N40003.AR.001293
PUERTO RICO NA
5090.3a

FINAL CORRECTIVE MEASURES STUDY WORK PLAN SWMU 73

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

Prepared for:

Department of the Navy
NAVFAC SOUTHEAST
North Charleston, South Carolina

Prepared by:

Baker

Michael Baker Jr., Inc.
Moon Township, PA

Contract No. N62470-07-D-0502
DO 0002

January 25, 2008

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

FINAL

CORRECTIVE MEASURES STUDY WORK PLAN
SWMU 73

NAVAL ACTIVITY PUERTO RICO
EPA I.D. NO. PR2170027203
CEIBA, PUERTO RICO

JANUARY 25, 2008

Prepared for:

DEPARTMENT OF THE NAVY
NAVFAC SOUTHEAST
North Charleston, SC

Under:

Contract No. N62470-07-D-0502
DELIVERY ORDER 0002

Prepared by:

MICHAEL BAKER JR., INC.
Moon Township, Pennsylvania

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

Signature _____________________

Name:__Jeffrey G Meyers_________

Title:___BRAC Env. Coordinator_

Date:___January 25, 2008________

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

TABLE OF CONTENTS
(Continued)

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ACRONYMS AND ABBREVIATIONS

APA	Aerial Photography Analysis
AQUIRE	Aquatic Toxicity Information Retrieval
AUF	Area Use Factor
ATSDR	Agency for Toxic Substance and Disease Registry
AUF	Area Use Factor
BAF	Bioaccumulation Factor
Baker	Michael Baker Jr., Inc.
BCF	Bioconcentration Factor
bgs	below ground surface
BRAC	Base Realignment and Closure
BW	Body Weight
CAOs	Corrective Action Objectives
CCME	Canadian Council of Ministers of the Environment
CERCLA	Comprehensive Environmental Recovery, Compensation, and Liabilities Act
CERFA	Community Environmental Response Facilitation Act
CFR	Code of Federal Regulations
CMS	Corrective Measures Study
CNO	Chief of Naval Operations
COC	Contaminant of Concern
COPC	Chemical of Potential Concern
D.I.	deionized water
DI	Dietary Intake
DO	Delivery Order
DPT	Direct-Push Technology
DRMO	Defense Reutilization and Marketing Office
Eco-SSL	Ecological Soil Screening Level
EC_{50}	Median effective Concentration
ECP	Environmental Condition of Property
EODMU	Explosive Ordnance Disposal Mobile Unit
ERA	Ecological Risk Assessment
FC_{xi}	Maximum Concentration of Chemical x in Food Item i
FCV	Final Chronic Value
FID	Flame Ionization Detector
FIR	Food Ingestion Rate
GPS	Global Positioning System
HASP	Health and Safety Plan
HEAST	Health Effects Assessment Summary Table
HM	Hazardous Materials
HQ	Hazard Quotient
HSA	Hollow-Stem Auger
ID	Internal Diameter
IRIS	Integrated Risk Information System

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

K_d	Adsorption Coefficient
K_{oc}	Organic Carbon Partition Coefficient
K_{ow}	Octanol-Water Partition Coefficient
LANTDIV	United States Navy, Atlantic Division
LD_{50}	Median Lethal Dose
LC_{50}	Median Lethal Concentration
LOAEL	Lowest Observed Adverse Effect Level
LOEC	Lowest Observed Effect Concentration
LOEL	Lowest Observed Effect Level
MATC	Maximum Acceptable Toxicant Concentration
MCLs	Maximum Contaminant Levels
MHSPE	Ministers of Housing, Spatial Planning and Environment
mg/kg	milligrams per kilogram
mg/kg-bw-day	milligram per kilogram-body weight per day
µg/kg	micrograms per kilogram
mg/L	milligrams per liter
µg/L	micrograms per liter
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NAPR	Naval Activity Puerto Rico
NAVFAC	Naval Facilities Engineering Command
NAWQC	National Ambient Water Quality Criteria
NOAA	National Oceanic and Atmospheric Administration
NOAEL	No Observed Adverse Effect Level
NOEC	No Observed Effect Concentration
NOEL	No Observed Effect Level
NTR	Navy Technical Representative
PAH	Polynuclear Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyl
PDF_i	Proportion of Diet Composed of Food Item i
PDS	Proportion of Diet Composed of Soil/sediment
PID	Photoionization Detector
PMO	Program Management Office
POL	Petroleum, Oils and Lubricants
PPRTV	Provisional Peer Reviewed Toxicity Values
PREQB	Puerto Rico Environmental Quality Board
PRG	Preliminary Remedial Goal
PR LRA	Puerto Rico Locale Reuse Authority
PWD	Public Works Division
QA/QC	Quality Assurance/Quality Control

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

R	data qualifier: the sample result is rejected; the presence of absence of the analyte cannot be verified
RAGS	Risk Assessment Guidance for Superfund
RBC	Risk Based Concentration
RCRA	Resource Conservation and Recovery Act
RfC	Reference Concentrations
RfD	Reference Dose
RFI	RCRA Facility Investigation
RR	Records Review
SC_x	Concentration of Chemical x in Soil/Sediment
SCV	Secondary Chronic Value
SDWA	Safe Drinking Water Act
SE	Southeast
SF	Slope Factor
SQUIRT	Screening Quick Reference Tables
SVOC	Semi-volatile organic compound
SWMU	Solid Waste Management Unit
U	data qualifier: the analyte was analyzed for, but not detected above the reported sample quantitation limit
UJ	data qualifier: the analyte was analyzed for, but not detected; the reported sample quantitation limit is qualified as estimated
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
VOC	Volatile Organic Compound
WCx	Concentration of Chemical x in Water
WIR	Water Ingestion Rate

1.0 INTRODUCTION

This work plan presents the technical approach for conducting a Corrective Measures Study (CMS) for Solid Waste Management Units (SWMU) 73 – former Defense Reutilization and Marketing Office (DRMO) Scrap Metal Recycling Yard, located at Naval Activity Puerto Rico (NAPR), Ceiba, Puerto Rico. This CMS work plan has been prepared by Michael Baker Jr., Inc. (Baker), for the Navy Base Realignment and Closure (BRAC) Program Management Office (PMO) Southeast (SE) office under contract with the Naval Facilities Engineering Command (NAVFAC), SE (Contract Number N62470-07-D-0502, Delivery Order (DO) 0002). This work plan was developed in accordance with the Resource Conservation and Recovery Act (RCRA) 7003 Administrative Order on Consent (United States Environmental Protection Agency [USEPA] Docket No. 02-2007-7301).

This work plan has been developed to direct the work that needs to be conducted to meet the objectives stated in Section 2.0. The EPA approved Final RFI Management Plans Naval Station Roosevelt Roads, Puerto Rico (Baker, 1995) containing the Project Management Plan, Data Collection Quality Assurance Plan, and Health and Safety Plan are to be used in conjunction with this work plan to meet these objectives.

1.1 NAPR Description and History

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

The facility was commissioned in 1943 as a Naval Operations Base, and finally re-designated a Naval Station in 1957. Naval Station Roosevelt Roads (NSRR) operated as a Naval Station from 1957 until March 31, 2004. NSRR has undergone operational closure as of March 31, 2004 and has been designated as Naval Activity Puerto Rico. NAPR will continue until the real estate disposal/transfer is completed. The mission of the NAPR is to protect the physical assets remaining, comply with environmental regulations, and sustain the value of the property until final disposal of the property.

In anticipation of operational closure of NSRR the Naval Facilities Engineering Command (NAVFAC), Atlantic Division (LANTDIV) prepared Phase I/Phase II Environmental Condition of Property (ECP) Reports to document the environmental condition of NSRR. Section 8132 of fiscal year 2004 Defense Appropriations Act, signed into law on September 30, 2003, directs that NSRR be disestablished within 6 months, and that the real estate disposal/transfer be carried out in accordance with procedures contained in the Base Realignment and Closure (BRAC) Act of 1990. This legislation requires that the base closure be conducted in accordance with the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), as amended by the Community Environmental Response Facilitation Act (CERFA).

The Draft Phase I Environmental Condition of Property Report dated March 31, 2004 (LANTDIV, 2004a) identified new sites at NAPR based on the results of a review of records, an analysis of historic aerial photographs, physical site inspections, and interviews with persons familiar with past and current operations and activities. The new ECP sites had not been previously identified or investigated under existing environmental program areas. A Phase II ECP field investigation was conducted in 2004 to conduct environmental sampling to determine if a release/disposal actually occurred at any of the Phase I ECP sites recommended for further evaluation in the Phase I ECP and, if so, whether any potential risk to human health was present. The Draft Phase II Environmental Condition of Property Report recommended additional sampling (to be undertaken as part of the RCRA Program) at several sites to permit a more detailed assessment (NAVFAC Atlantic, 2005).

The USEPA issued a RCRA 7003 Administrative Order (Environmental Protection Agency Docket No. RCRA-02-2007-7301), which identifies SWMU 73 (formerly referred to as ECP 19) having documented releases of solid and/or hazardous waste and hazardous constituents and requires an acceptable work plan to complete site characterization and a CMS to determine the final remedy. Following a public comment period the Consent Order became effective on January 29, 2007.

1.2 Site Background

The following subsections present a brief description and background on the SWMU that is addressed in this CMS work plan.

SWMU 73 (also known as ECP Site 19) the scrap metal recycling yard is located at NAPR as shown on Figure 1-2. This site is located near the Camp Moscrip area and the Dry Dock, at the eastern end of the base. The site originally consisted of a large, flat-lying, gravel-covered, scrap metal storage yard as described in the Phase II ECP Report, and as shown in Figure 1-3. However, the site boundary was expanded to the area outside of the scrap metal yard to include the secondary growth vegetation area around the perimeter of the storage yard (see Figure 1-3) during the field investigation, per LANTDIV's request, because of the amount of debris (i.e., wood, metal, etc.) observed in this vegetated area (see photographs A-44 through A-47 in Appendix A). The physical site inspection observed numerous small spills and stains of presumed petroleum oils and lubricant (POL) within the scrap metal yard, primarily from large pieces of construction equipment that were stored in the yard. The records review (RR), aerial photography analysis (APA), and interviews confirmed that this scrap metal yard has been operated as the DRMO Scrap Metal Recycling Yard since the 1970s, and that numerous pieces of equipment and vehicles have been stored at this scrap metal yard for extended periods of time, resulting in numerous small releases of POL throughout the usage period. Portions of the scrap metal yard contain miscellaneous debris including vehicle frames and tires, as well as other equipment.

During the Phase II ECP field investigation investigators observed the scrap metal storage bins (see Figure 1-3) within the recycling yard where concrete block walls constructed on a concrete pad make up separate storage areas based on the type of scrap metal that was to be disposed (see photograph A-43 in Appendix A). Also presented within photograph A-43, is a view looking northwest across the site at one of the temporary monitoring wells (19E-03) installed at this site during the Phase II ECP. The central and northeast portions of the recycling yard appeared to be scraped clean, with minor amounts of debris observed. In addition, piles of debris (i.e., wood, metal, etc.) were observed scattered across the wooded area around the perimeter of recycling yard as mentioned above, as shown in photographs A-44 through A-46. Also, a small concrete structure, possibly a foundation from a building that no longer exists is shown in Photograph A-47.

In addition, two unidentified metal structures were uncovered. The Environmental Division of the Public Works Division (PWD) was informed and they arranged for them to be removed from the site to a separate area of the Building 31 - PWD yard for further examination. After PWD personnel examined the structures, they requested that a representative from the field crew examine these structures. Based on the size, as well as their ordnance-like shape, the decision was made by PWD to have an ordnance expert inspect the structures to rule out the chance that they are unexploded ordnances. On May 12, 2004, a representative from the Explosive Ordnance Disposal Mobile Unit (EODMU) SIX Detachment Mayport arrived at the PWD to inspect the structures. The result of the inspection concluded that both ordnance-shaped structures were inert.

1.3 Investigative History & Basis for the Work Plan

The DRMO Scrap Metal Recycling Yard was first listed as a SWMU in the RCRA 7003 Administrative Order on Consent. SWMU 73 was included in the 2004 Phase II ECP investigation performed by Michael Baker Jr., Inc. (Baker). An aerial photograph of the site dating from 1958, which shows some of the areas of the site that were targeted during the ECP investigation, is shown in Figure 1-4.

During the Phase II ECP investigation, sample locations at this site were field located with a hand held global positioning system (GPS) receiver, while the additional five surface soil locations were surveyed.

SWMU 73 is located in the near-shore flatlands. Three soil borings (19E-01 through 19E-03) were advanced in the Former Scrap Metal and Recycling Yard as presented on Figure 1-4. It should be noted that the three soil borings were not located on the concrete pad that falls within this area. The depth of the soil borings at this site ranged from 14 feet bgs to 15 feet bgs (19E-01 and 19E-03). Fill was observed to be present from the ground surface to a depth ranging from 7-feet (at boring 19E-SB02) to 13-feet (at boring 19E-SB03). The fill material consisted of mainly sand and gravel, with lesser amounts of metal debris, silt, and clay. Marine sediments were observed immediately beneath the fill material. Fine to medium sand was observed at boring 19E-SB02, and peat at boring 19E-SB03. Groundwater was apparent beginning in the fill material at a depth ranging from 6- to 8-feet below ground surface (bgs).

Surface soil samples were collected from this site utilizing a stainless steel spoon in conjunction with a Macro Core sampler in conjunction with a Geoprobe® rig with direct-push technology (DPT) methods. One surface soil sample was collected from each soil boring location from a depth of 0 to 1 foot bgs. Subsurface soil samples were then collected from each boring location using the same method as for the surface soil mentioned above. Subsurface soil samples were collected from two-foot intervals (i.e., 1 to 3 feet bgs, 3 to 5 feet bgs, etc.), down to the groundwater interface (approximately 6 to 8 feet bgs). All surface and subsurface soil samples were screened in the field utilizing a flame ionization detector (FID) and photoionization detector (PID) with the results recorded in the field logbook. The screening results were compared against background to indicate if the soil has been impacted by past operations. Based on the observed piles of metal, wood, etc., found inside the wooded perimeter in the area around the recycling yard, the decision was made to collect six additional surface soil samples (19E-SS04 through 19E-SS09) in an attempt to determine if this environment has been negatively impacted by past practices.

Soil samples submitted to a fixed-base laboratory included surface soil samples (19E-SS01 through 19E-SS09) and subsurface soil samples (19E-SB01-02, 19E-SB02-03, and 19E-SB03-03). These samples were submitted to the fixed-base analytical laboratory for full Appendix IX analysis.

Temporary monitoring wells were installed at each of the three soil boring locations (19E-01 through 19E-03) as presented on Figure 1-4. Groundwater samples were submitted to the fixed-base analytical laboratory for full Appendix IX analysis. The inorganic analysis requested was for dissolved metals only.

1.3.1 Findings of the Investigations

The following paragraphs present a summary of the findings for the sampling and analysis investigation performed at SWMU 73 mentioned above. A complete detailed evaluation of the findings from the previous investigations at SWMU 73 can be found in the Final Phase II Environmental Condition of Property Report (NAVFAC Atlantic, 2005).

Nine surface soil, three subsurface soil, and three groundwater samples were obtained from nine locations as shown on Figure 1-3. The groundwater sample locations were not based on FID/PID screening, but they were pre-determined by the work plan (LANTDIV, 2004b). The results of the screening indicated that only one location had an exceedance of background in the soil vapor. No duplicate samples were taken at this site.

The results of the analyses showing the detected results in comparison to risk-screening criteria, are shown in Tables B-1 through B-6 of Appendix B. Organic compounds that exceeded USEPA Region III Residential risk based concentrations (RBCs) included 4,4'-DDT, 4,4'-DDE, and benzo(a)pyrene. These compounds only exceeded the criteria in the surface soil media. Several inorganics exceeded RBCs in soil, including arsenic, chromium, and vanadium. Only arsenic exceeded its established background concentration for NAPR at the site. None of the constituents in surface soil or subsurface soil exceeded their Industrial RBCs. Only vanadium exceeded its RBC in groundwater, which is likely due to leaching of high naturally occurring vanadium in the soils.

The Final Phase II ECP report (NAVFAC Atlantic, 2005) concluded that past operations have impacted the surface soil at the DRMO facility. However, the subsurface soil and the groundwater did not exhibit significant concentrations of compounds detected in the surface soil; therefore it can be concluded that these two media are not impacted. Due to the limited nature of the ECP Phase II investigation, however, it was recommended that additional site characterization be done to confirm the site contamination. The recommendation of the ECP investigation and the need for delineation of the proposed excavation areas forms the basis for the proposed CMS investigation.

1.4 Organization of the CMS Work Plan

This CMS Work Plan is organized into eleven sections. Section 1.0, the Introduction, is designed to introduce the reader to the basis for the work plan and a summary of the site status. Section 2.0 provides the objectives and the corrective measure standards being utilized for this project. The CMS Investigation to be performed at SWMU 73 is discussed in Section 3.0, with the corresponding CMS Investigation reporting discussed in Section 4.0. The ecological risk assessment to be performed is described in Section 5.0. Section 6.0 provides a method for establishing the corrective action objectives, and the method to be used to identify contaminants of concern (COCs) is discussed in Section 7.0. The tasks to be accomplished as part of the Corrective Measure Study are described in Section 8.0. The project schedule is provided in Section 9.0. Section 10.0 provides the project organization. Section 11.0 provides the references cited in this report.

2.0 CMS OBJECTIVES AND CORRECTIVE MEASURE STANDARDS

This section discusses the objectives of this CMS and the standards to assess the performance of the selected corrective measure. There are two distinct types of work associated with this CMS, 1) a CMS Investigation to further delineate the contamination at this SWMU and the associated report on these findings, and 2) the development of the corrective measures for SWMU 73. Development of Corrective Action Objectives (CAOs) for ecological receptors (see Section 5.8) and human health receptors (see Sections 6.4 through 6.6) are to be developed in the CMS.

2.1 Objectives

As noted above, there are two distinct tasks associated with the CMS: a CMS Investigation and the development of Corrective Measures for the CMS. The objectives of this CMS investigation (see Sections 3.0 through 7.0 of this work plan) are as follows:

- To identify those tasks required for the performance of a CMS Investigation to further delineate the contamination which poses a risk at SWMU 73.

- To identify realistic ecological and human health exposure pathways from contamination that may be present at SWMU 73.

- To identify those tasks required for the evaluation and delineation of the contamination in the soil and groundwater that may pose a risk at SWMU 73.

The objectives of the development of the corrective measures to address the contamination present at this SWMU (see Section 8.0) are as follows:

- To develop the human health (see Sections 6.4 through 6.6) and ecological (see Section 5.8) CAOs for SWMU 73.

- To identify those tasks required for assisting in screening applicable remedial technologies for SWMU 73.

This work plan documents the scope and objectives of a full CMS for SWMU 73, as well as the activities required to implement the program. The work plan serves as a tool for assigning responsibilities and establishing the project schedule and costs. The report for this investigation will be in the form of a "Task I" CMS Report with establishment of corrective action objectives (CAOs) for SWMU 73.

If, as a result of the CMS investigation, a streamlined CMS appears appropriate, approval for that approach will be sought in a "CMS Investigation Report." A highly focused or streamlined CMS may be appropriate for SWMU 73 since this site may have "straightforward remedial solutions" where standard engineering solutions can be applied that have proven effective in similar situations (USEPA 1994). Therefore, the screening of clean-up technologies, normally conducted in a CMS, may not occur.

2.2 Corrective Measures Standards

Corrective measure standards that may be applicable to SWMU 73 will be developed as part of the CMS "Task I" reporting effort (see Section 8.1). Once the possible corrective measures are selected for applicability, the appropriate standards will be developed.

The corrective measure standards to be considered will include the applicable Federal Maximum Contaminant Levels (MCLs) established under the Safe Drinking Water Act (SDWA) and the Puerto Rico Environmental Quality Board (PREQB) standards. The RCRA Corrective Action Program requirements under Code of Federal Regulations (CFR) (40 CFR 264.100) will also be reviewed for applicability to the site. In addition, ecological risks will be considered in the development of corrective measures standards by incorporating standards that are determined to be protective of ecological receptors by the risk assessment process described in Section 5.0.

Background inorganic concentrations will be considered in establishing exceedances of site contamination when appropriate. The *Revised Final Summary Report for Environmental Background Concentrations of Inorganics* (Baker, 2006a) will be used.

All of the above information to be considered for the corrective measure standards will be taken into account when the corrective action objectives for human health and the environment are developed as discussed in Section 6.0.

The corrective measures standards correlate with the development of the corrective action objectives. These standards are utilized during the selection of chemicals of potential concern (COPCs) as described in Sections 5.0 and 6.0.

3.0 CMS INVESTIGATION

This section of the work plan describes the technical elements of the field investigation for SWMU 73.

The objectives of this CMS Investigation are as follows:

- To determine the extent of contamination for excavation of surface soil
- To delineate inorganic and organic contamination, if any, in the subsurface soils
- To determine impact, if any, to the groundwater near SWMU 73
- To evaluate exposure pathways that may be present at SWMU 73

The soils in SWMU 73 had been found to contain contamination from the activities at the DRMO Scrap Metal Recycling Yard (NAVFAC, 2005). Therefore, it will be assumed during this investigation that the soils from this area will need to be remediated as part of a corrective measure. Remediation assumptions for surface soils generated from the findings of the analytical program conducted during the Phase II ECP investigation included excavation and removal of contaminated surface soils at two locations within the area, and restoration of the site. The estimated area of each excavation is approximately 75 feet by 75 feet, and the depth is assumed to be 1 foot bgs, representing a volume of about 210 cubic yards each, or a total of 420 cubic yards. The extent of remediation will be determined based on results of this investigation.

Table 3-1 contains the sampling matrix proposed for this CMS Investigation Work Plan. It is proposed to collect soil, subsurface soil, and groundwater samples within and around the DRMO Scrap Metal Recycling Yard to determine potential impacts. Groundwater samples will be taken at selected locations where soil samples are taken, in order to evaluate if groundwater has been impacted by activities at SWMU 73.

3.1 Surface and Subsurface Soil Sample Locations

Several locations were sampled during the ECP with a bias towards detecting contamination when visual signs or other historical information indicated the potential for a release. A determination was made to excavate two areas of 75-foot square dimensions each, around ECP locations 7E-03 and 19E-SS06. In order to determine the extent of surface soil to be excavated, additional samples will be taken at 20-foot spacing along four perpendicular directions traversing away from the two targeted locations, as shown on Figure 3-1. Surface soil samples (73SB01-00 through 73SB23-00) will be collected from a depth of 0 to 1 foot bgs at twenty three locations for a total of twenty six samples including three field duplicates, as summarized in Table 3-1.

They will be analyzed for Appendix IX VOCs, SVOCs, low level PAHs, organochlorine pesticides, and metals. Based upon data obtained during the ECP, it is expected that PAHs and pesticides would be adequate to determine the extent of excavation necessary to remove the suspected area of surface soil contamination. However, the other analytes have also been included to provide the data necessary to verify that the storage of scrap material at the site has not resulted in impacts from other chemical releases at the site.

An additional four subsurface soil samples will be collected from two locations to verify that vertical migration of contamination has not occurred. A total of four subsurface soil samples will be collected from these two locations. The two locations will consist of one from each of the two areas proposed for excavation and their exact locations will be selected based on field screening for elevated levels of VOCs (using a PID/FID) and visual field observations of color or staining within the surface soil samples. The subsurface soil samples will also be analyzed for the same constituents as the surface soil samples, in order to provide a comprehensive contamination profile with depth.

An additional ECP sample point has been identified for further evaluation under this investigation due to a revision to the Summary Report for Environmental Background Concentrations of Inorganic Compounds. This consisted of revising the background surface soil for vanadium, the outcome of which identified the need to further evaluate the ECP soil sample location 19E-SS07. Additional samples will be taken at 20-foot spacing along four perpendicular directions traversing away from 19E-SS07, as shown on Figure 3-1. Surface soil samples (73SB24-00 through 73SB35-00) will be collected from a depth of 0 to 1 ft bgs at twelve locations for a total of thirteen samples including one field duplicate as summarized in Table 3-1. Two subsurface soil samples will be collected at one location identified on Figure 3-1 to verify whether the vanadium concentrations continue to be elevated with vertical depth. The soil samples from these locations will be analyzed for Appendix IX metals.

All soil sampling locations will be flagged in the field and will be surveyed for horizontal location utilizing a portable GPS unit or traditional survey equipment.

The surface soil samples from a depth of 0 to 1 foot bgs will be obtained with a stainless steel spoon (see SOP F102 in Baker, 1995). The subsurface soil samples will be obtained during boring advancement for monitoring well installation (see SOP F102 in Baker, 1995).

A boring log will be prepared indicating lithology and water occurrence, and other observations. Soil samples will initially be screened at 6-inch intervals with a photoionization detector (PID) to develop a semi-quantitative profile. Soil samples will be collected continuously from ground surface to the water table with two subsurface soil samples and one surface soil sample per selected boring location being collected for fixed-base laboratory analysis. One subsurface soil sample per location will be collected from a depth of 1.0-3.0 feet below ground surface (bgs). The other subsurface soil sample will be collected from the depth of any suspected contamination, based on PID screening, at a depth shallower than the water table or 10 feet bgs, whichever occurs first.

Soil boring locations chosen for fixed base laboratory analyses will be labeled consecutively (beginning with 73SB01) in a manner consistent with previous sample designations at NAPR. Extensions to the sample identification will reflect the depth at which the sample was obtained. For the purposes of this work plan, two-foot discrete depths will be used. Sample identification extensions will follow the pattern shown below.

<u>73</u>SB01-00	SMWU 73 Sample
73<u>SB</u>01-00	Soil Boring Sample
73SB<u>01</u>-00	Soil boring location identifier
73SB01-<u>00</u>	0 to 1 foot bgs (surface soil) sampling interval

Subsurface soil samples will be designated as follows:

73SB01-<u>01</u>	First subsurface sampling interval, 1-3 feet bgs
73SB01-<u>02</u>	Second subsurface sampling interval, 3-5 feet, bgs and so on.

Surface soil samples (up to 1 foot bgs) are intended to provide data for evaluation of potential ecological exposure concerns. Surface soil and subsurface soil (to a depth of 10 feet bgs) are intended to provide data for evaluation of potential human health exposure concerns.

Following sample collection each borehole will be backfilled with the remaining soil to the extent practicable, in order to minimize the burden of waste disposal. The surface of the borehole will then be patched with bentonite grout.

Samples will be packed in ice and shipped next day air to the fixed-base laboratory. Because of previously encountered delays associated with sample shipments from Puerto Rico to the United States, additional insurance to cover re-sampling costs should be claimed on the bill of laden. At least one member of the field team will remain on the island until verification by the laboratory of receipt of all shipments. This will minimize any potential re-sampling costs associated with mobilization. Tracking numbers for each shipment will be forwarded to the project manager for assisting in verification of receipt.

All analysis at the laboratory will be performed using current methodologies for the compound list and with the quantitation limits presented in Table 3-2. To ensure that the data to be collected is of sufficient quality the quantitation limits have been reviewed against the screening levels presented in Table 5-1 and determined to meet these levels with a few exceptions. These quantitation limits have also been reviewed by the analytical laboratory to ensure that they can be met. In all cases, the quantitation limits are the lowest achievable by laboratory for the specified analytical method. The specific third party data validator is to be determined. All analytical work that is conducted on the mainland of the U.S.A. must be certified by a licensed Puerto Rico chemist.

3.2 Groundwater Sample Locations

Groundwater samples will be obtained from permanent monitoring wells to be installed at the two subsurface soil sampling locations (near 19E-SS06 and 19E-03) that may be selected based on field screening or other observations, as noted in Section 3.1. The groundwater samples will be collected in order to evaluate whether contamination may have migrated vertically into the aquifer at the two locations where subsurface contamination is suspected. These locations are shown on Figure 3-1. These well locations may be advanced to a total depth not to exceed 30 feet below ground surface in order to find subsurface fractures containing groundwater. Samples from the two locations, as well as one duplicate will be obtained from the top of the groundwater table and analyzed for Appendix IX VOCs, SVOCs, low level PAHs, and dissolved inorganics, as presented in Table 3-1.

Groundwater samples will also be collected from a permanent monitoring well to be installed at the location of the subsurface soil boring for investigating the vertical migration of the elevated vanadium concentrations near 19E-SS07. This location is also shown on Figure 3-1. This well will also be advanced to a total depth not to exceed 30 feet below ground surface in order to find subsurface fractures containing groundwater. One ground water sample from this location will be obtained from the middle of the screened interval and analyzed only for Appendix IX dissolved inorganics, as presented in Table 3-1.

Monitoring wells will be installed using techniques that will be selected depending on the underlying stratigraphy. The wells will be constructed of 2-inch ID, Schedule 40 PVC, with flush joint threads. Well screens will be 10-feet long and installed to straddle the water table.

- Soil sampling will be conducted in order to classify the soil during well installation. Upon completion of soil sampling, the borehole will be reamed as necessary to the desired depth using the prescribed drilling method. The well construction materials will be installed through the HSAs, casing, or in an open borehole, depending on the selected drilling technique.

- The well screen and bottom cap will be set at the bottom of the borehole. The screen will be connected to threaded, flush-joint, riser. An expandable, water tight locking cap or slip-cap with a vent hole will be placed at the top of the casing.

- The annular space around the well screen will be backfilled with a well-graded, fine to medium sand as the drilling tool or casing is being withdrawn from the borehole. The sand will extend to approximately 2 feet above the top of the screened interval. The thickness of the sand above the screened interval may be reduced if the well is too shallow to allow for placement of adequate sealing material.

- An approximately 2-foot thick sodium bentonite seal (minimum of 6 inches for very shallow wells) will be placed above the sand pack. If bentonite pellets or chips are used, they will be sized appropriately given the well and borehole diameter and placed in a careful manner that will prevent bridging. The bentonite will be hydrated with potable water, as necessary.

- The annular space above the bentonite seal will be backfilled with cement/bentonite grout to prevent surface and near subsurface water from infiltrating into the screened groundwater monitoring zone. The grout will consist of five to ten percent (by dry weight) of bentonite powder and seven gallons of potable water per 94-pound bag of portland cement. For very shallow wells, the cement/bentonite grout may be omitted.

- The depth intervals of all backfilled materials will be measured with a weighted measuring tape to the nearest 0.1-foot and recorded in the field logbook.

- The entire site area is heavily vegetated; therefore the wells will be provided with 2 to 3 feet of "stickup" above ground surface. Steel protective casing will be placed over the riser and surrounded by a concrete pad. The pad will be a minimum of 2 feet by 2 feet (length x width) and 6 inches in thickness (with 2 inches set into the ground outside the casing), and extending 2 feet bgs inside the annular space around the well. If water table conditions prevent having a 24-inch thick bentonite seal, the concrete pad depth in the annular space around the well may be decreased. Steel bollards will be installed around the concrete pad as additional protection and painted a bright color to aid in visibility.

- All wells will have a locking cap installed on the PVC riser or protective steel casing.

Each new permanent monitor well will be developed using pumping and surging methods (see SOP F103 in Baker, 1995) after allowing suitable time for the cement/bentonite grout to cure (typically a minimum of 24 hours). The purpose of well development is to restore the permeability of the formation which may have been reduced by the drilling operations and to remove fine-grained materials that may have entered/accumulated in the well or filter pack. The wells will be developed until the discharged water runs relatively clear of fine-grained materials. It should be noted that the water in some wells does not clear with continued development. Typical limits placed on well development may include any one or a combination of the following:

- Clarity of water based on visual determination
- A maximum time period (typically two hours for shallow wells)

- A maximum borehole volume (typically three to five borehole volumes plus the amount of any water added during the drilling or installation process)
- Stability of pH, specific conductance, and temperature measurements (typically less than 10 percent change between three successive measurements)
- Clarity based on turbidity measurements [typically less than 20 Nephelometric Turbidity Units (NTU)]
- A record of the well development will be completed to document the development process.

The groundwater will be sampled using a low flow sampling technique. Appendix C includes a detailed description of the low flow sampling technique. Field parameters of pH, temperature, turbidity, conductivity, dissolved oxygen, and oxidation-reduction potential will be obtained with appropriate instrumentation during sampling if enough volume of groundwater is present. The groundwater samples will be placed into appropriate laboratory supplied containers. The groundwater sampled will be filtered in the field for the dissolved metals analyses.

The groundwater sample designations will correspond to the soil boring location. For example, groundwater collected from soil boring location 73SB01 will have a groundwater sample identification of 73GW01.

Samples will be packed in ice and shipped next day air to the “fixed base” laboratory. Because of previously encountered delays associated with sample shipments from Puerto Rico to the United States, additional insurance to cover re-sampling costs should be claimed on the bill of laden. At least one member of the field team will remain on the island until verification by the laboratory of receipt of all shipments. This will minimize any potential re-sampling costs associated with mobilization. Tracking numbers for each shipment will be forwarded to the project manager for assisting in verification of receipt.

All analyses at the laboratory will be performed using current methodologies for the compound list and with the quantitation limits presented in Table 3-2. The quantitation limits have been reviewed against the screening levels presented in Table 5-2 and determined to meet these levels with a few exceptions. These quantitation limits have also been reviewed by the analytical laboratory to ensure that they can be met. In all cases, the quantitation limits are the lowest achievable by laboratory for the specified analytical method. The specific data validator is to be determined. All analytical work that is conducted on the mainland of the U.S.A. must be certified by a licensed Puerto Rico chemist.

3.3 <u>Other Field Activities</u>

During the investigation, the following activities will be performed:

- Utility Clearance
- Investigation Derived Waste (IDW) Management
- Decontamination
- Surveying
- Health and Safety Procedures
- Chain of Custody

3.3.1 Utility Clearance

If this work plan is initiated while NAPR is still under operation, the following procedure must be followed to obtain utility clearance. Fifteen days prior to the initiation of the proposed fieldwork, a digging permit request will be submitted to the Facility Management Transportation and Utility Division (FMTUD) of the Public Works Department at NAPR. All proposed soil borings and monitoring well locations will be cleared by the base utility department.

3.3.2 Investigation Derived Wastes (IDW)

The generation of IDW associated with soil sampling and monitoring well installation, including soil cuttings and decontamination fluids, will be collected and stored temporarily in 55-gallon drums. However, the soil cuttings from the subsurface soil sampling will be placed back into the boring from which they came, unless contamination is present. As much as possible, soils last out of the hole will be returned first, thereby, approximating original stratigraphy.

Two IDW samples will be collected during this investigation. One composite aqueous sample will be collected from all drums containing decontamination fluid (from sampling equipment and drill rig), and one composite soil sample will be collected from all drums containing drill cuttings. The samples will be analyzed for parameters as shown in Table 3-1 by methods presented in Table 3-2. These samples will provide the necessary data to be able to dispose of the generated IDW at an appropriate disposal facility. Upon completion of the field program, the drums will be moved and stored at a secure location by the contractor. The soil and water IDW will be removed and disposed of from the site by an approved vendor upon receipt and review of the IDW sample analytical data.

3.3.3 Decontamination

All reusable (non-dedicated and non-disposable) soil sampling and monitoring well installation equipment (i.e. augers, bits, split-spoon samplers, or selected drilling tool), will be decontaminated between each sampling location in accordance with SOPs F501 and F502 in Baker, 1995. The drill rig will be decontaminated before arriving at the site and before leaving the site. The remaining contaminant-free sampling equipment and materials utilized during this investigation will be disposable.

3.3.4 Surveying

All sampling locations will be surveyed. Traditional survey equipment or survey grade GPS unit will be utilized to obtain vertical (+/- 0.01 foot) and horizontal (+/- 0.1 foot) locations and top of PVC elevations of the wells for generating groundwater contours used for reporting purposes.

3.3.5 Health and Safety Procedures

The health and safety procedures previously presented in the RFI Management Plans (Baker, 1995) will be employed during this investigation.

3.3.6 Chain-of-Custody

Chain-of-Custody procedures will be followed to ensure a documented, traceable link between measurement results and the sample/parameter that they represent. These procedures are intended to provide a legally acceptable record of sample preparation, storage, and analysis.

