hazard Index Across Groundwater	**5.3**
Total Risk Across All Media and All Exposure Routes	5.1E-05	oss All Media and All Exposure Routes	**6.6**

Notes:
Target Organ Abbreviations:
CVS = Cardiovascular System
GIS = Gastrointestinal System

	Inhalation	Oral/Dermal	Total
Gastrointestinal System HI =		**2.7**	**2.7**
Cardiovascular System HI =		**3.9**	**3.9**
Skin HI =		**1.3**	**1.3**
Kidney HI =		**2.7**	**2.7**

APPENDIX T
BACKGROUND RISK CALCULATIONS

APPENDIX T
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
BACKGROUND
RISK EVALUATION OF BACKGROUND CONSTITUENTS
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Total Soil (Clay)
Exposure Medium: Total Soil (Clay)

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution) (1)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic (2)	Rationale (ProUCL)
Total Soil (Clay)	Cobalt	mg/kg	18.2	30.1 (NP)	78	30.1	mg/kg	95% UCL (NP)	95% KM (Chebyshev) UCL

Notes:

UCL = Upper Confidence Level

(1) Distribution and 95% UCL were calculated by ProUCL for data sets with greater than 8 samples and greater than 4 detections.
(NP) - Non-parametric distribution and 95% UCL

(2) Exposure point concentration statistic will be the 95% UCL (as calculated by ProUCL) or the maximum detected.

APPENDIX T
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
BACKGROUND
RISK EVALUATION OF BACKGROUND CONSTITUENTS
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Young Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Total Soil (Clay)	Total Soil (Clay)	Total Soil (Clay)	Cobalt	--	--	--	--	--	CVS	1.28	--	0.04	**1.32**
			Chemical Total	--	--	--	--	--		1.28	--	0.04	**1.32**
		Exposure Point Total						--					**1.32**
	Exposure Medium Total							--					**1.32**
	Air	Fugative Dust	Cobalt	--	1.6E-08	--	--	1.6E-08	RsS	--	<0.01	--	<0.01
			Chemical Total	--	1.6E-08	--	--	1.6E-08		--	<0.01	--	<0.01
		Exposure Point Total						1.6E-08					<0.01
	Exposure Medium Total							1.6E-08					<0.01
Total Soil (Clay) Total								**1.64E-08**					**1.32**

APPENDIX T
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
BACKGROUND
RISK EVALUATION OF BACKGROUND CONSTITUENTS
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Current, Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution) (1)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic (2)	Rationale (ProUCL)
Surface Soil									
	Cobalt	mg/kg	22.8	27.3 (NP)	50.2 J	27.3	mg/kg	95% UCL (NP)	95% KM (BCA) UCL
	Vanadium	mg/kg	148	174 (NP)	270	174	mg/kg	95% UCL (NP)	95% KM (t) UCL

Notes:

UCL = Upper Confidence Level

(1) Distribution and 95% UCL were calculated by ProUCL for data sets with greater than 8 samples and greater than 4 detections.
(NP) - Non-parametric distribution and 95% UCL

(2) Exposure point concentration statistic will be the 95% UCL (as calculated by ProUCL) or the maximum detected.

APPENDIX T
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
BACKGROUND
RISK EVALUATION OF BACKGROUND CONSTITUENTS
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Young Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	Cobalt	--	--	--	--	--	CVS	1.16	--	0.03	**1.20**
			Vanadium	--	--	--	--	--	GIS / Kidney	31.78	--	34.23	**66.01**
			Chemical Total	--	--	--	--	--		32.94	--	34.26	**67.20**
		Exposure Point Total						--					**67.20**
	Exposure Medium Total							--					**67.20**
	Air	Fugative Dust	Cobalt	--	1.5E-08	--	--	1.5E-08	RsS	--	<0.01	--	<0.01
			Vanadium	--	--	--	--	--	NA	--	<0.01	--	<0.01
			Chemical Total	--	1.5E-08	--	--	1.5E-08		--	<0.01	--	<0.01
		Exposure Point Total						1.5E-08					<0.01
	Exposure Medium Total							1.5E-08					<0.01
Surface Soil Total								**1.48E-08**					**67.21**

APPENDIX U
ROOSEVELT ROADS LOCAL REDEVELOPMENT AUTHORITY LETTER

COMMONWEALTH OF PUERTO RICO
DEPARTMENT OF
ECONOMIC DEVELOPMENT
& COMMERCE
DDEC

ROOSEVELT
ROADS

Local Redevelopment Authority
#355 FD Roosevelt Ave., Of. 106
Hato Rey, P.R. 00918
Tel: 787-758-4747

LRA-15-24

February 20, 2015

Mr. Gregory C. Preston
Director
BRAC Program Management Office, East
4911 S Broad Street
Bldg. 679
Philadelphia, PA 19112

Re: Land Use Control Recommendations, SWMU 59 Draft Final Corrective Measures Study, Naval Activity Puerto Rico, Ceiba, PR

Dear Mr. Preston:

As part of the ongoing environmental remediation and cleaning process being conducted by the U.S. NAVY in Former Naval Station Roosevelt Roads (FNSRR), the Roosevelt Roads Local Redevelopment Authority (RRLRA) is issuing this letter in response to U.S. Environmental Protection Agency (USEPA) and Puerto Rico Environmental Quality Board (PREQB) requirements, related to the Land Use Control (LUC) for SWMU 59.

The RRLRA hereby acknowledges and accepts the recommendation of implementation of Land Use Controls for SWMU 59 stated in the "**Draft Final Corrective Measures Study Final Report SWMU 59 – Former Vehicle Maintenance and Refueling Area**" (hereinafter, THE REPORT) submitted by the U.S. NAVY. We understand and agree that the U.S. NAVY is conducting and developing remedial alternatives to clean the site to an industrial level as stated in section 9.0 of THE REPORT.

RRLRA understands and accepts that once SWMU 59 parcel has been cleaned and transferred to RRLRA, the parcel area will be subject to some restrictions in use, excavation and groundwater usage as per section 10.0 of THE REPORT.

Finally, RRLRA acknowledges that if the new owner/tenant wishes to remove the LUC from the deed in the future, he is required to work with the NAVY, USEPA and PREQB to establish additional investigation, risk assessment, and/or remediation activities to comply with the required federal and local requirements.

Best regards,

María de L. Blázquez
Executive Director

c: Doug Pocze, USEPA
Gloria Toro, PR EQB
Thuane Fielding, BRAC PMO East
Stacin Martin, NAVFAC Atlantic