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FINAL PHASE I RCRA FACILITY INVESTIGATION WORK PLAN SWMU 71 - QUARRY DISPOSAL AREA

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

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Moon Township, PA

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

December 20, 2007

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

FINAL

PHASE I RCRA FACILITY INVESTIGATION WORK PLAN
SWMU 71 – QUARRY DISPOSAL SITE

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Prepared for:

DEPARTMENT OF THE NAVY
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North Charleston, SC

Under:

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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 _____

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Title: **BRAC Env. Coordinator**

Date: **December 20, 2007**

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LIST OF ACRONYMS AND ABBREVIATIONS

APA	Aerial Photo Analysis
Baker	Michael Baker Jr., Inc.
bgs	below ground surface
BRAC	Base Realignment and Closure
CERCLA	Comprehensive Environmental Response and Liability Act
CERFA	Community Environmental Response Facilitation Act
DI	deionized
DO	Delivery Order
DPT	Direct Push TechnologyDRO Diesel Range Organics
Eco-SSL	Ecological Soil Screening Level
ECP	Environmental Condition of Property
EPA	Environmental Protection Agency
ERA	Ecological Risk Assessment
FID	flame ionization detector
FMTUD	Facility Management Transportation and Utility Division
GIS	Geographic Information System
GPS	Global Positioning System
GRO	Gasoline Range Organics
HSA	Hollow Stem Auger
ID	Inner diameter
IDW	Investigation Derived Waste
LANTDIV	Naval Facilities Engineering Command
MCL	Maximum Contaminant Levels
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NAPR	Naval Activity Puerto Rico
NAVFAC	Navy Facilities Engineering Command
NFESC	Naval Facilities Engineering Service Center
NSSR	Naval Station Roosevelt Roads
NTU	Nephelometric Turbidity Units
OP	Organophosphorus (pesticides)
OVA	Organic Vapor Analyzer

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

PAH	Polynuclear Aromatic Hydrocarbons
PCB	Polychlorinated biphenyls
PI	Photo Identified
PID	Photoionization Detector
PMO	Program Management Office
PRG	Preliminary Remediation Goal
PR LRA	Puerto Rico Local Reuse Authority
PVC	polyvinyl chloride
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
QC	Quality Control
RBC	Risk Based Concentrations
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SE	Southeast
SOP	Standard Operating Procedure
SVOC	Semi-volatile Organic Compounds
SWMU	Solid Waste Management Unit
TPH	Total Petroleum Hydrocarbons
UCL	Upper Confidence Limit of the mean
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

1.0 INTRODUCTION

This document describes the activities required for the implementation of a Phase I Resource Conservation Recovery Act (RCRA) Facility Investigation (RFI) at Solid Waste Management Unit (SWMU) 71 – Quarry Disposal Site located at Naval Activity Puerto Rico (NAPR), formerly Naval Station Roosevelt Roads (NSRR), Ceiba, Puerto Rico (Figure 1-1).

This document 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 RCRA 7003 Administrative Order on Consent (United States Environmental Protection Agency [USEPA] Docket No. 02-2007-7301).

1.1 NAPR Description and History

NAPR 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. 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 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, 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, directed that NSRR be disestablished within 6 months, and that the real estate disposal/transfer be carried out in accordance with procedures contained in the 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 (LANTDIV, 2004b) was conducted in April 2004 including environmental sampling to determine if a release/disposal actually occurred at any of the Phase I ECP sites that were recommended for further evaluation in the Phase I ECP and, if so, whether any potential risk to human health was present. The Final Phase I/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 on Consent (USEPA Docket No. RCRA-02-2007-7301), which identifies SWMU 71 (formerly referred to as ECP 17) having documented releases of solid and/or hazardous waste and hazardous constituents and requires the submittal to the USEPA for their approval, an acceptable work plan to complete the equivalent to a Phase I RFI investigation. Following a public comment period the Consent Order became effective on January 29, 2007. This document meets the requirement for a Phase I RFI Work Plan.

1.2 Site Location and History

The result of the Phase II ECP concluded that SWMU 71 has been impacted by past operations at NAPR and recommended the site be incorporated into the RCRA Corrective Action Program. Figure 1-2 presents the location of SWMU 71 within NAPR. SWMU 71 is located off of Langley Drive , where a quarry once operated and an open grassy field is north of the Commissary Building and adjacent parking lot. The Aerial Photo Analysis (APA) identified this area as Photo Identified (PI) Site 24, due to the observation of numerous drums in open storage noted to be on the south side of the former quarry/rock crusher site from 1976-1983, and at least 25 drums located near the rock crusher (within the 197 polygon feature in the northeastern portion of the site), with staining on the ground adjacent to them. The records review identified the area as former quarry site, but there were no records pertaining to drum storage or disposal. The physical site inspection observed remnants of the quarry area, but saw no signs of disposal, stains, or stressed vegetation. Interviews confirmed both storage and disposal of drums containing a tar-like substance in the area, which were uncovered during construction of the Commissary Building. Figure 1-3 shows an aerial photo showing the presence of some stored material (possibly drums) within the intersection of the 1976 and 1977 polygon features. This figure also shows the polygons of suspected areas of site activity from the 1977 and 1985 aerial photographs reviewed during the APA, including an area (1985 polygon feature) described as “a fill area or disposal area with disturbed ground and possible rubble or debris”. The full extent of the disposal area is unknown. A review of the available historic aerial photographs indicates that the southern border of the Commissary Building is primarily where these drums were suspected to be located (near sample 17E-02 on Figure 1-4). The building is estimated to be constructed around 1995; the parking lot adjacent to the building was constructed after 1995.

There were no signs of a disposal area observed during the Phase II ECP investigation, nor were there any stains or stressed vegetation observed, as was the case during the physical site inspection. As shown in Appendix A, Photograph A-1, a majority of the area was covered in secondary growth vegetation.

During the ECP investigation, soil and groundwater samples were collected. Figure 1-4 shows the SWMU layout and sample locations from the ECP. The polygons from the APA have been overlaid on this figure to show how these historical areas related to the present site conditions.

1.3 Objectives

The purpose of this work plan is to describe the activities necessary to obtain data for further characterization of impacts to the environment due to past operations at SWMU 71. A Phase I RFI is required as outlined in the NAPR RCRA 7003 Administrative Order on Consent issued by the USEPA Region II. This RCRA Order provides for further investigation at this SWMU including the development of a work plan, field investigation, and reporting on the findings of the investigation with recommendations of future actions necessary to ensure protection of human health and the environment.

The current conditions at SWMU 71 are shown on Figure 1-4. The objectives of the proposed investigation at SWMU 71 are discussed below.

An investigation consisting of the collection of soil and groundwater samples will be performed at SWMU 71 to further characterize impacts to the environment. A surface and subsurface soil sampling program will be implemented to further characterize and delineate Volatile Organic Compounds (VOCs), Semi-volatile Organic Compounds (SVOCs), pesticides and metals detected during the ECP Phase II Investigation. A summary of the analytical results for soil samples from the ECP Phase II investigation as they were published in the ECP report can be found in Tables B-1 through B-4 in Appendix B. A groundwater sampling program will also be implemented to further delineate SVOCs and metals that were detected, as shown on Tables B-5 and B-6 in Appendix B. The sampling to be performed as part of the Phase I RFI, as well as previous results from the ECP Phase II Investigation at SWMU 71, is discussed below.

1.4 Organization of the Work Plan

This work plan is organized into seven sections. Section 1.0 of this document includes the site history and objectives of this RFI. Section 2.0 provides a description of the current conditions and usage of the site, as well as a summary of previous investigations. Section 3.0 provides a description of the scope of investigations for the upcoming fieldwork. The proposed scope of investigations include soil sampling and analysis program, groundwater sampling and analysis program and quality assurance/quality control (QA/QC) samples, as well as other investigation considerations. The reporting activities that will be conducted following the completion of the field investigation are described in Section 4.0. Section 5.0 discusses the proposed project schedule that will be followed for this Phase I RFI. The site management structure that will be utilized during this investigation, including project team responsibilities and field reporting requirements, is presented in Section 6.0, while Section 7.0 presents the report references.