To track sample custody transfers before ultimate disposition, sample custody will be documented using a similar chain-of-custody form as presented in the RFI Management Plans (Baker, 1995). A chain-of-custody form will be completed for each shipment in which the samples are shipped. After the samples are properly packaged, the shipping container will be sealed and prepared for shipment to the analytical laboratory.

3.4 Data Validation

All mainland laboratory data generated by the investigation will be subjected to independent, third party, validation to ensure that the data is of sufficient quality. The USEPA Region II Data Validation Standard Operating Procedures will be followed. The data will be qualified in accordance with these SOPs (i.e., ensuring that the measurement performance criteria for the various data quality indicators are met). The specific data validator will be determined at a later date.

3.5 Quality Assurance/Quality Control

QA/QC samples will be obtained during these investigations. These will include the collection of equipment rinsate samples, field blanks, trip blanks, field duplicates, and matrix spike/matrix spike duplicate (MS/MSD). QA/QC samples will be analyzed for parameters as shown in Table 3-1 by methods presented in Table 3-2.

Equipment rinsate blanks from reusable (non-dedicated and non-disposable) sampling equipment will be collected daily during the sampling event. Initially, samples from every other day should be analyzed. If analytes pertinent to the project are detected in any equipment rinsate blank, the remaining rinsate blanks will be analyzed. As an added level of QA/QC, a rinsate blank will also be collected from each batch of disposable sampling tools such as stainless steel spoons, groundwater sample tubing, etc. The results from the blanks will be used to verify that the decontamination of reusable equipment had rendered them free of cross-contaminating chemicals at levels of concern for the site; and to verify that disposable sampling tools were free of contaminants at levels of concern for the site. This comparison is made during data validation, and the equipment rinsate blank is analyzed for the same parameters as the related samples. One equipment rinsate will be collected per day of field sampling.

One field blank sample will be collected which will consist of lab grade deionized water (D.I.) used in the collection of the equipment rinsate sample.

Trip blank samples will be required to accompany the samples to the laboratory for volatile organic constituent samples scheduled for collection. One trip blank sample will accompany each cooler containing samples of this analysis.

Soil sample field duplicates will be homogenized and split and collected at a frequency of ten percent. One field duplicate groundwater sample for dissolved fraction will also be collected.

Analysis of duplicate and blanks associated with soil and groundwater sampling will include Appendix IX constituents for the analytical suites selected in Table 3-1.

MS/MSD samples are collected to evaluate the matrix effect of the sample upon the analytical methodology. An MS and MSD must be performed for each group of samples of a similar matrix (e.g., surface soil). MS/MSD samples will be collected at a frequency of five percent per media.

4.0 CMS INVESTIGATION REPORT

A report will be prepared on the methodologies and findings of the CMS investigation at SWMU 73. A draft report will be submitted to the USEPA 45 days upon receipt of the validated analytical data. The main elements of the document will consist of the following:

- Introduction
- Investigation Methodologies
- Nature and Extent of Contamination
- Conclusions, Justifications, and Recommendations for either a streamlined CMS or a full CMS

4.1 Introduction

The introduction will consist of a discussion of the historical background of the investigations conducted at SWMU 73 and incorporate the results from this CMS investigation in that context. The introduction will also provide a regulatory framework for SWMU 73, as well as a discussion of current conditions.

4.2 Investigation Methodologies

The investigation methodologies section will detail the investigation. The section will discuss sample locations, sample collection and handling procedures, QA/QC procedures, and analytical methods used. This section will also discuss problems encountered (including deviations, if any) and problem resolution.

4.3 Nature and Extent of Contamination

The nature and extent of contamination section will present analytical results and interpretation of the data. The soil data will be screened against USEPA Region IX Preliminary Remediation Goals (PRGs) and the ecological surface soil screening values developed for NAPR. The groundwater data will be compared to USEPA Region IX Tap Water PRGs and the Federal maximum contaminant levels (MCLs). Additionally, inorganics will be statistically compared against their respective background values using Navy guidance (Naval Facilities Engineering Support Center, [NFESC], 2002 and 2004). The background data to be used in the statistical evaluations are those presented in the *Revised Final Summary Report for Environmental Background Concentrations of Inorganic Compounds* (Baker, 2006a). The results of the screening of the data against these criteria as well as the results of the statistical comparison to background data will be discussed. Data will be presented on tables and figures with textual explanation. Results of QA/QC procedures will also be presented

4.4 Conclusions and Recommendations for a Streamlined CMS

Information from the nature and extent of contamination will be synthesized into conclusions regarding site conditions. Recommendations will be made from these conclusions, which will then be incorporated into the SWMU 73 CMS as appropriate. If the results of the investigation indicate that a streamlined CMS approach is appropriate then a CMS will be prepared in accordance with Section 8 Tasks III and IV, otherwise a full CMS will be prepared in accordance with Section 8 Tasks I through IV.

5.0 ECOLOGICAL RISK ASSESSMENT

This section presents the technical approach (described in general terms) for conducting an ecological risk assessment (ERA) at SWMU 73 (DRMO Scrap Metal Recycling Yard) NAPR, Ceiba, Puerto Rico. The ERA process at SWMU 73 will be conducted in accordance with the Navy policy for conducting ERAs (Chief of Naval Operations [CNO], 1999) the Navy guidance for conducting ERAs (available at http://web.ead.anl.gov/ecorisk/), as well as guidance provided by the USEPA (1997a).

The Navy ERA process (see Figure 5-1) consists of eight steps organized into three tiers and represents a clarification and interpretation of the eight-step ERA process outlined in the USEPA ERA guidance for the Superfund program (USEPA, 1997a). Tier 1 of the Navy ERA process represents the screening-level ERA:

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

Under Navy policy, if the results of Step 1 and Step 2 (Tier 1 screening-level ERA) indicate that, based on a set of conservative exposure assumptions, there are chemicals present in environmental media that may present a risk to receptor species/communities, the ERA process proceeds to the baseline ERA. According to Superfund guidance (USEPA, 1997a), Step 3 represents the problem formulation phase of the baseline ERA. Under Navy policy, the baseline ERA is defined as Tier 2, and the first activity under Tier 2 is Step 3a. Step 3a precedes the baseline risk assessment problem formulation (Step 3b). In Step 3a, the conservative exposure assumptions applied in Tier 1 are refined and risk estimates are recalculated using the same conceptual site model. The evaluation of risks in Step 3a may also include consideration of background data, and chemical bioavailability. If the re-evaluation of the conservative exposure assumptions in Step 3a does not support an acceptable risk determination, the site continues in the baseline ERA process (i.e., Steps 3b through 7; see Figure 5-1):

As CAOs for the protection of the environment will be developed (if necessary) based on the results of the screening-level ERA (Steps 1 and 2) and refinement of the screening-level ERA exposure assumptions (Step 3a), this section only presents the general methodology that will be used in Steps 1, 2, and 3a of the Navy ERA process.

5.1 Screening-Level Problem Formulation

The screening-level problem formulation is the first phase of the ERA process and establishes the goals, scope, and focus of the screening-level ERA. Major components of the screening-level problem formulation will include:

- **Environmental Setting** – A general description of the SWMU history and SWMU features, with emphasis on the habitats and ecological receptors known or likely to be present on or near the SWMU. This description is typically based on existing information and mapping.
- **Existing Analytical Data** – A summary of existing analytical chemistry data for ecologically relevant media at the SWMU.
- **Contaminant Fate and Transport Mechanisms** – A characterization of known or potential contaminant sources and the likely transport mechanisms (if any) to ecological habitats based on the fate properties of the site-specific chemicals. The mechanisms of toxicity for these chemicals are also considered.

- **Exposure Routes and Pathways** – An evaluation of potential exposure routes and a determination of the existence of any potentially complete exposure pathways.
- **Conceptual Model** – The screening-level problem formulation culminates in the development of a preliminary conceptual model, which describes how chemicals associated with the SWMU may come into contact with ecological receptors.
- **Endpoint Selection** – Assessment and measurement endpoints to be evaluated in the screening-level ERA are selected for potentially complete exposure pathways identified in the conceptual model.
- **Selection of Receptors** – Receptor species are selected based on the environmental setting and selected assessment endpoints

These major components of the screening-level problem formulation are described in more detail in the following sections. This phase of the ERA process is intended to answer two main questions: (1) do complete exposure pathways exist at the SWMU 73 and (2) are sufficient data available to conduct the screening-level ERA?

5.1.1 Environmental Setting

As described above, the description of the environmental setting focuses on the SWMU history (how the SWMU was used in the past and how it is currently being used), physical site features, and habitats and biota. The environmental setting will be described both for NAPR as a whole and for SWMU 73.

5.1.1.1 Site Description and Physical Features

Information on the site history provides an indication of the types of chemicals expected at the SWMU and the media in which they are likely to be present. The physical features of the SWMU, which include geological (e.g., soils), hydrogeological (e.g., surface water and groundwater flow patterns), and climatologic (e.g., precipitation) parameters, are important in determining how chemicals from source areas could be transported to ecological habitats. Sources of this information may include SWMU-specific documents, facility personnel, available mapping, soil survey documents, weather records, and site visits.

5.1.1.2 Habitat Types and Ecological Receptors

Descriptions of the habitat types and ecological receptors known or likely to be present on the SWMU are an important part of describing the environmental setting. This can encompass aquatic habitats (e.g., creeks and ponds) and receptors (e.g., fish), wetland habitats (e.g., marshes) and receptors (e.g., amphibians), and/or terrestrial habitats (e.g., forests) and receptors (e.g., wildlife and vegetation). Sources of this information may include facility-specific documents (e.g., natural resource management plans), available mapping, the literature, and site visits.

5.1.2 Existing Analytical Data

The existing analytical data for ecologically relevant media will be compiled and evaluated. The evaluation will consider such factors as sample size (i.e., number of samples of a given medium collected for analytical testing), sample location, analytical parameters, and reporting limits to determine if the available data are adequate to conduct the screening-level ERA. For example, low sample size could result in inadequate spatial coverage within habitats of potential interest to the ERA. In this case, insufficient data would be available on which to base a risk estimate.

5.1.3 Contaminant Fate and Transport Mechanisms

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

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

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

Octanol-water partitioning indicates whether a compound is hydrophilic or hydrophobic. The Octanol-water partition coefficient (K_{ow}) expresses the relative partitioning of a compound between octanol (lipids) and water. A high affinity for lipids equates to a high K_{ow} and vice versa. As discussed above, K_{ow} has been shown to correlate well with Bioconcentration Factors (BCFs) in aquatic organisms, adsorption to soil or sediment particles, and the potential to bioaccumulate in the food chain (Howard, 1991). Typically expressed as log K_{ow}, a value of three (3.0) or less generally indicates that the chemical will not bioconcentrate to a significant degree (Maki and Duthie, 1978).

5.1.4 Exposure Routes and Pathways

An exposure pathway links a source of contamination with one or more receptors through exposure to one or more ecologically relevant media. Exposure, and thus potential risk, can only occur if complete exposure pathways exist.

An exposure route describes the specific mechanism(s) by which a receptor is exposed to a chemical present in an environmental medium. The most common exposure routes are dermal contact, ingestion, and inhalation. Terrestrial vegetation may be exposed to chemicals present in surface soils through their root surfaces during water and nutrient uptake. Unrooted, floating aquatic plants, rooted submerged aquatic plants, and algae may be exposed to chemicals directly from the water or (for rooted plants) from sediments. Terrestrial and aquatic invertebrates may be exposed to chemicals in surface soil, sediment, or surface water through dermal adsorption and ingestion. Much of the toxicological data available for terrestrial and aquatic invertebrates are based on *in situ* studies that represent both pathways. Therefore, both pathways are typically considered together. Invertebrates also present a link between soil/sediment chemicals and invertebrate consumers through food web transfer. As such, they are typically included as prey items for upper trophic level dietary exposures.

Birds and mammals may be exposed to chemicals through: (1) the inhalation of gaseous chemicals or chemicals adhered to particulate matter; (2) the incidental ingestion of contaminated abiotic media (e.g., soil or sediment) during feeding or cleaning activities; (3) the ingestion of contaminated water; (4) the ingestion of contaminated plant and/or animal tissues for chemicals that have entered food webs; and/or (5) dermal contact with contaminated abiotic media. Their relative importance depends in part on the chemical being evaluated. For chemicals having the potential to bioaccumulate (e.g., PCBs), the greatest exposure to wildlife is likely to be from the ingestion of prey. For chemicals having a limited potential to bioaccumulate (.e.g., aluminum), the exposure of wildlife to chemicals is likely to be greatest through the direct ingestion of abiotic media, such as soil or sediment.

5.1.5 Conceptual Model

The conceptual model is designed to diagrammatically relate potentially exposed receptor populations with potential contaminant source areas based on the physical nature of the SWMU and potential exposure pathways. Important components of the preliminary conceptual model are the identification of potential sources of contaminants, transport pathways, exposure media, potential exposure routes, and potential receptor groups. Actual or potential exposures of ecological receptors associated with SWMU 73 will be determined by identifying the most likely pathways of contaminant release and transport. A complete exposure pathway has four components: (1) a source of chemicals that can be released to the environment; (2) a release and transport mechanism to move the chemicals from the source to an exposure point; (3) an exposure point where ecological receptors could contact the affected media; and (4) an exposure route whereby chemicals can be taken up by ecological receptors.

The main objective of the conceptual model in Step 1 of the ERA process is to identify any complete exposure pathways present at a site. The ERA will provide a conceptual model that relates directly to SWMU 73.

5.1.6 Endpoints and Risk Hypotheses

The screening-level problem formulation includes the selection of ecological endpoints. Endpoints in the screening-level ERA define ecological attributes that are to be protected (assessment endpoints) and a measurable characteristic of those attributes (measurement endpoints) that can be used to gauge the degree of impact that has or may occur (USEPA, 1992, 1997a, and 1998). Assessment endpoints most often relate to attributes of biological populations or communities, and are intended to focus the risk assessment on particular components of the ecosystem that could be adversely affected by chemicals attributable to the site (USEPA, 1997a). Assessment endpoints contain an entity (e.g., red-tailed hawk) and an attribute of that entity (e.g., survival rate). Individual assessment endpoints usually encompass a group of species or populations (the receptor) with some common characteristic, such as specific exposure route or contaminant sensitivity, with the receptor then used to represent the assessment endpoint in the risk evaluation.

The considerations for selecting assessment and measurement endpoints are summarized in USEPA (1992 and 1997a) and discussed in detail in Suter II (1989, 1990, and 1993). Assessment and measurement endpoints may involve ecological components from any level of biological organization, from individual organisms to the ecosystem (USEPA, 1992). Effects on individuals are important for some receptors, such as rare and endangered species, but population- and community-level effects are typically more relevant to ecosystems. Population- and community-level effects are usually difficult to evaluate directly without long-term and extensive study.

However, measurement endpoint evaluations at the individual level, such as an evaluation of the effects of chemical exposure on reproduction, can be used to predict effects on an assessment endpoint at the population- or community-level. In addition, use of criteria values designed to protect the vast majority (e.g., 95 percent) of the components of a community (e.g., Ambient Water Quality Criteria for the Protection of Aquatic Life) can be useful in evaluating potential community- and/or population-level effects.

The most appropriate generic assessment endpoint for ERAs will be the maintenance of receptor populations. Therefore, the specific objective of the ERA will be to determine if exposure to site-related chemicals present in environmental media are likely to result in declines in ecological receptor populations. Declines in populations could result in a shift in community structure and possible elimination of resident species.

Measurement endpoints are used in ERAs because it is often difficult or impossible to directly assess whether the environmental value that is to be protected (the assessment endpoint) is being impacted. For example, an assessment endpoint may involve a decline in a particular population or a shift in the structure of a community. While these things might be quantifiable, the necessary studies would generally be time-consuming and difficult to interpret. However, measurement endpoints indicative of observed adverse effects on individuals are relatively easy to measure in toxicity studies and can be related to the assessment endpoint. For example, contaminant concentrations that lead to decreased reproductive success or increased mortality of individuals in toxicity tests could, if found in the environment, result in shifts in population structure, potentially altering the community composition associated with a site.

5.1.7 Selection of Receptors

Because of the complexity of natural systems, it is generally not possible to directly assess the potential impacts to all ecological receptors present within an area. Therefore, receptor species (e.g., American robin) or species groups (e.g., terrestrial invertebrates and plants) are often selected as surrogates to evaluate potential risks to larger components of the ecological community (guilds; e.g., omnivorous birds) represented in the assessment endpoints (e.g., survival and reproduction of omnivorous birds). Selection criteria typically include those species that:

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

Upper trophic level receptor species will be chosen for dietary exposure modeling based on the criteria listed above, the general guidelines presented in USEPA (1991), the environmental setting (e.g., habitats), and the assessment endpoints selected for SWMU 73. Lower trophic level receptor species (e.g., terrestrial and aquatic invertebrates and plants) are generally evaluated in screening-level ERAs based on those taxonomic groupings for which screening values have been developed. These groupings and screening values are used in most ERAs. As such, specific species of lower trophic level biota will not be chosen as receptor species because of the limited information available for specific species and because these biota are dealt with on a community level via a comparison to medium-specific screening values. It is noted that only avian species will be selected as upper trophic level ecological receptors for evaluation in the ERA since the terrestrial mammals represented by potentially complete exposure pathways are limited to nonindigenous, nuisance species (i.e., Norway rat, black rat, and mongoose) that have been implicated in the decline of native bird populations (United States Fish and Wildlife Service [USFWS], 1996)

5.1.8 Screening-Level Problem Formulation Decision Point

As discussed in Section 5.1, the screening-level problem formulation is intended to answer two main questions: (1) do complete exposure pathways exist at the SWMU 73 and (2) are sufficient data available to conduct the screening-level ERA? Complete exposure pathways from a source area are likely to exist if all of the following are present:

- Habitat that supports ecological receptor populations.
- Contaminant transport pathways to ecologically relevant media.
- Complete exposure routes.

If no complete exposure pathways exist at SWMU 73, the ERA process will terminate at the screening-level problem formulation with a conclusion of negligible risk. If one or more complete exposure pathways are known or likely to exist, the ERA process will continue to the screening-level ecological effects evaluation, screening-level exposure estimation, and screening-level risk calculation but will only evaluate those pathways that have been determined to be complete.

5.2 Screening-Level Ecological Effects Evaluation

The purpose of the screening-level ecological effects evaluation is the establishment of chemical exposure levels (screening values) that represent conservative thresholds for adverse ecological effects. One set of screening values is typically developed for each of the selected assessment endpoints.

Two types of screening values (media-specific screening values and ingestion-based screening values) will be developed for the ERA at SWMU 73. Media-specific screening values will be developed for ecologically relevant media at SWMU 73 (e.g., surface soil). Ingestion-based screening values will be developed for upper trophic level food web (dietary) exposures.

5.2.1 Media-Specific Screening Values

The sections that follow describe the various criteria and toxicological benchmarks that will be used as media-specific screening values (toxicological thresholds) for chemicals in surface soil (collected from the 0 to 1-foot depth interval), subsurface soil (collected from the 1 to 3-foot depth interval), and groundwater. The media-specific screening values represent conservative exposure thresholds above which adverse ecological effects may occur.

5.2.1.1 Soil Screening Values

USEPA Ecological Soil Screening Levels (Eco-SSLs) for terrestrial plants and invertebrates (available at http://www.epa.gov/ecotox/ecossl/) will be preferentially used as surface and subsurface soil screening values. For a given metal, if an Eco-SSL has been established for both terrestrial plants and invertebrates, the lowest value will be selected as the soil screening value.

For those chemicals lacking an Eco-SSL, the literature-based toxicological benchmarks listed below will be used as soil screening values.

- Toxicological thresholds for earthworms and microorganisms (Efroymson et al., 1997a)
- Toxicological thresholds for plants (Efroymson et al., 1997b)

If more than one screening value is available from Efroymson et al. (1997a and 1997b), the lowest value will be selected as the soil screening value. For those chemicals lacking an Eco-SSL or a toxicological threshold from Efroymson et al. (1997a and 1997b), the following literature-based values, listed in their order of decreasing preference, will be used as soil screening values.

- Toxicity reference values for plants and invertebrates listed in USEPA, 1999
- Soil standards developed by the Ministry of Housing, Spatial Planning and Environment (MHSPE, 2000), assuming a minimum default soil organic carbon content of 2.0 percent
- Canadian soil quality guidelines (agricultural land use) developed by the Canadian Council of Ministers of the Environment (CCME, 2006)

CCME soil quality guidelines will be given the lowest preference since they are background-based values that do not represent effect concentrations. A listing of the soil screening values for Appendix IX VOCs, SVOCs, PAHs, organochlorine pesticides, and metals, selected using the preference hierarchy presented above, is provided in Table 5-1. The soil screening values summarized in Table 5-1 have previously been accepted by the USEPA for use in ERAs at NAPR (Baker, 2006b and 2006c).

5.2.1.2 Groundwater Screening Values

As SWMU 56 is located upgradient of open water marine habitat, groundwater data will be screened against saltwater toxicological thresholds (open water marine habitat represents a likely discharge point for groundwater). Chronic saltwater National Ambient Water Quality Criteria (NAWQC) (USEPA, 2006; available at http://www.epa.gov/waterscience/criteria/wqcriteria.html) will be used as groundwater screening values. USEPA NAWQC for arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc are expressed as dissolved concentrations. As a measure of conservatism, they will be converted to total recoverable concentrations using the appropriate conversion factors (USEPA, 2006). For those chemicals lacking a saltwater NAWQC, groundwater screening values will be identified from the following information listed in their order of decreasing preference:

- Final Chronic Values (FCVs) for saltwater contained in Ecotox Thresholds (USEPA, 1996a)
- Chronic screening values for saltwater contained in Ecological Risk Assessment Bulletins – Supplement to Risk Assessment Guidelines (RAGS) (USEPA, 2001)
- Minimum chronic toxicity test endpoints (No Observed Effect Concentration [NOEC], No Observed Effect Level [NOEL], and Maximum Acceptable Toxicant Concentration [MATC] values) for saltwater species reported in the ECOTOX Database System (Aquatic Toxicity Information Retrieval [AQUIRE] database) (USEPA, 2003a) and the Ecotoxicity Database (USEPA, 2005)
- Chronic Lowest Observable Effect Levels (LOELs) for saltwater contained in National Oceanic and Atmospheric Administration (NOAA) Screening Quick Reference Tables (SQUIRTs) (Buchman, 1999)

The order of preference was selected based on their level of protection. For example, FCVs would be expected to offer a greater degree of protection than a single species NOEC, MATC, or LOEL since their derivation considers a larger toxicological database. In the absence of the above-mentioned FCVs, USEPA Region IV chronic screening values, chronic test endpoints, and chronic LOELs, screening values will be derived from the acute literature values listed below:

- Acute LOELs for saltwater contained in NOAA SQUIRTs (Buchman, 1999)
- Acute toxicity test endpoints (NOEC, NOEL, LOEL, Lowest Observed Effect Concentration [LOEC], median lethal concentration [LC_{50}], and median effective concentration [EC_{50}] values) for saltwater species contained in the ECOTOX Database System (AQUIRE database) (USEPA, 2003a) and the Ecotoxicity Database (USEPA, 2005)
- LC_{50} values for saltwater species contained in Superfund Chemical Matrix (USEPA, 1996b)

Chronic-based screening values will be extrapolated from acute NOEC, NOEL, LOEC, LOEL, LC_{50}, and EC_{50} values as follows:

- An uncertainty factor of 10 will be used to convert an acute NOEC, NOEL, LOEC, or LOEL to a chronic-based screening value
- An uncertainty factor of 100 will be used to convert an EC_{50} or LC_{50} to a chronic-based screening value

When acute toxicity data are used to extrapolate a chronic screening value, NOECs/NOELs will be given preference over LOECs/LOELs, LOECs/LOELs will be given preference over LC_{50} and EC_{50} values, and EC_{50} values will be given preference over LC_{50} values. When more than one value is available from the literature for a given test endpoint (e.g., NOEC), the minimum value will be conservatively used to extrapolate a chronic screening value. In some cases, chronic and acute LOELs for chemical classes (e.g., PAHs) are available from Buchman (1999). A LOEL based on a chemical class will be used to derive a chronic screening value only if that chemical lacked literature-based benchmarks and/or toxicity test endpoints.

For those chemicals lacking saltwater toxicological thresholds and literature values, surface water screening values will be identified or developed from freshwater values using the sources and procedures discussed in the preceding paragraphs with one exception. This exception involves the consideration of freshwater Secondary Chronic Values (SCVs) developed by the USEPA (1996a) and Suter II (1996). A listing of the groundwater screening values for Appendix IX VOCs, SVOCs, PAHs, and metals, selected using the preference hierarchy presented above, is provided in Table 5-2. The screening values summarized in Table 5-2 have previously been accepted by the USEPA for use in ERAs at NAPR (Baker, 2006b and 2006c).

5.2.2 Ingestion-Based Screening Values

Ingestion-based screening values for upper trophic level dietary exposures will be derived for each receptor species and chemical evaluated for food web exposures. Toxicological information from the literature for wildlife species most closely related to the receptor species will be used if available. This information will be supplemented by laboratory studies of non-wildlife species (e.g., laboratory mice) when necessary.

Chronic No Observed Adverse Effect Levels (NOAELs) based on growth or reproduction will be preferentially used as ingestion-based screening values for upper trophic level receptors.

NOAELs represent the highest dose of a chemical at which an effect being measured in a toxicity test does not occur. If several chronic toxicity studies are available from the literature for a given chemical, the most appropriate study will be selected for each receptor species based on study design, study methodology, study duration, study endpoint and test species. When chronic NOAEL values are unavailable, estimates will be derived or extrapolated from chronic Lowest Observed Adverse Effect Levels (LOAELs) or acute values (LD_{50}). LOAELs represent the lowest dose of a chemical at which an effect being measured in a toxicity test occurs, while an LD_{50} represents the dose of a chemical at which half of the organisms being tested die. An uncertainty factor of 10 will be used to convert a reported LOAEL to a NOAEL, while an uncertainty factor of 100 will be used to convert the acute LD_{50} to a chronic NOAEL (i.e., the LD_{50} will be multiplied by 0.01 to obtain the chronic NOAEL).

As discussed in Section 5.1.7, only avian species will be evaluated for upper trophic level food web exposures. Ingestion-based screening values for birds, expressed as milligrams of chemical per kilogram body weight of the receptor per day (mg/kg-BW/day), are summarized in Table 5-3. The ingestion-based screening values listed in Table 5-3 have previously been accepted by the USEPA for use in ERAs at NAPR (Baker, 2006b and 2006c). It is noted that Sample et al. (1996) consider a scaling factor of 1.0 most appropriate for interspecies extrapolation between birds. Therefore, the NOAEL and LOAEL values summarized in Table 5-3 will not be adjusted to reflect differences in body weights between avian test species and avian receptor species. Not all chemicals analyzed in ecologically relevant media will be evaluated for food web exposures. The Appendix IX VOCs and SVOCs that will be evaluated for food web exposures are those with the potential to bioaccumulate to a significant extent. Bioaccumulative chemicals are defined herein as those with a maximum reported log octanol-water partition coefficient (log K_{ow}) greater than or equal to 3.0. Rationale for using a log K_{ow} of 3.0 to define an organic chemical with the potential to bioaccumulate is included as Appendix D. This approach has previously been accepted by the USEPA for the selection of organic chemicals evaluated for upper trophic level food web exposures (Baker, 2006b and 2006c). For conservatism, all Appendix IX metals will be evaluated for food web exposures.

5.3 Screening-Level Exposure Estimation

This portion of the screening-level ERA involves the identification of the data to be used to represent concentrations of chemicals to which ecological receptors may be exposed to in various media and the derivation of exposure point concentrations from those data (typically the maximum detected concentration). Exposure assumptions, exposure models, and model input parameters are also developed.

5.3.1 Selection Criteria for Analytical Data

Available analytical data for ecologically relevant media will be selected for use in the screening-level ERA based on a set of selection criteria that will include (where applicable):

- Data must be validated by a qualified data validator using acceptable data validation methods. Rejected (R) values will not be used in the ERA. Unqualified data and data qualified as J will be treated as detected. Data qualified as U or UJ will be treated as non-detected.
- Maximum reporting limits will be conservatively used to estimate exposure for non-detected chemicals.
- In some instances, duplicate samples have been or will be collected in the field. The maximum concentration of each chemical in the original or duplicate sample will be used as a conservative estimate of chemical concentrations at a particular sampling point.

- For surface soil, analytical data for samples collected from the surface to a maximum depth of one foot below ground surface (bgs) will be used since this depth range is the most active biological zone (Suter II 1995).
- For surface water and groundwater, total (unfiltered) metals data will be used in the medium-specific screening evaluation.

5.3.2 Exposure Point Concentrations – Abiotic Media

Maximum detected concentrations in abiotic media (e.g., surface soil) will be used to conservatively estimate potential chemical exposures for the ecological receptors selected to represent the assessment endpoints. For conservatism, the maximum reporting limit for chemicals that were analyzed for but not detected also will be compared to medium-specific screening values and (where applicable) used for food web exposure modeling. This will be done to ensure that reporting limits are similar to, or less than, chemical concentrations at which potential adverse effects to ecological receptors may occur. For samples with duplicate analyses, the higher of the two concentrations will be used in the screening (when both values are detects or both values are non-detects). In cases where one result is a detection and the other a non-detect, the detected value will be used in the assessment.

5.3.3 Exposure Point Concentrations – Prey Items

Exposures for upper trophic level receptor species via the food web will be determined by estimating the chemical-specific concentrations in each dietary component using uptake and food web models. Ingestion of abiotic media, if appropriate, will also be included when calculating the total level of exposure. As indicated previously, maximum measured concentrations in abiotic media will be used in all calculations to provide a conservative assessment.

Estimates for food web exposures will be based on bioaccumulation factors developed from the literature. The uptake of chemicals from the abiotic media into these food items will be based on conservative (e.g., maximum or 90th percentile) BCFs or bioaccumulation factors (BAFs). Default factors of 1.0 (dry weight to dry weight) will be used only where data are unavailable for a chemical in the literature. The completed screening-level will contain tables listing the BAFs/BCFs selected for each prey item. The methodology and models used to derive these estimates also will be included within the completed screening-level ERA.

Dietary intakes for each upper trophic level receptor species selected to represent the assessment endpoints will be calculated using the following formula (modified from USEPA [1993]):

$$DI_x = \frac{[[\sum_i [(FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]][AUF]}{BW}$$

where:

DI_x	=	Dietary intake for chemical x (mg chemical/kg body weight/day)
FIR	=	Food ingestion rate (kg/day, dry weight)
FC_{xi}	=	Concentration of chemical x in food item i (mg/kg, dry weight)
PDF_i	=	Proportion of diet composed of food item i (dry weight basis)
SC_x	=	Concentration of chemical x in soil/sediment (mg/kg, dry weight)
PDS	=	Proportion of diet composed of soil/sediment (dry weight basis)
WIR	=	Water ingestion rate (L/day)
WC_x	=	Concentration of chemical x in water (mg/L)

BW	=	Body weight (kg, wet weight)
AUF	=	Area Use Factor (unitless)

As discussed in USEPA (1997a), exposure parameter values used in this food web model will be selected to provide for a conservative evaluation in the screening-level ERA. Examples of these conservative assumptions include:

- All of the dietary items consumed by the receptor are obtained from the site (i.e., an Area Use Factor [AUF] of 1 will be assumed) at the point of maximum concentrations.
- Chemicals are assumed to be 100 percent bioavailable.
- Maximum ingestion rates will be used (calculated maximum ingestion rates are based on the maximum body weight).
- Minimum body weights will be used.

5.4 Screening-Level Risk Calculation

The screening-level risk calculation is the final step in a screening-level ERA. In this step, the maximum exposure concentrations (abiotic media) or exposure doses (upper trophic level receptor species) are compared with the corresponding screening values to derive screening risk estimates. The outcome of this step is a list of Ecological Chemicals of Potential Concern (ecological COPCs) for each medium-pathway-receptor combination evaluated or a conclusion of negligible risk.

5.4.1 Selection of Ecological Chemicals of Potential Concern

Ecological COPCs will be selected using the hazard quotient (HQ) method. HQs are calculated by dividing the maximum chemical concentration in the medium being evaluated by the corresponding medium-specific screening value or, in the case of upper trophic level receptors, by dividing the exposure dose by the corresponding ingestion-based screening value. Chemicals with HQs greater than 1.0 will be considered ecological COPCs in the screening-level ERA.

The following conservative methodology will be used to identify ecological COPCs for abiotic media:

- The maximum detected concentration in each ecologically relevant media will be used to calculate media-specific HQs. For a given medium, chemicals with HQs greater than 1.0 based on maximum detected concentrations will be identified as ecological COPCs for that medium.
- For chemicals not detected in any samples of a particular medium, the maximum reporting limit will be used to calculate media-specific HQs. For a given medium, non-detected chemicals with HQs greater than 1.0 based on maximum reporting limits will be identified as ecological COPCs for that medium.
- Chemicals (detected and non-detected) without screening values for a given medium will be identified as ecological COPCs for that medium.

To select ecological COPCs for food web exposures, maximum chemical concentrations in ecologically relevant abiotic media will be used to estimate dietary doses for each receptor. All chemicals identified as important bioaccumulative chemicals (see Appendix D) will be evaluated for upper trophic level food web exposures. HQs will be calculated with NOAELs, LOAELs, and Maximum Acceptable Toxicant Concentrations (MATCs) (the geometric mean of the NOAEL and LOAEL). Calculations with NOAELs provide the most conservative risk estimate, while calculations with LOAELs provide the least conservative risk estimate. Calculations with MATCs provide realistic risk estimates since the MATC represents an estimation of the threshold concentration (i.e., the concentration above which a toxic effect on the test endpoint is produced). For the screening-level ERA, chemicals (detected and non-detected) with NOAEL-based HQs greater than or equal to 1.0 will be identified as preliminary ecological COPCs. Identical to the media-specific screening, chemicals without ingestion-based screening values also will be retained as ecological COPCs for upper trophic level receptors.

HQs exceeding one indicate the potential for risk since the chemical concentration or dose (exposure) exceeds the screening value (effect). However, screening values and exposure estimates are derived using intentionally conservative assumptions such that HQs greater than or equal to one do not necessarily indicate that risks are present or impacts are occurring. Rather, it identifies chemical-pathway-receptor combinations requiring further evaluation. Following the same reasoning, HQs that are less than one indicate that risks are very unlikely, enabling a conclusion of no unacceptable risk to be reached with high confidence.

5.5 Uncertainties

Once the screening-level ERA is complete, the results will be evaluated to identify the type and magnitude of uncertainty associated with the risk conclusions. Reliance on results from a risk assessment can be misleading without a consideration of uncertainties, limitations, and assumptions inherent in the process. Uncertainties are present in all risk assessments because of the limitations of the available data and the need to make certain assumptions and extrapolations based on incomplete information.

5.6 Screening-Level ERA Decision Point

The results of the screening-level ERA will be used to evaluate the status of SWMU 73 in terms of potential ecological risk. Possible decision points following completion of the screening-level ERA are:

- **No further action is warranted**. This decision is appropriate if the screening-level ERA indicates that sufficient data are available on which to base a conclusion of no unacceptable risk (HQ values for each media-pathway-receptor combination is less than one).
- **Further evaluation is warranted**. This decision is appropriate if the screening-level ERA indicates that there is the potential for unacceptable risk for one or more media-pathway-receptor combinations. In this instance, the ERA process will proceed to Step 3a wherein the risk estimates are refined based on more realistic and site-specific assumptions and data.
- **Further data are required**. This decision is appropriate if the screening-level ERA indicates that there are insufficient data on which to base a risk estimate. This decision may also be appropriate if the potential for unacceptable risks is identified following the screening-level ERA and additional data are needed to refine these estimates in Step 3a.
- **Take remedial action**. This decision may be appropriate for sites in which the potential for unacceptable risks was identified following the screening-level ERA but these potential risks could be best addressed through remedial action (e.g., presumptive remedy, soil removal) rather than additional study.

5.7 Step 3a of the Baseline Ecological Risk Assessment

If the results of the screening-level ERA suggest that further ecological risk evaluation or data collection is warranted, the ERA process will proceed to Step 3a of the baseline ERA. This section documents the technical approach that will be used for conducting Step 3a of the baseline ERA at SWMU 73.

5.7.1 General Methodology for Step 3a

In Step 3a, the conservative assumptions employed in the screening-level ERA (Tier 1) are refined and risk estimates are recalculated using the same conceptual model. Step 3a may also include consideration of background data and chemical bioavailability.

The specific assumptions, parameters, and methods that will be modified for the recalculation of media-specific and food web HQ values are identified below, along with justification for each modification. These refinements and methods will be used in Step 3a of the baseline ERA to weigh the evidence of potential risk for each ecological COPC identified for each media and receptor to determine whether the development of CAOs is warranted.

- Refined risk estimates will be derived using average (arithmetic mean) chemical concentrations. For individual receptor species, average chemical concentrations provide a better estimate of the likely level of chemical exposure because each receptor would be expected to forage in several different areas of the site, and, in many cases, off-site. Average concentrations are also appropriate for evaluating impacts *to populations* of lower trophic level receptors (e.g., terrestrial invertebrates). Because some of these receptors are relatively immobile, *individuals* are likely to be impacted by locations of maximum concentrations. However, evaluation of the average exposure case is more indicative of the level of impact that might be expected at the *population* level.
- Literature-based BCFs and BAFs based on, or modeled from, central tendency estimates (e.g., mean, median, midpoint) will be used in place of maximum or high-end (e.g., 90th percentile) estimates. An assumed BCF/BAF of 1.0 will still used for those chemicals lacking a literature-based BAF/BCF. The refined BCFs and BAFs for those chemicals carried into Step 3a of the baseline ERA will be summarized in tables.
- Central tendency estimates (e.g., mean, median, midpoint) for body weight and food ingestion rate will be used to develop exposure estimates for upper trophic level receptors rather than the minimum body weights and maximum food ingestion rates used in the screening-level ERA. The use of central tendency estimates is more relevant because they represent the characteristics of a greater proportion of the individuals in the population. The evaluation of food web exposures will still assumed an AUF of 1.0.
- In addition to the NOAELs-based risk estimates used in the screening-level ERA, consideration also will given to food web exposure risk estimates based on LOAELs and MATCs.
- Consideration will be given to background data by statistically comparing site concentrations to background concentrations in accordance with Navy guidance (NFESC, 2002, 2003, and 2004). The process that will be used to statistically evaluate data is depicted on Figure 5-2. As evidenced by the figure, statistical comparisons will include descriptive summaries of each data set (maximum, minimum, and mean concentrations), statistical tests on the mean/median of the distributions (i.e., student's t-test, Wilcoxin rank sum test, Gehan test, and Satterthwaite's t-test), and statistical tests on the right tail of the distributions (i.e., quantile test and/or slippage test). The significance level (the

probability criteria for rejecting the null hypotheses that data sets were sampled from the same population) will be set at 0.05 for all statistical tests (NFESC, 2002, 2003, and 2004). For a given medium, the background data to be used in the statistical evaluation will be the background data set presented and discussed within the *Revised Final Summary Report for Environmental Background Concentrations of Inorganic Compounds* (Baker, 2006a).

- As exposure does not necessarily equate to risk, consideration will be given to site-specific factors that can affect the bioavailability of chemicals.
- Chemicals not identified as ecological COPCs because maximum detected concentrations (or maximum reporting limits in the case of non-detected chemicals) are less than medium-specific screening values will not evaluated in Step 3a of the baseline ERA since a conclusion of no unacceptable risk can be made with high confidence.

5.7.2 Step 3a Decision Points

Possible decision points based on the results of Step 3a include:

- **No further action is warranted.** This decision is appropriate if Step 3a of the baseline ERA indicates that there is no reasonable potential for unacceptable ecological risk within acceptable uncertainty.
- **Evaluate the need for corrective measures.** This decision is appropriate if Step 3a of the baseline ERA indicates that there is a reasonable likelihood for unacceptable ecological risks within acceptable uncertainty. Whether or not corrective measures are taken will depend upon a number of risk management factors such as the results of any human health risk assessments and the potential impact of the remedial action itself on the habitats and biota present on the site.

5.8 Ecological Corrective Action Objectives

Corrective Action Objectives (CAOs) will be established for chemicals retained as ecological COPCs in Step 3a of the Navy ERA process. CAOs for abiotic media (e.g., surface soil) will be developed by multiplying medium-specific screening values by 0.99:

$$CAO_x = (SV_x)(0.99)$$

where CAO_x is the Corrective Action Objective for chemical x and SV_x is the medium-specific screening value for chemical x, and 0.99 represents a default HQ for the derivation of CAOs. CAOs calculated using this default value correspond to medium-specific chemical concentrations that result in risk estimates equal to 0.99. As discussed in Section 5.4.1, HQ values less than 1.0 indicates that risks are unlikely. CAOs for food web exposures will be developed by modifying the dietary intake equation presented in Section 5.3.3. Using surface soil as an example, the CAOs for food web exposures will be calculated as follows:

$$CAO_x = \frac{(0.99)(SV_{xj})(BW_j)}{[[\sum_i (FIR_j)(BAF_{ix} or BCF_{ix})(PDF_{ij})] + [(FIR_j)(PDS_j)]][AUF]}$$

where:

CAO_x = Corrective Action Objective for chemical x (mg/kg, dry weight)

SV_{ij}	=	Ingestion-based screening value for chemical i applied to receptor j (mg chemical/kg body weight/day)
BWj	=	Body weight for receptor j (kg, wet weight)
FIR	=	Food ingestion rate for receptor j (kg/day, dry-weight)
BAF_{ix}	=	Surface soil-Biota BAF for chemical x and food item i (dry weight basis)
BCF_{ix}	=	Surface soil-Biota BCF for chemical x and food item i (dry weight basis)
PDF_{ij}	=	Proportion of diet composed of food item i for receptor j (dry weight basis)
PDS_j	=	Proportion of diet composed of surface soil for receptor j (dry weight basis)
AUF_j	=	Area Use Factor for receptor j (unitless)

For a given medium, if a chemical is retained as an ecological COPC based on the abiotic screening and food web exposure evaluation (e.g., retained as a surface soil COPC and as an upper trophic level terrestrial receptor COPC in Step 3a of the ERA process), the minimum CAO will be selected as the final CAO.

6.0 ESTABLISHMENT OF CORRECTIVE ACTION OBJECTIVES

6.1 Introduction

This section of the document will discuss the steps required to establish the site-specific objectives and clean up goals used to identify corrective measures.

The first step in evaluating corrective measures will be to develop CAOs, which consist of medium- and chemical-specific goals for protecting human health and the environment. The CAOs will be used to focus the development of corrective measure alternatives on technologies that may achieve appropriate target levels, thereby limiting the number of alternatives analyzed.

CAOs can be specific and numerical (i.e., quantitative) or general and descriptive (i.e., qualitative). They are achieved by reducing exposure (e.g., installing a soil cover or limiting access) or by reducing contaminant levels (e.g., active remediation) (USEPA, 1988). CAOs will be used to evaluate the extent of contamination within a site that may require corrective measures, and the corrective measures alternative that best protects human health and the environment.

6.2 Land Use and Potentially Exposed Receptors

To focus on developing practicable and cost-effective corrective measures alternatives for SWMU 73, and to streamline its environmental cleanup process, USEPA guidance ("Land Use in the Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA] Remedy Selection Process," (USEPA, 1995) and U.S. Department of Defense (Longuemare, 1997) direct that CAOs should reflect the reasonably anticipated land use.

SWMU 73 is in an industrial area of NAPR. Future property use of these sites is expected to remain industrial for the duration of Naval operations (caretaker) of NAPR, as well as after property is transferred. As a result, potential human exposure is limited to industrial or commercial property use, now and in the foreseeable future.

Therefore, based on USEPA and Department of Defense guidance that CAOs should reflect actual anticipated land use, the assumed land use will be industrial (airfield), with industrial workers (i.e., civilians and or military personnel stationed at NAPR) the most likely receptors. Construction workers may be exposed to soil from the surface to a depth of ten feet below ground surface. Additionally, it is conservatively assumed that on-site trespassers could access the site and potentially be exposed to COPCs at the site. It is unlikely this site would ever be developed into a residential area given the current use of the area. If land use changes in the future, the SWMU will be reevaluated.

6.3 Selection of Contaminants of Potential Concern

The CAO development process in the CMS for SWMU 73 will identify the potential for human health risk to receptors exposed to surface soil (trespassers, industrial workers, and construction workers), subsurface soil (construction workers), and groundwater (industrial workers via inhalation of volatiles in indoor air and construction workers via dermal contact) at SWMU 73, which are affected by site-related activities. The previously mentioned potential COPCs from the ECP (NAVFAC Atlantic, 2005) will be incorporated into the CMS.

COPCs are those contaminants retained for further evaluation at this stage of the CMS process. They are contaminants that are detected in at least one sample in a given media at concentrations that are greater than screening criteria. As noted in USEPA's Risk Assessment Guidance for

Superfund (RAGS) (USEPA, 1989), estimated concentrations, such as “J” qualified (estimated) data, will be included in the COPC screening process and subsequent quantitative risk assessment (if a contaminant is retained as a COPC). The screening criteria are USEPA Region IX residential and industrial soil preliminary remediation goals (PRGs), the Federal MCLs, and the USEPA Region IX Tap Water PRGs. PRGs are derived by USEPA Region IX using default exposure parameter values and the most recent toxicological criteria available. The PRGs used for this report are those issued in October 2004 (USEPA, 2004a) (or the most recent version at the time the CMS is completed) and are based on conservative residential and industrial exposure for soil and residential tap water exposure for groundwater. (The target risk used to calculate the PRGs is $1x10^{-6}$, while the target HQ is 0.1 to account for cumulative effects.)

Tables will be provided which summarize the data for the media identified at SWMU 73 (soil and groundwater) and the COPC selection process.

6.4 Exposure Assessment and Methodology for Development of CAOs

6.4.1 Qualitative CAOs

6.4.1.1 Groundwater

There is no direct current exposure to contaminated groundwater at SWMU 73 nor is future exposure likely based on the future land use scenarios discussed in Section 6.2. (Indirect exposure via inhalation of volatiles emitted from the contaminated groundwater through the overlying soils is possible, as discussed in detail below.) Groundwater is not currently used for potable purposes because drinking water is supplied via pipeline from El Yunque (rain forest), which supplies all of NAPRs present and projected needs.

Under nonresidential land use – particularly the continued industrial future land use scenario, in which the U.S. Navy determines the specific use of the property – it is reasonable to assume that no groundwater well will be installed within the limited volume of contaminated groundwater and be used for domestic purposes. Section 6.4.2 describes the methodology and exposure pathways for developing quantitative CAOs. The qualitative CAOs for contaminated groundwater are:

- To prevent further degradation of Puerto Rico’s waters (Anti-degradation Policy, Regulation No. 4282, Puerto Rico Water Quality Standards Regulation, effective August 19, 1990.)

- To further restrict and prevent possible exposure to contaminated groundwater (e.g., by institutional controls).

- To protect public health and the environment in accordance with regulatory requirements (i.e., the general objective of all corrective measures).

6.4.1.2 Soil

Under the continued industrial land use scenario, contact with contaminants will occur from both surface and subsurface soil at SWMU 73. Section 6.4.2 describes the methodology and exposure pathways for developing quantitative CAOs based on these potential exposures. The qualitative CAOs for soil are:

- To prevent further degradation of Puerto Rico's waters (Anti-degradation Policy, Regulation No. 4282, Puerto Rico Water Quality Standards Regulation, effective August 19, 1990.)

- To protect human health and the environment in accordance with regulatory requirements (i.e., the general objective of all corrective measures).

6.4.2 Quantitative CAOs

Quantitative CAOs are acceptable residual contaminant concentrations. The following components will be used to determine CAOs for soil and groundwater:

- Intake by assumed exposure pathways.

- Chemical-specific toxicity data in the form of health effects criteria (see Section 6.5).

- Assumed target cancer risk level and noncancer hazard quotient.

The target risk level and HQ are general health effects levels deemed acceptable for exposure to individual carcinogenic and noncarcinogenic contaminants, respectively. The general equation for chemical intake that will be used in the human health RA is:

$$Intake(mg/kg\text{-}day) = \frac{C \times IR \times EF \times ED \times CF}{BW \times AT} \qquad \text{(Eq 6-1)}$$

where:

C	=	chemical concentration
IR	=	intake rate
EF	=	exposure frequency
ED	=	exposure duration
CF	=	conversion factor (to attain proper units)
BW	=	body weight
AT	=	averaging time for cancer or noncancer effects.

(Note: Units for the above parameters will vary depending on the medium of concern, i.e., soil or groundwater.)

This equation is algebraically combined with the general expressions for cancer risk and noncancer health effects, respectively:

$$Risk = Intake * SF \qquad \text{(Eq 6-2)}$$

$$HQ = Intake/RfD \qquad \text{(Eq 6-3)}$$

where:

Risk	=	target risk level ($1x10^{-6}$, or one in 1 million excess cancer cases due to exposure to a chemical, given the assumed exposure pathway). (unitless)
SF	=	slope factor, or health effects criterion for cancer effects. $(mg/kg/day)^{-1}$

HQ = target HQ (1.0, implying that intake should not exceed the RfD). (unitless)

RfD = reference dose, or health effects criterion for noncancer effects. (mg/kg/day)

Assumed values for risk and HQ and chemical-specific SFs or RfDs are used to solve for the concentration term, or the pathway-specific CAO.

For the continued industrial land use scenario at these sites, the industrial worker and construction worker will be used to characterize potential future exposure to contaminated soil and groundwater. Industrial worker exposure is limited to surface soil (defined as zero to two feet) at SWMU 73, while construction workers may also be exposed to subsurface soil (zero to ten feet) at SWMU 73. Additionally, it is conservatively assumed that adult and/or adolescent trespassers may gain access to the site in the future and will also be used in the evaluation of potential exposure to contaminated surface soil.

The exposure pathways evaluated for developing quantitative CAOs for soil in the CMS are likely to be inadvertent ingestion, inhalation of contaminants in particulates; inhalation of volatiles emitted from soil, and dermal absorption of contaminants following direct contact with soil and groundwater.

Industrial workers will only likely to be exposed to contaminants in groundwater via inhalation of volatiles emitted through the soil into buildings. The methodology outlined in USEPA's November 29, 2002 Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance) (USEPA, 2002) will be used to determine whether the subsurface vapor intrusion pathway is complete and, if so, whether vapors are present at levels that may pose unacceptable exposure risk. This guidance includes a three-tiered approach for screening the exposure pathway. The three tiers involve increasing levels of complexity and specificity, and generic screening levels allow for a simple quantitative screen of contaminant concentrations.

The Johnson and Ettinger (1991) model, included as part of the guidance, may be used to quantify this exposure if the screening procedure outlined in the Subsurface Vapor Intrusion Guidance (USEPA, 2002) suggests it is necessary. USEPA placed this model into a spreadsheet format and produced a User's Guide for use at contaminated sites (USEPA, 2000). The new version of the Johnson and Ettinger model states that exposure by indoor inhalation of contaminants is much greater than outdoor exposure due to greater dilution in outside air and enhanced volatilization indoors due to chimney and pressure effects. For these reasons, and because the model assumes full time exposure indoors (i.e., leaving no time for additional outdoor exposure), outdoor inhalation exposure to groundwater is not quantitatively evaluated.

6.5 Toxicity Evaluation

For the development of quantitative CAOs based on exposure to chemicals, the following health effects criteria will be of principal importance:

- RfDs for oral exposure – estimates of acceptable daily intake for chronic and subchronic exposure that will not produce deleterious noncancer effects. USEPA defines subchronic exposure as periods of less than 7 years (USEPA, 1989). Therefore, subchronic RfDs apply to construction workers, while chronic RfDs apply to industrial workers.

- Reference concentrations (RfCs) for inhalation exposure – estimates of acceptable concentrations for chronic and subchronic exposure that will not produce deleterious noncancer effects. These values are converted to inhalation RfDs by multiplying the RfC by the reference IR value of 20 m^3/day and dividing by the reference BW of 70 kilograms. RfCs are used in the Johnson and Ettinger (1991) model, while other inhalation pathways use the inhalation RfD. Subchronic inhalation RfDs and RfCs apply to the construction worker only, as discussed for RfDs for oral exposure.

- SFs for oral exposure – plausible upper-bound estimates of the probability of an individual developing cancer as a result of lifetime exposure to a potential carcinogen (USEPA, 1989).

- SFs for the inhalation route – plausible upper-bound estimates of the probability of an individual developing cancer as a result of lifetime exposure to a potential carcinogen (USEPA, 1989). Inhalation SFs are calculated from inhalation unit risk values in a similar manner as described above for inhalation RfDs. Unit risk values are used in the Johnson and Ettinger (1991) model, while all other inhalation pathways use the inhalation SF.

The primary source of chemical-specific health effects criteria which will be used during the CMS will be USEPA's Integrated Risk Information System (IRIS) database (USEPA, 2007). IRIS is a computer-housed catalog of USEPA health effects criteria and information. Data in IRIS are reviewed and updated monthly. If health effects criteria are not available in IRIS, USEPA recommends use of the Provisional Peer Reviewed Toxicity Values (PPRTVs) (database of values developed on a chemical-specific basis when requested by USEPA's Superfund program) as a secondary data source (USEPA, 2003b). Additional health effects criteria not provided in IRIS or as PPRTVs are obtained from other USEPA (e.g., Health Effects Assessment Summary Table [HEAST] [USEPA, 1997b]) and non-USEPA (e.g., Agency for Toxic Substances and Disease Registry [ATSDR] Minimal Risk Levels) sources of toxicity information. These sources should provide toxicity information based on similar methods and procedures as those used for IRIS and PPRTVs, contain values which are peer reviewed, are available to the public, and are transparent about the methods and processes used to develop the values.

Health effects criteria are available only for the oral and inhalation routes, and most of these criteria are based on the administered rather than the absorbed dose (i.e., the amount of chemical at a human exchange boundary, such as skin, that is available for absorption – but not the amount actually absorbed into the blood).

Adjustment will be made using oral absorption efficiency data (i.e., data on gastrointestinal absorption) from the species on which the oral health effects criteria are based. The administered dose oral health effects criterion will be multiplied (for RfDs) or divided (for SFs) by the gastrointestinal absorption factor to derive the absorbed dose criterion. Recommended oral absorption efficiencies for those compounds/analytes with chemical-specific dermal absorption factors from soil will be obtained from Risk Assessment Guidance for Superfund (RAGS) Part E (USEPA, 2004b).

6.6 Background Concentrations as CAOs

Background concentrations of inorganics may be used as quantitative CAOs when they exceed risk-based CAOs. The National Contingency Plan (NCP) preamble (55 *Federal Register*, 8717) states that preliminary remediation goals (PRGs; i.e., the CERCLA equivalent to quantitative

CAOs) may be revised based on consideration of “technical factors,” which may include background levels of contaminants. Therefore, if a calculated CAO is less than background inorganic constituents, the background concentration is used as the CAO.

7.0 IDENTIFICATION OF COCs

Contaminants of concern (COCs) are those contaminants detected at a site at concentrations that exceed human health based CAOs (derived using the protocol described in Section 6.0) or that pose an unacceptable ecological risk as determined by exceedance of ecological CAOs (derived using the protocol described in Section 5.0). Once COCs are identified they are evaluated as potential candidates for clean-up throughout the remainder of the CMS process. This evaluation includes examination of the spatial and concentration distributions of COCs within the media in which they occur.

8.0 POTENTIAL CORRECTIVE MEASURES

This section of the CMS work plan describes the stepwise approach to be taken in performing the CMS for SWMU 73 (DRMO Scrap Metal Recycling Yard). The CMS consists of four tasks, which are described in the sections that follow.

8.1 Task I - Identification and Development of the Corrective Measure Alternative or Alternatives

This task will identify, screen, and develop the alternative or alternatives for removal, containment, treatment and/or other disposition of the contamination based on the objectives established for the corrective measure. The analysis will be based on the results of the all previous investigations at SWMU 73 as well as the CMS investigation described in Sections 3.0 and 4.0 of this document.

8.1.1 Description of the Current Situation

The current situation and the known nature and extent of contamination at SWMU 73 will be described in this section. A statement of the purpose for the response, based on the results of the ECP and CMS investigations will be provided, as will the actual or potential exposure pathways to potential human or ecological receptors of concern that will be addressed by the corrective measures.

8.1.2 Establishment of Corrective Action Objectives

Site specific objectives for the corrective action will be established in conjunction with the USEPA. These objectives will be based on public health and environmental criteria, information obtained from site investigations, USEPA guidance, and any applicable federal or Commonwealth of Puerto Rico statutes. The CAOs will be consistent with 40 CFR 264.100 as applicable.

8.1.3 Screening of Corrective Measure Technologies

The corrective measure technologies, which are applicable at the facility, will be reviewed based on all the available data and information at SWMU 73. This screening process focuses on eliminating those technologies that have severe limitations for a given set of waste and site-specific conditions or due to inherent technology limitations.

8.1.4 Identification of the Corrective Measure Alternative or Alternatives

The corrective measure alternative or alternatives will be developed based on the CAOs and analysis of the corrective measure technologies. Those alternatives that appear most suitable for the site based on sound engineering will be retained. Technologies can be combined to form the overall corrective action alternative or alternatives. The reasons for excluding any technology shall be documented.

8.2 Task II - Evaluation of the Corrective Measure Alternative or Alternatives

Each corrective measure technology and its components that passed through the initial screening in Task I will be described and evaluated. This evaluation will be based on technical, environmental, human health, and institutional concerns. Cost estimates for each corrective measure will also be developed.

8.2.1 Technical/Environmental/Human Health/Institutional

A description of each corrective measure alternative which includes but is not limited to preliminary process flow sheets, preliminary sizing and type of construction for buildings and structures, and rough quantities of utilities required will be provided. Each alternative will be evaluated in the following four areas:

8.2.1.1 Technical

Each corrective measure alternative will be evaluated based on performance, reliability, implementability, and safety.

8.2.1.2 Environmental

An environmental assessment will be performed for each alternative, which will focus on the facility conditions and pathways of contamination actually addressed by each alternative. The environmental assessment for each alternative will include, at a minimum, an evaluation of: the short and long term beneficial and adverse effects of the response alternative; any adverse effects on environmentally sensitive areas; and an analysis of measures to mitigate adverse effects.

8.2.1.3 Human Health

Each alternative will be assessed in terms of the extent to which it mitigates short- and long-term potential exposure to any residual contamination and protects human health both during and after implementation of the corrective measure. The assessment will describe the levels and characterizations of contaminants on-site, potential exposure routes, and potentially affected populations. Each alternative will be evaluated to determine the level of exposure to contaminants and the reduction over time. For management of mitigation measures, the relative reduction of impact will be determined by comparing residual levels of each alternative with existing criteria, standards, or guidelines acceptable to the USEPA.

8.2.1.4 Institutional

The relevant institutional needs for each alternative will be assessed. Specifically the effects of Federal, State, and local environmental and public health standards, regulations, guidance, advisories, ordinances, or community relations on the design, operation, and timing of each alternative will be examined.

8.2.2 Cost Estimate

A cost estimate of each corrective measure alternative will be developed. The cost estimate will include capital, operation, and maintenance costs.

8.3 Task III - Justification and Recommendation of the Corrective Measure or Measures

The corrective measure alternative will be recommended and justified using technical, human health, and environmental criteria. Tradeoffs among health risks, environmental effects, and other pertinent factors will be highlighted. The USEPA will select the corrective measure alternative or alternatives to be implemented based on the results of Task II and III. At a minimum the criteria in the sections that follow will be used to justify the final corrective measure or measures.

8.3.1 Technical

8.3.1.1 Performance

Corrective measure or measures that are most effective at performing their intended functions and maintaining the performance over extended periods of time will be given preference.

8.3.1.2 Reliability

Corrective measure or measures that do not require frequent or complex operation and maintenance activities and that have proven effective under waste and facility conditions similar to those anticipated will be given preference.

8.3.1.3 Implementability

Corrective measure or measures that can be constructed and operated to reduce levels of contamination to attain or exceed applicable standards in the shortest period of time will be preferred.

8.3.1.4 Safety

Corrective measure or measures that pose the least threat to the safety of nearby residents and environments as well as workers during implementation will be preferred.

8.3.2 Human Health

The corrective measure or measures will comply with existing USEPA criteria, standards, or guidelines for the protection of human health. Corrective measures that provide the minimum level of exposure to contaminants and the maximum reduction in exposure with time are preferred.

8.3.3 Environmental

The corrective measure or measures posing the least adverse impact (or greatest improvement) over the shortest period of time on the environment will be favored.

8.4 Task IV - Reports

8.4.1 Corrective Measures Study Report(s)

A CMS Task 1 Report will be prepared and submitted for approval within forty-five (45) days after receipt of the data validation report for data collected during the CMS Investigation described in this work plan. The Task I report shall include the items listed in Section 8.1 of this work plan, including establishment of CAOs. Alternatively, a CMS Investigation report will be prepared and submitted, proposing a streamlined CMS process.

Upon approval of the CMS Task 1 Report or CMS Investigation Report, a CMS Final Report will be prepared and submitted for approval within sixty (60) days. The CMS Final Report to be developed will include all the information gathered under the approved CMS Work Plan. At a minimum the report will include:

- A description of the facility;
    - Site topographic map & preliminary layouts.

- A summary of the corrective measure or measures;
    - Description of the corrective measure or measures and rationale for selection;
    - Performance expectations;
    - Preliminary design criteria and rationale;
    - General operation and maintenance requirements; and
    - Long-term monitoring requirements.

- A summary of the previous investigations and impact on the selected corrective measure or measures;
    - Field studies (groundwater and soil);
    - Laboratory studies (bench scale treatability studies); and
    - Pilot-scale tests.

- Design and Implementation Precautions;
    - Special technical problems;
    - Additional engineering data required;
    - Permits and regulatory requirements;
    - Access, easements, right-of-way;
    - Health and safety requirements; and
    - Community relations activities.

- Cost Estimates and Schedules;
    - Capital cost estimate;
    - Operation and maintenance cost estimate; and
    - Project schedule (design, construction, operation).

9.0 SCHEDULE

A schedule for the implementation of this work plan, and follow-up reports for the CMS reports for SWMU 73 is provided as Figure 9-1.

It should be noted that this schedule is dependent upon USEPA review time. Many other factors can also extend the schedule such as resampling if further re-characterization is required, weather delays in the field, funding is delayed by the Navy, or consensus cannot be reached on how the USEPA's comments are to be incorporated.

10.0 PROJECT ORGANIZATION

An organizational chart presenting the proposed staffing for this project is provided on Figure 10-1. This section also outlines the responsibilities and reporting requirements of field personnel and staff.

10.1 Project Team Responsibilities

A Project Manager (Mr. David Jones, U.S. Army Reserve) will manage the Project Team. His responsibilities will be to direct the technical performance of the project staff, costs and schedule, ensuring that QA/QC procedures are followed during the course of the project. He will maintain communication with the BRAC PMO SE, Navy Technical Representative (NTR), Mr. Mark Davidson. A QA/QC Manager (Mr. Gene Sinar, U.S. Army Reserve) will be assigned to administer overall QA/QC for this project.

The field activities of this project will consist of one field team managed by the Geologist (Mr. David Jones, U.S. Army Reserve). The Mr. Jones's responsibilities include directing the field team and subcontractors. A report coordinator (Mr. Barrett Borry, U.S. Army Reserve) will direct the reporting effort of the field investigation. The report coordinator will direct and ensure that all necessary staffing is utilized to assist in developing the CMS Reports for SWMU 73.

10.2 Field Reporting Requirements

The Geologist will maintain a daily summary of each day's field activities. The following information will be included in this summary:

- Contractor and subcontractor personnel on site
- Major activities of the day
- Samples collected
- Problems encountered
- Other pertinent site information

The Geologist will receive direction from the Project Manager regarding any changes in scope of the investigation.

11.0 REFERENCES

Baker Environmental, Inc. (Baker), 2006a. Revised Final Summary Report for Environmental Background Concentrations of Inorganic Compounds, Naval Activity Puerto Rico, Ceiba, Puerto Rico. October 17, 2006.

Baker, 2006b. Final Additional Data Collection Report and Screening-Level Ecological Risk Assessment and Step 3a of the Baseline Ecological Risk Assessment at SWMU 45. Moon Township, Pennsylvania. January 11, 2006.

Baker, 2006c. Final Additional Data Collection Report and Screening-Level Ecological Risk Assessment and Step 3a of the Baseline Ecological Risk Assessment at SWMUs 1 and 2. Moon Township, Pennsylvania. May 18, 2006.

Baker, 1995. Final RCRA Facility Investigation Management Plans, Naval Station Roosevelt Roads, Ceiba, Puerto Rico. September 14, 1995.

Buchman, M.F., 1999. NOAA Screening Quick Reference Tables. NOAA HAZMAT Report 99-1. National Oceanic and Atmospheric Administration, Seattle, WA. 12 pp.

Canadian Council of Ministers of the Environment (CCME), 2006. Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health: Summary Tables (Version 6.0.2). November 2006. http://www.ccme.ca/assets/pdf/ceqg_soil_summary_table_v6_e.pdf.

Chief of Naval Operations (CNO), 1999. Navy Policy for Conducting Ecological Risk Assessments. Memorandum from Chief of Naval Operations to Commander, Naval Facilities Engineering Command. Ser. N453E/9U595355. April 5, 1999.

Efroymson, R.A., Will, M.E., and Suter II, G.W, 1997a. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. (ES/ER/TM-126/R2).

Efroymson, R.A., Will, M.E., Suter II, G.W., and Wooten, A.C, 1997b. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision. Oak Ridge National Laboratory. Oak Ridge, TN. (ES/ER/TM-85/R3).

Howard, P.H. 1991. Handbook of Environmental Fate and Exposure Data for Organic Chemicals, Volume III. Lewis Publishers, Chelsea, MI.

Johnson, P. C., and R. A. Ettinger, 1991. Heuristic Model for Predicting the Intrusion Rate of Contaminant Vapors Into Buildings. Environmental Science and Technology, Vol. 25, pp. 1445-1452.

LANTDIV, 2004a. Phase I Environmental Condition of Property Report, U.S. Naval Station Roosevelt Roads, Ceiba, Puerto Rico. Prepared for Commander, Navy Region Southeast (CNRSE), U.S. Navy, by Naval Facilities Engineering Command, Atlantic Division, Norfolk, Virginia. March 31, 2004.

LANTDIV, 2004b. Phase II Environmental Condition of Property Work Plan, U.S. Naval Station Roosevelt Roads, Ceiba, Puerto Rico. Prepared for Commander, Navy Region Southeast (CNRSE), U.S. Navy, by Naval Facilities Engineering Command, Atlantic Division, Norfolk, Virginia. April 30, 2004.

Longuemare, R. N., 1997. Responsibility for Additional Environmental Cleanup after Transfer of Real Property. Office of Under Secretary of Defense, July 25, 1997.

Lyman, W.J., W.F. Reehl, and D.H. Rosenblatt, 1990. Handbook of Chemical Property Estimation Methods. American Chemical Society, Washington D.C.

Maki, A.W. and J.R. Duthie, 1978. Summary of Proposed Procedures for the Evaluation of Aquatic Hazard. In Cairns, J., Jr., K.L. Dickson, and A.W. Maki (eds), Estimating the Hazard of Chemical Substances to Aquatic Life. ASTM STP 657. pp 153-163.

Ministry of Housing, Spatial Planning and Environment (MHSPE), 2000. Circular on Target Values and Intervention Values for Soil Remediation. Directorate-General for Environmental Protection, Department of Soil Protection, The Hague, Netherlands. February 4, 2000.

Naval Facilities Engineering Command Atlantic (NAVFAC Atlantic), 2005. Final Phase I/II Environmental Condition of Property, Former U.S. Naval Station Roosevelt Roads, Ceiba, Puerto Rico. Norfolk, Virginia.

Naval Facilities Engineering Service Center (NFESC), 2004. Guidance for Environmental Background Analysis. Volume 3: Groundwater. NFESC User's Guide UG-2054-ENV. April 2004.

NFESC, 2003. Guidance for Environmental Background Analysis. Volume 2: Sediment. NFESC User's Guide UG-2054-ENV. April 2003

NFESC, 2002. Guidance for Environmental Background Analysis. Volume I: Soil. NFESC User's Guide UG-209-ENV. April 2002.

Sample, B.E., D.M. Opresko, and G.W. Suter II, 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. Risk Assessment Program, Health Sciences Research Division. Oak Ridge, Tennessee.

Suter II, G.W., 1996. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Freshwater Biota. Environ. Toxicol. and Chem. 15:1232-1241.

Suter, G.W. II, 1995. Guide for Performing Screening Ecological Risk Assessments at DOE Facilities. Environmental Restoration Division, ORNL Environmental Restoration Program. ES/ER/TM-153.

Suter, G.W. II, 1993. Ecological Risk Assessment. Lewis Publishers, Chelsea, MI. 538 pp.

Suter, G.W. II, 1990. Endpoints for Regional Ecological Risk Assessment. Environmental Management. 14:9-23.

Suter, G.W. II, 1989. Ecological Endpoints. Chapter 2 In Warren-Hicks, W., B.R. Parkhurst, and S.S. Baker, Jr. (eds), Ecological Assessment of Hazardous Waste Sites: a Field and Laboratory Reference. USEPA/600/3-89/013.

U.S. Environmental Protection Agency (USEPA), 2007. Integrated Risk Information System (IRIS), online. Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, Ohio.

USEPA, 2006. National Recommended Water Quality Criteria. Office of Water and Office of Science and Technology. http://www.epa.gov/waterscience/criteria/nrwqc-2006.pdf.

USEPA, 2005. Ecotoxicity Database. Office of Pesticide Programs, Washington, D.C. http://www.epa.gov/oppefed1/general/databasesdescription.htm - ecotoxicity.

USEPA, 2004a. Region IX Preliminary Remediation Goals. http://www.epa.gov/region09/waste/sfund/prg/index.htm. October 2004.

USEPA, 2004b. Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual Part E Supplemental Guidance for Dermal Risk Assessment. Interim. Final. Office of Emergency and Remedial Response. Washington, DC. July 2004. USEPA 540/R/99/005.

USEPA, 2003a. ECOTOX Database System, Aquatic Toxicity Information Retrieval (AQUIRE) Database. Mid-Continent Ecology Division (MED), Duluth, MN. http://www.epa.gov/ecotox/.

USEPA, 2003b. Human Health Toxicity Values in Superfund Risk Assessments. OSWER Directive 9285.7-53. December 5, 2003.

USEPA, 2002. Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils, Draft Guidance (Subsurface Vapor Intrusion Guidance). USEPA 530-F-02-052, Office of Solid Waste and Emergency Response, Washington D.C., November, 2002.

USEPA, 2001. Region 4 Ecological Risk Assessment Bulletins – Supplement to RAGS. Waste Management Division, Atlanta, GA. http://www.epa.gov/region4/waste/ots/ecolbul.htm.

USEPA, 2000. User's Guide for the Johnson and Ettinger (1991) Model for Subsurface Vapor Intrusion into Buildings (Revised). Office of Emergency and Remedial Response, Washington, D.C., December 2000.

USEPA, 1999. Screening-Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities. EPA/530/D-99/001A.

USEPA, 1998. Guidelines for Ecological Risk Assessment. Risk Assessment Forum, Washington, DC. USEPA/630/R-95/002B.

USEPA, 1997a. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (Interim Final). Office of Solid Waste and Emergency Response. USEPA/540/R-97-006.

USEPA, 1997b. Health Effects Assessment Summary Tables (HEAST), Annual Update, FY 1997. National Center for Environmental Assessment, Office of Research and Development, Washington, D.C.