2.0 CURRENT CONDITIONS AND SITE BACKGROUND

The following sections provide a discussion of the current conditions that exist at SWMU 71 along with previous investigation findings from the Phase II ECP investigation.

2.1 Current Site Conditions/Usage

The developed area in the southern portion of the site currently consists of the Commissary Building and adjacent parking lot, constructed in approximately 1995. The northern portion of the site including the 1977 and 1985 polygon areas remains as an undeveloped, wooded hillside. It should be noted that access to this portion of the site during the Phase II ECP was limited due to the topography. No wetland areas are known to exist at this site. The areas surrounding the Commissary Building and parking lot are assumed to be disturbed to a depth of about 1 foot below ground surface (bgs) because of construction activities. A road (Langley Drive) separates the assumed boundary of the SWMU from a wooded area, which is not expected to have been impacted by the SWMU or the construction activity.

2.2 Previous Investigations

The Phase II ECP investigation included the sampling and analysis of surface and subsurface soil at one location, and subsurface soil and groundwater at a second location. Analytical data from the Phase II ECP are presented in Appendix B, including comparisons to human health and ecological screening criteria used at that time. The tables also include comparison to the applicable facility background levels for metals utilized at that time.

One surface soil sample was collected from soil boring location 17E-01 where the former quarry was located (see Figure 1-4 for sampling locations) utilizing a hand auger in conjunction with a stainless steel spoon from a depth of 0 to 1 foot bgs. Sand and rock fragments (possibly spoils from the quarry operations) were encountered, followed by solid rock at soil boring location 17E-01. Therefore, only one subsurface soil sample was collected utilizing a hand auger in conjunction with a stainless steel spoon, from a depth of 1.0 to 1.3 ft bgs. The soil samples from 17E-01 were submitted to the fixed-base analytical laboratory for Appendix IX VOCs, SVOCs, pesticides, polychlorinated biphenyls (PCBs), organo-phosphorus (OP) pesticides, chlorinated herbicides, and metals.

A second boring was advanced at 17E-02, in an area where approximately 25 drums containing a tar-like substance was uncovered during the construction of the new Commissary Building. Surface soil was not obtained from soil boring location 17E-02, as was originally proposed in the ECP work plan, because the surface soil from this location was considered to have been disturbed by the construction activity and therefore, unrepresentative of releases to the surface at the site. Subsurface soil samples were collected from soil boring location 17E-02 from two-foot intervals (i.e., 1 to 3 feet bgs, 3 to 5 feet bgs, etc…), down to groundwater (24 feet bgs), where the boring was terminated. Fill material consisting of mainly gravel was encountered to a depth of 8 feet bgs, followed by gravel in a clay matrix. Fuel odor and staining was observed within the depth range of approximately 5 feet to 10 feet bgs. All subsurface soil samples from soil boring location 17E-02 were screened in the field utilizing a Flame Ionization Detector (FID) and Photoionization Detector (PID). Based on the FID/PID results from 17E-02, two subsurface soil samples from sampling intervals of 1.0 to 3.0 feet bgs and 7.0 to 9.0 feet bgs were sent to the fixed-base analytical laboratory from this location. The selected subsurface soil samples from 17E-02 were submitted to the fixed-base analytical laboratory for Appendix IX VOCs, SVOCs, pesticides, polychlorinated biphenyls (PCBs), organo-phosphorus (OP) pesticides, chlorinated herbicides, and metals.

A groundwater program followed the soil sampling program based on the PID/FID levels observed at

soil boring location 17E-02. Groundwater was encountered at a depth of 20 feet bgs and a temporary monitoring well was installed for groundwater sample collection. The groundwater sample was submitted to the fixed-base analytical laboratory for Appendix IX VOCs, SVOCs, pesticides/ PCBs, OP-pesticides, chlorinated herbicides, and dissolved metals.

In general, the VOCs and SVOCs detected in the soil and groundwater samples are associated with fuel contamination and degreasing operations. They are also likely to be associated with the tar-like substance that was said to be present in drums that were stored at the SWMU. Benzene, ethylbenzene, and xylene were present in the soil samples, as was acetone and carbon tetrachloride. Ethylbenzene and acetone were also found in the groundwater. The SVOC fraction detected consisted primarily of polynuclear aromatic hydrocarbons (PAHs). A high concentration of 2-Methylnaphthalene was found in the subsurface soil at 17E-02, at a depth of 7 to 9 feet bgs. This compound may have degraded and leached to the groundwater, resulting in the naphthalene detection. Inorganic compounds detected at SWMU 71 are typically associated with background compounds present at NAPR.

Summaries of the analytical data along with comparisons to screening criteria for the various media are given in Tables B-1 to B-6 in Appendix B. Dibenzo(a,h)anthracene (in subsurface soil), benzo(a)pyrene (in subsurface soil), and naphthalene (in groundwater) exceeded their USEPA Region III Residential Risk Based Concentrations for soil or their USEPA Region III Tap Water RBCs for groundwater. Arsenic (in subsurface soil), chromium (in subsurface soil), and vanadium (in surface and subsurface soil, and in groundwater) exceeded their respective USEPA Region III Residential RBCs.or USEPA Region III Tap Water RBCs for groundwater. None of the concentrations of these compounds exceeded the established background concentrations at NAPR at that time. In the surface soil, silver, nickel, and tin slightly exceeded twice the average detected background concentrations, but did not exceed any RBC criteria. No PCBs, OP-pesticides, or chlorinated herbicides were detected in any medium.

From the detections of fuel compounds in both the soil and groundwater at the Quarry Disposal Site, it is likely that previous activities have impacted the environment at this site. Therefore, the ECP report recommended further investigation of the media at this SWMU.

3.0 SCOPE OF INVESTIGATION

Surface, subsurface soil and groundwater samples will be collected from SWMU 71 as part of the Phase I RFI. Sampling locations presented in this section were identified from historical aerial photographs (1976, 1977 and 1985) and the ECP findings. Consideration was given to site topography, site features, historical operational features of the facility, and the results from the ECP Phase II Investigation.

The sampling and analytical program for this investigation is summarized in Table 3-1. The proposed sampling locations for SWMU 71 are shown on Figure 3-1. It is important to note that the sampling program discussed below and the sample locations on Figure 3-1 are subject to change due to site conditions. It was noted in the Phase II ECP Report that a drill rig could not be used in the area north/northwest of the Commissary Building on the hillside due to its steep slope. Additionally, a hand auger was not able to advance beyond 1.3 feet bgs at sample location 17E-01, because solid rock was encountered at this depth. Sample locations 71SB01, 71SB02, and 71SB03 are proposed in this area.

Samples 71SB04, 71SB05, and 71SB06 are proposed at areas south of the Commissary Building, and parking lot near the locations where the drums containing a tar-like material were uncovered. This is also the area where fuel odor and staining was observed during the ECP investigation in boring 17E-02. No surface soil is proposed for sampling in this area because construction activities described in Section 2.1 are likely to have rendered them unrepresentative of the SWMU releases to the surface. During soil sampling, if FID/PID readings obtained at 71SB04, 71SB05, and 71SB06 are elevated (above the background air level), or if visual indications (staining, or phase-separated hydrocarbons) are present, or olfactory observations indicating possible fuel contamination are present, then soil samples will be collected for analysis. Furthermore, if elevated PID/FID readings and/or other signs of fuel contamination noted previously are present in the soil or groundwater at these locations, then the sampling program will be expanded to include subsurface soil and groundwater sampling at 71SB07, 71SB08 and 71SB09 to investigate whether the contamination has migrated further downgradient. Finally, 71SB10 is proposed in a location between the two areas of historical polygon features to verify that there has been no significant impact between the two primary areas being investigated based on the historical polygons.