USEPA, 1996a. Ecotox Thresholds. Eco Update, Volume 3, Number 2. Office of Solid Waste and Emergency Response, Washington, D.C. EPA 540/F-95/038.

USEPA,1996b. Superfund Chemical Data Matrix. EPA/540/R-96/028.

USEPA, 1995. Land Use in the CERCLA Remedy Selection Process. Office of Solid Waste and Emergency Response Directive 9355.7-04, Washington, D.C., May 25, 1995.

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

USEPA, 1993 Wildlife Exposure Factors Handbook. Office of Research and Development, Washington, D.C. USEPA/600/R-93/187a.

USEPA, 1992. Framework for Ecological Risk Assessment. Environmental Protection Agency, Risk Assessment Forum, Washington, DC. USEPA/630/R92/001.

USEPA, 1991. Criteria for Choosing Indicator Species for Ecological Risk Assessments at Superfund Sites. USEPA/101/F-90/051.

USEPA, 1989. Risk Assessment Guidance for Superfund Volume I. Human Health Evaluation Manual (Part A) Interim Final. Office of Solid Waste and Emergency Response. Washington, D.C. December 1989. EPA/540/1-89-002.

USEPA, 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA. OSWER Directive 9335.3-01, Office of Solid Waste and Emergency Response, Washington, D.C.

United States Fish and Wildlife Service (USFWS), 1996. Yellow-Shouldered Blackbird Revised Recovery Plan (*Agelaius xanthomus*). USFWS, Southeast Region, Atlanta, GA. November 12, 1996.

TABLES

TABLE 3-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM
ENVIRONMENTAL SAMPLES
SWMU 73 CMS WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

		Fixed Based Analytical Lab Analysis								
Media	**Sample Depth (ft bgs)**	App IX VOCs	App IX SVOCs	Low Level PAHs	Organochlorine Pesticides	App IX Metals (Total)	App IX Metals (Dissolved)	RCRA Metals	Benzene	**Comment**
Surface Soil Samples										
73SB01-00	0.0 - 1.0	X	X	X	X	X				
73SB01-00D	0.0 - 1.0	X	X	X	X	X				Duplicate
73SB01-00MS/MSD	0.0 - 1.0	X	X	X	X	X				Matrix Spike/Matrix Spike Duplicate
73SB02-00	0.0 - 1.0	X	X	X	X	X				
73SB03-00	0.0 - 1.0	X	X	X	X	X				
73SB04-00	0.0 - 1.0	X	X	X	X	X				
73SB05-00	0.0 - 1.0	X	X	X	X	X				
73SB06-00	0.0 - 1.0	X	X	X	X	X				
73SB07-00	0.0 - 1.0	X	X	X	X	X				
73SB08-00	0.0 - 1.0	X	X	X	X	X				
73SB09-00	0.0 - 1.0	X	X	X	X	X				
73SB10-00	0.0 - 1.0	X	X	X	X	X				
73SB11-00	0.0 - 1.0	X	X	X	X	X				
73SB11-00D	0.0 - 1.0	X	X	X	X	X				Duplicate
73SB12-00	0.0 - 1.0	X	X	X	X	X				
73SB13-00	0.0 - 1.0	X	X	X	X	X				
73SB14-00	0.0 - 1.0	X	X	X	X	X				
73SB15-00	0.0 - 1.0	X	X	X	X	X				
73SB16-00	0.0 - 1.0	X	X	X	X	X				
73SB17-00	0.0 - 1.0	X	X	X	X	X				
73SB18-00	0.0 - 1.0	X	X	X	X	X				
73SB19-00	0.0 - 1.0	X	X	X	X	X				
73SB20-00	0.0 - 1.0	X	X	X	X	X				
73SB21-00	0.0 - 1.0	X	X	X	X	X				
73SB21-0D	0.0 - 1.0	X	X	X	X	X				Duplicate
73SB21-00MS/MSD	0.0 - 1.0	X	X	X	X	X				Matrix Spike/Matrix Spike Duplicate
73SB22-00	0.0 - 1.0	X	X	X	X	X				
73SB23-00	0.0 - 1.0	X	X	X	X	X				
73SB24-00	0.0 - 1.0					X				
73SB25-00	0.0 - 1.0					X				
73SB26-00	0.0 - 1.0					X				
73SB27-00	0.0 - 1.0					X				
73SB28-00	0.0 - 1.0					X				
73SB29-00	0.0 - 1.0					X				
73SB30-00	0.0 - 1.0					X				
73SB31-00	0.0 - 1.0					X				
73SB31-00D	0.0 - 1.0					X				Duplicate
73SB32-00	0.0 - 1.0					X				
73SB33-00	0.0 - 1.0					X				
73SB34-00	0.0 - 1.0					X				
73SB35-00	0.0 - 1.0					X				

TABLE 3-1 Revised: January 25, 2008

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM
ENVIRONMENTAL SAMPLES
SWMU 73 CMS WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

		Fixed Based Analytical Lab Analysis								
Media	**Sample Depth (ft bgs)**	App IX VOCs	App IX SVOCs	Low Level PAHs	Organochlorine Pesticides	App IX Metals (Total)	App IX Metals (Dissolved)	RCRA Metals	Benzene	**Comment**
Subsurface Soil Samples (Depths will be approximately 1-2 and 9-11 feet bgs)										
73SB01-01	1.0-3.0	X	X	X	X	X				
73SB01-05[(1)]	9.0-11.0	X	X	X	X	X				
73SB02-01	1.0-3.0	X	X	X	X	X				
73SB02-05[(1)]	9.0-11.0	X	X	X	X	X				
73SB03-01	1.0-3.0					X				
73SB03-01D	1.0-3.0					X				Duplicate
73SB03-01MS/MSD	1.0-3.0					X				Matrix Spike/Matrix Spike Duplicate
73SB03-05[(1)]	9.0-11.0					X				
Groundwater Samples										
73GW01[(1)]	NA	X	X	X			X			
73GW02[(1)]	NA	X	X	X			X			
73GW02D[(1)]	NA	X	X	X			X			Duplicate
73GW02MS[(1)]	NA	X	X	X			X			Matrix Spike
73GW02MSD[(1)]	NA	X	X	X			X			Matrix Spike Duplicate
73GW03[(1)]	NA						X			
Other Field QA/QC Samples										
Trip Blank Samples										
73TB-XX	NA	X								One sample will accompany each cooler containing samples for VOC analysis
Equipment Rinsate Samples										
73ER01	NA	X	X	X	X		X			Stainless Steel Spoon
73ER02	NA	X	X	X	X		X			Groundwater sample tubing
73ER-XX	NA	X	X	X	X		X			Auger or selected drilling tool, one per day of sampling
Field Blank Samples										
73FB01	NA	X	X	X	X	X				Lab Grade Deionized Water
73FB02	NA	X	X	X	X	X				Store-bought Distilled Water
73FB03	NA	X	X	X	X	X				NAPR Potable Water
IDW Samples										
73IDW01	NA							X	X	Solid waste
73IDW02	NA							X	X	Aqueous waste

Notes:

(1) - The sample designator will be determined based on the soil boring location identifier.
ft bgs - feet below ground surface.
NA - Not Applicable.

TABLE 3-2

METHOD PERFORMANCE LIMITS
APPENDIX IX COMPOUND LIST AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)
SWMU 73 CMS WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Appendix IX - VOCs	Quantitation Limits*		Method Number (Description)
	Water (µg/L)	Low Soil (µg/kg)	
Acetone	5.0	20	8260B (5030)(low level)
Acetonitrile	20	100	8260B (5030)(low level)
Acrolein	25.0	100	8260B (5030)(low level)
Acrylonitrile	5.0	20	8260B (5030)(low level)
Benzene	0.5	5.0	8260B (5030)(low level)
Bromodichloromethane	0.5	5.0	8260B (5030)(low level)
Bromoform	0.5	5.0	8260B (5030)(low level)
Bromomethane	0.5	5.0	8260B (5030)(low level)
Carbon Disulfide	0.5	5.0	8260B (5030)(low level)
Carbon Tetrachloride	0.5	5.0	8260B (5030)(low level)
Chlorobenzene	0.5	5.0	8260B (5030)(low level)
Chloroethane	0.5	5.0	8260B (5030)(low level)
Chloroform	0.5	5.0	8260B (5030)(low level)
Chloromethane	0.5	5.0	8260B (5030)(low level)
Chloroprene (2-Chloro-1,3-butadiene)	0.5	5.0	8260B (5030)(low level)
3-Chloro-1-propene (Allyl chloride)	0.5	5.0	8260B (5030)(low level)
1,2-Dibromo-3-chloropropane	2.0	5.0	8260B (5030)(low level)
Dibromochloromethane	0.5	5.0	8260B (5030)(low level)
1,2-Dibromoethane	0.5	5.0	8260B (5030)(low level)
Dibromomethane	0.5	5.0	8260B (5030)(low level)
trans-1,4-Dichloro-2-butene	5.0	50	8260B (5030)(low level)
Dichlorodifluoromethane	0.5	5.0	8260B (5030)(low level)
1,1-Dichloroethane	0.5	5.0	8260B (5030)(low level)
1,2-Dichloroethane	0.5	5.0	8260B (5030)(low level)
cis-1,2-dichloroethene	0.5	5.0	8260B (5030)(low level)
trans-1,2-dichloroethene	0.5	5.0	8260B (5030)(low level)
1,1-Dichloroethene	0.5	5.0	8260B (5030)(low level)
Methylene Chloride	0.5	5.0	8260B (5030)(low level)
1,2-Dichloropropane	0.5	5.0	8260B (5030)(low level)
cis-1,3-Dichloropropene	0.5	5.0	8260B (5030)(low level)
trans-1,3-Dichloropropene	0.5	5.0	8260B (5030)(low level)
Ethyl benzene	0.5	5.0	8260B (5030)(low level)
Ethyl methacrylate	0.5	5.0	8260B (5030)(low level)
2-Hexanone	5.0	10	8260B (5030)(low level)
Iodomethane (Methyl iodide)	0.5	5.0	8260B (5030)(low level)
Isobutanol	25	250	8260B (5030)(low level)
Methacrylonitrile	5.0	50	8260B (5030)(low level)
2-Butanone	5.0	10	8260B (5030)(low level)
Methyl methacrylate	0.5	5.0	8260B (5030)(low level)
4-Methyl-2-pentanone	5.0	10	8260B (5030)(low level)
Pentachloroethane	0.5	5.0	8260B (5030)(low level)
Propionitrile	10	100	8260B (5030)(low level)
Stryene	0.5	5.0	8260B (5030)(low level)
1,1,1,2-Tetrachloroethane	0.5	5.0	8260B (5030)(low level)
1,1,2,2-Tetrachloroethane	0.5	5.0	8260B (5030)(low level)
Tetrachloroethene	0.5	5.0	8260B (5030)(low level)
Toluene	0.5	5.0	8260B (5030)(low level)
1,1,1-Trichloroethane	0.5	5.0	8260B (5030)(low level)
1,1,2-Trichloroethane	0.5	5.0	8260B (5030)(low level)

METHOD PERFORMANCE LIMITS
APPENDIX IX COMPOUND LIST AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)
SWMU 73 CMS WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Appendix IX - VOCs (Cont.)	Quantitation Limits* Water (μg/L)	Low Soil (μg/kg)	Method Number (Description)
Trichloroethene	0.5	5.0	8260B (5030)(low level)
Trichlorofluoromethane	0.5	5.0	8260B (5030)(low level)
1,2,3-Trichloropropane	1.0	5.0	8260B (5030)(low level)
Vinyl Acetate	0.5	10	8260B (5030)(low level)
Vinyl Chloride	0.5	5.0	8260B (5030)(low level)
Xylene (total)	0.5	5.0	8260B (5030)(low level)

Appendix IX - SVOCs	Quantitation Limits* Water (μg/L)	Low Soil (μg/kg)	Method Number (Description)
Acenaphthene	5.0	170	8270C
Acenaphthylene	5.0	170	8270C
Acetophenone	5.0	170	8270C
2-Acetylaminofluorene	5.0	170	8270C
4-Aminobiphenyl	5.0	500	8270C
Aniline	5.0	500	8270C
Anthracene	5.0	170	8270C
Aramite	15	1700	8270C
Benzo(a)anthracene	5.0	170	8270C
Benzo(b)fluoranthene	5.0	170	8270C
Benzo(k)fluoranthene	5.0	170	8270C
Benzo(g,h,i)perylene	5.0	170	8270C
Benzo(a)pyrene	5.0	170	8270C
Benzyl alcohol	15	500	8270C
Bis(2-chloroethoxyl)methane	5.0	170	8270C
Bis(2-chloroethyl)ether	5.0	170	8270C
Bis(2-ethylhexyl)phthalate	5.0	330	8270C
4-Bromophenyl phenyl ether	5.0	170	8270C
Butylbenzylphthalate	5.0	170	8270C
4-Chloroaniline	5.0	170	8270C
Chlorobenzilate	10	170	8270C
4-Chloro-3-methylphenol	5.0	170	8270C
2-Chloronaphthalene	5.0	170	8270C
2-Chlorophenol	5.0	170	8270C
4-Chlorophenyl phenyl ether	5.0	170	8270C
Chrysene	5.0	170	8270C
3&4 Methylphenol	10	330	8270C
2-Methylphenol	5.0	170	8270C
Diallate (trans/cis)	5.0	170	8270C
Dibenzofuran	5.0	170	8270C
Di-n-butyl phthalate	5.0	170	8270C
Dibenz(a,h)anthracene	5.0	170	8270C
o-Dichlorobenzene	5.0	170	8270C
m-Dichlorobenzene	5.0	170	8270C
p-Dichlorobenzene	5.0	170	8270C
3,3'-Dichlorobenzidine	5.0	330	8270C
2,4-Dichlorophenol	5.0	170	8270C
2,6-Dichlorophenol	5.0	170	8270C
Diethylphthalate	5.0	170	8270C
Dimethoate	10	500	8270C

TABLE 3-2

METHOD PERFORMANCE LIMITS
APPENDIX IX COMPOUND LIST AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)
SWMU 73 CMS WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Appendix IX - SVOCs (Cont.)	Quantitation Limits* Water (µg/L)	Low Soil (µg/kg)	Method Number (Description)
p-(Dimethylamino)azobenzene	5.0	170	8270C
7,12-Dimethyl benz(a)anthracene	5.0	170	8270C
3,3-Dimethyl benzidine	25	1,000	8270C
2,4-Dimethylphenol	10	170	8270C
alpha, alpha-Dimethylphenethylamine	50	1,700	8270C
Dimethyl phthalate	5.0	170	8270C
m-Dinitrobenzene	5.0	170	8270C
4,6-Dinitro-2-methylphenol	15	500	8270C
2,4-Dinitrophenol	60	2,000	8270C
2,4-Dinitrotoluene	5.0	170	8270C
2,6-Dinitrotoluene	5.0	170	8270C
Di-n-octylphthalate	5.0	170	8270C
1,4-Dioxane	5.0	330	8270C
Ethylmethanesulfonate	5.0	170	8270C
Fluoranthene	5.0	170	8270C
Fluorene	5.0	170	8270C
Hexachlorobenzene	5.0	170	8270C
Hexachlorobutadiene	5.0	170	8270C
Hexachlorocyclopentadiene	15	500	8270C
Hexachloroethane	5.0	170	8270C
Hexachloropropene	5.0	330	8270C
Indeno(1,2,3-cd)pyrene	5.0	170	8270C
Isodrin	5.0	170	8270C
Isophorone	5.0	170	8270C
Isosafrole	5.0	170	8270C
Methapyrilene	50	5,000	8270C
3-Methylcholanthrene	5.0	170	8270C
Methyl methanesulfonate	5.0	170	8270C
2-Methylnaphthalene	5.0	170	8270C
Naphthalene	5.0	170	8270C
1,4-Naphthoquinone	30	3,300	8270C
1-Naphthylamine	15	500	8270C
2-Naphthylamine	15	500	8270C
2-Nitroaniline	5.0	170	8270C
3-Nitroaniline	5.0	170	8270C
4-Nitroaniline	5.0	170	8270C
Nitrobenzene	5.0	170	8270C
2-Nitrophenol	5.0	170	8270C
4-Nitrophenol	30	500	8270C
4-Nitroquinoline-1-oxide	60	1,000	8270C
n-Nitrosodi-n-butylamine	5.0	170	8270C
n-Nitrosodiethylamine	5.0	170	8270C
n-Nitrosodimethylamine	5.0	170	8270C
n-Nitrosodiphenylamine	5.0	170	8270C
n-Nitrosodi-n-propylamine	5.0	170	8270C

METHOD PERFORMANCE LIMITS
APPENDIX IX COMPOUND LIST AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)
SWMU 73 CMS WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Appendix IX - SVOCs (Cont.)	Quantitation Limits* Water (µg/L)	Quantitation Limits* Low Soil (µg/kg)	Method Number (Description)
n-Nitrosomethylethylamine	5.0	170	8270C
n-Nitrosomorpholine	5.0	170	8270C
n-Nitrosopiperidine	5.0	170	8270C
n-Nitrosopyrrolidine	5.0	170	8270C
5-Nitro-o-toluidine	5.0	500	8270C
bis-(2-chloroisopropyl)ether	5.0	170	8270C
Pentachlorobenzene	5.0	170	8270C
Pentachloronitrobenzene	5.0	170	8270C
Pentachlorophenol	15	500	8270C
Phenacetin	5.0	170	8270C
Phenanthrene	5.0	170	8270C
Phenol	5.0	170	8270C
1,4-Phenylenediamine	250	33,000	8270C
2-Picoline	5.0	330	8270C
Pronamide	5.0	170	8270C
Pyrene	5.0	170	8270C
Pyridine	5.0	170	8270C
Safrole	5.0	170	8270C
1,2,4,5-Tetrachlorobenzene	5.0	170	8270C
2,3,4,6-Tetrachlorophenol	5.0	170	8270C
Tetraethyldithiopyrophosphate (Sulfotep)	5.0	170	8270C
Thionazin	5.0	170	8270C
o-Toluidine	5.0	670	8270C
1,2,4-Trichlorobenzene	5.0	170	8270C
2,4,5-Trichlorophenol	5.0	170	8270C
2,4,6-Trichlorophenol	5.0	170	8270C
O,O,O-Triethylphosphorothioate	5.0	170	8270C
1,3,5-Trinitrobenzene	15	500	8270C

METHOD PERFORMANCE LIMITS
APPENDIX IX COMPOUND LIST AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)
SWMU 73 CMS WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Organochlorine Pesticides	Quantitation Limits* Water (ng/L)	Quantitation Limits* Low Soil (ng/g)	Method Number (Description)
Aldrin	0.02	0.83	8081A
Alpha-BHC	0.01	1.0	8081A
beta-BHC	0.02	2.0	8081A
delta-BHC	0.01	0.83	8081A
gamma-BHC (Lindane)	0.01	0.83	8081A
Chlordane	0.5	17	8081A
4,4'-DDT	0.02	1.7	8081A
4,4'-DDE	0.02	1.7	8081A
4,4'-DDD	0.02	1.7	8081A
Dieldrin	0.02	1.7	8081A
Endosulfan I	0.01	0.83	8081A
Endosulfan II	0.02	1.7	8081A
Endosulfan sulfate	0.02	1.7	8081A
Endrin	0.02	1.7	8081A
Kepone	0.2	7.0	8081A
Toxaphene	3.0	33	8081A
Endrin Aldehyde	0.1	1.7	8081A
Heptachlor	0.01	0.83	8081A
Heptachlor epoxide	0.01	0.83	8081A
Methoxychlor	0.1	8.3	8081A

Low Level PAHs (1)	Quantitation Limits* Water (μg/L)	Quantitation Limits* Low Soil (μg/kg)	Method Number
Acenaphthene	0.05	1.7	8270C-SIM
Acenaphthylene	0.05	1.7	8270C-SIM
Anthracene	0.05	1.7	8270C-SIM
Benzo(a)anthracene	0.05	1.7	8270C-SIM
Benzo(b)fluoranthene	0.05	1.7	8270C-SIM
Benzo(k)fluoranthene	0.05	1.7	8270C-SIM
Benzo(g,h,i)perylene	0.05	1.7	8270C-SIM
Benzo(a)pyrene	0.05	1.7	8270C-SIM
Chrysene	0.05	1.7	8270C-SIM
Dibenz(a,h)anthracene	0.05	1.7	8270C-SIM
Fluoranthene	0.05	1.7	8270C-SIM
Fluorene	0.05	1.7	8270C-SIM
Indeno(1,2,3-cd)pyrene	0.05	1.7	8270C-SIM
1-Methylnaphthalene	0.05	3.3	8270C-SIM
2-Methylnaphthalene	0.05	1.7	8270C-SIM
Naphthalene	0.05	3.3	8270C-SIM
Phenanthrene	0.05	1.7	8270C-SIM
Pyrene	0.05	1.7	8270C-SIM

TABLE 3-2 Revised: January 25, 2008

METHOD PERFORMANCE LIMITS
APPENDIX IX COMPOUND LIST AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)
SWMU 73 CMS WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Appendix IX - Metals	**Quantitation Limits*** **Water (µg/L)**	**Low Soil (mg/kg)**	**Method Number (Description)**
Antimony	5.0	5.0	6020 (Inductively Coupled Plasma-Mass Spec)
Arsenic	4.0	2.0	6020 (Inductively Coupled Plasma-Mass Spec)
Barium	5.0	2.0	6020 (Inductively Coupled Plasma-Mass Spec)
Beryllium	2.5	2.5	6020 (Inductively Coupled Plasma-Mass Spec)
Cadmium	2.0	0.5	6020 (Inductively Coupled Plasma-Mass Spec)
Chromium	4.0	2.5	6020 (Inductively Coupled Plasma-Mass Spec)
Cobalt	5.0	2.0	6020 (Inductively Coupled Plasma-Mass Spec)
Copper	5.0	1.0	6020 (Inductively Coupled Plasma-Mass Spec)
Lead	4.0	2	6020 (Inductively Coupled Plasma-Mass Spec)
Mercury	0.2	0.03	7470A/7471A (Cold Vapor AA)
Nickel	10	1.0	6020 (Inductively Coupled Plasma-Mass Spec)
Selenium	5.0	1.0	6020 (Inductively Coupled Plasma-Mass Spec)
Silver	2.0	0.5	6020 (Inductively Coupled Plasma-Mass Spec)
Thallium	4.0	2.0	6020 (Inductively Coupled Plasma-Mass Spec)
Tin	20	1.0	6010 (Inductively Coupled Plasma)
Vanadium	5.0	2.0	6020 (Inductively Coupled Plasma-Mass Spec)
Zinc	20	5.0	6020 (Inductively Coupled Plasma-Mass Spec)
	Quantitation Limits* **Water (µg/L)**	**Low Soil (mg/kg)**	**Method Number (Description)**
RCRA Metals			
Arsenic	4.0	2.0	6020 (Inductively Coupled Plasma-Mass Spec)
Barium	5.0	2.0	6020 (Inductively Coupled Plasma-Mass Spec)
Cadmium	2.0	0.5	6020 (Inductively Coupled Plasma-Mass Spec)
Chromium	4.0	2.5	6020 (Inductively Coupled Plasma-Mass Spec)
Lead	4.0	2.0	6020 (Inductively Coupled Plasma-Mass Spec)
Mercury	0.2	0.03	7471A/7470A (Cold Vapor AA)
Selenium	5.0	1.0	6020 (Inductively Coupled Plasma-Mass Spec)
Silver	2.0	0.5	6020 (Inductively Coupled Plasma-Mass Spec)

* Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis, will be higher.

µg/L - micrograms per liter
µg/kg - micrograms per kilogram
mg/kg - milligrams per kilogram
NA - Not Applicable

TABLE 5-1
SOIL SCREENING VALUES
SWMU 73 - FORMER DEFENSE REUTILIZATION OFFICE (DRMO) SCRAP METAL YARD
CORRECTIVE MEASURES STUDY WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Soil Screening Value	Reference	Comment
Volatile Organics (ug/kg):			
1,1,1,2-Tetrachloroethane	100	CCME 2006	Canadian soil quality guideline based on agricultural land uses
1,1,1-Trichloroethane	100	CCME 2006	Canadian soil quality guideline based on agricultural land uses
1,1,2,2-Tetrachloroethane	100	CCME 2006	Canadian soil quality guideline based on agricultural land uses
1,1,2-Trichloroethane	100	CCME 2006	Canadian soil quality guideline based on agricultural land uses
1,1-Dichloroethane	100	CCME 2006	Canadian soil quality guideline based on agricultural land uses
1,1-Dichloroethene	100	CCME 2006	Canadian soil quality guideline based on agricultural land uses
1,2,3-Trichloropropane	NA	---	---
1,2-Dibromo-3-chloropropane	NA	---	---
1,2-Dibromoethane (EDB)	100	CCME 2006	Canadian soil quality guideline based on agricultural land uses
1,2-Dichloroethane	402 (1)	MHSPE 2000	---
1,2-Dichloropropane	700,000	Efroymson et al. 1997a	Toxicological threshold for earthworms
2-Butanone (Methyl ethyl ketone)	NA	---	---
2-Hexanone	NA	---	---
3-Chloropropene (Allyl chloride)	NA	---	---
4-Methyl-2-pentanone (MIBK)	NA	---	---
Acetone	NA	---	---
Acetonitrile	NA	---	---
Acrolein (Propenal)	NA	---	---
Acrylonitrile	1,000,000	Efroymson et al. 1997a	Toxicological threshold for earthworms
Benzene	101 (1)	MHSPE 2000	---
Bromodichloromethane	NA	---	---
Bromoform	NA	---	---
Bromomethane (Methyl bromide)	NA	---	---
Carbon disulfide	NA	---	---
Carbon tetrachloride	1,000,000	Efroymson et al. 1997a	Toxicological threshold for microbial processes
Chlorobenzene	40,000	Efroymson et al. 1997a	Toxicological threshold for earthworms
Chloroethane	NA	---	---
Chloroform	1,002 (1)	MHSPE 2000	---
Chloromethane (Methyl chloride)	NA	---	---
Chloroprene	NA	---	---

TABLE 5-1
SOIL SCREENING VALUES
SWMU 73 - FORMER DEFENSE REUTILIZATION OFFICE (DRMO) SCRAP METAL YARD
CORRECTIVE MEASURES STUDY WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Soil Screening Value	Reference	Comment
Volatile Organics (ug/kg):			
cis-1,3-Dichloropropene	100	CCME 2006	Canadian soil quality guideline based on agricultural land uses
Dibromochloromethane	NA	---	---
Dibromomethane (Methylene bromide)	NA	---	---
Dichlorodifluoromethane	NA	---	---
Ethylbenzene	5,003 (1)	MHSPE 2000	---
Ethyl methacrylate	NA	---	---
Iodomethane (Methyl iodide)	NA	---	---
Isobutanol (Isobutyl alcohol)	NA	---	---
Methacrylonitrile	NA	---	---
Methylene chloride (Dichloromethane)	1,004 (1)	MHSPE 2000	---
Methyl methacrylate	NA	---	---
Pentachloroethane	NA	---	---
Propionitrile	NA	---	---
Styrene	10,030 (1)	MHSPE 2000	---
Tetrachloroethene	400 (1)	MHSPE 2000	---
Toluene	13,001 (1)	MHSPE 2000	---
1,2-Dichloroethene (total)	100	CCME 2006	Canadian soil quality guideline based on agricultural land uses
trans-1,2-Dichloroethene	100	CCME 2006	Canadian soil quality guideline based on agricultural land uses
trans-1,3-Dichloropropene	100	CCME 2006	Canadian soil quality guideline based on agricultural land uses
trans-1,4-Dichloro-2-butene	1,000,000	Efroymson et al. 1997a	Toxicological threshold for microbial processess
Trichloroethene	6,010 (1)	MHSPE 2000	---
Trichlorofluoromethane	NA	---	---
Vinyl acetate	NA	---	---
Vinyl chloride	11.0 (1)	MHSPE 2000	---
Xylene	2,501 (1)	MHSPE 2000	---
Semi-Volatile Organics (ug/kg):			
1,2,4,5-Tetrachlorobenzene	50.0	CCME 2006	Canadian soil quality guideline based on agricultural land uses
1,2,4-Trichlorobenzene	20,000	Efroymson et al. 1997a	Toxicological threshold for earthworms
1,3-Dichlorobenzene (m-Dichlorobenzene)	3,003 (1)	MHSPE 2000	Value for total chlorobenzenes (2)

TABLE 5-1
SOIL SCREENING VALUES
SWMU 73 - FORMER DEFENSE REUTILIZATION OFFICE (DRMO) SCRAP METAL YARD
CORRECTIVE MEASURES STUDY WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Soil Screening Value	Reference	Comment
Semi-Volatile Organics (ug/kg) (continued):			
1,4-Dichlorobenzene (p-Dichlorobenzene)	20,000	Efroymson et al. 1997a	Toxicological threshold for earthworms
1,4-Dioxane	NA	---	---
1,4-Naphthoquinone	NA	---	---
1,4-Phenylenediamine (p-phenylenediamine)	NA	---	---
1-Naphthylamine	NA	---	---
2,3,4,6-Tetrachlorophenol	1,001 (1)	MHSPE 2000	Value for total chlorophenols (3)
2,4,5-Trichlorophenol	4,000	Efroymson et al. 1997b	Toxicological threshold for plants
2,4,6-Trichlorophenol	10,000	Efroymson et al. 1997a	Toxicological threshold for earthworms
2,2'-Oxybis(1-chloropropane)	NA	---	---
2,4-Dichlorophenol	1,001 (1)	MHSPE 2000	Value for total chlorophenols (3)
2,4-Dimethylphenol	100	CCME 2006	Canadian soil quality guideline based on agricultural land uses
2,4-Dinitrophenol	20,000	Efroymson et al. 1997b	Toxicological threshold for plants
2,6-Dichlorophenol	1,001 (1)	MHSPE 2000	Value for total chlorophenols (3)
2-Acetylaminofluorene	NA	---	---
2-Chloronaphthalene	NA	---	---
2-Chlorophenol	1,001 (1)	MHSPE 2000	Value for total chlorophenols (3)
2-Naphthylamine	NA	---	---
2-Nitroaniline (o-Nitroaniline)	NA	---	---
2-Nitrophenol (o-Nitrophenol)	7,000	---	Value for 4-nitrophenol used as a surrogate
2-Picoline	NA	---	---
3,3'-Dichlorobenzidine	NA	---	---
3,3'-Dimethylbenzidine	NA	---	---
3-Methylcholanthrene	NA	---	---
3-Nitroaniline (m-Nitroaniline)	NA	---	---
4,6-Dinitro-2-methylphenol (4,6-Dinitro-o-cresol)	NA	---	---
4-Aminobiphenyl	NA	---	---
4-Bromophenylphenyl ether	NA	---	---
4-Chloro-3-methylphenol	NA	---	---
4-Chloroaniline	NA	---	---

TABLE 5-1
SOIL SCREENING VALUES
SWMU 73 - FORMER DEFENSE REUTILIZATION OFFICE (DRMO) SCRAP METAL YARD
CORRECTIVE MEASURES STUDY WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Soil Screening Value	Reference	Comment
Semi-Volatile Organics (ug/kg) (continued):			
4-Chlorophenylphenyl ether	NA	---	---
4-Nitroaniline (p-Nitroaniline)	NA	---	---
4-Nitrophenol (p-nitrophenol)	7,000	Efroymson et al. 1997a	Toxicological threshold for earthworms
4-Nitroquinoline-1-oxide	NA	---	---
5-Nitro-o-toluidine	NA	---	---
7,12-Dimethylbenz(a)anthracene	NA	---	---
Acetophenone	NA	---	---
A,A-Dimethylphenethylamine	NA	---	---
Aniline	NA	---	---
Aramite	NA	---	---
Benzyl alcohol	NA	---	---
bis(2-Chloroethoxy)methane	NA	---	---
bis(2-Chloroethyl)ether	NA	---	---
bis(2-Ethylhexyl)phthalate	6,010 (1)	MHSPE 2000	Value for total phthalates (4)
Butylbenzylphthalate	6,010 (1)	MHSPE 2000	Value for total phthalates (4)
Chlorobenzilate	NA	---	---
Diallate	NA	---	---
Dibenzofuran	NA	---	---
Diethylphthalate	100,000	Efroymson et al. 1997b	Toxicological threshold for plants
Dimethylphthalate	200,000	Efroymson et al. 1997a	Toxicological threshold for earthworms
Dimethoate	NA	---	---
Di-n-butylphthalate	200,000	Efroymson et al 1997b	Toxicological threshold for plants
Di-n-octylphthalate	6,010 (1)	MHSPE 2000	Value for total phthalates (4)
Ethyl methanesulfonate	NA	---	---
Hexachlorobenzene	1,000,000	Efroymson et al. 1997a	Toxicological threshold for earthworms
Hexachlorobutadiene	NA	---	---
Hexachlorocyclopentadiene	10,000	Efroymson et al. 1997b	Toxicological threshold for plants
Hexachloroethane	NA	---	---
Hexachloropropene	NA	---	---
Isodrin	100	Friday 1998	Background-based value
Isophorone	NA	---	---

TABLE 5-1
SOIL SCREENING VALUES
SWMU 73 - FORMER DEFENSE REUTILIZATION OFFICE (DRMO) SCRAP METAL YARD
CORRECTIVE MEASURES STUDY WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Soil Screening Value	Reference	Comment
Semi-Volatile Organics (ug/kg) (continued):			
Isosafrole	NA	---	---
m-Dinitrobenzene (1,3-Dinitrobenzene)	NA	---	---
m-Cresol (3-Methylphenol)	100	CCME 2006	Canadian soil quality guideline based on agricultural land uses
Methapyrilene	NA	---	---
Methyl methanesulfonate	NA	---	---
N-Nitrosodiethylamine	20,000	---	Value for n-Nitrosdiphenylamine used as a surrogate
N-Nitrosodimethylamine	20,000	---	Value for n-Nitrosdiphenylamine used as a surrogate
N-Nitroso-di-n-butylamine	20,000	---	Value for n-Nitrosdiphenylamine used as a surrogate
N-Nitroso-di-n-propylamine	20,000	---	Value for n-Nitrosdiphenylamine used as a surrogate
N-Nitrosodiphenylamine	20,000	Efroymson et al. 1997a	Toxicological threshold for earthworms
N-Nitrosomethylethylamine	20,000	---	Value for n-Nitrosdiphenylamine used as a surrogate
N-Nitrosomorpholine	NA	---	---
N-Nitrosopiperidine	NA	---	---
N-Nitrosopyrrolidine	NA	---	---
o-Cresol (2-Methylpheneol)	100	CCME 2006	Canadian soil quality guideline based on agricultural land uses
o-Toluidine	NA	---	---
p-Cresol (4-Methylphenol)	100	CCME 2006	Canadian soil quality guideline based on agricultural land uses
p-(Dimethylamino)azobenzene	NA	---	---
Pentachlorobenzene	1,150	USEPA 1999	Toxicological threshold for earthworms
Pentachloronitrobenzene	NA	---	---
Pentachlorophenol	1,730	USEPA 1999	Toxicological threshold for plants
Phenacetin	NA	---	---
Phenol	30,000	Efroymson et al. 1997a	Toxicological threshold for earthworms
Pronamide	NA	---	---
Pryridine	NA	---	---
Safrole	NA	---	---
Sulfotepp	NA	---	---
Thionazin	NA	---	---
o,o,o-Triethylphosphorothioate	NA	---	---
PAHs (ug/kg):			
1-Methylnaphthalene	1,200	---	Value for benzo(a)pyrene used as a surrogate
2-Methylnaphthalene	1,200	---	Value for benzo(a)pyrene used as a surrogate
Acenaphthene	20,000	Efroymson et al. 1997b	Toxicological threshold for plants

TABLE 5-1
SOIL SCREENING VALUES
SWMU 73 - FORMER DEFENSE REUTILIZATION OFFICE (DRMO) SCRAP METAL YARD
CORRECTIVE MEASURES STUDY WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Soil Screening Value	Reference	Comment
PAHs (ug/kg) (continued):			
Acenaphthylene	1,200	---	Value for benzo(a)pyrene used as a surrogate
Anthracene	1,200	---	Value for benzo(a)pyrene used as a surrogate
Benzo(a)anthracene	1,200	USEPA 1999	Value for benzo(a)pyrene used as a surrogate
Benzo(a)pyrene	1,200	USEPA 1999	Toxicological threshold for plants
Benzo(b)fluoranthene	1,200	USEPA 1999	Toxicological threshold for plants
Benzo(g,h,i)perylene	1,200	---	Value for benzo(a)pyrene used as a surrogate
Benzo(k)fluoranthene	1,200	USEPA 1999	Value for benzo(a)pyrene used as a surrogate
Chrysene	1,200	USEPA 1999	Value for benzo(a)pyrene used as a surrogate
Dibenzo(a,h)anthracene	1,200	USEPA 1999	Value for benzo(a)pyrene used as a surrogate
Fluoranthene	1,200	---	Value for benzo(a)pyrene used as a surrogate
Fluorene	30,000	Efroymson et al. 1997a	Toxicological threshold for earthworms
Indeno(1,2,3-cd)pyrene	1,200	---	Value for benzo(a)pyrene used as a surrogate
Naphthalene	1,200	---	Value for benzo(a)pyrene used as a surrogate
Phenanthrene	1,200	---	Value for benzo(a)pyrene used as a surrogate
Pyrene	1,200	---	Value for benzo(a)pyrene used as a surrogate
Organochlorine Pesticides (ug/kg):			
4,4'-DDD	401 (1)	MHSPE 2000	Value for total DDD, DDE, and DDT (5)
4,4'-DDE	401 (1)	MHSPE 2000	Value for total DDD, DDE, and DDT (5)
4,4'-DDT	401 (1)	MHSPE 2000	Value for total DDD, DDE, and DDT (5)
Aldrin	401 (1)	MHSPE 2000	Value for total aldrin, endrin, and dieldrin (6)
alpha-BHC	201 (1)	MHSPE 2000	Value for total BHC compounds (7)
alpha-Chlordane	100	Friday 1998	Background-based value
beta-BHC	201 (1)	MHSPE 2000	Value for total BHC compounds (7)
delta-BHC	201 (1)	MHSPE 2000	Value for total BHC compounds (7)
Dieldrin	401 (1)	MHSPE 2000	Value for total aldrin, endrin, and dieldrin (6)
Endosulfan I	100	Friday 1998	Background-based value
Endosulfan II	100	Friday 1998	Background-based value
Endosulfan sulfate	100	Friday 1998	Background-based value
Endrin	401 (1)	MHSPE 2000	Value for total aldrin, endrin, and dieldrin (6)
Endrin aldehyde	100	Friday 1998	Background-based value
gamma-BHC (lindane)	201 (1)	MHSPE 2000	Value for total BHC compounds (7)

TABLE 5-1
SOIL SCREENING VALUES
SWMU 73 - FORMER DEFENSE REUTILIZATION OFFICE (DRMO) SCRAP METAL YARD
DRAFT CORRECTIVE MEASURES STUDY WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Soil Screening Value	Reference	Comment
Organochlorine Pesticides (ug/kg) (continued):			
gamma-Chlordane	100	Friday 1998	Background-based value
Heptachlor	100	Friday 1998	Background-based value
Heptachlor epoxide	100	Friday 1998	Background-based value
Kepone	100	Friday 1998	Background-based value
Methoxychlor	100	Friday 1998	Background-based value
Toxaphene	100	Friday 1998	Background-based value
Inorganics (mg/kg):			
Antimony	78	USEPA 2005a	Ecological soil screening level for invertebrates
Arsenic	18	USEPA 2005b	Ecological soil screening level for plants
Barium	330	USEPA 2005c	Ecological soil screening level for invertebrates
Beryllium	40	USEPA 2005d	Ecological soil screening level for invertebrates
Cadmium	32	USEPA 2005e	Ecological soil screening level for plants
Chromium (total)	0.4	Efroymson et al. 1997a	Toxicological threshold for earthworms
Cyanide	0.9	CCME 2006	Canadian soil quality guideline based on agricultural land uses
Cobalt	13	USEPA 2005f	Ecological soil screening level for plants
Copper	70	USEPA 2006a	Ecological soil screening level for plants
Lead	120	USEPA 2005g	Ecological soil screening level for plants
Mercury	0.1	Efroymson et al. 1997a	Toxicological threshold for earthworms
Nickel	30	Efroymson et al. 1997b	Toxicological threshold for plants
Selenium	1	Efroymson et al. 1997b	Toxicological threshold for plants
Silver	560	USEPA 2006b	Ecoloigcal soil screening level for plants
Thallium	1	Efroymson et al. 1997b	Toxicological threshold for plants
Vanadium	2	Efroymson et al. 1997b	Toxicological threshold for plants
Zinc	50	Efroymson et al. 1997b	Toxicological threshold for plants

Notes:

NA = Not Available
MHSPE = Ministry of Housing, Spatial Planning and Environment
CCME = Canadian Council of Ministers of the Environment
USEPA = United States Environmental Protection Agency
DDD = Dichlorodiphenyldichloroethane
DDE = Dichlorodiphenyldichloroethylene
DDT = Dichlorodiphenyltrichloroethane
BHC = Benzene hexachloride
µg/kg = microgram per kilogram
mg/kg = milligram per kilogram

TABLE 5-1
SOIL SCREENING VALUES
SWMU 73 - FORMER DEFENSE REUTILIZATION OFFICE (DRMO) SCRAP METAL YARD
DRAFT CORRECTIVE MEASURES STUDY WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Notes (continued):

(1) The screening value shown is an average of the target and intervention soil standards. The value is based on a default organic carbon content of 0.02 (2 percent), which represents a minimum value (adjustment range is 2 to 30 percent).

(2) The value represents a total concentration for chlorobenzenes (mono, di, tri, tetra, penta, and hexachlorobenzene).

(3) The value represents a total concentration for all chlorophenols (mono, di, tri, tetra, and pentachlorophenol).

(4) The value represents a total concentration for all phthalates.

(5) The value represents a sum of the DDT, DDD, and DDE concentrations.

(6) The value represents the sum of the aldrin, dieldrin, and endrin concentrations.

(7) Value represents the sum of alpha-BHC, beta-BHC, delta-BHC, and gamma-BHC concentrations.

Table References:

Canadian Council of Ministers of the Environment (CCME). 2006. Canadian Soil Quality Guidelines for the Protection of Environment and Human Health. Update 6.0.2 http://www.ccme.ca/assets/pdf/ceqg_soil_summary_table_v6_e.pdf

Efroymson, R.A., M.E. Will, and G.W. Suter II. 1997a. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revisions. Oak Ridge National Laboratory, Oak Ridge, TN. ES/ER/TM-126/R2.

Efroymson, R.A., M.E. Will, G.W. Suter II, and A.C. Wooten. 1997b. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revisions. Oak Ridge National Laboratory, Oak Ridge, TN. ES/ER/TM-85/R3

Friday, G.P. 1998. Ecological Screening Values for Surface Water, Sediment, and Soil. Westinghouse Savannah River Company, Savannah River Site, Aiken, SC. WSRC-TR-98-00110.

Ministry of Housing, Spatial Planning and Environment (MHSPE). 2000. Circular on Target Values and Intervention Values for Soil Remediation. Directorate-General for Environmental Protection, Department of Soil Protection, The Hague, Netherlands. February 4, 2000.

United States Environmental Protection Agency (USEPA). 2006a. Ecological Soil Screening Levels for Copper (Interim Final). Office of Solid Waste and Emergecny Response, Washington, D.C. OSWER Directive 9285.7-77.

USEPA. 2006b. Ecological Soil Screening Levels for Silver (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWEER Directive 9285.7-61

USEPA. 2005a. Ecological Soil Screening Levels for Antimony (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-61.

USEPA. 2005b. Ecological Soil Screening Levels for Arsenic (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-62.

TABLE 5-1
SOIL SCREENING VALUES
SWMU 73 - FORMER DEFENSE REUTILIZATION OFFICE (DRMO) SCRAP METAL YARD
CORRECTIVE MEASURES STUDY WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Table References (continued):

USEPA. 2005c. Ecological Soil Screening Levels for Barium (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-63.

USEPA. 2005d. Ecological Soil Screening Levels for Beryllium (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-63.

USEPA. 2005e. Ecological Soil Screening Levels for Cadmium (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-65.

USEPA. 2005f. Ecological Soil Screening Levels for Cobalt (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-67

USEPA. 2005g. Ecological Soil Screening Levels for Lead (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-70.

USEPA. 1999. Screening-Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities. EPA/530/D-99/001A.

TABLE 5-2
GROUNDWATER SCREENING VALUES
SWMU 73 - DEFENSE REUTILIZATION SCRAPE METAL YARD
CORRECTIVE MEASURES STUDY WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Surface Water Screening Value (1)	Reference	Comment
Volatile Organics (ug/L):			
1,1,1,2-Tetrachloroethane	902	Buchman 1999	Acute LOEL with a safety factor of 10
1,1,1-Trichloroethane	312	USEPA 2001	EPA Region 4 chronic screening value
1,1,2,2-Tetrachloroethane	90.2	USEPA 2001	EPA Region 4 chronic screening value
1,1,2-Trichloroethane	340	USEPA 2003	Minimum acute value (48-hr LC_{50} for *Pleuronectes platessa* [sand dab]) with a safety factor of 100
1,1-Dichloroethane	47.0 (2)	USEPA 1996a	Tier II Value
1,1-Dichloroethene	2,240	USEPA 2001	EPA Region 4 chronic screening value
1,2,3-Trichloropropane	274 (2)	USEPA 2003	Minimum acute value (96-hr LC_{50} for *Pimephales promelas* [fathead minnow]) with a safety factor of 100
1,2-Dibromo-3-chloropropane	100	USEPA 2003	Minimum acute value (48-hr EC_{50} for *Mercenaria mercenaria* [hard clam]) with a safety factor of 100
1,2-Dibromoethane (EDB)	48.0	USEPA 2003	Minimum acute value (48-hr LC_{50} for *Cyprinodon variegatus* [sheepshead minnow]) with a safety factor of 100
1,2-Dichloroethane	1,130	USEPA 2001	EPA Region 4 chronic screening value
1,2-Dichloropropane	2,400	USEPA 2001	EPA Region 4 chronic screening value
2-Butanone (Methyl ethyl ketone)	40,000	USEPA 2003	Minimum acute value (96-hour NOEC for *Cyprinodon variegatus* [sheepshead minnow]) with a safety factor of 10
2-Hexanone	98.8 (2)	Suter II 1996	Tier II secondary chronic value
3-Chloropropene (Allyl chloride)	3.40 (2)	USEPA 2003	Minimum acute value (48-hr LC_{50} for *Xenopus laevis* [clawed toad]) with a safety factor of 100
4-Methyl-2-pentanone (MIBK)	164	Suter II 1996	Tier II Secondary Chronic Value
Acetone	1,000	USEPA 2003	Minimum acute value (96-hr LC_{50} for *Lumbriculus variegatus* [Oligochaete]) with a safety factor of 100
Acetonitrile	160,000 (2)	USEPA 2003	Minimum chronic value (21-day NOEC for *daphnia magna* based on reproduction)
Acrolein (Propenal)	0.55	USEPA 2001	EPA Region 4 chronic screening value
Acrylonitrile	58.1	USEPA 2003	Minimum acute value (96-hr $LC_{50 \text{ for}}$ *Americamysis bahia* [opossum shrimp]) with a safety factor of 100
Benzene	109	USEPA 2001	EPA Region 4 chronic screening value
Bromodichloromethane	6,400	Buchman 1999	Chronic LOEL for chemical class
Bromoform	640	USEPA 2001	EPA Region 4 chronic screening value
Bromomethane (Methyl bromide)	120	USEPA 2003	Minimum acute value (96-hr LC_{50} for *Menidia beryllina* [inland silverside]) with a safety factor of 100
Carbon disulfide	650 (2)	USEPA 2003	Minimum acute value (96-hr LC_{50} for *Alburnus alburnus* [bleak]) with a safety factor of 100
Carbon tetrachloride	1,500	USEPA 2001	EPA Region 4 chronic screening value
Chlorobenzene	105	USEPA 2001	EPA Region 4 chronic screening value
Chloroethane	NA	---	---
Chloroform	815	USEPA 2001	EPA Region 4 chronic screening value
Chloromethane (Methyl chloride)	2,700	USEPA 2003	Minimum acute value (96-hr LC_{50} for *Menidia beryllina* [inland silverside]) with a safety factor of 100
Chloroprene	NA	---	---
cis-1,3-Dichloropropene	7.90	USEPA 2001	EPA Region 4 chronic screening value (cis and trans)
Dibromochloromethane	6,400	Buchman 1999	Chronic LOEL for chemical class
Dibromomethane (Methyl bromide)	6,400	Buchman 1999	Chronic LOEL for chemical class
Dichlorodifluoromethane	6,400	Buchman 1999	Chronic LOEL for chemical class
Ethylbenzene	4.30	USEPA 2001	EPA Region 4 chronic screening value
Ethyl methacrylate	NA	---	---

TABLE 5-2
GROUNDWATER SCREENING VALUES
SWMU 73 - DEFENSE REUTILIZATION SCRAPE METAL YARD
CORRECTIVE MEASURES STUDY WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Revised: January 25, 2008

Chemical	Surface Water Screening Value [(1)]	Reference	Comment
Volatile Organics (ug/L):			
Iodomethane (Methyl iodide)	NA	---	---
Isobutanol (Isobutyl alcohol)	10,000	USEPA 2003	Minimum acute value (96-hr LC_{50} for *Alburnus alburnus* [bleak]) with a safety factor of 100
Methacrylonitrile	NA	---	---
Methylene chloride (Dichloromethane)	2,560	USEPA 2001	EPA Region 4 chronic screening value
Methyl methacrylate	1,300 [(2)]	USEPA 2003	Minumum acute value (96-hr LC_{50} for *Pimephales promelas* [fathead minnow]) with a safety factor of 100
Pentachloroethane	281	Buchman 1999	Chronic LOEL
Propionitrile	15,200 [(2)]	USEPA 2003	Minimum acute value (96-hr LC_{50} for *Pimephales promelas* [fathead minnow]) with a safety factor of 100
Styrene	510	USEPA 2003	Minimum acute value (96-hr NOEC for *Cyprinodon variegatus* [sheepshead minnow]) with a safety factor of 10
Tetrachloroethene	45.0	USEPA 2001	EPA Region 4 chronic screening value
Toluene	37.0	USEPA 2001	EPA Region 4 chronic screening value
trans-1,2-dichloroethene	22,400	Buchman 1999	Acute LOEL (summation of all isomers) with a safety factor of 10
trans-1,3-Dichloropropene	7.90	USEPA 2001	EPA Region 4 chronic screening value (cis and trans)
trans-1,4-Dichloro-2-butene	NA	---	---
Trichloroethene	200	Buchman 1999	Acute LOEL with a safety factor of 10
Trichlorofluoromethane	6,400	Buchman 1999	Chronic LOEL for chemical class
Vinyl acetate	100	USEPA 2003	Minimum acute value (48-hr LC_{50} for *Crangon crangon* [sand shrimp]) with a safety factor of 100
Vinyl chloride	87.8 [(2)]	Suter II 1996	Tier II secondary chronic value
Xylene	41.0 [(3)]	USEPA 2003	Minimum acute value (96-hr EC_{50} for *Strongylocentrotus droebachiensis* [green sea urchin]) with a safety factor of 100
Semi-Volatile Organics (ug/L):			
1,2,4,5-Tetrachlorobenzene	30.0	USEPA 2003	Minimum acute value (96-hr NOEC for *Cyprinodon variegatus* [sheepshead minnow]) with a safety factor of 10
1,2,4-Trichlorobenzene	4.50	USEPA 2001	EPA Region 4 chronic screening value
1,3,5-Trinitrobenzene	80.0 [(2)]	USEPA 2003	Minimum chronic value (71-day NOEC for *Oncorhynchus mykiss* [rainbow trout] based on reproduction)
1,2-Dichlorobenzene (o-Dichlorobenzene)	19.7	USEPA 2001	EPA Region 4 chronic screening value
1,3-Dichlorobenzene (m-Dichlorobenzene)	28.5	USEPA 2001	EPA Region 4 chronic screening value
1,4-Dichlorobenzene (p-Dichlorobenzene)	19.9	USEPA 2001	EPA Region 4 chronic screening value
1,4-Dioxane	67,000	USEPA 2003	Minimum acute value (96-hr LC_{50} for *Menidia beryllina* [inland silverside]) with a safety factor of 100
1,4-Naphthoquinone	NA	---	---
1,4-Phenylenediamine (p-phenylenediamine)	200 [(2)]	USEPA 2003	Minimum acute value (48-hr LC_{50} for *Oryzias latipes* [medaka]) with a safety factor of 100
1-Naphthylamine	NA	---	---
2,3,4,6-Tetrachlorophenol	44.0	Buchman 1999	Acute LOEL with a safety factor of 10
2,4,5-Trichlorophenol	11.0	Buchman 1999	Proposed CCC
2,4,6-Trichlorophenol	12.1	USEPA 2003	Minimum acute value (96-hr LC_{50} for *Palaemonetes pugio* [daggerblade grass shrimp]) with a safety factor of 100
2,2'-Oxybis(1-chloropropane)	NA	---	---
2,4-Dichlorophenol	5.00	USEPA 2003	Minimum acute value (96-hr NOEC for *Allorchestes compressa* [scud]) with a safety factor of 10
2,4-Dimethylphenol	131	USEPA 2003	Minimum chronic value (28-day NOEC for *Menidia beryllina* [inland silverside] based on survival)
2,4-Dinitrophenol	48.5	USEPA 2001	EPA Region 4 chronic screening value
2,4-Dinitrotoluene	20.0 [(2)]	USEPA 2003	Minimum chronic value (21-day NOEC for *Daphnia magna* based on reproduction)

TABLE 5-2
GROUNDWATER SCREENING VALUES
SWMU 73 - DEFENSE REUTILIZATION SCRAPE METAL YARD
CORRECTIVE MEASURES STUDY WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Surface Water Screening Value (1)	Reference	Comment
Semi-Volatile Organics (ug/L):			
2,6-Dichlorophenol	54.0	USEPA 2003	Minimum acute value (96-hr LC_{50} for *Platichthys flesus* [european flounder]) with a safety factor of 100
2,6-Dinitrotoluene	60.0 (2)	USEPA 2003	Minimum chronic value (21-day NOEC for *Daphnia magna* based on reproduction)
2-Acetylaminofluorene	100 (2)	USEPA 2003	Minimum acute value (96-hr LOEC for *Xenopus laevis* [clawed toad]) with a safety factor of 10
2-Chloronaphthalene	0.75	Buchman 1999	Acute LOEL for chemical class with a safety factor of 10
2-Chlorophenol	53.0	USEPA 2003	Minimum acute value (96-hr LC_{50} for *Crangon septemspinosa* [bay shrimp]) with a safety factor of 100
2-Naphthylamine	NA	---	---
2-Nitroaniline (o-Nitroaniline)	48.9 (2)	USEPA 2003	Minumum acute value (48-hr EC_{50} for *daphnia magna*) with a safety factor of 100
2-Nitrophenol (o-Nitrophenol)	10,000	USEPA 2003	Minimum chronic value (28-day MATC for *Cyprinodon variegatus* [sheepshead minnow] based on egg hatchability)
2-Picoline	8,979 (2)	USEPA 2003	Minimum acute value (96-hr LC_{50} for *Pimephales promelas* [fathead minnow]) with a safety factor of 100
3,3'-Dichlorobenzidine	10.5 (2)	USEPA 2003	Minimum acute value (48-hr EC_{50} for *Daphnia magna*) with a safety factor of 100
3,3'-Dimethylbenzidine	160 (2)	USEPA 2003	Minimum chronic value (21-day NOEC for *Daphnia magna* based on behavior [equilibrium])
3-Methylcholanthrene	NA	---	---
3-Nitroaniline (m-Nitroaniline)	9.80 (2)	USEPA 2003	Minimum acute value (48-hr EC_{50} for *Daphnia magna*) with a safety factor of 100
4,6-Dinitro-2-methylphenol (4,6-Dinitro-o-cresol)	10.0 (2)	USEPA 2003	Minimum chronic value (21-day NOEC for *Daphnia magna* based on reproduction)
4-Aminobiphenyl	NA	---	---
4-Bromophenylphenyl ether	3.60 (2)	USEPA 2003	Minimum acute value (48-hr LC_{50} for *Daphnia magna*) with a safety factor of 100
4-Chloro-3-methylphenol	1,300 (2)	USEPA 2003	Minimum chronic value (21-day NOEC for *Daphnia magna* based on for reproduction)
4-Chloroaniline	129	Buchman 1999	Chronic LOEL for chemical class
4-Chlorophenylphenyl ether	7.30 (2)	USEPA 2003	Minimum acute value (96-hr LC_{50} for *Salvelinus fontinalis* [brook trout]) with a safety factor of 100
4-Nitroaniline (p-Nitroaniline)	170 (2)	USEPA 2003	Minimum acute value (48-hr EC_{50} for *Daphnia magna*) with a safety factor of 100)
4-Nitrophenol (p-nitrophenol)	71.7	USEPA 2001	EPA Region 4 chronic screening value
4-Nitroquinoline-1-oxide	NA	---	---
5-Nitro-o-toluidine	190 (2)	USEPA 2003	Minimum acute value (96-hr LC_{50} for *Pimephales promelas* [fathead minnow]) with a safety factor of 100
7,12-Dimethylbenz(a)anthracene	30.0	Buchman 1999	Acute LOEL for chemical class with a safety factor of 10
Acetophenone	1,550 (2)	USEPA 2003	Minimum acute value (96-hr LC_{50} for *Pimephales promelas* [fathead minnow]) with a safety factor of 100
A,A-Dimethylphenethylamine	NA	---	---
Aniline	294	USEPA 2003	Minimum acute value (96-hr LC_{50} for *Crangon septemspinosa* [sand shrimp]) with a safety factor of 100
Aramite	0.60 (2)	USEPA 2003	Minimum acute value (96-hr LC_{50} for *Gammarus fasciatus* [scud]) with a safety factor of 100
Benzyl alcohol	150	USEPA 2003	Minimum acute value (96-hr LC_{50} for *Menidia beryllina* [inland silverside]) with a safety factor of 100
bis(2-Chloroethoxy)methane	6,400	Buchman 1999	Chronic LOEL for the chemical class
bis(2-Chloroethyl)ether	910 (2)	USEPA 2003	Minimum acute value (48-hr LC_{50} for *Oncorhynchus mykiss* [rainbow trout]) with a safety factor of 100
bis(2-Ethylhexyl)phthalate	360	Buchman 1999	Proposed CCC
Butylbenzylphthalate	29.4	USEPA 2001	EPA Region 4 chronic screening value
Chlorobenzilate	76.0	USEPA 2005	Minimum acute value (96-hr NOEL for *Cyprinodon variegatus* [sheepshead minnow]) with a safety factor of 10
Diallate	82.0 (2)	USEPA 2003	Minimum acute value (48-hr LC_{50} for *Rasbora heteromorpha* [harlequinfish]) with a safety factor of 100

TABLE 5-2
GROUNDWATER SCREENING VALUES
SWMU 73 - DEFENSE REUTILIZATION SCRAPE METAL YARD
CORRECTIVE MEASURES STUDY WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Surface Water Screening Value (1)	Reference	Comment
Semi-Volatile Organics (ug/L):			
Dibenzofuran	100	USEPA 2003	Minimum acute value (96-hr NOEC for *Cyprinodon variegatus* [sheepshead minnow]) with a safety factor of 10
Diethylphthalate	75.9	USEPA 2001	EPA Region 4 chronic screening value
Dimethylphthalate	580	USEPA 2001	EPA Region 4 chronic screening value
Dimethoate	2,500	USEPA 2005	Minimum acute value (96-hr NOEL for *Americamysis bahia* [mysid shrimp]) with a safety factor of 10
Di-n-butylphthalate	3.40	USEPA 2001	EPA Region 4 chronic screening value
Di-n-octylphthalate	3,450	USEPA 2003	Minimum acute value (96-hr NOEC for *Americamysis bahia* [opossum shrimp]) with a safety factor of 10
Ethyl methanesulfonate	NA	---	---
Hexachlorobenzene	10.0	USEPA 2003	Minimum acute value (48-hr EC_{50} for *Crassostrea virginica* [Virginia oyster]) with a safety factor of 100
Hexachlorobutadiene	0.32	USEPA 2001	EPA Region 4 chronic screening value
Hexachlorocyclopentadiene	0.07	USEPA 2001	EPA Region 4 chronic screening value
Hexachloroethane	9.40	USEPA 2001	EPA Region 4 chronic screening value
Hexachloropropene	NA	---	---
Isodrin	0.12 (2)	USEPA 2003	Minimum acute value (24-hr LC50 for *Lepomis macrochirus* [bluegill]) with a safety factor of 100
Isophorone	129	USEPA 2001	EPA Region 4 chronic screening value
Isosafrole	NA	---	---
m-Dinitrobenzene (1,3-Dinitrobenzene)	500 (2)	USEPA 2003	Minimum chronic value (69-day NOEC for *Oncorhynchus mykiss* [rainbow trout] based on reproduction)
m-Cresol (3-Methylphenol)	100	USEPA 2003	Minimum acute value (48-hr LC_{50} for *Crangon crangon* [sand shrimp]) with a safety factor of 100
Methapyrilene	NA	---	---
Methyl methanesulfonate	NA	---	---
N-Nitrosodiethylamine	330,000	Buchman 1999	Acute LOEL for chemical class with a safety factor of 10
N-Nitrosodimethylamine	13,650 (2)	USEPA 2003	Minimum acute value (96-hr LC_{50} for *Dugesia dorotocephala* [flatworm]) with a safety factor of 100
N-Nitroso-di-n-butylamine	330,000	Buchman 1999	Acute LOEL for chemical class with a safety factor of 10
N-Nitroso-di-n-propylamine	330,000	Assumed	Acute LOEL for chemical class with a safety factor of 10
N-Nitrosodiphenylamine	33,000	USEPA 2001	EPA Region 4 chronic screening value
N-Nitrosomethylethylamine	330,000	Assumed	Acute LOEL for chemical class with a safety factor of 10
N-Nitrosomorpholine	NA	---	---
N-Nitrosopiperidine	NA	---	---
N-Nitrosopyrrolidine	NA	---	---
Nitrobenzene	66.8	USEPA 2001	EPA Region 4 chronic screening value
o-Cresol (2-Methylpheneol)	102	USEPA 2003	Minimum acute value (96-hr LC_{50} for *Elasmopus pectinicrus* [scud]) with a safety factor of 100
o-Toluidine	400	USEPA 2003	Minimum acute value (96-hr LC_{50} for *Elasmopus pectinicrus* [scud]) with a safety factor of 100
p-Cresol (4-Methylphenol)	50.0	USEPA 2003	Minimum acute value (96-hr EC_{50} for *Strongylocentrotus droebachiensis* [green sea urchin]) with a safety factor of 100
p-(Dimethylamino)azobenzene	NA	---	---
Pentachlorobenzene	129	USEPA 2001	EPA Region 4 chronic screening value
Pentachloronitrobenzene	0.23	USEPA 2003	Minimum acute value (96-hr LC_{50} for *Americamysis bahia* [opossum shrimp]) with a safety factor of 100
Pentachlorophenol	7.90	USEPA 2006	CCC
Phenacetin	NA	---	---
Phenol	58.0	USEPA 2001	EPA Region 4 chronic screening value

TABLE 5-2
GROUNDWATER SCREENING VALUES
SWMU 73 - DEFENSE REUTILIZATION SCRAPE METAL YARD
CORRECTIVE MEASURES STUDY WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Surface Water Screening Value [(1)]	Reference	Comment
Semi-Volatile Organics (ug/L):			
Pronamide	35.0	USEPA 2003	Minimum acute value (96-hr EC_{50} for *Crassostrea virginica* [Virginia oyster]) with a safety factor of 100
Pryridine	500	USEPA 2003	Minimum acute value (96-hr LC_{50} for *Crangon septemspinosa* [sand shrimp]) with a safety factor of 100
Safrole	NA	---	---
Sulfotepp	3.0	USEPA 2005	Minimum acute value (96-hr NOEC for *Lepomis macrochirus* [bluegill sunfish]) with a safety factor of 10
Thionazin	NA	---	---
o,o,o-Triethylphosphorothioate	NA	---	---
PAHs (ug/L):			
1-Methylnaphthalene	19.0	USEPA 2003	Minimum acute value (96-hr LC_{50} for *Cancer magister* [dungeness crab]) with a safety factor of 100
2-Methylnaphthalene	3.0	USEPA 2003	Minimum acute value (96-hr LC_{50} for *Gadus morhua* [Atlantic cod]) with a safety factor of 100
Acenaphthene	9.70	USEPA 2001	EPA Region 4 chronic screening value
Acenaphthylene	30.0	Buchman 1999	Acute LOEL for chemical class with a safety factor of 10
Anthracene	50.0	USEPA 1996b	Acute value (LC_{50}) with a safety factor of 100
Benzo(a)anthracene	30.0	Buchman 1999	Acute LOEL for chemical class with a safety factor of 10
Benzo(a)pyrene	10.0	USEPA 1996b	Acute value (LC_{50}) with a safety factor of 100
Benzo(b)fluoranthene	30.0	Buchman 1999	Acute LOEL for chemical class with a safety factor of 10
Benzo(g,h,i)perylene	30.0	Buchman 1999	Acute LOEL for chemical class with a safety factor of 10
Benzo(k)fluoranthene	30.0	Buchman 1999	Acute LOEL for chemical class with a safety factor of 10
Chrysene	10.0	USEPA 1996b	Acute value (LC_{50}) with a safety factor of 100
Dibenzo(a,h)anthracene	30.0	Buchman 1999	Acute LOEL for chemical class with a safety factor of 10
Fluoranthene	11.0	USEPA 1996a	Final Chronic Value
Fluorene	10.0	USEPA 2003	Minimum acute value (96-hr LC_{50} for *Nereis arenaceodentata* [polychaete]) with a safety factor of 100
Indeno(1,2,3-cd)pyrene	30.0	Buchman 1999	Acute LOEL for chemical class with a safety factor of 10
Naphthalene	23.5	USEPA 2001	EPA Region 4 chronic screening value
Phenanthrene	8.30	USEPA 1996a	Final Chronic Value
Pyrene	30.0	Buchman 1999	Acute LOEL for chemical class with a safety factor of 10
Inorganics (ug/L):			
Antimony	500	Buchman 1999	Proposed CCC
Arsenic	36.0	USEPA 2006	Total recoverable CCC for trivalent arsenic
Barium	50,000	USEPA 2003	Minimum acute value (96-hr NOEC for *Cyprinodon variegatus* [sheepshead minnow]) with a safety factor of 100
Beryllium	310	USEPA 2003	Minimum acute value (96-hr LC_{50} for *Fundulus heteroclitus* [mummichog]) with a safety factor of 100
Cadmium	8.85	USEPA 2006	Total recoverable CCC
Chromium (total)	50.4	USEPA 2006	Total recoverable CCC for hexavalent chromium
Cobalt	45.0	USEPA 2003	Minimum acute value (96-hr LC_{50} for *Nitocra spinipes* [Harpacticoid copepod] with a safety factor of 100
Copper	3.73	USEPA 2006	Total recoverable CCC
Lead	8.52	USEPA 2006	Total recoverable CCC
Mercury	1.11	USEPA 2006	Total recoverable CCC
Nickel	8.28	USEPA 2006	Total recoverable CCC
Selenium	71.1	USEPA 2006	Total recoverable CCC
Silver	0.23	USEPA 2001	EPA Region 4 chronic screening value

TABLE 5-2
GROUNDWATER SCREENING VALUES
SWMU 73 - DEFENSE REUTILIZATION SCRAPE METAL YARD
CORRECTIVE MEASURES STUDY WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Surface Water Screening Value (1)	Reference	Comment
Metals (ug/L):			
Thallium	21.3	USEPA 2001	EPA Region 4 chronic screening value
Tin	NA	---	---
Vanadium	120 (2)	USEPA 2003	Minimum chronic value (28-day NOEC for *Pimephales promelas* [fathead minnow] based on growth)
Zinc	85.6	USEPA 2006	Total recoverable CCC

Notes:

NA = Not Available
EPA = Environmental Protection Agency
CCC = Criteria Continuous Concentration
PAH = Polynuclear Aromatic Hydrocarbon
LOEL = Lowest Observed Effect Level
MATC = Maximum Acceptable Toxicant Concentra
NOEC = No Observed Effect Concentration
NOEL = No Observed Effect Level
USEPA = United States Environmental Protection Agency
CCC = Criteria Continuous Concentration
EC_{50} = Median Effective Concentration
LC_{50} = Median Lethal Concentration
µg/L = microgram per liter

(1) The values shown are marine/estuarine screening values unless otherwise noted.
(2) The chemical lacks a marine/estuarine surface water screening value. The value shown is a freshwater screening value.
(3) The value shown is for o-xylene.

Table References:

Buchman, M.F. 1999. NOAA Screening Quick Reference Tables. NOAA HAZMAT Report 99-1. National Oceanic and Atmospheric Administration, Seattle, WA. 12pp.

Suter II, G.W. 1996. Toxicological benchmarks for Screening Contaminants of Piotential Concern for Effects on Freshwater Biota. Environ. Toxicol. Chem. 15:1232-1241.

United States Environmental Protection Agency (USEPA). 2006. National Recommended Water Quality Criteria. Office of Water and Office of Science and Technology, Washington, D.C.

USEPA. 2005. Ecotoxicity Database. Office of Pesticide Programs, Washington, D.C. http://www.epa.gov/oppefed1/general/databasesdescription.htm - ecotoxicity.

USEPA. 2003. ECOTOX Database System, Aquatic Toxicity Informastion Retrieval (AQUIRE) Database. Mid-Continent Ecology Division (MED), Duluth, MN. http://cfpub.epa.gov/ecotox/.

USEPA. 2001. Region 4 Ecological Risk Assessment Bulletins - Supplement to RQGS. Waste Management Division, Atlanta, GA. http://www.epa.gov/region04/waste/ots/ecolbul.htm.

USEPA. 1996a. Ecotox Thresholds. Eco Update, Volume 3, Number 2. Office of Solid Waste and Emergency Response, Washington, D.C. EPA/F-95/038.

USEPA. 1996b. Superfund Chemical Data Matrix. EPA/540/R-96/028.