The discussion below, Table 3-1 and Figure 3-1 represent the maximum numbers of samples proposed to be collected during the Phase I RFI Investigation.

The samples that are proposed as part of the Phase I RFI are as follows:

- Ten surface soil samples will be collected from locations shown on Figure 3-1 (71SB01 through 71SB10).
- Fourteen subsurface soil samples will be collected from the proposed seven boring locations within the SWMU boundary. Depending on site conditions, a minimum of two samples will be collected from different depths at each boring location. If site conditions allow, one sample will be collected from any area of suspected contamination and the other will be obtained just above the groundwater interface. Based on the findings of the ECP Phase II field investigation, if the steepness of the terrain prevent safe operation of a drill rig or the rockiness of the substrate do not allow adequate penetration or recovery for sample collection, then, the locations and depth of subsurface samples may vary from what is proposed in this work plan. Under such conditions, professional judgment will determine the location and collection of subsurface soil samples as well as their depths. If suspected

contamination is noted in multiple sample depths, then additional samples will be obtained from that boring location.

- Additional subsurface soil samples will be collected from 71SB07, 71SB08, and 71SB09, based on field observations at 71SB04, 71SB05 and 71SB06, as noted above. Subsurface soil samples will also be collected if field observations noted above indicate the presence of contamination in the surface soil at 71SB07, 71SB08, and 71SB09.
- Three groundwater samples are proposed to be collected initially within the SWMU boundary from boring locations shown on Figure 3-1. Permanent wells will be installed at soil borings 71SB04, 71SB05 and 71SB06, south of the Commissary Building. If signs of contamination are noted in the groundwater interface at one or more of these locations (FID/PID readings above background air levels, visual indications (staining, or phase-separated hydrocarbons) present, or olfactory observations indicating possible fuel contamination) then up to three additional permanent wells will be installed in the assumed downgradient direction (which is in a generally east/southeast direction towards the nearest shoreline to the ocean) from the site. The three permanent monitoring wells will be installed near Langley Drive at locations 71SB07, 71SB08, and 71SB09 shown on Figure 3-1. Permanent monitoring wells will also be installed at these three locations if signs of contamination noted above are evident in the subsurface soil samples at one or more locations.

3.1 Soil Sampling and Analysis Program

Surface and subsurface soil samples will be collected from SWMU 71. The following outlines the specific sampling protocol.

Figure 3-1 identifies the location of ten soil borings proposed to be advanced at SWMU 71. Surface soil samples are proposed for collection at all ten locations. Subsurface soil samples are proposed for collection initially at only seven locations. Four borings are proposed within the former quarry, north of the commissary parking lot and three are proposed south (71SB04-71SB06) of the Commissary Building. Three additional locations (71SB07 through 71SB09) for subsurface soil sampling are proposed further south near Langley Drive if field observations described above indicate the need.

If site topography allows, borings for this RFI will be advanced using a track-mounted 66DT Geoprobe rig capable of direct push and augering. If adverse site conditions (rocky conditions) do not allow for the Geoprobe rig to penetrate the subsurface adequately, then a hollow-stem auger rig will be utilized.

Subsurface samples will be collected from two-foot intervals until the water table is reached, if possible (see SOP F102 in Baker, 1995). Care will be taken to achieve maximum recovery so that a good stratigraphic profile can be developed, but it should be noted that this may not be realistic at the upland locations, because of the subsurface conditions expected to be encountered there. A boring log will be prepared indicating blow counts, lithology, water occurrence, FID/PID readings, and miscellaneous (visual and olfactory) observations.. One surface soil sample (0 to 1 foot bgs) and a minimum of two subsurface soil samples (one based on FID/ PID screening or visual/olfactory observations and the other just above the water table) will be collected from each boring location, if site topography and terrain allow. The surface and subsurface samples will be analyzed for Appendix IX VOCs, SVOCs, low-level PAHs, pesticides, and metals as presented in Table 3-1. Total Petroleum Hydrocarbons (TPH) Diesel Range Organics (DRO) is included for the analyses of surface soil samples collected from 71SB07, 71SB08, and 71SB09 to investigate for the potential migration of fuel-contaminated surface soil from the disturbance of surface soil in the Commissary Building area. The analysis of TPH Gasoline Range Organics (GRO) near the Commissary Building

and in the contingent locations is limited to the subsurface soil because their volatility is likely to render them unlikely to be present in the surface soil unless there has been a recent release.

The analyses of TPH DRO and TPH GRO is not proposed in the samples from the upland area north of the Commissary Building because there is no evidence of a release of petroleum compounds (fuel or tar) in this area.

The soil sample designations will include the SWMU location followed by extensions to reflect the depth at which the sample was obtained. For the purposes of this work plan, two-foot discrete depths will be used except for surface soil. Sample identification extensions will follow the pattern shown below.

71SB01-00 – SWMU 71 sample
71SB01-00 – Soil boring sample
71SB01-00 – Soil boring location identifier
71SB01-00 – 0 to 1 foot bgs (surface soil) sampling interval

Subsurface soil samples will be designated as follows:

71SB01-01 – First subsurface sampling interval, 1 to 3 feet bgs
71SB01-02 – Second subsurface sampling interval, 3 to 5 feet bgs, etc.

Sample identification extensions will follow the pattern shown above. However, the actual sample depth will be determined in the field as noted above.

Following sample collection each borehole that is not converted to a monitoring well 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 as presented in Table 3-2. All analytical work performed on the mainland of the United States must be certified by a licensed Puerto Rico chemist. The specific laboratory and third party validator, as well as a certified licensed chemist from Puerto Rico, are to be determined at a later date. Standard Operating Procedures used by the analytical laboratory will be requested from the laboratory after selection.

3.2 Monitoring Well Installation Program

A minimum of three and a maximum of six permanent monitoring wells will be installed within the soil borings advanced at SWMU 71, if groundwater is encountered. The approximate locations of these monitoring wells (south of the Commissary Building) are presented on Figure 3-1. The three permanent wells near the suspected location of the former drum disposal area (71GW04 through 71GW06) will be installed first, followed by downgradient monitoring wells (71GW07 through 71GW09) south of the road depending on the field observations of contamination in soil or groundwater samples from the first three wells as described earlier. Permanent wells 71GW07

through 71GW09 will also be installed if subsurface soil at these locations indicates the presence of contamination, as described earlier.

The monitoring well location designation will correspond to the soil boring location. For example, from the permanent well installed at soil boring location 71SB04 will have the identification of 71GW04. .

Monitoring wells will be installed using hollow-stem augers (HSAs) or air rotary techniques, depending on the underlying stratigraphy. The wells will be constructed of 2-inch inner diameter (ID), Schedule 40 Polyvinyl chloride (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.

- 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 HSAs or casing are 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.

- Wells in high traffic areas will be completed at the surface using a "flush" manhole type cover. The flush-mounted cover will be surrounded by a concrete pad and slightly elevated above the ground surface with the concrete sloping away from the cover to the existing ground surface. However, if any of the wells are relocated into areas that are heavily vegetated; these 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.

3.3 Groundwater Sampling and Analysis Program

The groundwater sampling will be used to aid in characterization of the groundwater potentially suspected to have been impacted by prior activities at SWMU 71. All groundwater samples collected (from a maximum of six locations) will be analyzed for Appendix IX VOCs, SVOCs, pesticides, low-level PAHs, metals (total and dissolved) and TPH DRO/GRO (See Table 3-1).