TABLE 5-3
INGESTION-BASED SCREENING VALUES FOR BIRDS
SWMU 73 - FORMER DEFENSE REUTILIZATION OFFICE (DRMO) SCRAP METAL YARD
CORRECTIVE MEASURES STUDY WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Test Organism	Body Weight (kg)	Duration	Exposure Route	Effect/Endpoint	Test Material	LOAEL (mg/kg/d)	NOAEL (mg/kg/d)	Reference
Volatile Organics:									
1,1,1,2-Tetrachloroethane	---	---	---	---	---	---	NA	NA	---
Carbon tetrachloride	---	---	---	---	---	---	NA	NA	---
Chlorobenzene	---	---	---	---	---	---	NA	NA	---
Chloroform	---	---	---	---	---	---	NA	NA	---
Ethylbenzene	---	---	---	---	---	---	NA	NA	---
Pentachloroethane	---	---	---	---	---	---	NA	NA	---
Styrene	---	---	---	---	---	---	NA	NA	---
Toluene	---	---	---	---	---	---	NA	NA	---
Trichloroethene	---	---	---	---	---	---	NA	NA	---
Xylene	Quail	0.191	Subacute	?	"Toxicity"	---	405	40.5	Hill and Camardese 1986
Semi-Volatile Organics:									
1,2,4,5-Tetrachlorobenzene	---	---	---	---	---	---	NA	NA	---
1,2,4-Trichlorobenzene	---	---	---	---	---	---	NA	NA	---
1,2-Dichlorobenzene (o-Dichlorobenzene)	Northern bobwhite	0.157	14 days	Oral (gavage)	Growth/mortality	?	2,500	250	Grimes and Jaber 1989
1,3-Dichlorobenzene (m-Dichlorobenzne)	Northern bobwhite	0.157	14 days	Oral (gavage)	Growth/mortality	?	2,500	250	Grimes and Jaber 1989
1,4-Dichlorobenzene (p-Dichlorobenzne)	Northern bobwhite	0.157	14 days	Oral (gavage)	Growth/mortality	?	2,500	250	Grimes and Jaber 1989
2,3,4,6-Tetrachlorophenol	---	---	---	---	---	---	NA	NA	---
2,4,5-Trichlorophenol	---	---	---	---	---	---	NA	NA	---
2,4,6-Trichlorophenol	---	---	---	---	---	---	NA	NA	---
2,4-Dichlorophenol	---	---	---	---	---	---	NA	NA	---
2-Acetylaminofluorene	---	---	---	---	---	---	NA	NA	---
2-Chloronaphthalene	---	---	---	---	---	---	NA	NA	---
3,3'-Dichlorobenzidine	---	---	---	---	---	---	NA	NA	---
3,3-Dimethylbenzidine	---	---	---	---	---	---	NA	NA	---
3-Methylcholanthrene	---	---	---	---	---	---	NA	NA	---
4-Bromophenylphenyl ether	---	---	---	---	---	---	NA	NA	---
4-Chloro-3-methylphenol	---	---	---	---	---	---	NA	NA	---
4-Chlorophenylphenyl ether	---	---	---	---	---	---	NA	NA	---
7-12-Dimethyl benz(a)anthracene	---	---	---	---	---	---	NA	NA	---
Aramite	---	---	---	---	---	---	NA	NA	---
bis(2-Ethylhexyl)phthalate	Ringed dove	0.155	4 weeks	Oral in diet	Reproduction	Not Applicable	11.0	1.10	Sample et al. 1996
Butylbenzylphthalate	---	---	---	---	---	---	NA	NA	---
Chlorobenzilate	Bobwhite quail	?	14 days	Oral (gavage)	Mortality	Not Applicable	19.73	9.73	USEPA 2005a
Diallate	---	---	---	---	---	---	NA	NA	---
Dibenzofuran	---	---	---	---	---	---	NA	NA	---
Diethylphthalate	---	---	---	---	---	---	NA	NA	---
Di-n-butylphthalate	Ringed dove	0.155	4 weeks	Oral in diet	Reproduction	Not Applicable	1.10	0.11	Sample et al. 1996
Di-n-octylphthalate	Ring-necked pheasant	1.00	?	?	Mortality	Not Applicable	500	50.0	TERRTOX 1998
Dinoseb (2-sec-butyl-4,6-Dintrophenol)	Ring-necked pheasant	?	14 days	Oral (gavage)	Mortality	Not Applicable	2.64	0.264	USEPA 2005a
Hexachlorobenzene	Japanese quail	0.19	90 days	Oral	Reproduction	Not Applicable	0.80	0.08	Coulston and Kolbye 1994
Hexachlorobutadiene	Japanese quail	0.19	?	Oral	Reproduction	Not Applicable	8.00	2.50	Coulston and Kolbye 1994
Hexachlorocyclopentadiene	---	---	---	---	---	---	NA	NA	---
Hexachloroethane	---	---	---	---	---	---	NA	NA	---
Hexachlorophene	---	---	---	---	---	---	NA	NA	---
Hexachloropropene	---	---	---	---	---	---	NA	NA	---
Isosafrole	---	---	---	---	---	---	---	---	---

TABLE 5-3
INGESTION-BASED SCREENING VALUES FOR BIRDS
SWMU 73 - FORMER DEFENSE REUTILIZATION OFFICE (DRMO) SCRAP METAL YARD
CORRECTIVE MEASURES STUDY WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Test Organism	Body Weight (kg)	Duration	Exposure Route	Effect/Endpoint	Test Material	LOAEL (mg/kg/d)	NOAEL (mg/kg/d)	Reference
Semi-Volatile Organics:									
N-Nitrosodiphenylamine	---	---	---	---	---	---	NA	NA	---
p-Dimethylaminoazobenzene	---	---	---	---	---	---	NA	NA	---
Pentachlorobenzene	---	---	---	---	---	---	NA	NA	---
Pentachloronitrobenzene	Chicken	1.50	35 weeks	Oral in diet	Reproduction	Not Applicable	70.7	7.07	Sample et al. 1996
Pentachlorophenol	Chicken	1.50	8 weeks	Oral	Growth	Not Applicable	200	100	Eisler 1989
Pronamide	---	---	---	---	---	---	NA	NA	---
Sulfotepp	---	---	---	---	---	---	NA	NA	---
PAHs:									
1-Methylnaphthalene	Mallard duck	1.04	7 months	Oral in diet	Hepatic	Not Applicable	228	22.8	Patton and Dieter 1980
2-Methylnaphthalene	Mallard duck	1.04	7 months	Oral in diet	Hepatic	Not Applicable	228	22.8	Patton and Dieter 1980
Acenaphthene	Chicken	1.50	34 days	Oral in diet	Reproduction	Not Applicable	395	39.5	Rigdon and Neal 1963
Acenaphthylene	Chicken	1.50	34 days	Oral in diet	Reproduction	Not Applicable	395	39.5	Rigdon and Neal 1963
Anthracene	Mallard duck	1.043	7 months	Oral in diet	Hepatic	Not Applicable	228	22.8	Patton and Dieter 1980
Benzo(a)anthracene	Chicken	1.50	34 days	Oral in diet	Reproduction	Not Applicable	395	39.5	Rigdon and Neal 1963
Benzo(a)pyrene	Chicken	1.50	34 days	Oral in diet	Reproduction	Not Applicable	395	39.5	Rigdon and Neal 1963
Benzo(b)fluoranthene	Chicken	1.50	34 days	Oral in diet	Reproduction	Not Applicable	395	39.5	Rigdon and Neal 1963
Benzo(g,h,i)perylene	Chicken	1.50	34 days	Oral in diet	Reproduction	Not Applicable	395	39.5	Rigdon and Neal 1963
Benzo(k)fluoranthene	Chicken	1.50	34 days	Oral in diet	Reproduction	Not Applicable	395	39.5	Rigdon and Neal 1963
Chrysene	Chicken	1.50	34 days	Oral in diet	Reproduction	Not Applicable	395	39.5	Rigdon and Neal 1963
Dibenz(a,h)anthracene	Chicken	1.50	34 days	Oral in diet	Reproduction	Not Applicable	395	39.5	Rigdon and Neal 1963
Fluoranthene	Chicken	1.50	34 days	Oral in diet	Reproduction	Not Applicable	395	39.5	Rigdon and Neal 1963
Fluorene	Chicken	1.50	34 days	Oral in diet	Reproduction	Not Applicable	395	39.5	Rigdon and Neal 1963
Indeno(1,2,3-cd)pyrene	Chicken	1.50	34 days	Oral in diet	Reproduction	Not Applicable	395	39.5	Rigdon and Neal 1963
Naphthalene	Mallard duck	1.04	7 months	Oral in diet	Hepatic	Not Applicable	228	22.8	Patton and Dieter 1980
Phenanthrene	Chicken	1.50	34 days	Oral in diet	Reproduction	Not Applicable	395	39.5	Rigdon and Neal 1963
Pyrene	Chicken	1.50	34 days	Oral in diet	Reproduction	Not Applicable	395	39.5	Rigdon and Neal 1963
Organochlorine Pesticides:									
4,4'-DDD	American kestrel	0.115	2 years	Oral	Reproduction	Not Applicable	0.50	0.05	McLane and Hall 1972
4,4'-DDE	American kestrel	0.115	2 years	Oral	Reproduction	Not Applicable	0.50	0.05	McLane and Hall 1972
4,4'-DDT	American kestrel	0.115	2 years	Oral	Reproduction	Not Applicable	0.50	0.05	McLane and Hall 1972
Aldrin	Mallard duck	1.134	Chronic	Oral	Mortality	Not Applicable	5.00	0.50	Tucker and Crabtree 1970
alpha-BHC	Japanese quail	0.15	90 days	Oral in diet	Reproduction	Not Applicable	2.25	0.56	Sample et al. 1996
alpha-Chlordane	Red-winged blackbird	0.064	84 Days	Oral in diet	Mortality	Not Applicable	10.7	2.14	Sample et al. 1996
beta-BHC	Japanese quail	0.15	90 days	Oral in diet	Reproduction	Not Applicable	2.25	0.56	Sample et al. 1996
delta-BHC	Japanese quail	0.15	90 days	Oral in diet	Reproduction	Not Applicable	2.25	0.56	Sample et al. 1996
Dieldrin	Barn owl	0.466	2 years	Oral in diet	Reproduction	Not Applicable	0.77	0.077	Sample et al. 1996
Endosulfan 1	Grey partridge	0.40	4 weeks	Oral in diet	Reproduction	Not Applicable	100	10	Sample et al. 1996
Endosulfan 11	Grey partridge	0.40	4 weeks	Oral in diet	Reproduction	Not Applicable	100	10	Sample et al. 1996
Endosulfan sulfate	Grey partridge	0.40	4 weeks	Oral in diet	Reproduction	Not Applicable	100	10.0	Sample et al. 1996
Endrin	Screech owl	0.181	>83 days	Oral in diet	Reproduction	Not Applicable	0.10	0.01	Sample et al. 1996
Endrin aldehyde	Screech owl	0.181	>83 days	Oral in diet	Reproduction	Not Applicable	0.10	0.01	Sample et al. 1996
gamma-BHC (Lindane)	Mallard duck	1.00	8 weeks	Oral (intubation)	Reproduction	Not Applicable	20.0	2.00	Sample et al. 1996
gamma-Chlordane	Red-winged blackbird	0.064	84 Days	Oral in diet	Mortality	Not Applicable	10.7	2.14	Sample et al. 1996
Heptachlor	Quail	0.191	5 days	Oral in diet	Mortality	Not Applicable	4.05	0.405	Hill et. al 1975
Heptachlor epoxide	Quail	0.191	5 days	Oral in diet	Mortality	Not Applicable	4.05	0.405	Hill et. al 1975

TABLE 5-3
INGESTION-BASED SCREENING VALUES FOR BIRDS
SWMU 73 - FORMER DEFENSE REUTILIZATION OFFICE (DRMO) SCRAP METAL YARD
DRAFT CORRECTIVE MEASURES STUDY WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Chemical	Test Organism	Body Weight (kg)	Duration	Exposure Route	Effect/Endpoint	Test Material	LOAEL (mg/kg/d)	NOAEL (mg/kg/d)	Reference
Organochlorine Pesticides:									
Kepone	Mallard duck	?	14 days	Oral (gavage)	Mortality	Not Applicable	11.67	1.67	USEPA 2004
Methoxychlor	Quail	0.191	5 days	Oral in diet	Mortality	Not Applicable	4,050	405	Hill and Camardese 1986
Toxaphene	Mallard duck	1.043	5 days	Oral in diet	Mortality	Not Applicable	3.07	0.307	Hill and Camardese 1986
Inorganics:									
Antimony	Northern bobwhite	0.19	6 weeks	Oral	?	Unknown	47,400	4,740	Opresko et al. 1993
Arsenic	Chicken	Unknown	19 days	Oral in diet	Mortality	Unknown	22.4	2.24	USEPA 2005b
Barium	One-day old chicks	0.121	4 weeks	Oral in diet	Mortality	Barium hydroxide	41.7	20.8	Sample et al. 1996
Beryllium	---	---	---	---	---	---	NA	NA	---
Cadmium	Multiple species	Unknown	Various	Oral in diet	Reproduction/growth	Unknown	11.47	1.47 (1)	USEPA 2005c
Chromium	Multiple species	Unknown	Various	Oral in diet	Reproduction/growth	Trivalent chromium	26.6	2.66 (1)(2)	USEPA 2005d
Cobalt	Multiple species	Unknown	Various	Oral in diet	Growth	Unknown	76.1	7.61 (1)	USEPA 2005e
Copper	Chicken	Unknown	84 days	Oral in diet	Reproduction	Unknown	12.1	4.05	USEPA 2006a
Lead	Chicken	Unknown	4 weeks	Oral in diet	Reproduction	Unknown	3.26	1.63	USEPA 2005f
Mercury	Mallard duck	1.00	3 generations	Oral in diet	Reproduction	Methyl mercury dicyandiamide	0.078	0.026	USEPA 1997
Nickel	Mallard duckling	0.782	90 days	Oral in diet	Growth/mortality	Nickel sulfate	107	77.4	Sample et al. 1996
Selenium	Mallard duck	1.00	100 days	Oral in diet	Reproduction	Selanomethionine	0.80	0.40	Sample et al. 1996
Silver	Turkey	Unknown	5 weeks	Oral in diet	Growth	Unknown	20	2.02	USEPA 2006b
Thallium	European starling	Unknown	acute	Oral	Unknown	Unknown	3.50	0.35	USEPA 1999
Tin	Japanese quail	0.15	6 weeks	Oral in diet	Reproduction	bis(Tributyltin)-oxide	16.9	6.80	Sample et al. 1996
Vanadium	Chicken	Unknown	5 weeks	Oral in diet	Growth	Unknown	0.688	0.344	USEPA 2005g
Zinc	White leghorn hen	1.935	44 weeks	Oral in diet	Reproduction	Zinc sulfate	131	14.5	Sample et al. 1996

Notes:

NA = Not Available
NOAEL = No Observed Adverse Effect Level
LOAEL = Lowest Observed Adverse Effect Level
DDD = Dichlorodiphenyldichloroethane
DDE = Dichlorodiphenyldichloroethylene
DDT = Dichlorodiphenyltrichloroethane
BHC = Benzene hexachloride
USEPA = United States Environmental Protection Agency
mg/kg/day = milligram per kiligram-body weight per day
kg = kilogram

(1) The NOAEL value represents a geometric mean of NOAEL values for growth and/or reproduction. The NOAEL value was used bu the USEPA in the derivation of the avian ecological soil screening level.

(2) The NOAEL value shown is for trivalent chromium.

Table References:

Coulston, F. and A.C. Kolbye, Jr. (eds.) 1994. Interpretive Review of the Potetnial Adverse Effects of Chlorinated Organic Chemicals on Human Health and the Environment. Regul. Toxicol. Pharmacol. 20:S1-S1056.

Eisler, R. 1989. Pentachlorophenol Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. U.S. Fish and Wildlife Service Biological Report 85(1.17), Contaminant Hazard Reviews Report No. 17. 72pp.

Grimes, J and M. Jaber. 1989. Para-dichlorobenzene: An Acute Oral Toxicity Study with the Bobwhite, Final Report. Prepared by Wildlife International, Ltd. - Easton, MD under Project No. 264-101 and Submitted to the Chemical Manufacturers Association.

Hill, E.F. and M.B. Camardese. 1986. Lethal Dietary Toxicities of Environmental Contaminants and Pesticides to Coturnix. U.S. Fish and Wildlife Services Technical Report 2.

Hill, E.F., R.G. Heath, J.W. Spann, and J.D. Willaims. 1975. Lethal Dietary Toxicities of Environmental Pollutants to Birds. U.S. Fiah and Wildlife Service Special Scientific Report - Wildlife No. 191, Washington, D.C.

TABLE 5-3
INGESTION-BASED SCREENING VALUES FOR BIRDS
SWMU 73 - FORMER DEFENSE REUTILIZATION OFFICE (DRMO) SCRAP METAL YARD
CORRECTIVE MEASURES STUDY WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Table References (continued):

McLane, M.A.R. and L.C. Hall. 1972. DDE Thins Screech Owl Eggshells. Bull. Environ. Contam. Toxicol. 8:65-68.

Opresko, D.M., B.E. Sample, and G.W. Suter II. 1993. Toxicological Benchmarks for Wildlife. Environmental Restoration Division, ORNL Environmental Restoration Program. ES/ER/TM-86

Patten, J.F. and M.P. Dieter. 1980. Effects of Petroleum Hydrocarbons on Hepatic Function in the Duck. Comp. Biochem. Physiol. 65C:33-36.

Rigdon, R.H. and J.Neal. 1963. Fluorescence of Chickens and Eggs Following the Feeding of Benzpyrene Crystals. Texas Reports on Biology and Medicine. 21(4):558-566.

Sample, B.E., D.M. Opresko, and G.W. Suter II. 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. Oak Ridge National Laboratory, Health Sciences Research Division, Oak Ridge, TN. ES/ER/TM-86/R3.

Terrestrial Toxicity Database (TERRETOX). 1998. Environmental Research Laboratory, U.S. Environmental Protection Agency, Duluth, MN.

Tucker, R.K. and D.G. Crabtree. 1970. Handbook of Toxicology of Pesticides to Wildlife. U.S. Fish and Wildlife Service Research Publication 84. 131 pp.

United States Environmental Protection Agency (USEPA). 2006a. Ecological Soil Screening Levels for Copper (Interim Final). Office of Solid Waste and Emergecny Response, Washington, D.C. OSWER Directive 9285.7-77.

USEPA. 2006b. Ecological Soil Screening Levels for Silver (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWEER Directive 9285.7-61

USEPA. 2005a. Ecotoxicity Database. http://www.epa.gov/pesticides/science/models_db.htm.

USEPA. 2005b. Ecological Soil Screening Levels for Arsenic (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-62.

USEPA. 2005c. Ecological Soil Screening Levels for Cadmium (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-65.

USEPA. 2005d. Ecological Soil Screening Levels for Chromium (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-66.

USEPA. 2005e. Ecological Soil Screening Levels for Cobalt (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-67

USEPA. 2005f. Ecological Soil Screening Levels for Lead (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-70.

USEPA. 2005g. Ecological Soil Screening Levels for Vanadium (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-75.

USEPA. 1999. Screening-Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities. EPA/530/D-99/001A.

USEPA. 1997. Mercury Study Report to Congress. Volume VI: An Ecological Assessment for Anthropogenic Mercury Emissions in the United States. EPA-452/R-97-008.

FIGURES

111626_73_00.dwg

4 0 2 4 8

1 inch = 4 miles

Baker

FIGURE 1-1
REGIONAL LOCATION MAP
SWMU 73-DRMO SCRAP METAL RECYCLING YARD
CMS WORK PLAN

SOURCE: METRODATA, INC., 1999.

NAVAL ACTIVITY PUERTO RICO

LEGEND

- SWMUs
- 73 – AREA TO WHICH THIS INVESTIGATION PERTAINS
- AOC D – AOCs

SOURCE: GEO–MARINE, INC., SEPTEMBER 6, 2000.

3000 0 1500 3000
1 inch = 3000 ft.

FIGURE 1–2
SWMU/AOC LOCATION MAP
SWMU 73–DRMO SCRAP METAL RECYCLING YARD
CMS WORK PLAN

NAVAL ACTIVITY PUERTO RICO

300 0 150 300

1 inch = 300 ft.

Baker

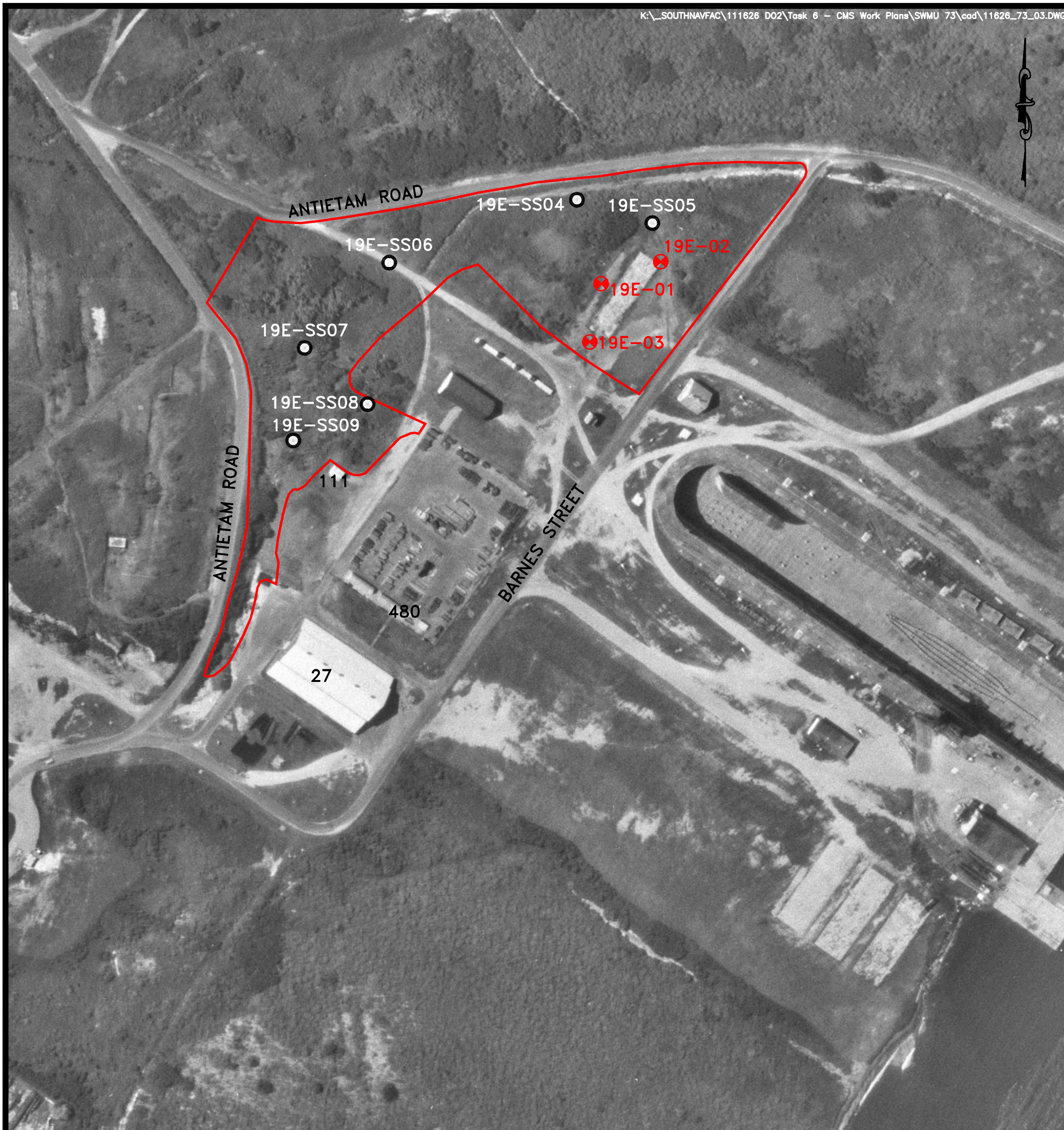
LEGEND

- ⊗ – SURFACE SOIL, SUBSURFACE SOIL, AND GROUNDWATER SAMPLE LOCATION
- ● – SURFACE SOIL SAMPLE LOCATION
- ◇ – SWMU SITE BOUNDARY

SOURCE: GEO-MARINE, INC., SEPTEMBER 6, 2000.
AERIAL IMAGE FROM 1998

FIGURE 1-3
ECP SAMPLE LOCATION MAP
SWMU 73-DRMO SCRAP
METAL RECYCLING YARD
CMS WORK PLAN

NAVAL ACTIVITY PUERTO RICO



300 0 150 300

1 inch = 300 ft.

Baker

LEGEND

- – SURFACE SOIL, SUBSURFACE SOIL, AND GROUNDWATER SAMPLE LOCATION
- – SURFACE SOIL SAMPLE LOCATION
- – SWMU SITE BOUNDARY

SOURCE: GEO–MARINE, INC., SEPTEMBER 6, 2000.

FIGURE 1–4
1958 AERIAL MAP
SWMU 73–DRMO SCRAP
METAL RECYCLING YARD
CMS WORK PLAN

NAVAL ACTIVITY PUERTO RICO

Baker

LEGEND

- SURFACE SOIL, SUBSURFACE SOIL, AND GROUNDWATER SAMPLE LOCATION, (ECP 2004)
- SURFACE SOIL SAMPLE LOCATION, (ECP 2004)
- SWMU SITE BOUNDARY
- PROPOSED LIMIT OF EXCAVATIONS
- PROPOSED SURFACE SOIL SAMPLING LOCATION
- PROPOSED SURFACE SOIL, SUBSURFACE SOIL, AND GROUNDWATER SAMPLING LOCATION

SOURCE: GEO–MARINE, INC., SEPTEMBER 6, 2000.
AERIAL IMAGE FROM 1998

FIGURE 3–1
PROPOSED SAMPLE LOCATION MAP
SWMU 73–DRMO SCRAP
METAL RECYCLING YARD
CMS WORK PLAN

NAVAL ACTIVITY PUERTO RICO

Figure 5-1: Navy Ecological Risk Assessment Tiered Approach

RPM Input and Risk Management Consideration[3]

Step 8: Risk Management

Tier 1. Screening Risk Assessment (SRA): Identify pathways and compare exposure point concentrations to bench marks.

Step 1: Site visit; Pathway Identification/Problem Formulation; Toxicity Evaluation

Step 2: Exposure Estimate; Risk Calculation (SMDP) [1]

Proceed to Exit Criteria for SRA

Exit Criteria for the Screening Risk Assessment: Decision for exiting or continuing the ecological risk assessment.

1) Site passes screening risk assessment: A determination is made that the site poses acceptable risk and shall be closed out for ecological concerns.

2) Site fails screening risk assessment: The site must have both complete pathway and unacceptable risk. As a result the site will either have an interim cleanup or moves to the second tier.

Tier 2. Baseline Ecological Risk Assessment (BERA): Detailed assessment of exposure and hazard to "assessment endpoints" (ecological qualities to be protected). Develop site specific values that are protective of the environment.

Step 3a: Refinement of Conservative Exposure Assumptions[2] (SRA)---- **Proceed to Exit Criteria for Step 3a**

Step 3b: Problem Formulation - Toxicity Evaluation; Assessment Endpoints; Conceptual Model; Risk Hypothesis (SMDP)

Step 4: Study Design/DQO - Lines of Evidence; Measurement Endpoints; Work Plan and Sampling & Analysis Plan (SMDP)

Step 5: Verification of Field Sampling Design (SMDP)

Step 6: Site Investigation and Data Analysis [SMDP]

Step 7: Risk Characterization

Proceed to Exit Criteria for BERA

Exit Criteria Step 3a Refinement

1) If re-evaluation of the conservative exposure assumptions (SRA) support an acceptable risk determination then the site exits the ecological risk assessment process.

2) If re-evaluation of the conservative exposure assumptions (SRA) do not support an acceptable risk determination then the site continues in the Baseline Ecological Risk Assessment process. **Proceed to Step 3b**.

Exit Criteria Baseline Risk Assessment

1) If the site poses acceptable risk then no further evaluation and no remediation from an ecological perspective is warranted.

2) If the site poses unacceptable ecological risk and additional evaluation in the form of remedy development and evaluation is appropriate, proceed to third tier.

Tier 3. Evaluation of Remedial Alternative (RAGs C)

a. Develop site specific risk based cleanup values.

b. Qualitatively evaluate risk posed to the environment by implementation of each alternative (short term) impacts and estimate risk reduction provided by each (long-term) impacts; provide quantitative evaluation where appropriate. Weigh alternative using the remaining CERCLA 9 Evaluation Criteria. Plan for monitoring and site closeout.

Notes: 1) See USEPA's 8 Step ERA Process for requirements for each Scientific Management Decision Point (SMDP).
2) Refinement includes but is not limited to background, bioavailability, detection frequency, etc.
3) Risk Management is incorporated throughout the tiered approach.

FIGURE 5-2

STATISTICAL ANALYSIS PROCESS
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

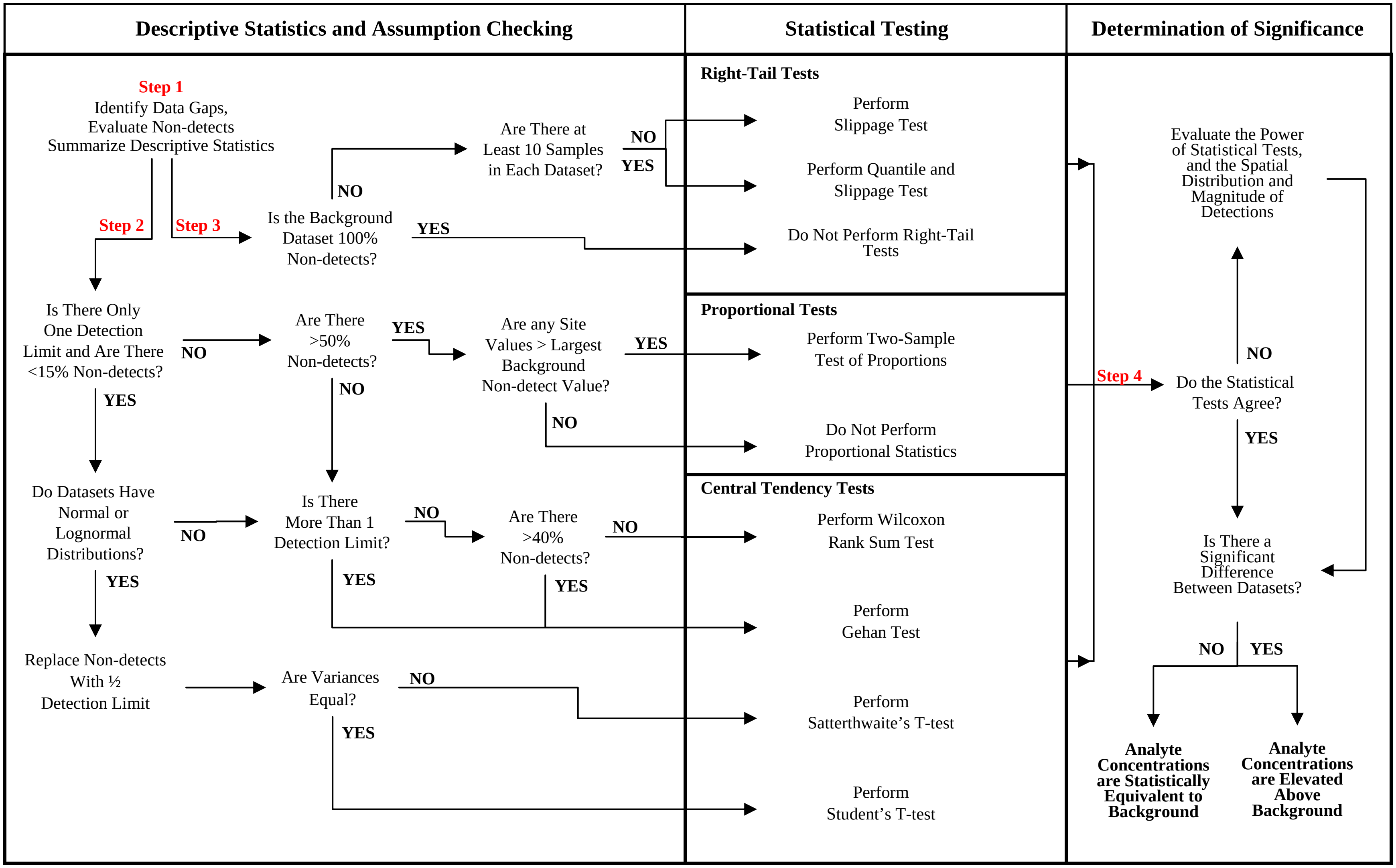
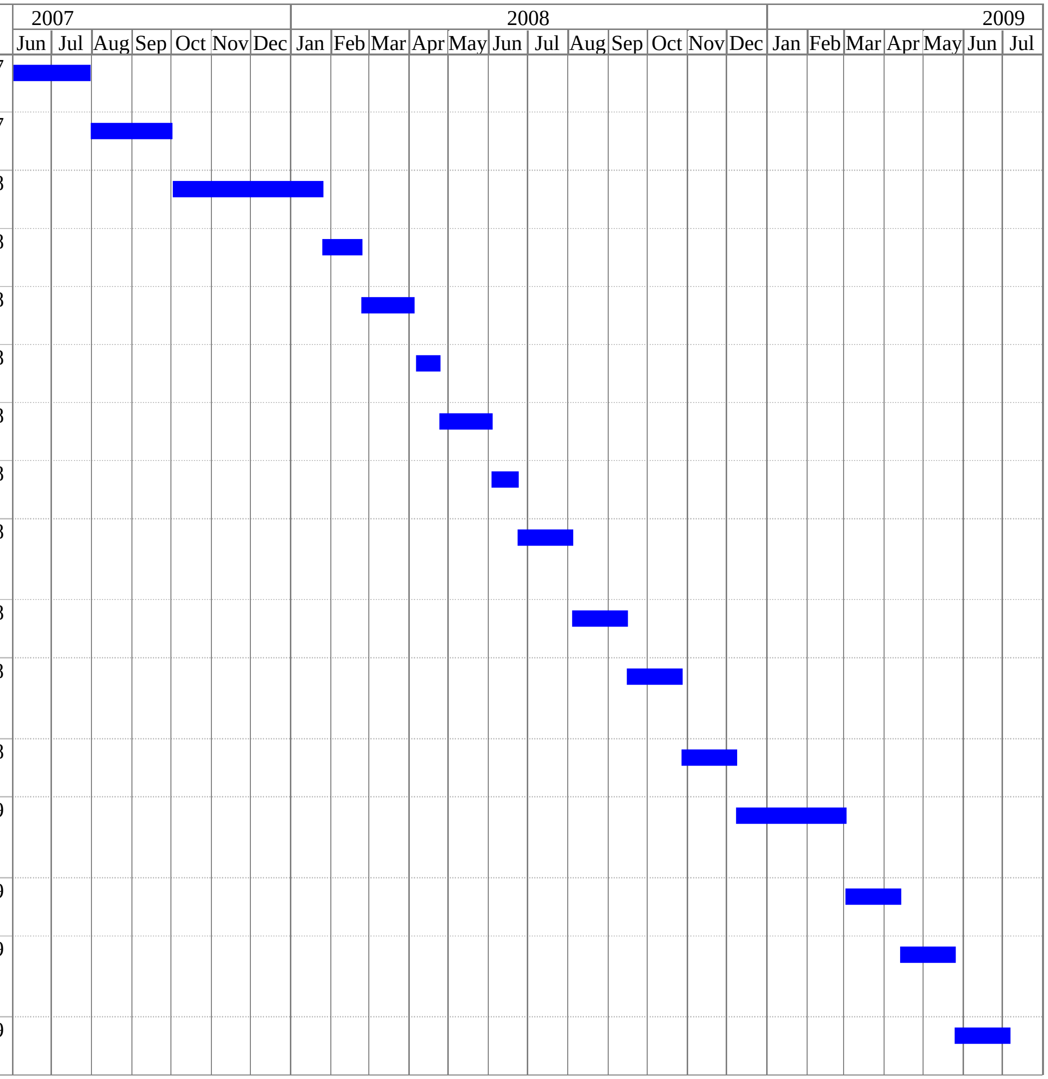


Figure Adapted from NFESC, 1998
T-tests performed on log-transformed data if datasets have lognormal distributions.

Revised: January 25, 2008

FIGURE 9-1
PROPOSED PROJECT SCHEDULE
SWMU 73
CMS WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

ID	Task Name	Duration	Start	Finish
1	Draft CMS Work Plan to the EPA	60 edays	6/1/07	7/31/07
2	EPA Review	62 edays	8/1/07	10/2/07
3	Final CMS Work Plan to the EPA	115 edays	10/2/07	1/25/08
4	EPA Review & Approval	30 edays	1/25/08	2/24/08
5	Initiate Field Work	30 days	2/25/08	4/4/08
6	Field Investigation	14 days	4/7/08	4/24/08
7	Laboratory Analysis	28 days	4/25/08	6/3/08
8	Data Validation	14 days	6/4/08	6/23/08
9	Draft CMS Task 1 or CMS Investigation Report for SWMU 73 to EPA	30 days	6/24/08	8/4/08
10	EPA Review	30 days	8/5/08	9/15/08
11	Final CMS Task 1 or CMS Investigation Report for SWMU 73 to EPA	30 days	9/16/08	10/27/08
12	EPA Review & Approval	30 days	10/28/08	12/8/08
13	Draft CMS Final Report for SWMU 73 to EPA	60 days	12/9/08	3/2/09
14	EPA Review	30 days	3/3/09	4/13/09
15	Final CMS Final Report for SWMU 73 to EPA	30 days	4/14/09	5/25/09
16	EPA Review & Approval	30 days	5/26/09	7/6/09

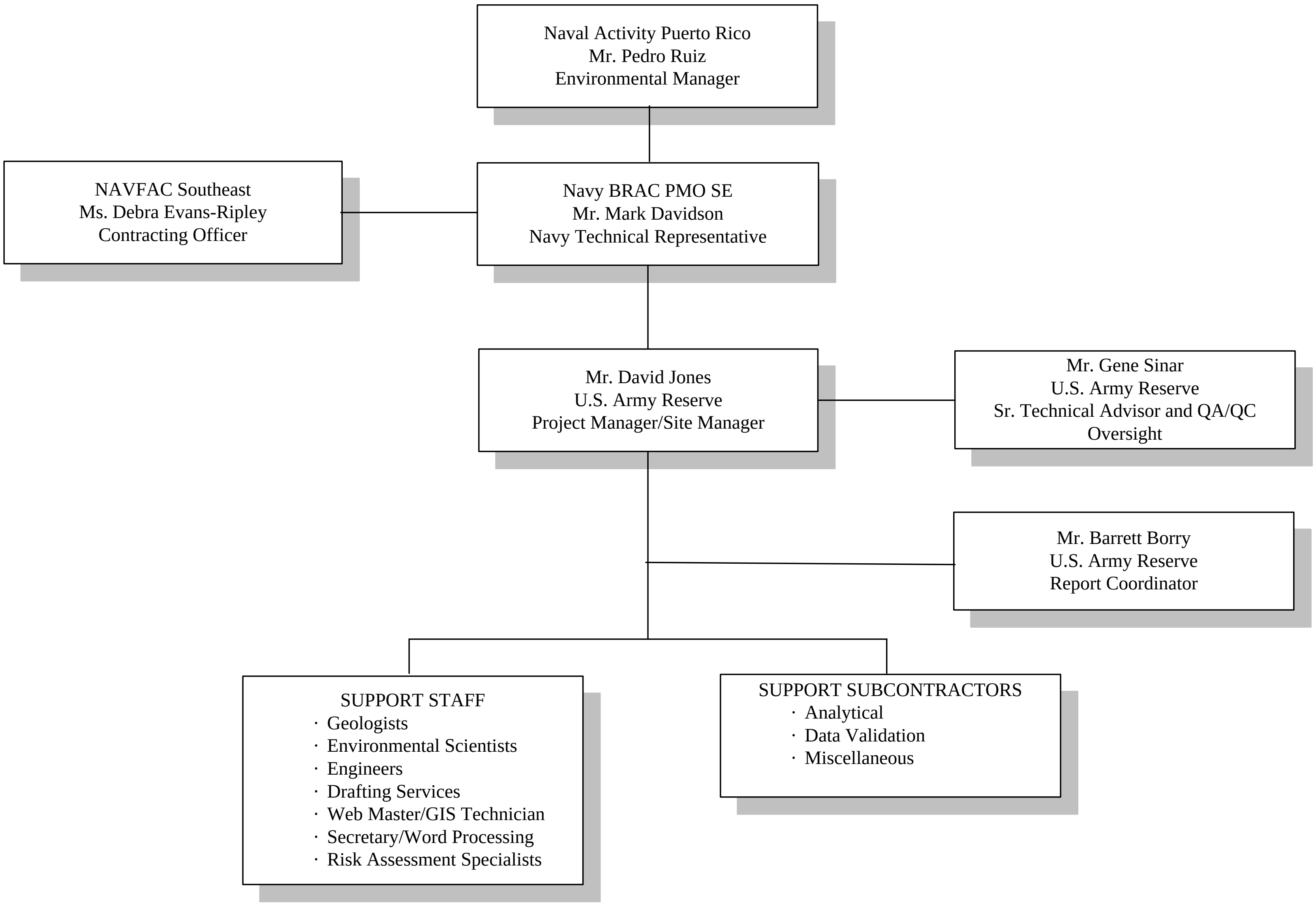


Task

Project: CMS Work Plan
Date: 1/25/08

Revised: January 25, 2008

FIGURE 10-1
PROJECT ORGANIZATION
CMS WORK PLAN – SWMU 73
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



APPENDIX A
PHOTOGRAPHS OF SWMU 73, ECP SITE 19

Photograph A-43. ECP Site 19 – DRMO Scrap Metal Recycling Yard

Photograph A-44. ECP Site 19 – DRMO Scrap Metal Recycling Yard

Photograph A-45. ECP Site 19 – DRMO Scrap Metal Recycling Yard

Photograph A-46. ECP Site 19 – DRMO Scrap Metal Recycling Yard

Photograph A-47. ECP Site 19 – DRMO
Scrap Metal Recycling Yard

APPENDIX B
SUMMARY OF ANALYTICAL RESULTS FROM PHASE II ECP STUDY

APPENDIX B.1

SUMMARY OF ORGANIC DETECTIONS IN SURFACE SOIL
SWMU 73 - DRMO SCRAP METAL RECYCLING YARD
CMS WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	EPA Region III	**EPA Region III**	19E-01	19E-02	19E-03	19E-SS04	19E-SS05	19E-SS06	19E-SS07	19E-SS08	19E-SS09
Sample ID	Industrial	**Residential**	19E-SS01	19E-SS02	19E-SS03	19E-SS04	19E-SS05	19E-SS06	19E-SS07	19E-SS08	19E-SS09
Sample Date	RBCs	**RBCs**	05/06/04	05/06/04	05/06/04	05/13/04	05/13/04	05/13/04	05/13/04	05/13/04	05/13/04
Sample Depth (ft bgs)	(ug/kg)	(ug/kg)	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00
Volatile Organic Compounds (ug/kg)											
Carbon tetrachloride	22,000	4,900	2.6 J	2.9 J	5.6 U	7.9 U	6.8 U	5.8 U	6 U	6.5 U	6.3 U
Xylene	20,000,000	1,600,000	9.7 U	11 U	3.8 J	16 U	14 U	12 U	12 U	13 U	12 U
Tetrachloroethene	5,300	1,200	4.8 U	5.6 U	5.6 U	7.9 U	3.8 J	5.7 J	6 U	6.5 U	6.3 U
Chlorobenzene	2,000,000	160,000	4.8 U	5.6 U	5.6 U	7.9 U	6.8 U	1.8 J	6 U	6.5 U	6.3 U
Semivolatile Organic Compounds (ug/kg)											
Butylbenzylphthalate	20,000,000	16,000,000	52 J	380 U	420 U	320 J	490 U	400 U	440 U	450 U	440 U
Fluoranthene	4,100,000	310,000	34 J	380 U	41 J	540 U	490 U	200 J	440 U	56 J	440 U
Indeno(1,2,3-cd)pyrene	3,900	870	43 J	380 U	420 U	540 U	490 U	190 J	440 U	450 U	440 U
Pyrene	3,100,000	230,000	39 J	18 J	43 J	540 U	490 U	300 J	440 U	54 J	440 U
Benzo(g,h,i)perylene	NE	NE	49 J	380 U	32 J	540 U	490 U	230 J	440 U	450 U	440 U
Benzo(k)fluoranthene	39,000	8,700	26 J	380 U	420 U	540 U	490 U	350 J	440 U	450 U	440 U
Chrysene	390,000	87,000	360 U	380 U	420 U	540 U	490 U	320 J	440 U	450 U	440 U
Acenaphthylene	NE	NE	360 U	380 U	420 U	540 U	490 U	71 J	440 U	450 U	440 U
Anthracene	31,000,000	2,300,000	360 U	380 U	420 U	540 U	490 U	48 J	440 U	450 U	440 U
Benzo(a)anthracene	3,900	870	360 U	380 U	420 U	540 U	490 U	220 J	440 U	450 U	440 U
Benzo(a)pyrene	390	87	360 U	380 U	420 U	540 U	490 U	**270** J	440 U	450 U	440 U
Benzo(b)fluoranthene	3,900	870	360 U	380 U	420 U	540 U	490 U	320 J	440 U	450 U	440 U

APPENDIX B.1

SUMMARY OF ORGANIC DETECTIONS IN SURFACE SOIL
SWMU 73 - DRMO SCRAP METAL RECYCLING YARD
CMS WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	EPA Region III	**EPA Region III**	19E-01	19E-02	19E-03	19E-SS04	19E-SS05	19E-SS06	19E-SS07	19E-SS08	19E-SS09
Sample ID	Industrial	**Residential**	19E-SS01	19E-SS02	19E-SS03	19E-SS04	19E-SS05	19E-SS06	19E-SS07	19E-SS08	19E-SS09
Sample Date	RBCs	**RBCs**	05/06/04	05/06/04	05/06/04	05/13/04	05/13/04	05/13/04	05/13/04	05/13/04	05/13/04
Sample Depth (ft bgs)	(ug/kg)	(ug/kg)	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00	0.00 - 1.00
Pesticides/PCBs (ug/kg)											
Dieldrin	180	40	7.7	1.9 J	840 U	5.4 U	6.7	4 U	4.4 U	4.5 U	4.4 U
Heptachlor	640	140	3.7 P	3.9 U	430 U	2.8 U	2.5 U	2 U	2.3 U	2.3 U	2.3 U
4,4'-DDT	12,000	2,700	7.2 U	10	**5,300**	7.1	4.9 U	4.9	4.4 U	4.5 U	3.7 J
4,4'-DDE	8,400	1,900	7.6	66	**4,700**	22	8.8	4.3	4.4 U	4.5 U	1 JP
4,4'-DDD	8,400	1,900	7.2 U	1.4 JP	810 J	5.4 U	4.9 U	4 U	4.4 U	4.5 U	4.4 U
Kepone	360	80	370 U	390 U	43,000 U	280 U	250 U	26 J	230 U	230 U	230 U
Aroclor-1248	1,400	320	140	75 U	8,400 U	54 U	49 U	40 U	44 U	45 U	44 U
Aroclor-1254	1,400	320	72 U	40 J	8,400 U	54 U	49 U	40 U	44 U	45 U	44 U
Aroclor-1260	1,400	320	120	15 JP	8,400 U	54 U	73	40 U	44 U	45 U	44 U

OP-Pesticides (ug/kg)
Not Detected

Chlorinated Herbicides (ug/kg)
Not Detected

Notes:
J - The reported result is an estimated concentration that is less than the PQL, but greater than or equal to the MDL.
U - The compound was analyzed for, but was not detected at or above the MDL/PQL.
P - The GC or HPLC confirmation criteria was exceeded. The relative percent difference is greater than 40% between the two GC columns or HPLC detectors.
NE - Not Established.
ft bgs - feet below ground surface.
ug/kg - micrograms per kilogram.

APPENDIX B.1

SUMMARY OF ORGANIC DETECTIONS IN SURFACE SOIL
SWMU 73 - DRMO SCRAP METAL RECYCLING YARD
CMS WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Sample Date Sample Depth (ft bgs)	EPA Region III Industrial RBCs (ug/kg)	**EPA Region III Residential RBCs** (ug/kg)	Number Exceeding EPA Region III Industrial RBCs	Range Exceeding EPA Region III Industrial RBCs	**Number Exceeding EPA Region III Residential RBCs**	**Range Exceeding EPA Region III Residential RBCs**	Location of Maximum Detection
Volatile Organic Compounds (ug/kg)							
Carbon tetrachloride	22,000	4,900	0/9	---	0/9	---	19E-SS02
Xylene	20,000,000	1,600,000	0/9	---	0/9	---	193-SS03
Tetrachloroethene	5,300	1,200	0/9	---	0/9	---	19E-SS06
Chlorobenzene	2,000,000	160,000	0/9	---	0/9	---	19E-SS06
Semivolatile Organic Compounds (ug/kg)							
Butylbenzylphthalate	20,000,000	16,000,000	0/9	---	0/9	---	19E-SS04
Fluoranthene	4,100,000	310,000	0/9	---	0/9	---	19E-SS06
Indeno(1,2,3-cd)pyrene	3,900	870	0/9	---	0/9	---	19E-SS06
Pyrene	3,100,000	230,000	0/9	---	0/9	---	19E-SS06
Benzo(g,h,i)perylene	NE	NE	NE	---	NE	---	19E-SS06
Benzo(k)fluoranthene	39,000	8,700	0/9	---	0/9	---	19E-SS06
Chrysene	390,000	87,000	0/9	---	0/9	---	19E-SS06
Acenaphthylene	NE	NE	NE	---	NE	---	19E-SS06
Anthracene	31,000,000	2,300,000	0/9	---	0/9	---	19E-SS06
Benzo(a)anthracene	3,900	870	0/9	---	0/9	---	19E-SS06
Benzo(a)pyrene	390	87	0/9	---	1/9	270J	19E-SS06
Benzo(b)fluoranthene	3,900	870	0/9	---	0/9	---	19E-SSS06

APPENDIX B.1

SUMMARY OF ORGANIC DETECTIONS IN SURFACE SOIL
SWMU 73 - DRMO SCRAP METAL RECYCLING YARD
CMS WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Sample Date Sample Depth (ft bgs)	EPA Region III Industrial RBCs (ug/kg)	**EPA Region III Residential RBCs** (ug/kg)	Exceeding EPA Region III Industrial RBCs	Exceeding EPA Region III Industrial RBCs	**Exceeding EPA Region III Residential RBCs**	**Exceeding EPA Region III Residential RBCs**	Location of Maximum Detection
Pesticides/PCBs (ug/kg)							
Dieldrin	180	40	0/9	---	0/9	---	19E-SS01
Heptachlor	640	140	0/9	---	0/9	---	19E-SS01
4,4'-DDT	12,000	2,700	0/9	---	1/9	5,300	19E-SS03
4,4'-DDE	8,400	1,900	0/9	---	1/9	4,700	19E-SS03
4,4'-DDD	8,400	1,900	0/9	---	0/9	---	19E-SS03
Kepone	360	80	0/9	---	0/9	---	19E-SS06
Aroclor-1248	1,400	320	0/9	---	0/9	---	19E-SS01
Aroclor-1254	1,400	320	0/9	---	0/9	---	19E-SS02
Aroclor-1260	1,400	320	0/9	---	0/9	---	19E-SS01

OP-Pesticides (ug/kg)
Not Detected

Chlorinated Herbicides (ug/kg)
Not Detected

Notes:
J - The reported result is an estimated concentration that is less than the PQL, but greater than or equal to the MDL.
U - The compound was analyzed for, but was not detected at or above the MDL/PQL.
P - The GC or HPLC confirmation criteria was exceeded. The relative percent difference is greater than 40% between the two GC columns or HPLC detectors.
NE - Not Established.
ft bgs - feet below ground surface.
ug/kg - micrograms per kilogram.

APPENDIX B.2

SUMMARY OF INORGANIC DETECTIONS IN SURFACE SOIL
SWMU 73 - DRMO SCRAP METAL RECYCLING YARD
CMS WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Sample Date Sample Depth (ft bgs)	EPA Region III Industrial RBCs (mg/kg)	**EPA Region III Residential RBCs** (mg/kg)	2x Average Detected Background (mg/kg)	19E-01 19E-SS01 05/06/04 0.00 - 1.00	19E-02 19E-SS02 05/06/04 0.00 - 1.00	19E-03 19E-SS03 05/06/04 0.00 - 1.00	19E-SS04 19E-SS04 05/13/04 0.00 - 1.00	19E-SS05 19E-SS05 05/13/04 0.00 - 1.00	19E-SS06 19E-SS06 05/13/04 0.00 - 1.00	19E-SS07 19E-SS07 05/13/04 0.00 - 1.00	19E-SS08 19E-SS08 05/13/04 0.00 - 1.00	19E-SS09 19E-SS09 05/13/04 0.00 - 1.00
Appendix IX Inorganics (mg/kg)												
Silver	510	39	0.37	0.14 B	1 U	1.1 U	1.5 U	1.4 U	1.1 U	1.2 U	1.3 U	1.2 U
Arsenic	1.9	0.43	2.4	**2.3**	**1.8**	**1** B	1.5 U	1.4 U	**3.8**	1.2 U	**4.6**	**1.5**
Barium	7,200	550	181	83	82	130	67	89	46	53	120	140
Beryllium	200	16	0.45	0.32 B	0.22 B	0.2 B	0.28 B	0.23 B	0.16 B	0.57	0.35 B	0.36 B
Cadmium	100	7.8	0.27	4.2	0.28 B	1	0.77 U	0.87	0.35 B	3 U	0.65 U	0.62 U
Cobalt	2,000	160	44.0	16	16	13	22	26	10	7.7	19	27
Chromium	310	23	59.3	**27**	19	**25**	**28**	**24**	22	22	**24**	**34**
Copper	4,100	310	234	120	110	110	170	250	210	290	170	180
Nickel	2,000	160	16.6	44 E	17 E	21 E	15	16	11	6.4	12	14
Lead	400[1]	400[1]	125	73	9.3	56	26	67	58	4.6	13	21
Tin	61,000	4,700	2.43	2.7 B	2.8 B	2.6 B	4 B	4.3 B	2.9 B	2.8 B	4.1 B	4 B
Vanadium	100	7.8	355	**100**	**110**	**85**	**130**	**130**	**65**	**270**	**160**	**150**
Zinc	31,000	2,300	125	240	72	160	210 E	220 E	120 E	71 E	160 E	120 E
Cyanide	2,000	160	0.52	0.53 U	0.56 U	0.63 U	0.8 U	0.72 U	0.6 U	0.65 U	0.36 B	0.37 B
Sulfide	NE	NE	28.48	27 U	28 U	32 U	41 U	37 U	30 U	34 U	34 B	33 U
Mercury	31[2]	2.3[2]	0.11	0.033	0.055	0.25 S	0.3 S	0.29 S	2.1	0.022 B	0.038	0.092 S

Notes:

B - The reported result is an estimated concentration that is less than the PQL, but greater than or equal to the MDL.
U - The compound was analyzed for, but was not detected at or above the MDL/PQL.
S - The result was determined by Method of Standard Addition.
E - The reported value is an estimated because of the presence of matrix interference.
NE - Not Established.
ft bgs - feet below ground surface.
mg/kg - milligrams per kilogram.
(1) - 1996 Soil Screening Guidance.
(2) - Value based on the RBC for Mercuric Chloride.

APPENDIX B.2

SUMMARY OF INORGANIC DETECTIONS IN SURFACE SOIL
SWMU 73 - DRMO SCRAP METAL RECYCLING YARD
CMS WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Sample Date Sample Depth (ft bgs)	EPA Region III Industrial RBCs (mg/kg)	**EPA Region III Residential RBCs** (mg/kg)	2x Average Detected Background (mg/kg)	Number Exceeding EPA Region III Industrial RBCs	Range Exceeding EPA Region III Industrial RBCs	**Number Exceeding EPA Region III Residential RBCs**	**Range Exceeding EPA Region III Residential RBCs**	Number Exceeding 2x Average Detected Background	Range Exceeding 2x Average Detected Background	Location of Maximum Detection
Appendix IX Inorganics (mg/kg)							---			
Silver	510	39	0.37	0/9	---	0/9	---	0/9	---	19E-SS01
Arsenic	1.9	0.43	2.4	3/9	2.3 - 4.6	6/9	1 - 4.6	2/9	3.8 - 4.6	19E-SS08
Barium	7,200	550	181	0/9	---	0/9	---	0/9	---	19E-SS09
Beryllium	200	16	0.45	0/9	---	0/9	---	1/9	0.57	19E-SS07
Cadmium	100	7.8	0.27	0/9	---	0/9	---	5/9	0.28B - 4.2	19E-SS01
Cobalt	2,000	160	44.0	0/9	---	0/9	---	0/9	---	19E-SS09
Chromium	310	23	59.3	0/9	---	6/9	24 - 34	0/9	---	19E-SS09
Copper	4,100	310	234	0/9	---	0/9	---	2/9	250 - 290	19E-SS07
Nickel	2,000	160	16.6	0/9	---	0/9	---	3/9	17E - 44E	19E-SS01
Lead	400[(1)]	400[(1)]	125	0/9	---	0/9	---	0/9	---	19E-SS01
Tin	61,000	4,700	2.43	0/9	---	0/9	---	9/9	2.6B - 4.3B	19E-SS05
Vanadium	100	7.8	355	6/9	110 - 270	9/9	65 - 270	0/9	---	19E-SS07
Zinc	31,000	2,300	125	0/9	---	0/9	---	5/9	160 - 240	19E-SS01
Cyanide	2,000	160	0.52	0/9	---	0/9	---	0/9	---	19E-SS09
Sulfide	NE	NE	28.48	NE	---	NE	---	0/9	---	19E-SS08
Mercury	31[(2)]	2.3[(2)]	0.11	0/9	---	0/9	---	4/9	0.25S - 2.1	19E-SS06

Notes:
B - The reported result is an estimated concentration that is less than the PQL, but greater than or equal to the MDL.
U - The compound was analyzed for, but was not detected at or above the MDL/PQL.
S - The result was determined by Method of Standard Addition.
E - The reported value is an estimated because of the presence of matrix interference.
NE - Not Established.
ft bgs - feet below ground surface.
mg/kg - milligrams per kilogram.
(1) - 1996 Soil Screening Guidance.
(2) - Value based on the RBC for Mercuric Chloride.

APPENDIX B.3

SUMMARY OF ORGANIC DETECTIONS IN SUBSURFACE SOIL
SWMU 73 - DRMO SCRAP METAL RECYCLING YARD
CMS WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Sample Date Sample Depth (ft bgs)	EPA Region III Industrial RBCs (ug/kg)	**EPA Region III Residential RBCs** (ug/kg)	19E-01 19E-SB01-02 05/06/04 3.00 - 5.00	19E-02 19E-SB02-03 05/06/04 5.00 - 7.00	19E-03 19E-SB03-03 05/06/04 5.00 - 7.00	Number Exceeding EPA Region III Industrial RBCs	Range Exceeding EPA Region III Industrial RBCs	**Number Exceeding EPA Region III Residential RBCs**	**Range Exceeding EPA Region III Residential RBCs**	Location of Maximum Detection
Volatile Organic Compounds (ug/kg)										
Carbon tetrachloride	22,000	4,900	5.1 U	1.1 J	5.2 U	0/3	---	0/3	---	19E-SB02-03
Semivolatile Organic Compounds (ug/kg)										
Not Detected										
Pesticides/PCBs (ug/kg)										
4,4'-DDT	8,400	1,900	7.4 U	1.2 JP	230	0/3	---	0/3	---	19E-SB03-03
4,4'-DDE	8,400	1,900	7.4 U	9	120	0/3	---	0/3	---	19E-SB03-03
4,4'-DDD	12,000	2,700	7.4 U	7.4 U	19 J	0/3	---	0/3	---	19E-SB03-03
OP-Pesticides (ug/kg)										
Not Detected										
Chlorinated Herbicides (ug/kg)										
Not Detected										

Notes:

J - The reported result is an estimated concentration that is less than the PQL, but greater than or equal to the MDL.
U - The compound was analyzed for, but was not detected at or above the MDL/PQL.
P - The GC or HPLC confirmation criteria was exceeded. The relative percent difference is greater than 40% between the two GC columns or HPLC detectors.
ft bgs - feet below ground surface.
ug/kg - micrograms per kilogram.

APPENDIX B.4

SUMMARY OF INORGANIC DETECTIONS IN SUBSURFACE SOIL
SWMU 73 - DRMO SCRAP METAL RECYCLING YARD
CMS WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Sample Date Sample Depth (ft bgs)	EPA Region III Industrial RBCs (mg/kg)	**EPA Region III Residential RBCs** (mg/kg)	2x Average Detected Background (mg/kg)	19E-01 19E-SB01-02 05/06/04 3.00 - 5.00	19E-02 19E-SB02-03 05/06/04 5.00 - 7.00	19E-03 19E-SB03-03 05/06/04 5.00 - 7.00	Number Exceeding EPA Region III Industrial RBCs	Range Exceeding EPA Region III Industrial RBCs	**Number Exceeding EPA Region III Residential RBCs**	**Range Exceeding EPA Region III Residential RBCs**	Number Exceeding 2x Average Detected Background	Range Exceeding 2x Average Detected Background	Location of Maximum Detection
Appendix IX Inorganics (mg/kg)													
Silver	510	39	0.46	0.13 B	1 U	0.12 B	0/3	---	0/3	---	0/3	---	19E-SB01-02
Barium	7,200	550	222	73	97	110	0/3	---	0/3	---	0/3	---	19E-SB03-03
Beryllium	200	16	0.74	0.15 B	0.14 B	0.18 B	0/3	---	0/3	---	0/3	---	19E-SB03-03
Cadmium	100	7.8	0.74	0.61	0.15 B	0.51 U	0/3	---	0/3	---	0/3	---	19E-SB01-02
Cobalt	2,000	160	30.0	23	23	20	0/3	---	0/3	---	0/3	---	19E-SB01-02, 19E-
Chromium	310	23	133	**37**	21	**28**	0/3	---	2/3	28 - 37	0/3	---	19E-SB01-02
Copper	4,100	310	193	130	130	120	0/3	---	0/3	---	0/3	---	19E-SB01-02, 19E-
Nickel	2,000	160	31.9	14 E	18 E	17 E	0/3	---	0/3	---	0/3	---	19E-SB02-03
Lead	400 (1)	400 (1)	8.68	1.1	1.6	5.7	0/3	---	0/3	---	0/3	---	19E-SB03-03
Tin	61,000	4,700	2.96	1.6 B	3 B	2.8 B	0/3	---	0/3	---	1/3	3B	19E-SB02-03
Vanadium	100	7.8	462	**110**	**140**	**100**	2/3	110 - 140	3/3	100 - 140	0/3	---	19E-SB02-03
Zinc	31,000	2,300	88.6	200	81	85	0/3	---	0/3	---	1/3	200	19E-SB01-02
Sulfide	NE	NE	32.58	28 B	28 U	27 U	NE	---	NE	---	0/3	---	19E-SB01-02
Mercury	31 (2)	2.3 (2)	0.093	0.0048 B	0.014 B	0.0055 B	0/3	---	0/3	---	0/3	---	19E-SB02-03

Notes:

B - The reported result is an estimated concentration that is less than the PQL, but greater than or equal to the MDL.
U - The compound was analyzed for, but was not detected at or above the MDL/PQL.
E - The reported value is an estimated because of the presence of matrix interference.
(1) - 1996 Soil Screening Guidance.
(2) - Value based on the RBC for Mercuric Chloride.
NE - Not Established.
ft bgs - feet below ground surface.
mg/kg - milligrams per kilogram.

APPENDIX B.5

SUMMARY OF ORGANIC DETECTIONS IN GROUNDWATER
SWMU 73 - DRMO SCRAP METAL RECYCLING YARD
CMS WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Sample Date	Federal MCLs (ug/L)	**EPA Region III Tap Water RBCs** (ug/L)	PR Water Quality Standards (ug/L)	19E-01 19E-GW01 05/10/04	19E-02 19E-GW02 05/10/04	19E-03 19E-GW03 05/10/04	Number Exceeding Federal MCLs	Range Exceeding Federal MCLs	**Number Exceeding EPA Region III Tap Water RBCs**	**Range Exceeding EPA Region III Tap Water RBCs**	Number Exceeding PR Water Quality Standards	Range Exceeding PR Water Quality Standards	Location Maximum Detection
Volatile Organic Compounds (ug/L)													
Ethyl benzene	700	130	700	1 U	0.61 J	1 U	0/3	---	0/3	---	0/3	---	19E-GW02
Toluene	1,000	75	1,000	1	1.2	1 U	0/3	---	0/3	---	0/3	---	19E-GW02
Carbon disulfide	NE	100	NE	1.3	1.6	1 U	NE	---	0/3	---	NE	---	19E-GW02
Semivolatile Organic Compounds (ug/L)													
Cresol, m & p	NE	NE	NE	10 U	1.8 J	10 U	NE	---	NE	---	NE	---	19E-GW02
Pesticides/PCBs (ug/L)													
4,4'-DDT	NE	0.20	NE	0.1 U	0.1 U	0.088 J	NE	---	0/3	---	NE	---	19E-GW03
4,4'-DDE	NE	0.20	NE	0.1 U	0.015 J	0.11	NE	---	0/3	---	NE	---	19E-GW03
4,4'-DDD	NE	0.28	NE	0.1 U	0.088 J	0.04 J	NE	---	0/3	---	NE	---	193-GW02

OP-Pesticides (ug/L)
Not Detected

Chlorinated Herbicides (ug/L)
Not Detected

Notes:
J - The reported result is an estimated concentration that is less than the PQL, but greater than or equal to the MDL.
U - The compound was analyzed for, but was not detected at or above the MDL/PQL.
ug/L - micrograms per liter.
NE - Not Established.

APPENDIX B.6

SUMMARY OF INORGANIC DETECTIONS IN GROUNDWATER
SWMU 73 - DRMO SCRAP METAL RECYCLING YARD
CMS WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Sample Date	Federal MCLs (mg/L)	**EPA Region III Tap Water RBCs** (mg/L)	--- Quality Standards (mg/L)	19E-01 19E-GW01 05/10/04	19E-02 19E-GW02 05/10/04	19E-03 19E-GW03 05/10/04	Number Exceeding Federal MCLs	Range Exceeding Federal MCLs	**Number Exceeding EPA Region III Tap Water RBCs**	**Range Exceeding EPA Region III Tap Water RBCs**	Number Exceeding PR Water Quality Standards	Range Exceeding PR Water Quality Standards	Location Maximum Detection
Appendix IX (Dissolved) Inorganics (mg/L)													
Barium	2	0.26	NE	0.015	0.01 B	0.021	0/3	---	0/3	---	NE	---	19E-GW03
Cobalt	NE	0.073	NE	0.01 U	0.002 B	0.002 B	NE	---	0/3	---	NE	---	19E-GW02, 19E-GW03
Nickel	NE	0.073	NE	0.003 B	0.04 U	0.04 U	NE	---	0/3	---	NE	---	19E-GW01
Vanadium	NE	0.0037	NE	**0.026**	**0.014**	0.003 B	NE	---	2/3	0.014 - 0.026	NE	---	19E-GW01

Total Cyanide and Sulfide (mg/L)
Not Detected

Notes:
B - The reported result is an estimated concentration that is less than the PQL, but greater than or equal to the MDL.
U - The compound was analyzed for, but was not detected at or above the MDL/PQL.
NE - Not Established.
mg/L - milligrams per liter.

APPENDIX C
USEPA REGION II GROUND WATER SAMPLING PROCEDURE
LOW STRESS (Low Flow) PURGING AND SAMPLING

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION II

GROUND WATER SAMPLING PROCEDURE
LOW STRESS (Low Flow) PURGING AND SAMPLING

I. SCOPE & APPLICATION

This Low Stress (or Low-Flow) Purging and Sampling Procedure is the EPA Region II standard method for collecting low stress (low flow) ground water samples from monitoring wells. Low stress Purging and Sampling results in collection of ground water samples from monitoring wells that are representative of ground water conditions in the geological formation. This is accomplished by minimizing stress on the geological formation and minimizing disturbance of sediment that has collected in the well. The procedure applies to monitoring wells that have an inner casing with a diameter of 2.0 inches or greater, and maximum screened intervals of ten feet unless multiple intervals are sampled. The procedure is appropriate for collection of ground water samples that will be analyzed for volatile and semi-volatile organic compounds (VOCs and SVOCs), pesticides, polychlorinated biphenyls (PCBs), metals, and microbiological and other contaminants in association with all EPA programs.

This procedure does not address the collection of light or dense non-aqueous phase liquids (LNAPL or DNAPL) samples, and should be used for aqueous samples only. For sampling NAPLs, the reader is referred to the following EPA publications: DNAPL Site Evaluation (Cohen & Mercer, 1993) and the RCRA Ground-Water Monitoring: Draft Technical Guidance (EPA/530-R-93-001), and references therein.

II. METHOD SUMMARY

The purpose of the low stress purging and sampling procedure is to collect ground water samples from monitoring wells that are representative of ground water conditions in the geological formation. This is accomplished by setting the intake velocity of the sampling pump to a flow rate that limits drawdown inside the well casing.

Sampling at the prescribed (low) flow rate has three primary benefits. First, it minimizes disturbance of sediment in the bottom of the well, thereby producing a sample with low turbidity (i.e., low concentration of suspended particles). Typically, this saves time and analytical costs by eliminating the need for collecting and analyzing an additional filtered sample from the same well. Second, this procedure minimizes aeration of the ground water during sample collection, which improves the sample quality for VOC analysis. Third, in most cases the procedure significantly reduces the volume of ground water purged from a well and the costs associated with its proper treatment and disposal.

III. ADDRESSING POTENTIAL PROBLEMS

Problems that may be encountered using this technique include a) difficulty in sampling wells with insufficient yield; b) failure of one or more key indicator parameters to stabilize; c) cascading of water and/or formation of air bubbles in the tubing; and d) cross-contamination between wells.

Insufficient Yield

Wells with insufficient yield (i.e., low recharge rate of the well) may dewater during purging. Care should be taken to avoid loss of pressure in the tubing line due to dewatering of the well below the level of the pump=s intake. Purging should be interrupted before the water level in the well drops below the top of the pump, as this may induce cascading of the sand pack. Pumping the well dry should therefore be avoided to the extent possible in all cases. Sampling should commence as soon as the volume in the well has recovered sufficiently to allow collection of samples. Alternatively, ground water samples may be obtained with techniques designed for the unsaturated zone, such as lysimeters.

Failure to Stabilize Key Indicator Parameters

If one or more key indicator parameters fails to stabilize after 4 hours, one of four options should be considered: a) continue purging in an attempt to achieve stabilization; b) discontinue purging, do not collect samples, and document attempts to reach stabilization in the log book; c) discontinue purging, collect samples, and document attempts to reach stabilization in the log book; or d) Secure the well, purge and collect samples the next day (preferred). The key indicator parameter for samples to be analyzed for VOCs is dissolved oxygen. The key indicator parameter for all other samples is turbidity.

Cascading

To prevent cascading and/or air bubble formation in the tubing, care should be taken to ensure that the flow rate is sufficient to maintain pump suction. Minimize the length and diameter of tubing (i.e., 1/4 or 3/8 inch ID) to ensure that the tubing remains filled with ground water during sampling.

Cross-Contamination

To prevent cross-contamination between wells, it is strongly recommended that dedicated, in-place pumps be used. As an alternative, the potential for cross-contamination can be reduced by performing the more thorough Adaily@ decontamination procedures between sampling of each well in addition to the start of each sampling day (see Section VII, below).

Equipment Failure

Adequate equipment should be on-hand so that equipment failures do not adversely impact sampling activities.

IV. PLANNING DOCUMENTATION AND EQUIPMENT

< Approved site-specific Field Sampling Plan/Quality Assurance Project Plan (QAPP). This plan must specify the type of pump and other equipment to be used. The QAPP must also specify the depth to which the pump intake should be lowered in each well. Generally, the target depth will correspond to the mid-point of the most permeable zone in the screened interval. Borehole geologic and geophysical logs can be used to help select the most permeable zone. However, in some cases, other criteria may be used to select the target depth for the pump

intake. In all cases, the target depth must be approved by the EPA hydrogeologist or EPA project scientist.

< Well construction data, location map, field data from last sampling event.

< Polyethylene sheeting.

< Flame Ionization Detector (FID) and Photo Ionization Detector (PID).

< Adjustable rate, positive displacement ground water sampling pump (e.g., centrifugal or bladder pumps constructed of stainless steel or Teflon). A peristaltic pump may only be used for inorganic sample collection.

< Interface probe or equivalent device for determining the presence or absence of NAPL.