The groundwater will be sampled using a low flow sampling technique to the extent practicable, in view of the slow recharge experienced at several NAPR sites. Appendix C includes a detailed description of low-flow sampling technique. Field parameters of pH, temperature, turbidity, conductivity, 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 the appropriate laboratory supplied containers. The groundwater samples will be filtered in the field for the dissolved metals analysis. Prior to sampling, a synoptic set of static water levels will also be recorded in order to obtain data to more accurately interpret the groundwater flow direction at the SWMU.

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 as presented in Table 3-2. All analytical work performed on the mainland of the United States must be certified by a licensed Puerto Rico chemist. The specific laboratory and validator, as well as a certified licensed chemist from Puerto Rico, will be determined at a later date.

3.4 Quality Assurance/Quality Control Samples

QA/QC samples will be obtained during this investigation. These will include the collection of equipment rinsate samples, field blanks, trip blanks, field duplicates, and matrix spike/matrix spike duplicate (MS/MSD). The analytical suites for field duplicates and MS/MSD samples are shown in Table 3-1. The analytical suites for the other QA/QC samples are shown in Table 3-3. The analytical methods are specified in Table 3-2.

Equipment rinsate blanks will be collected daily from reusable (non-dedicated and non-disposable) sampling equipment 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, Macro Core liners, 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.

Field blank samples will consist of laboratory-grade deionized water (DI), store-bought distilled water, and NAPR potable water, if they are used during this investigation.

Trip blank samples will be required to accompany the samples to the laboratory for volatile organic constituent and TPH-GRO samples scheduled for analysis. One trip blank sample will accompany each cooler containing samples to be analyzed for VOCs and TPH-GRO.

Soil sample field duplicates will be homogenized and split and collected at a frequency of ten percent per media. Groundwater duplicates will be collected at a frequency of ten percent, and will include at least one total and one filtered groundwater sample.

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.

3.5 Data Validation

All mainland laboratory data generated by the investigation will be subjected to independent, third party, validation. The USEPA Region II Data Validation Standard Operating Procedures will be followed. The specific data validator will be determined at a later date.

3.6 Other Field Activities

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

3.6.1 Utility Clearance

If this work plan is initiated while NAPR is still under operation, the following procedure needs to 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. Although utilities are not identified on the Geographic Information System (GIS) utility layer, all proposed soil borings and permanent monitoring well locations will be cleared by the base utility department.

3.6.2 Investigation Derived Wastes (IDW)

The generation of IDW associated with soil sampling, 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 visible 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 3-3, as well as 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.

3.6.3 Decontamination

All reusable (non-dedicated and non-disposable) soil sampling equipment (i.e. auger, bits, etc.), will be decontaminated between each sampling location in accordance SOPs F501 and F502 (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.

3.6.4 Surveying

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

3.6.5 Health and Safety Procedures

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

3.6.6 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.

4.0 REPORTING

This section outlines the reporting activities that are associated with the field investigation. The reports shall include at a minimum:

Introduction
SWMU Investigation
Physical Characteristics of Study Area
Nature and Extent of Contamination
Conclusions and Recommendations

The Phase I RFI reports sections are discussed in the following subsection.

4.1 Introduction and Site Background

The introduction will consist of a discussion of the site location, its current conditions and its historical background, including any investigations conducted at the SWMU. The introduction will also provide a regulatory framework for NAPR and the SWMU, as well as a discussion of current conditions.

4.2 SWMU Investigation

The investigation methodologies employed to fulfill the Phase I RFI work plan objectives for the SWMU will be discussed, including the sample locations, sample collection and handling procedures, QA/QC procedures, and analytical methods used. This section will also discuss any problems encountered including any deviations from the work plan and problem resolution.

4.3 Physical Characteristics of Study Area

The physical characteristics of the SWMU will be recorded in the field. Those observations will be photographically recorded and summarized in this section.

4.4 Nature and Extent of Contamination

The nature and extent of contamination section will present analytical results and interpretation of the data. The surface and subsurface soil analytical data will be screened against USEPA Region IX Residential and Industrial Preliminary Remediation Goals (PRGs). Analytical data for surface soil and subsurface soil collected from the 1 to 3-foot depth interval also will be compared to ecological soil screening values previously developed for use in ecological risk assessments (ERAs) at NAPR (Baker, 2006a and 2006b). The ecological soil screening values will be updated as necessary to reflect current information from the literature (i.e., ecological soil screening levels [Eco-SSLs] available at http://www.epa.gov/ecotox/ecossl/). Analytical data for subsurface soil collected from deeper depth intervals (e.g., 3 to 5-feet bgs) will not be compared to ecological soil screening values since these depths are not likely to represent a significant exposure point for ecological receptors (most heterotrophic activity and soil invertebrates occur on the surface or within the oxidized root zone [Suter II, 1995]). The groundwater analytical data will be compared to USEPA Region IX Tap Water PRGs and federal maximum contaminant levels (MCLs). A comparison of groundwater data to ecological surface water screening values will not be performed as SWMU 71 is not located contiguous to a surface water body (see Figure 1-2).

For a given medium (surface soil, subsurface soil, and groundwater), analytical data for inorganic chemicals exceeding one or more of the screening values (human health or ecological) will be

statistically compared to background analytical data in accordance with Navy guidance (Naval Facilities Engineering Service Center [NFESC], 2002 and 2004). The background analytical data used in the statistical evaluations will be those contained in the Revised Final Summary Report for Environmental Background Concentrations of Inorganic Compounds (Baker, 2006c). The process that will be used to statistically evaluate the data is depicted in Figure 4-1. As shown by the figure, statistical evaluations will include descriptive summaries of each data set (range of detected values, range of non-detected values, maximum, mean, and 95 percent upper confidence limit [UCL] of the mean concentrations), statistical tests on the mean/median of the distributions (i.e., student's t-test, Gehan test, Satterthwaite's t-test, or Wilcoxon rank sum test), statistical tests on the right tail of the distributions (i.e., quantile test and slippage test), and proportional statistics (two-sample test of proportions). 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 in accordance with Navy guidance (NFESC, 2002, and 2004).

The results of the screening and statistical evaluations will be presented on tables and figures with textual explanation. Results of QA/QC procedures also will be presented within the nature and extent of contamination section.

4.5 Conclusions and Recommendations

Information from the nature and extent of contamination will be synthesized into conclusions regarding the extent of the releases to the environmental media at the site. Recommendations will be made from these conclusions as to whether a Full RFI is needed or the SWMU can proceed toward a determination of Corrective Action Complete.

5.0 SCHEDULE

A schedule for the implementation of this work plan, and follow-up reports for the Phase I RFI for SWMU 71 is provided as Figure 5-1.

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, delays in Navy funding, or consensus cannot be reached on how the USEPA's comments are to be incorporated.

6.0 SITE MANAGEMENT

An organization chart presenting the proposed staffing for this project is provided on Figure 6-1. This section also outlines the responsibilities and reporting requirements of field personnel and staff.

6.1 Project Team Responsibilities

Mr.Mark Kimes, P.E., Activity Coordinator for all work in Puerto Rico, will manage the Baker 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. Mr. John Mentz will administer overall QA/QC for this project.

The field activities of this project will consist of one field team managed by the Geologist, Mr. Joseph Burawa. Mr. Burawa's responsibilities include directing the field team and subcontractors. Mr. Rick Aschenbrenner, P.E. will direct the reporting effort associated with the field investigation, ensuring that all necessary staffing is utilized to assist in developing the Phase I RFI Report for SWMU 71.

6.2 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.