< Teflon or Teflon-lined polyethylene tubing to collect samples for organic analysis. Teflon or Teflon-lined polyethylene, PVC, Tygon or polyethylene tubing to collect samples for inorganic analysis. Sufficient tubing of the appropriate material must be available so that each well has dedicated tubing.

< Water level measuring device, minimum 0.01 foot accuracy, (electronic preferred for tracking water level drawdown during all pumping operations).

< Flow measurement supplies (e.g., graduated cylinder and stop watch or in-line flow meter).

< Power source (generator, nitrogen tank, etc.).

< Monitoring instruments for indicator parameters. Eh and dissolved oxygen must be monitored in-line using an instrument with a continuous readout display. Specific conductance, pH, and temperature may be monitored either in-line or using separate probes. A nephalometer is used to measure turbidity.

< Decontamination supplies (see Section VII, below).

< Logbook (see Section VIII, below).

< Sample bottles.

< Sample preservation supplies (as required by the analytical methods).

< Sample tags or labels, chain of custody.

V. SAMPLING PROCEDURES

Pre-Sampling Activities

1. Start at the well known or believed to have the least contaminated ground water and proceed systematically to the well with the most contaminated ground water. Check the well, the lock, and the locking cap for damage or evidence of tampering. Record observations.

2. Lay out sheet of polyethylene for placement of monitoring and sampling equipment.

3. Measure VOCs at the rim of the unopened well with a PID and FID instrument and record the reading in the field log book.

4. Remove well cap.

5. Measure VOCs at the rim of the opened well with a PID and an FID instrument and record the reading in the field log book.
6. If the well casing does not have a reference point (usually a V-cut or indelible mark in the well casing), make one. Note that the reference point should be surveyed for correction of ground water elevations to the mean geodesic datum (MSL).

7. Measure and record the depth to water (to 0.01 ft) in all wells to be sampled prior to purging. Care should be taken to minimize disturbance in the water column and dislodging of any particulate matter attached to the sides or settled at the bottom of the well.

8. If desired, measure and record the depth of any NAPLs using an interface probe. Care should be taken to minimize disturbance of any sediment that has accumulated at the bottom of the well. Record the observations in the log book. If LNAPLs and/or DNAPLs are detected, install the pump at this time, as described in step 9, below. Allow the well to sit for several days between the measurement or sampling of any DNAPLs and the low-stress purging and sampling of the ground water.

Sampling Procedures

9. Install Pump: Slowly lower the pump, safety cable, tubing and electrical lines into the well to the depth specified for that well in the EPA-approved QAPP or a depth otherwise approved by the EPA hydrogeologist or EPA project scientist. The pump intake must be kept at least two (2) feet above the bottom of the well to prevent disturbance and resuspension of any sediment or NAPL present in the bottom of the well. Record the depth to which the pump is lowered.

10. Measure Water Level: Before starting the pump, measure the water level again with the pump in the well. Leave the water level measuring device in the well.

11. Purge Well: Start pumping the well at 200 to 500 milliliters per minute (ml/min). The water level should be monitored approximately every five minutes. Ideally, a steady flow rate should be maintained that results in a stabilized water level (drawdown of 0.3 ft or less). Pumping rates should, if needed, be reduced to the minimum capabilities of the pump to ensure stabilization of the water level. As noted above, care should be taken to maintain pump suction and to avoid entrainment of air in the tubing. Record each adjustment made to the pumping rate and the water level measured immediately after each adjustment.

12. Monitor Indicator Parameters: During purging of the well, monitor and record the field indicator parameters (turbidity, temperature, specific conductance, pH, Eh, and DO)

approximately every five minutes. The well is considered stabilized and ready for sample collection when the indicator parameters have stabilized for three consecutive readings as follows (Puls and Barcelona, 1996):

±0.1 for pH
±3% for specific conductance (conductivity)
±10 mv for redox potential
±10% for DO and turbidity

Dissolved oxygen and turbidity usually require the longest time to achieve stabilization. The pump must not be removed from the well between purging and sampling.

13. Collect Samples: Collect samples at a flow rate between 100 and 250 ml/min and such that drawdown of the water level within the well does not exceed the maximum allowable drawdown of 0.3 ft. VOC samples must be collected first and directly into sample containers. All sample containers should be filled with minimal turbulence by allowing the ground water to flow from the tubing gently down the inside of the container.

    Ground water samples to be analyzed for volatile organic compounds (VOCs) require pH adjustment. The appropriate EPA Program Guidance should be consulted to determine whether pH adjustment is necessary. If pH adjustment is necessary for VOC sample preservation, the amount of acid to be added to each sample vial prior to sampling should be determined, drop by drop, on a separate and equal volume of water (e.g., 40 ml). Ground water purged from the well prior to sampling can be used for this purpose.

14. Remove Pump and Tubing: After collection of the samples, the tubing, unless permanently installed, must be properly discarded or dedicated to the well for resampling by hanging the tubing inside the well.

15. Measure and record well depth.

16. Close and lock the well.

VI. FIELD QUALITY CONTROL SAMPLES

Quality control samples must be collected to determine if sample collection and handling procedures have adversely affected the quality of the ground water samples. The appropriate EPA Program Guidance should be consulted in preparing the field QC sample requirements of the site-specific QAPP.

All field quality control samples must be prepared exactly as regular investigation samples with regard to sample volume, containers, and preservation. The following quality control samples should be collected during the sampling event:

< Field duplicates
< Trip blanks for VOCs only
< Equipment blank (not necessary if equipment is dedicated to the well)

As noted above, ground water samples should be collected systematically from wells with the lowest level of contamination through to wells with highest level of contamination. The equipment blank should be collected after sampling from the most contaminated well.

VII. DECONTAMINATION

Non-disposable sampling equipment, including the pump and support cable and electrical wires which contact the sample, must be decontaminated thoroughly each day before use (Adaily decon@) and after each well is sampled (Abetween-well decon@). Dedicated, in-place pumps and tubing must be thoroughly decontaminated using Adaily decon@ procedures (see #17, below) prior to their initial use. For centrifugal pumps, it is strongly recommended that non-disposable sampling equipment, including the pump and support cable and electrical wires in contact with the sample, be decontaminated thoroughly each day before use (Adaily decon@).

EPA=s field experience indicates that the life of centrifugal pumps may be extended by removing entrained grit. This also permits inspection and replacement of the cooling water in centrifugal pumps. All non-dedicated sampling equipment (pumps, tubing, etc.)

must be decontaminated after each well is sampled (Abetween-well decon,@ see #18 below).

17. **Daily Decon**

A) Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

B) Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Alconox, for 5 minutes and flush other equipment with fresh detergent solution for 5 minutes. Use the detergent sparingly.

C) Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

D) Disassemble pump.

E) Wash pump parts: Place the disassembled parts of the pump into a deep basin containing 8 to 10 gallons of non-phosphate detergent solution. Scrub all pump parts with a test tube brush.

F) Rinse pump parts with potable water.

G) Rinse the following pump parts with distilled/ deionized water: inlet screen, the shaft, the suction interconnector, the motor lead assembly, and the stator housing.

H) Place impeller assembly in a large glass beaker and rinse with 1% nitric acid (HNO_3).

I) Rinse impeller assembly with potable water.

J) Place impeller assembly in a large glass bleaker and rinse with isopropanol.

K) Rinse impeller assembly with distilled/deionized water.

18. **Between-Well Decon**

A) Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.
B) Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Alconox, for 5 minutes and flush other equipment with fresh detergent solution for 5 minutes. Use the detergent sparingly.

C) Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

D) Final Rinse: Operate pump in a deep basin of distilled/deionized water to pump out 1 to 2 gallons of this final rinse water.

VIII. FIELD LOG BOOK

A field log book must be kept each time ground water monitoring activities are conducted in the field. The field log book should document the following:

< Well identification number and physical condition.
< Well depth, and measurement technique.
< Static water level depth, date, time, and measurement technique.
< Presence and thickness of immiscible liquid layers and detection method.
< Collection method for immiscible liquid layers.
< Pumping rate, drawdown, indicator parameters values, and clock time, at three to five minute intervals; calculate or measure total volume pumped.
< Well sampling sequence and time of sample collection.
< Types of sample bottles used and sample identification numbers.
< Preservatives used.
< Parameters requested for analysis.

< Field observations of sampling event.
< Name of sample collector(s).
< Weather conditions.
< QA/QC data for field instruments.

IX. REFERENCES

Cohen, R.M. and J.W. Mercer, 1993, DNAPL Site Evaluation, C.K. Smoley Press, Boca Raton, Florida.

Puls, R.W. and M.J. Barcelona, 1996, Low-Flow (Minimal Drawdown) Ground-water Sampling Procedures, EPA/540/S-95/504.

U.S. EPA, 1993, RCRA Ground-Water Monitoring: Draft Technical Guidance, EPA/530-R-93-001.

U.S. EPA Region II, 1989, CERCLA Quality Assurance Manual.

APPENDIX D
IDENTIFICATION OF BIOACCUMULATIVE CHEMICALS

APPENDIX D

IDENTIFICATION OF BIOACCUMULATIVE CHEMICALS

Only those organic chemicals with a log octanol-water partition coefficient (K_{ow}) value greater than or equal to 3.0 will be considered a bioaccumulative chemical. Justification for defining bioaccumulative organic chemicals as those with log K_{ow} values greater than or equal to 3.0 is provided below.

- The potential for organic chemicals to accumulate in organisms has been shown to correlate well with the K_{ow}. USEPA (1985), as sited in USEPA/ACOE (1998), recommends that only chemicals for which the log K_{ow} is greater than 3.5 be considered for evaluation of bioaccumulation potential since chemicals with log K_{ow} values less than 3.5 are not likely to bioaccumulate to a significant degree.

- Although organic chemicals with log K_{ow} values in the 2 to 7 range have at least some potential to bioconcentrate (Connell, 1990), significant bioconcentration does not generally occur for chemicals with log K_{ow} values less than 3.0 (Maki and Duthie, 1978) to 5.0 (Gobas and Mackay, 1990). Most work with bioconcentration (uptake from the surrounding medium, such as water) and bioaccumulation (uptake from all exposure routes, including via food) of organic chemicals has concerned chemicals with log K_{ow} values of 3.0 or more (USEPA, 1995a), since organic chemicals with lower log K_{ow} values generally have little potential for significant bioaccumulation.

- The USEPA has developed a number of scoring algorithms to evaluate the relative hazard of chemicals to human or ecological receptors. All of these algorithms have a component that addresses bioaccumulation potential. The evaluation of bioaccumulation potential is generally based on measured or estimated (using log K_{ow} values) BCFs or BAFs, or less commonly using log K_{ow} itself. For example, USEPA (1980) developed a bioaccumulation potential scoring system that considered organics with BCF values of less than 100 (equivalent to a log K_{ow} of approximately 3.0) to have negligible potential to bioaccumulate in aquatic food webs, while organic chemicals with BCFs in the 100 to 1,000 range (equivalent to log K_{ow} values of about 3.0 to 4.3) are considered to have low bioaccumulation potential. The more recent Scoring and Ranking Assessment Model (SCRAM), developed by EPA Region 5 for the Great Lakes, has similar bioaccumulation scoring cut-offs (USEPA, 2000).

- The proposed categorization of persistent, bioaccumulative, and toxic (PBT) chemicals under the Toxic Substances Control Act (TSCA) defines chemicals with a tendency to accumulate in organisms as those with a BCF or BAF of greater than 1,000 (Federal Register 63(192):53417; 10/5/98). Using the equation listed below (USEPA, 1995b), a BCF/BAF of 1,000 equates to a log K_{ow} value of approximately 4.3.

$$Log\ BCF = [(0.79)(log\ K_{ow}) - 0.40] \qquad \text{(Equation D-1)}$$

- The Beta Test Version 1.0 of the EPA Waste Minimization Prioritization Tool (WMPT), used to develop a list of PBTs for the Resource Conservation and Recovery Act (RCRA) program, defined organic chemicals with a low potential to bioaccumulate as those with log K_{ow} values of less than 3.5 and those with a high potential to bioaccumulate as those with log K_{ow} values greater than 5.0 (USEPA, 1998). The 1998 version of the EPA WMPT defines bioaccumulation potential based on BCF or BAF values (rather than on log K_{ow} values directly), with a scoring "fenceline" for organic chemicals with a low bioaccumulation potential defined as a BCF or BAF of less than 250. Although the tool no longer uses log K_{ow} directly, log K_{ow} values can be used to estimate a BCF or BAF value. Using Equation D-1, a BCF/BAF of 250 equates to a log K_{ow} value of approximately 3.5.

- Garten and Trabalka (1983) have reviewed terrestrial food web data and concluded that only organic chemicals with log K_{ow} values greater than 3.5 have the potential to significantly bioaccumulate from food to birds to mammals.

The information listed above indicates that a log K_{ow} of 3.0 to 3.5 is a reasonable, non-arbitrary parameter value to use in defining an organic chemical with the potential to bioaccumulate. For conservatism, the low end (3.0) of this log K_{ow} range will be used to define a bioaccumulative organic chemical. Table D-1 lists log K_{ow} values (range and recommended value) for volatile and semi-volatile organic chemicals, that will be analyzed for in media collected from SWMU 73. Log K_{ow} values were primarily obtained from the USEPA (1995c and 1996). The recommended value from these sources generally represents a "high-end" or best estimate from empirical data. The organic chemicals that will be evaluated in the dietary intake models are those with a log K_{ow} value of greater than or equal to 3.0. For conservatism, the maximum value in the log K_{ow} range is used for this determination not the recommended value.

Inorganic chemicals were not quantitatively screened for bioaccumulation potential since log K_{ow} values are not available for these chemicals. However, cyanide was eliminated from the list since it is readily metabolized and is not known to bioaccumulate (Eisler, 1991). Although all Appendix IX metals are retained for evaluation in the upper trophic level food chain models, only mercury and selenium are known to biomagnify in food chains (in organic forms; Suter, 1993) and only cadmium, copper, and zinc generally have the potential to bioaccumulate significantly. The other metals are retained by default.

References

Connell, D.W. 1990. Bioaccumulation of Xenobiotic Compounds. CRC Press, Inc., Boca Raton, Florida. 219 pp.

Eisler, R. 1991. Cyanide Hazards to Fish, Wildlife, and Invertebrates: a Synoptic Review. U.S. Fish and Wildlife Service Biological Report 85(1.23), Contaminant Hazard Reviews Report No. 23. 55 pp.

U.S. Environmental Protection Agency (USEPA). 2000. Defining Persistent, Bioaccumulative and Toxic Great Lakes Contaminants and Research Need. EPA Region 5 web page. http://www.epa.gov/grtlakes/toxteam/pbtrept/index.html.

USEPA. 1998. Waste Minimization Prioritization Tool Spreadsheet Document for the RCRA Waste Minimization PBT Chemical List. Docket Number F-98-MMLP-FFFFF. November 9, 1998. http://www.epa.gov/epaoswer/hazwaste/minimize/chemlist/index.htm.

USEPA. 1996. Superfund Chemical Data Matrix. EPA/540/R-96/028.

USEPA. 1995a. Great Lakes Water Quality Initiative Technical Support Document for the Procedure to Determine Bioaccumulation Factors. EPA/820/B-95/005.

USEPA. 1995b. Water Quality Guidance for the Great Lakes System: Supplementary Information Document (SID). Office of Water. EPA/820/B-95/001.

USEPA. 1995c. Internal Report on Summary of Measured, Calculated and Recommended log K_{ow} Values. Environmental Research Laboratory, Athens, GA.

USEPA. 1985. Technical Support Document for Water Quality-Based Toxics Control. EPA/440/4-85/032.

USEPA. 1980. Proceedings of the EPA Workshop on the Environmental Scoring of Chemicals. EPA/560/11-80/010.

USEPA/ACOE. 1998. Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. - Testing Manual (Inland Testing Manual). EPA/823/B-98/004.

Garten, C.T. Jr. and J.R. Trabalka. 1983. Evaluation of Models for Predicting Terrestrial Food Chain Behavior of Xenobiotics. Environ. Sci. Technol. 17:590-595.

Gobas, F. and D. Mackay. 1990. Biosorption, Bioaccumulation and Food Chain Transfer of Organic Chemicals. Ontario Ministry of the Environment. ISBN 0-7729-6823-3.

Maki, A.W. and J.R. Duthie. 1978. Summary of Proposed Procedures for the Evaluation of Aquatic Hazard. Pages 153-163 IN Cairns, J., Jr., K.L. Dickson, and A.W. Maki (eds). Estimating the Hazard of Chemical Substances to Aquatic Life. ASTM STP 657.

Suter, G.W. II. 1993. Ecological Risk Assessment. Lewis Publishers, Boca Raton, FL. 538 pp.

TABLE D-1
LOG K_{ow} VALUES FOR ORGANIC CHEMICALS
SWMU 73 - FORMER DRMO SCRAP METAL RECYCLING YARD
CORRECTIVE MEASURES STUDY WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

	Log K_{ow} Range	Recommended Log K_{ow}	Reference	Bioaccumulative Chemical (1)
Volatile Organics:				
1,1,1,2-Tetrachloroethane	2.63 to 3.03	2.63	USEPA 1995	Yes
1,1,1-Trichloroethane	2.47 to 2.51	2.48	USEPA 1995	No
1,1,2,2-Tetrachloroethane	2.31 to 2.64	2.39	USEPA 1995	No
1,1,2-Trichloroethane	2.03 to 2.07	2.05	USEPA 1995	No
1,1-Dichloroethane	1.78 to 1.85	1.79	USEPA 1995	No
1,1-Dichloroethene	2.13 to 2.37	2.13	USEPA 1995	No
1,2,3-Trichloropropane	1.98 to 2.63	2.25	USEPA 1995	No
1,2-Dibromo-3-chloropropane	2.26 to 2.41	2.34	USEPA 1995	No
1,2-Dibromoethane (EDB)	Not Reported	2.00	USEPA 1996	No
1,2-Dichloroethane	1.4 to 1.48	1.47	USEPA 1995	No
1,2-Dichloropropane	1.94 to 1.99	1.97	USEPA 1995	No
2-Butanone (Methyl ethyl ketone)	0.28 to 0.69	0.28	USEPA 1995	No
2-Hexanone	Not Reported	1.38	USEPA 1996	No
3-Chloropropene (Ally chloride)	Not Reported	1.93	SRC 1998	No
4-Methyl-2-pentanone (MIBK)	Not Reported	1.31	SRC 1998	No
Acetone	-0.21 to -0.24	-0.24	USEPA 1995	No
Acetonitrile	-0.34 to -0.39	-0.34	USEPA 1995	No
Acrolein (Propenal)	-0.01 to 0.90	-0.01	USEPA 1995	No
Acrylonitrile	-0.92 to 1.20	0.25	USEPA 1995	No
Benzene	1.83 to 2.50	2.13	USEPA 1995	No
Bromodichloromethane	1.88 to 2.14	2.10	USEPA 1995	No
Bromoform	2.30 to 2.38	2.35	USEPA 1995	No
Bromomethane (Methyl bromide)	Not Reported	1.19	USEPA 1996	No
Carbon disulfide	1.84 to 2.16	2.00	USEPA 1995	No
Carbon tetrachloride	2.03 to 3.10	2.73	USEPA 1995	Yes
Chlorobenzene	2.56 to 3.79	2.86	USEPA 1995	Yes
Chloroethane	Not Reported	1.43	USEPA 1996	No
Chloroform	1.81 to 3.04	1.92	USEPA 1995	Yes
Chloromethane (Methyl chloride)	Not Reported	0.91	USEPA 1996	No
Chloroprene	2.03 to 2.13	2.08	USEPA 1995	No
cis-1,3-Dichloropropene	Not Reported	2.06	SRC 1998	No
Dibromochloromethane	2.13 to 2.24	2.17	USEPA 1995	No
Dibromomethane (Methylene bromide)	Not Reported	1.53	USEPA 1996	No
Dichlorodifluoromethane	2.0 to 2.37	2.16	USEPA 1995	No
Ethylbenzene	3.07 to 3.57	3.14	USEPA 1995	Yes
Ethyl methacrylate	1.59 to 1.65	1.59	USEPA 1996	No
Iodomethane (Methyl iodide)	Not Reported	1.51	SRC 1998	No
Isobutanol (Isobutyl alcohol)	0.65 to 0.76	0.75	USEPA 1995	No
Methacrylonitrile	0.54 to 0.70	-0.54	USEPA 1996	No
Methylene chloride (Dichloromethane)	1.22 to 1.40	1.25	USEPA 1995	No
Methyl methacrylate	1.11 to 1.38	1.38	USEPA 1995	No
Pentachloroethane	Not Reported	3.06	USEPA 1996	Yes
Propionitrile (ethyl cyanide)	Not Reported	0.16	SRC 1998	No
Styrene	2.76 to 3.16	2.94	USEPA 1995	Yes
Tetrachloroethene	2.53 to 2.98	2.67	USEPA 1995	No
Toluene	2.21 to 3.13	2.75	USEPA 1995	Yes
trans-1,2-Dichloroethene	1.77 to 2.10	2.07	USEPA 1995	No
trans-1,3-Dichloropropene	Not Reported	2.03	SRC 1998	No
trans-1,4-Dichloro-2-butene	Not Reported	2.60	SRC 1998	No
Trichloroethene	2.42 to 3.14	2.71	USEPA 1995	Yes
Trichlorofluoromethane	2.44 to 2.58	2.53	USEPA 1995	No

TABLE D-1
LOG K_{ow} VALUES FOR ORGANIC CHEMICALS
SWMU 73 - FORMER DRMO SCRAP METAL RECYCLING YARD
CORRECTIVE MEASURES STUDY WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

	Log K_{ow} Range	Recommended Log K_{ow}	Reference	Bioaccumulative Chemical [1]
Volatile Organics (continued):				
Vinyl acetate	0.21 to 0.83	0.73	USEPA 1995	No
Vinyl chloride	1.23 to 1.52	1.50	USEPA 1995	No
Xylene [2]	2.77 to 3.54	3.13	USEPA 1995	Yes
Semi-Volatile Organics:				
1,2,4,5-Tetrachlorobenzene	4.51 to 4.83	4.64	USEPA 1995	Yes
1,2,4-Trichlorobenzene	3.89 to 4.23	4.01	USEPA 1995	Yes
1,3,5-Trinitrobenzene	1.18 to 1.37	1.18	USEPA 1995	No
1,2-Dichlorobenzene (o-Dichlorobenzene)	3.20 to 3.61	3.43	USEPA 1995	Yes
1,3-Dichlorobenzene (m-Dichlorobenzene)	Not Reported	3.60	USEPA 1996	Yes
1,4,-Dichlorobenzene (p-Dichlorobenzene)	3.26 to 3.78	3.42	USEPA 1995	Yes
1,4-Dioxane	Not Reported	-0.27	USEPA 1996	No
1,4-Naphthoquinone	Not Reported	1.71	SRC 1998	No
1,4-Phenylenediamine (p-Phenylenediamine)	Not Reported	-0.30	SRC 1998	No
1-Naphthylamine	2.09 to 2.40	2.24	USEPA 1995	No
2,3,4,6-Tetrachlorophenol	Not Reported	4.45	USEPA 1996	Yes
2,4,5-Trichlorophenol	Not Reported	3.72	USEPA 1996	Yes
2,4,6-Trichlorophenol	3.29 to 4.05	3.70	USEPA 1995	Yes
2,2'-Oxybis(1-Chloropropane)	Not Reported	2.48	USEPA 1996	No
2,4-Dichlorophenol	2.80 to 3.30	3.08	USEPA 1995	Yes
2,4-Dinitrotoluene	1.98 to 2.05	2.01	USEPA 1995	No
2,4-Dimethylphenol	1.99 to 2.49	2.36	USEPA 1995	No
2,4-Dinitrophenol	1.40 to 1.79	1.55	USEPA 1995	No
2,6-Dichlorophenol	Not Reported	2.75	SRC 1998	No
2,6-Dinitrotoluene	1.72 to 2.03	1.87	USEPA 1995	No
2-Acetylaminofluorene	Not Reported	3.12	SRC 1998	Yes
2-Chloronaphthalene	Not Reported	3.38	USEPA 1996	Yes
2-Chlorophenol	0.83 to 2.32	2.15	USEPA 1995	No
2-Naphthylamine	2.09 to 2.42	2.28	USEPA 1995	No
2-Nitroaniline (o-Nitroaniline)	Not Reported	1.85	USEPA 1996	No
2-Nitrophenol (o-Nitrophenol)	Not Reported	1.79	USEPA 1996	No
2-Picoline	Not Reported	1.11	SRC 1998	No
3,3'-Dichlorobenzidine	3.51 to 3.95	3.51	USEPA 1995	Yes
3,3'-Dimethylbenzidine	2.34 to 3.01	2.68	USEPA 1995	Yes
3-Methylcholanthrene	6.42 to 6.76	6.42	USEPA 1995	Yes
3-Nitroaniline (m-nitroaniline)	Not Reported	1.37	USEPA 1996	No
4,6-Dinitro-2-methylphenol (4,6-Dinitro-o-cresol)	Not Reported	2.12	USEPA 1996	No
4-Aminobiphenyl	Not Reported	2.86	SRC 1998	No
4-Bromophenylphenyl ether	4.89 to 5.24	5.00	USEPA 1995	Yes
4-Chloro-3-methylphenol	Not Reported	3.10	SRC 1998	Yes
4-Chloroaniline	1.57 to 2.02	1.85	USEPA 1995	No
4-Chlorophenylphenyl ether	4.08 to 5.09	4.95	USEPA 1995	Yes
4-Nitroaniline (p-Nitroaniline)	Not Reported	1.39	USEPA 1996	No
4-Nitrophenol (p-Nitrophenol)	Not Reported	1.91	SRC 1998	No
4-Nitroquinoline-1-oxide	Not Reported	1.09	SRC 1998	No
5-Nitro-o-toluidine	Not Reported	1.87	SRC 1998	No
7,12-Dimethylbenz(a)anthracene	5.98 to 6.66	6.62	USEPA 1995	Yes
Acetophenone	1.55 to 1.72	1.64	USEPA 1995	No
A, A-Dimethylphenethylamine	Not Reported	1.90	USEPA 1996	No
Aniline	0.78 to 1.24	0.98	USEPA 1995	No
Aramite	Not Reported	4.82	SRC 1998	Yes
Benzyl alcohol	0.87 to 1.22	1.11	USEPA 1995	No

TABLE D-1
LOG K_{ow} VALUES FOR ORGANIC CHEMICALS
SWMU 73 - FORMER DRMO SCRAP METAL RECYCLING YARD
CORRECTIVE MEASURES STUDY WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

	Log K_{ow} Range	Recommended Log K_{ow}	Reference	Bioaccumulative Chemical [(1)]
Semi-Volatile Organics (continued):				
bis(2-Chloroethoxy)methane	Not Reported	0.75	USEPA 1996	No
bis(2-Chloroethyl)ether	1.0 to 1.29	1.21	USEPA 1995	No
bis(2-Chloroisopropyl)ether	2.4 to 2.58	2.58	USEPA 1995	No
bis(2-Ethylhexyl)phthalate	4.20 to 8.61	7.30	USEPA 1995	Yes
Butylbenzylphthalate	3.57 to 5.02	4.84	USEPA 1995	Yes
Chlorobenzilate	Not Reported	4.74	SRC 1998	Yes
Diallate	3.79 to 5.23	4.49	USEPA 1995	Yes
Dibenzofuran	Not Reported	4.20	USEPA 1996	Yes
Diethylphthalate	1.40 to 3.00	2.50	USEPA 1995	Yes
Dimethoate	0.50 to 0.79	0.69	USEPA 1995	No
Dimethylphthalate	1.34 to 1.90	1.57	USEPA 1995	No
Di-n-butylphthalate	3.74 to 4.79	4.61	USEPA 1995	Yes
Di-n-octylphthalate	8.03 to 9.49	8.06	USEPA 1995	Yes
Dinoseb (2-sec-butyl-4,6-Dinitrophenol)	Not Reported	3.69	USEPA 1996	Yes
Ethyl methanesulfonate	0.01 to 0.05	0.05	USEPA 1995	No
Hexachlorobenzene	5.00 to 7.42	5.89	USEPA 1995	Yes
Hexachlorobutadiene	4.74 to 5.16	4.81	USEPA 1995	Yes
Hexachlorocyclopentadiene	5.04 to 5.51	5.39	USEPA 1995	Yes
Hexachloroethane	3.82 to 4.14	4.00	USEPA 1995	Yes
Hexachlorophene	7.08 to 7.60	7.54	USEPA 1995	Yes
Hexachloropropene	Not Reported	4.38	SRC 1998	Yes
Isophorone	1.67 to 1.90	1.70	USEPA 1995	No
Isosafrole	Not Reported	3.37	SRC 1998	Yes
m-Cresol (3-Methylphenol)	1.92 to 2.05	1.97	USEPA 1995	No
m-Dinitrobenzene (1,3-Dinitrobenzene)	1.49 to 1.63	1.50	USEPA 1995	No
Methapyrilene	Not Reported	2.87	SRC 1998	No
Methyl methanesulfonate	Not Reported	-0.66	SRC 1998	No
n-Nitrosodiethylamine	0.29 to 0.56	0.48	USEPA 1995	No
n-Nitrosodimethylamine	-0.77 to -0.48	-0.57	USEPA 1995	No
n-Nitroso-di-n-butylamine	2.41 to 2.45	2.41	USEPA 1995	No
n-Nitroso-di-n-propylamine	1.31 to 1.45	1.40	USEPA 1995	No
n-Nitrosodiphenylamine	3.13 to 3.45	3.16	USEPA 1995	Yes
n-Nitrosomethylethylamine	-0.24 to 1.35	-0.12	USEPA 1995	No
n-Nitrosomorpholine	Not Reported	-0.44	SRC 1998	No
n-Nitrosopiperidine	0.25 to 0.63	0.63	USEPA 1995	No
n-Nitrosopyrrolidine	-0.29 to -0.19	-0.19	USEPA 1995	No
Nitrobenzene	Not Reported	1.84	USEPA 1996	No
o-Cresol (2-Methylphenol)	1.90 to 2.04	1.99	USEPA 1995	No
o-Toluidine	1.34 to 1.63	1.34	USEPA 1995	No
p-Cresol (4-Methylphenol)	1.38 to 2.04	1.95	USEPA 1995	No
p-Dimethylaminoazobenzene	Not Reported	4.58	SRC 1998	Yes
Pentachlorobenzene	4.88 to 6.12	5.26	USEPA 1995	Yes
Pentachloronitrobenzene	4.18 to 4.64	4.64	USEPA 1995	Yes
Pentachlorophenol	3.29 to 5.24	5.09	USEPA 1995	Yes
Phenacetin	Not Reported	1.58	SRC 1998	No
Phenol	0.79 to 1.55	1.48	USEPA 1995	No
Pronamide	3.26 to 3.86	3.51	USEPA 1995	Yes
Pryridine	0.62 to 1.28	0.67	USEPA 1995	No
Safrole	2.66 to 2.88	2.66	USEPA 1995	No
Sulfotepp	Not Reported	4.46	SRC 1998	Yes
Thionazin	Not Reported	1.86	SRC 1998	No
o,o,o-Triethylphosphorothioate	Not Reported	2.64	SRC 1998	No

TABLE D-1
LOG K_{ow} VALUES FOR ORGANIC CHEMICALS
SWMU 73 - FORMER DRMO SCRAP METAL RECYCLING YARD
CORRECTIVE MEASURES STUDY WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

	Log K_{ow} Range	Recommended Log K_{ow}	Reference	Bioaccumulative Chemical [(1)]
PAHs (continued):				
1-Methylnaphthalene	Not Reported	3.87	SRC 1998	Yes
2-Methylnaphthalene	Not Reported	3.90	USEPA 1996	Yes
Acenaphthene	3.77 to 4.49	3.92	USEPA 1995	Yes
Acenaphthylene	Not Reported	4.10	USEPA 1996	Yes
Anthracene	3.45 to 4.80	4.55	USEPA 1995	Yes
Benzo(a)anthracene	4.00 to 5.79	5.70	USEPA 1995	Yes
Benzo(a)pyrene	5.98 to 6.42	6.11	USEPA 1995	Yes
Benzo(b)fluoranthene	5.79 to 6.40	6.20	USEPA 1995	Yes
Benzo(g,h,i)perylene	6.63 to 7.05	6.70	USEPA 1995	Yes
Benzo(k)fluoranthene	6.12 to 6.27	6.20	USEPA 1995	Yes
Chrysene	5.41 to 5.79	5.70	USEPA 1995	Yes
Dibenzo(a,h)anthracene	6.50 to 6.88	6.69	USEPA 1995	Yes
Fluoranthene	4.31 to 5.39	5.12	USEPA 1995	Yes
Fluorene	4.04 to 4.40	4.21	USEPA 1995	Yes
Indeno(1,2,3-cd)pyrene	6.58 to 6.72	6.65	USEPA 1995	Yes
Naphthalene	3.01 to 4.70	3.36	USEPA 1995	Yes
Phenanthrene	4.28 to 4.57	4.55	USEPA 1995	Yes
Pyrene	4.76 to 5.52	5.11	USEPA 1995	Yes
Organochlorine Pesticides:				
4,4'-DDD	4.73 to 6.38	6.10	USEPA 1995	Yes
4,4'-DDE	5.63 to 6.94	6.76	USEPA 1995	Yes
4,4'-DDT	4.64 to 7.01	6.53	USEPA 1995	Yes
Aldrin	5.11 to 7.50	6.50	USEPA 1995	Yes
alpha-BHC	3.75 to 3.81	3.80	USEPA 1995	Yes
alpha-Chlordane	5.80 to 6.41	6.32	USEPA 1995	Yes
beta-BHC	3.75 to 3.84	3.81	USEPA 1995	Yes
delta-BHC	Not Reported	4.14	USEPA 1996	Yes
Dieldrin	Not Reported	5.40	SRC 1998	Yes
Endosulfan 1	Not Reported	4.10	USEPA 1996	Yes
Endosulfan 11	Not Reported	4.10	USEPA 1996	Yes
Endosulfan sulfate	Not Reported	3.66	USEPA 1996	Yes
Endrin	2.92 to 5.20	5.06	USEPA 1995	Yes
Endrin aldehyde	Not Reported	4.00	USEPA 1995	Yes
gamma-BHC (lindane)	3.00 to 4.95	3.73	USEPA 1995	Yes
gamma-Chlordane	5.80 to 6.41	6.32	USEPA 1995	Yes
Heptachlor	4.93 to 6.26	6.26	USEPA 1995	Yes
Heptachlor epoxide	3.50 to 5.40	5.00	USEPA 1995	Yes
Isodrin	Not Reported	6.50	SRC 1998	Yes
Kepone	4.45 to 5.30	5.30	USEPA 1995	Yes
Methoxychlor	3.31 to 5.60	5.08	USEPA 1995	Yes
Toxaphene	3.23 to 5.56	5.50	USEPA 1995	Yes

Notes:

K_{ow} = Ocatnol-Water Partitian Coefficient
USEPA = United States Environmental Protection Agency
SRC = Syracuse Research Corporation

[(1)] An organic chemical is considered a bioaccumulative chemical if its Log K_{ow} value is greater than or equal to 3.0. When a range of Log K_{ow} values is reported, the upper value within the range was conservatively used to identify bioaccumulative chemicals.

[(2)] The log K_{ow} values shown are for o-xylene

TABLE D-1
LOG K_{ow} VALUES FOR ORGANIC CHEMICALS
SWMU 73 - FORMER DRMO SCRAP METAL RECYCLING YARD
CORRECTIVE MEASURES STUDY WORK PLAN
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Table references:

USEPA. 1996. Superfund Chemical Data Matrix. EPA/540/R-96/028

USEPA. 1995. Internal Report on Summary of Measured, Calculated and Recommended Log K_{ow} Values. Environmental Research Laboratory, Athens, GA. April 10, 1995.

Syracuse Research Corporation (SRC). 1998. Experimental Octanol/Water Partition Coefficient (Log P) Database. http://www.syrres.com/esc/default.htm