7.0 REFERENCES

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TABLES

TABLE 3-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM
SWMU 71 - QUARRY DISPOSAL SITE
PHASE I RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO

		Fixed Based Analytical Lab Analysis								
Media	**Sample Depth (ft bgs)**	App IX VOCs	App IX SVOCs	Appendix IX Pesticides	App IX Low Level PAHs	App IX Metals (Total)	App IX Metals (Dissolved)	TPH DRO	TPH GRO	**Comment**
Surface Soil Samples										
71SB01-00	0.0 - 1.0	X	X	X	X	X				
71SB02-00	0.0 - 1.0	X	X	X	X	X				
71SB03-00	0.0 - 1.0	X	X	X	X	X				
71SB03-00D	0.0 - 1.0	X	X	X	X	X				Duplicate
71SB03-00MS/MSD	0.0 - 1.0	X	X	X	X	X				Matrix Spike/Matrix Spike Duplicate
71SB07-00	0.0 - 1.0	X	X	X	X	X		X		
71SB08-00	0.0 - 1.0	X	X	X	X	X		X		
71SB09-00	0.0 - 1.0	X	X	X	X	X		X		
71SB010-00	0.0 - 1.0	X	X	X	X	X				
Subsurface Soil Samples[2]										
71SB01-XX[1]	TBD	X	X	X	X	X				
71SB01-XX[1]	TBD	X	X	X	X	X				
71SB02-XX[1]	TBD	X	X	X	X	X				
71SB02-XX[1]	TBD	X	X	X	X	X				
71SB03-XX[1]	TBD	X	X	X	X	X				
71SB03-XX[1]	TBD	X	X	X	X	X				
71SB04-XX[1]	TBD	X	X	X	X	X		X	X	
71SB04-XX[1]	TBD	X	X	X	X	X		X	X	
71SB05-XX[1]	TBD	X	X	X	X	X		X	X	
71SB05-XX[1]	TBD	X	X	X	X	X		X	X	
71SB06-XX[1]	TBD	X	X	X	X	X		X	X	
71SB06-XX[1]	TBD	X	X	X	X	X		X	X	
71SB06-XXD[1]	TBD	X	X	X	X	X		X	X	Duplicate
71SB06-XXMS/MSD[1]	TBD	X	X	X	X	X		X	X	Matrix Spike/Matrix Spike Duplicate
71SB07-XX[1][3]	TBD	X	X	X	X	X		X	X	
71SB07-XX[1][3]	TBD	X	X	X	X	X		X	X	
71SB07-XXD[1][3]	TBD	X	X	X	X	X		X	X	
71SB07-XXMS/MSD[1][3]	TBD	X	X	X	X	X		X	X	
71SB08-XX[1][3]	TBD	X	X	X	X	X		X	X	
71SB08-XX[1][3]	TBD	X	X	X	X	X		X	X	
71SB09-XX[1][3]	TBD	X	X	X	X	X		X	X	
71SB09-XX[1][3]	TBD	X	X	X	X	X		X	X	
71SB10-XX[1]	TBD	X	X	X	X	X				
71SB10-XX[1]	TBD	X	X	X	X	X				

TABLE 3-1

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM
SWMU 71 - QUARRY DISPOSAL SITE
PHASE I RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO

		Fixed Based Analytical Lab Analysis								
Media	**Sample Depth (ft bgs)**	App IX VOCs	App IX SVOCs	Appendix IX Pesticides	App IX Low Level PAHs	App IX Metals (Total)	App IX Metals (Dissolved)	TPH DRO	TPH GRO	**Comment**
Groundwater Samples										
71GW04	NA	X	X	X	X	X	X	X	X	
71GW05	NA	X	X	X	X	X	X	X	X	
71GW05D	NA	X	X	X	X	X	X	X	X	Duplicate
71GW05MS/MSD	NA	X	X	X	X	X	X	X	X	Matrix Spike/Matrix Spike Duplicate
71GW06	NA	X	X	X	X	X	X	X	X	
71GW07[(3)]	NA	X	X	X	X	X	X	X	X	
71GW08[(3)]	NA	X	X	X	X	X	X	X	X	
71GW09[(3)]	NA	X	X	X	X	X	X	X	X	

Notes:

[(1)] XX - This indicates the designation for the depth interval from which the sample will be collected (i.e., 01 = 1-3ft bgs, 02 = 3-5 ft bgs, etc.). This will be established in the field.

[(2)] - Although two subsurface soil samples are proposed per boring, additional subsurface soil will be collected if areas of staining or other indicators of contamination are encountered at multiple depths. In this event, the number of QA/QC samples outlined in Section 3.3 and listed on this table will be adjusted.

[(3)] These samples are only to be taken if signs of contamination (i.e., presence of elevated FID/PID readings or other indicators of contamination discussed in Section 3.1) are noted at locations 71SB04, 71SB05, and 71SB06 or in the surface soil at 71SB07, 71SB08, or 71SB09

ft bgs - feet below ground surface.

NA - Not Applicable.

TBD - To be determined in the field

TABLE 3-2
METHOD PERFORMANCE LIMITS
APPENDIX IX COMPOUND LIST AND CONTRACT
REQUIRED QUANTITATION LIMITS (CRQL)
SWMU 71- QUARRY DISPOSAL SITE
PHASE I RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO

Volatiles	Quantitation Limits*		Method Number
	Water (µg/L)	Low Soil (µg/kg)	
Acetone	25	50	8260B (5030B)(low level)
Acetonitrile	40	200	8260B (5030B)(low level)
Acrolein	20	100	8260B (5030B)(low level)
Acrylonitrile	20	100	8260B (5030B)(low level)
Benzene	1.0	5.0	8260B (5030B)(low level)
Bromodichloromethane	1.0	5.0	8260B (5030B)(low level)
Bromoform	1.0	5.0	8260B (5030B)(low level)
Bromomethane	1.0	10	8260B (5030B)(low level)
Carbon Disulfide	1.0	5.0	8260B (5030B)(low level)
Carbon Tetrachloride	1.0	5.0	8260B (5030B)(low level)
Chlorobenzene	1.0	5.0	8260B (5030B)(low level)
Chloroethane	1.0	10	8260B (5030B)(low level)
Chloroform	1.0	5.0	8260B (5030B)(low level)
Chloromethane	1.0	10	8260B (5030B)(low level)
Chloroprene	1.0	5.0	8260B (5030B)(low level)
3-Chloro-1-propene	1.0	5.0	8260B (5030B)(low level)
1,2-Dibromo-3-chloropropane	1.0	10	8260B (5030B)(low level)
Dibromochloromethane	1.0	5.0	8260B (5030B)(low level)
1,2-Dibromoethane	1.0	5.0	8260B (5030B)(low level)
Dibromomethane	1.0	5.0	8260B (5030B)(low level)
trans-1,4-Dichloro-2-butene	2.0	10	8260B (5030B)(low level)
Dichlorodifluoromethane	1.0	5.0	8260B (5030B)(low level)
1,1-Dichloroethane	1.0	5.0	8260B (5030B)(low level)
1,2-Dichloroethane	1.0	5.0	8260B (5030B)(low level)
trans-1,2-dichloroethene	1.0	5.0	8260B (5030B)(low level)
1,1-Dichloroethene	1.0	5.0	8260B (5030B)(low level)
Methylene Chloride	5.0	5.0	8260B (5030B)(low level)
1,2-Dichloropropane	1.0	5.0	8260B (5030B)(low level)
cis-1,3-Dichloropropene	1.0	5.0	8260B (5030B)(low level)
trans-1,3-Dichloropropene	1.0	5.0	8260B (5030B)(low level)
Ethyl benzene	1.0	5.0	8260B (5030B)(low level)
Ethyl methacrylate	1.0	5.0	8260B (5030B)(low level)
2-Hexanone	10	25	8260B (5030B)(low level)
Iodomethane	5.0	5.0	8260B (5030B)(low level)
Isobutanol	40	200	8260B (5030B)(low level)
Methacrylonitrile	20	100	8260B (5030B)(low level)
2-Butanone	10	25	8260B (5030B)(low level)
Methyl methacrylate	1.0	5.0	8260B (5030B)(low level)
4-Methyl-2-pentanone	10	25	8260B (5030B)(low level)

TABLE 3-2
METHOD PERFORMANCE LIMITS
APPENDIX IX COMPOUND LIST AND CONTRACT
REQUIRED QUANTITATION LIMITS (CRQL)
SWMU 71- QUARRY DISPOSAL SITE
PHASE I RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO

Volatiles (Cont.)	Quantitation Limits*		Method Number
	Water (µg/L)	Low Soil (µg/kg)	
Pentachloroethane	5.0	25	8260B (5030B)(low level)
Propionitrile	20	100	8260B (5030B)(low level)
Stryene	1.0	5.0	8260B (5030B)(low level)
1,1,1,2-Tetrachloroethane	1.0	5.0	8260B (5030B)(low level)
1,1,2,2-Tetrachloroethane	1.0	5.0	8260B (5030B)(low level)
Tetrachloroethene	1.0	5.0	8260B (5030B)(low level)
Toluene	1.0	5.0	8260B (5030B)(low level)
1,1,1-Trichloroethane	1.0	5.0	8260B (5030B)(low level)
1,1,2-Trichloroethane	1.0	5.0	8260B (5030B)(low level)
Trichloroethene	1.0	5.0	8260B (5030B)(low level)
Trichlorofluoromethane	1.0	5.0	8260B (5030B)(low level)
1,2,3-Trichloropropane	1.0	5.0	8260B (5030B)(low level)
Vinyl Acetate	2.0	10	8260B (5030B)(low level)
Vinyl Chloride	1.0	10	8260B (5030B)(low level)
Xylene	2.0	10	8260B (5030B)(low level)

TABLE 3-2
METHOD PERFORMANCE LIMITS
APPENDIX IX COMPOUND LIST AND CONTRACT
REQUIRED QUANTITATION LIMITS (CRQL)
SWMU 71- QUARRY DISPOSAL SITE
PHASE I RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO

Semivolatiles	Quantitation Limits*		Method Number
	Water (µg/L)	Low Soil (µg/kg)	
Acenaphthene	10	330	8270C
Acenaphthylene	10	330	8270C
Acetophenone	10	330	8270C
2-Acetylaminofluorene	10	330	8270C
4-Aminobiphenyl	20	330	8270C
Aniline	20	660	8270C
Anthracene	10	330	8270C
Aramite	10	330	8270C
Benzo(a)anthracene	10	330	8270C
Benzo(b)fluoranthene	10	330	8270C
Benzo(k)fluoranthene	10	330	8270C
Benzo(g,h,i)perylene	10	330	8270C
Benzo(a)pyrene	10	330	8270C
Benzyl alcohol	10	330	8270C
Bis(2-chloroethoxyl)methane	10	330	8270C
Bis(2-chloroethyl)ether	10	330	8270C
Bis(2-ethylhexyl)phthalate	10	330	8270C
4-Bromophenyl phenyl ether	10	330	8270C
Butylbenzylphthalate	10	330	8270C
4-Chloroaniline	20	660	8270C
4-Chloro-3-methylphenol	10	330	8270C
2-Chloronaphthalene	10	330	8270C
2-Chlorophenol	10	330	8270C
4-Chlorophenyl phenyl ether	10	330	8270C
Chrysene	10	330	8270C
3&4 Methylphenol	10	330	8270C
2-Methylphenol	10	330	8270C
Diallate	10	330	8270C
Dibenzofuran	10	330	8270C
Di-n-butyl phthalate	10	330	8270C
Dibenzo(a,h)anthracene	10	330	8270C
o-Dichlorobenzene	10	330	8270C
m-Dichlorobenzene	10	330	8270C
p-Dichlorobenzene	10	330	8270C
3,3'-Dichlorobenzidine	20	660	8270C
2,4-Dichlorophenol	10	330	8270C
2,6-Dichlorophenol	10	330	8270C
Diethylphthalate	10	330	8270C
p-(Dimethylamino)azobenzene	10	330	8270C
7,12-Dimethyl benz(a)anthracene	10	330	8270C
3,3-Dimethyl benzidine	20	1,700	8270C
2,4-Dimethylphenol	10	330	8270C
alpha, alpha-Dimethylphenethylamine	2,000	67,000	8270C
Dimethyl phthalate	10	330	8270C

TABLE 3-2
METHOD PERFORMANCE LIMITS
APPENDIX IX COMPOUND LIST AND CONTRACT
REQUIRED QUANTITATION LIMITS (CRQL)
SWMU 71- QUARRY DISPOSAL SITE
PHASE I RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO

Semivolatiles (Cont.)	Quantitation Limits*		Method Number
	Water (µg/L)	Low Soil (µg/kg)	
m-Dinitrobenzene	10	330	8270C
4,6-Dinitro-2-methylphenol	50	1,700	8270C
2,4-Dinitrophenol	50	1,700	8270C
2,4-Dinitrotoluene	10	330	8270C
2,6-Dinitrotoluene	10	330	8270C
Di-n-octylphthalate	10	330	8270C
1,4-Dioxane	10	330	8270C
Dinoseb	10	330	8270C
Ethylmethanesulfonate	10	330	8270C
Fluoranthene	10	330	8270C
Fluorene	10	330	8270C
Hexachlorobenzene	10	330	8270C
Hexachlorobutadiene	10	330	8270C
Hexachlorocyclopentadiene	10	330	8270C
Hexachloroethane	10	330	8270C
Hexachlorophene	5,000	170,000	8270C
Hexachloropropene	10	330	8270C
Indeno(1,2,3-cd)pyrene	10	330	8270C
Isophorone	10	330	8270C
Isosafrole	10	330	8270C
Methapyrilene	2,000	67,000	8270C
3-Methylcholanthrene	10	330	8270C
Methyl methanesulfonate	10	330	8270C
2-Methylnaphthalene	10	330	8270C
Naphthalene	10	330	8270C
1,4-Naphthoquinone	10	330	8270C
1-Naphthylamine	10	330	8270C
2-Naphthylamine	10	330	8270C
2-Nitroaniline	50	1,700	8270C
3-Nitroaniline	50	1,700	8270C
4-Nitroaniline	50	1,700	8270C
Nitrobenzene	10	330	8270C
2-Nitrophenol	10	330	8270C
4-Nitrophenol	50	1,700	8270C
4-Nitroquinoline-1-oxide	20	3,300	8270C
n-Nitrosodi-n-butylamine	10	330	8270C
n-Nitrosodiethylamine	10	330	8270C
n-Nitrosodimethylamine	10	330	8270C
n-Nitrosodiphenylamine	10	330	8270C
n-Nitrosodi-n-propylamine	10	330	8270C
n-Nitrosomethylethylamine	10	330	8270C
n-Nitrosomorpholine	10	330	8270C
n-Nitrosopiperidine	10	330	8270C
n-Nitrosopyrrolidine	10	330	8270C

TABLE 3-2
METHOD PERFORMANCE LIMITS
APPENDIX IX COMPOUND LIST AND CONTRACT
REQUIRED QUANTITATION LIMITS (CRQL)
SWMU 71- QUARRY DISPOSAL SITE
PHASE I RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO

Semivolatiles (Cont.)	Quantitation Limits*		Method Number
	Water (µg/L)	Low Soil (µg/kg)	
5-Nitro-o-toluidine	10	330	8270C
bis-(2-chloroisopropyl)ether	10	330	8270C
Pentachlorobenzene	10	330	8270C
Pentachloronitrobenzene	10	330	8270C
Pentachlorophenol	50	1,700	8270C
Phenacetin	10	330	8270C
Phenanthrene	10	330	8270C
Phenol	10	330	8270C
1,4-Phenylenediamine	2,000	1,700	8270C
2-Picolin	10	330	8270C
Pronamide	10	330	8270C
Pyrene	10	330	8270C
Pyridine	50	330	8270C
Safrole	10	330	8270C
1,2,4,5-Tetrachlorobenzene	10	330	8270C
2,3,4,6-Tetrachlorophenol	10	330	8270C
o-Toluidine	20	330	8270C
1,2,4-Trichlorobenzene	10	330	8270C
2,4,5-Trichlorophenol	10	330	8270C
2,4,6-Trichlorophenol	10	330	8270C
1,3,5-Trinitrobenzene	10	330	8270C
Low Level PAHs	**Quantitation Limits***		**Method Number**
	Water (µg/L)	**Low Soil (µg/kg)**	
Acenaphthene	0.2	6.7	8270C
Acenaphthylene	0.2	6.7	8270C
Anthracene	0.2	6.7	8270C
Benzo(a)anthracene	0.2	6.7	8270C
Benzo(b)fluoranthene	0.2	6.7	8270C
Benzo(k)fluoranthene	0.2	6.7	8270C
Benzo(g,h,i)perylene	0.2	6.7	8270C
Benzo(a)pyrene	0.2	6.7	8270C
Chrysene	0.2	6.7	8270C
Dibenzo(a,h)anthracene	0.2	6.7	8270C
Fluoranthene	0.2	6.7	8270C
Fluorene	0.2	6.7	8270C
Indeno(1,2,3-cd)pyrene	0.2	6.7	8270C
1-Methylnaphthalene	0.2	6.7	8270C
2-Methylnaphthalene	0.2	6.7	8270C
Naphthalene	0.2	6.7	8270C
Phenanthrene	0.2	6.7	8270C
Pyrene	0.2	6.7	8270C

TABLE 3-2
METHOD PERFORMANCE LIMITS
APPENDIX IX COMPOUND LIST AND CONTRACT
REQUIRED QUANTITATION LIMITS (CRQL)
SWMU 71- QUARRY DISPOSAL SITE
PHASE I RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO

Pesticides	Quantitation Limits*		Method Number
	Water (µg/L)	Low Soil (µg/kg)	
Aldrin	0.05	1.7	8081A
Alpha-BHC	0.05	1.7	8081A
beta-BHC	0.05	1.7	8081A
delta-BHC	0.05	1.7	8081A
gamma-BHC	0.05	1.7	8081A
Chlordane	0.5	17	8081A
Chlorobenzilate	0.5	17	8081A
4,4'-DDT	0.1	3.3	8081A
4,4'-DDE	0.1	3.3	8081A
4,4'-DDD	0.1	3.3	8081A
Dieldrin	0.1	3.3	8081A
Endosulfan I	0.05	1.7	8081A
Endosulfan II	0.1	3.3	8081A
Endosulfan sulfate	0.1	3.3	8081A
Endrin	0.1	3.3	8081A
Isodrin	0.05	3.3	8081A
Kepone	1.0	170	8081A
Toxaphene	5.0	170	8081A
Endrin Aldehyde	0.1	3.3	8081A
Heptachlor	0.05	1.7	8081A
Heptachlor epoxide	0.05	1.7	8081A
Methyoxychlor	0.5	17	8081A
Total Petroleum Hydrocarbons	**Quantitation Limits***		**Method Number**
	Water (µg/L)	**Low Soil (µg/kg)**	
TPH DRO	100	3300	8015B
TPH GRO	50	250	8015B

* Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil, calculated on dry weight basis, will be higher.
µg/L - micrograms per liter.
µg/kg - micrograms per kilogram.

TABLE 3-2

METHOD PERFORMANCE LIMITS
APPENDIX IX COMPOUND LIST AND CONTRACT
REQUIRED QUANTITATION LIMITS (CRQL)
SWMU 71 - QUARRY DISPOSAL SITE
PHASE I RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO

Inorganics	Method Number	Quantitation Limits* Water (µg/L)	Quantitation Limits* Low Soil (mg/kg)	Method Description
Antimony	6010B	20	2.0	Inductively Coupled Plasma
Arsenic	6010B	10	1.0	Inductively Coupled Plasma
Barium	6010B	10	1.0	Inductively Coupled Plasma
Beryllium	6010B	4.0	0.4	Inductively Coupled Plasma
Cadmium	6010B	5.0	0.5	Inductively Coupled Plasma
Chromium	6010B	10	1.0	Inductively Coupled Plasma
Cobalt	6010B	10	1.0	Inductively Coupled Plasma
Copper	6010B	20	2.0	Inductively Coupled Plasma
Lead	6010B	5.0	0.5	Inductively Coupled Plasma
Mercury	7470A/7471A	0.2	0.02	Cold Vapor AA
Nickel	6010B	40	4.0	Inductively Coupled Plasma
Selenium	6010B	10	1.0	Inductively Coupled Plasma
Silver	6010B	10	1.0	Inductively Coupled Plasma
Thallium	6010B	10	1.0	Inductively Coupled Plasma
Tin	6010B	10	5.0	Inductively Coupled Plasma
Vanadium	6010B	10	1.0	Inductively Coupled Plasma
Zinc	6010B	20	2.0	Inductively Coupled Plasma
RCRA Metals	**Method Number**	**Quantitation Limits* Soil (mg/kg)**	**Quantitation Limits* Water (µg/L)**	**Method Description**
Arsenic	6010B(3050B/3010A)	1.0	10	Inductively Coupled Plasma
Barium	6010B(3050B/3010A)	1.0	10	Inductively Coupled Plasma
Cadmium	6010B(3050B/3010A)	0.50	5	Inductively Coupled Plasma
Chromium	6010B(3050B/3010A)	1.0	10	Inductively Coupled Plasma
Lead	6010B(3050B/3010A)	0.50	5.0	Inductively Coupled Plasma
Mercury	7470A/7471A	0.020	0.20	Cold Vapor AA
Selenium	6010B(3050B/3010A)	1.0	10	Inductively Coupled Plasma
Silver	6010B(3050B/3010A)	1.0	10	Inductively Coupled Plasma

Notes:

* 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.

mg/kg - milligrams per kilogram.

TABLE 3-3

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM
QA/QC AND IDW SAMPLES
SWMU 71 - QUARRY DISPOSAL SITE
PHASE I RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO

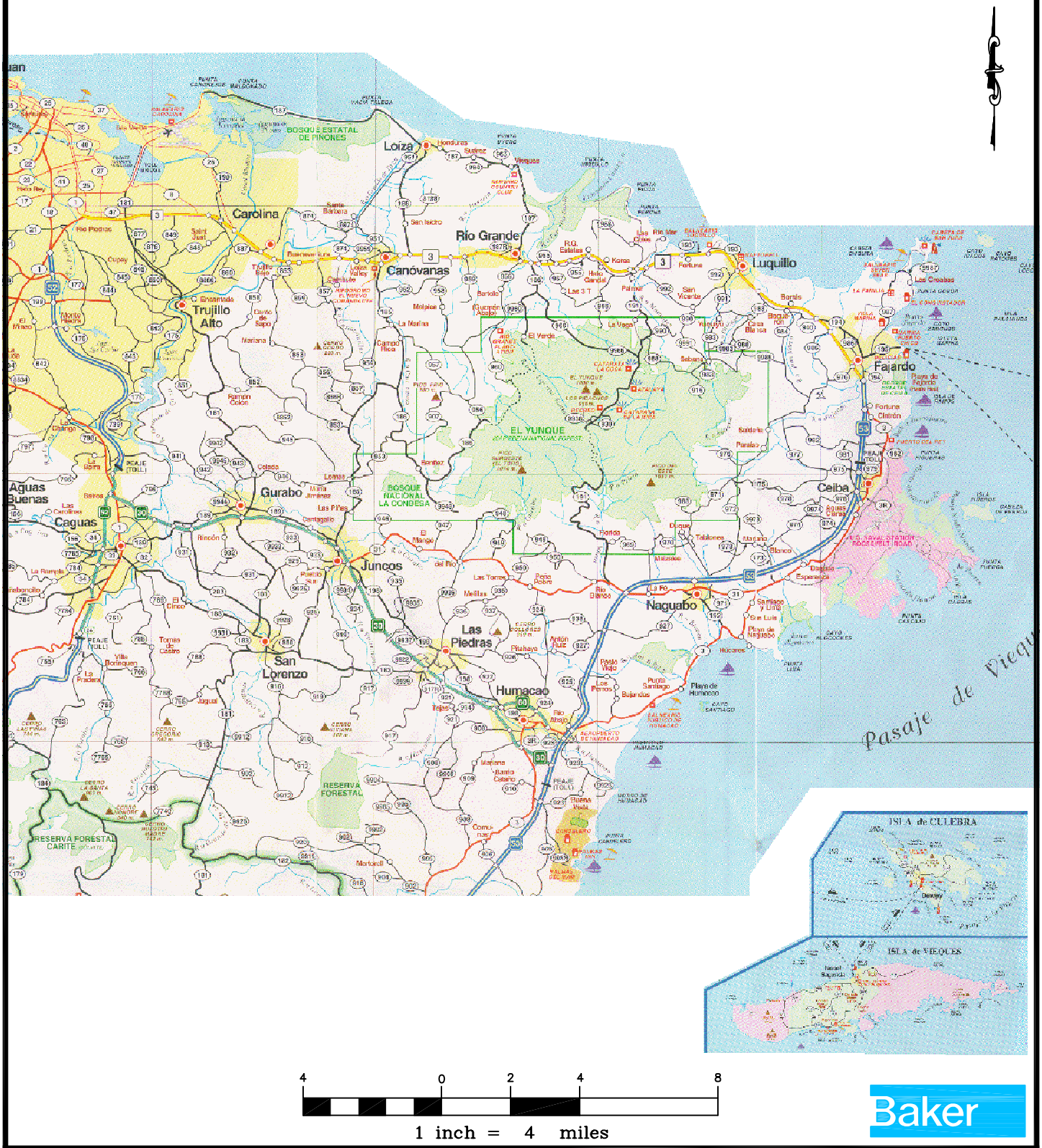
	Aqueous Samples Analysis Requested										Solid Samples Analysis Requested		
Media	App IX VOCs	App IX SVOCs	App IX Pesticides	App IX Low Level PAHs	App IX Metals (Total)	App IX Metals (Dissolved)	TPH DRO	TPH GRO	Benzene	RCRA Metals	Benzene	RCRA Metals	**Comment**
Trip Blank Samples													
71TB01	X(1)							X(1)					
71TB02	X(1)							X(1)					
71TB03	X(1)							X(1)					
Equipment Rinsate Samples													
71ER01	X	X	X	X	X								Stainless Steel Spoon or Macro Core Liner
71ER02	X	X	X	X	X								Split Spoon Sampler or Macro Core Liner
71ER03	X	X	X	X	X	X	X	X					Polyethylene and silicon tubing
Field Blank Samples													
71FB01	X	X	X	X	X	X	X	X					Lab Grade Deionized Water
71FB02	X	X	X	X	X	X	X	X					Store Bought Distilled Warer
71FB03	X	X	X	X	X	X	X	X					NAPR Potable Water
IDW Samples													
71IDW01									X	X			Aqueous
71IDW02											X	X	Solid

Note:

(1) - The analysis required for this sample will be dependent on which samples are being accompanied in the cooler.

FIGURES

K:_SOUTHNAVFAC\111626 D02\Task 5 - RFI Work Plans\SWMU 71 RFI\CAD\ 111626_71_01



4 0 2 4 8

1 inch = 4 miles

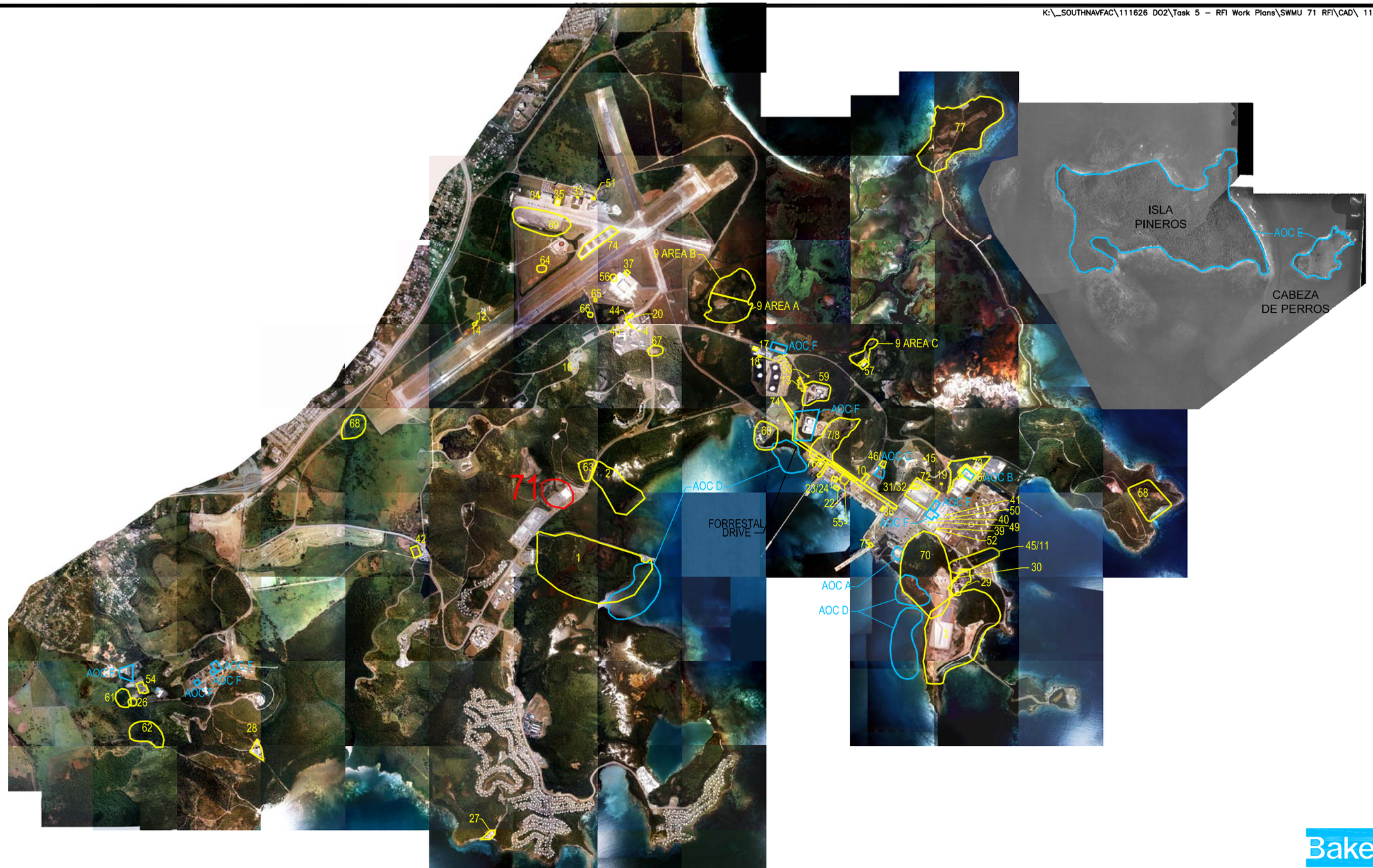
Baker

FIGURE 1-1
REGIONAL LOCATION MAP
SWMU 71-QUARRY DISPOSAL AREA
PHASE I RFI WORK PLAN

SOURCE: METRODATA, INC., 1999.

NAVAL ACTIVITY PUERTO RICO

K:_SOUTHNAVFAC\111626 DO2\Task 5 – RFI Work Plans\SWMU 71 RFI\CAD\ 111626_71_02



Baker

LEGEND

1 – SWMUs

71 – AREA TO WHICH THIS INVESTIGATION PERTAINS

AOC D – AOCs

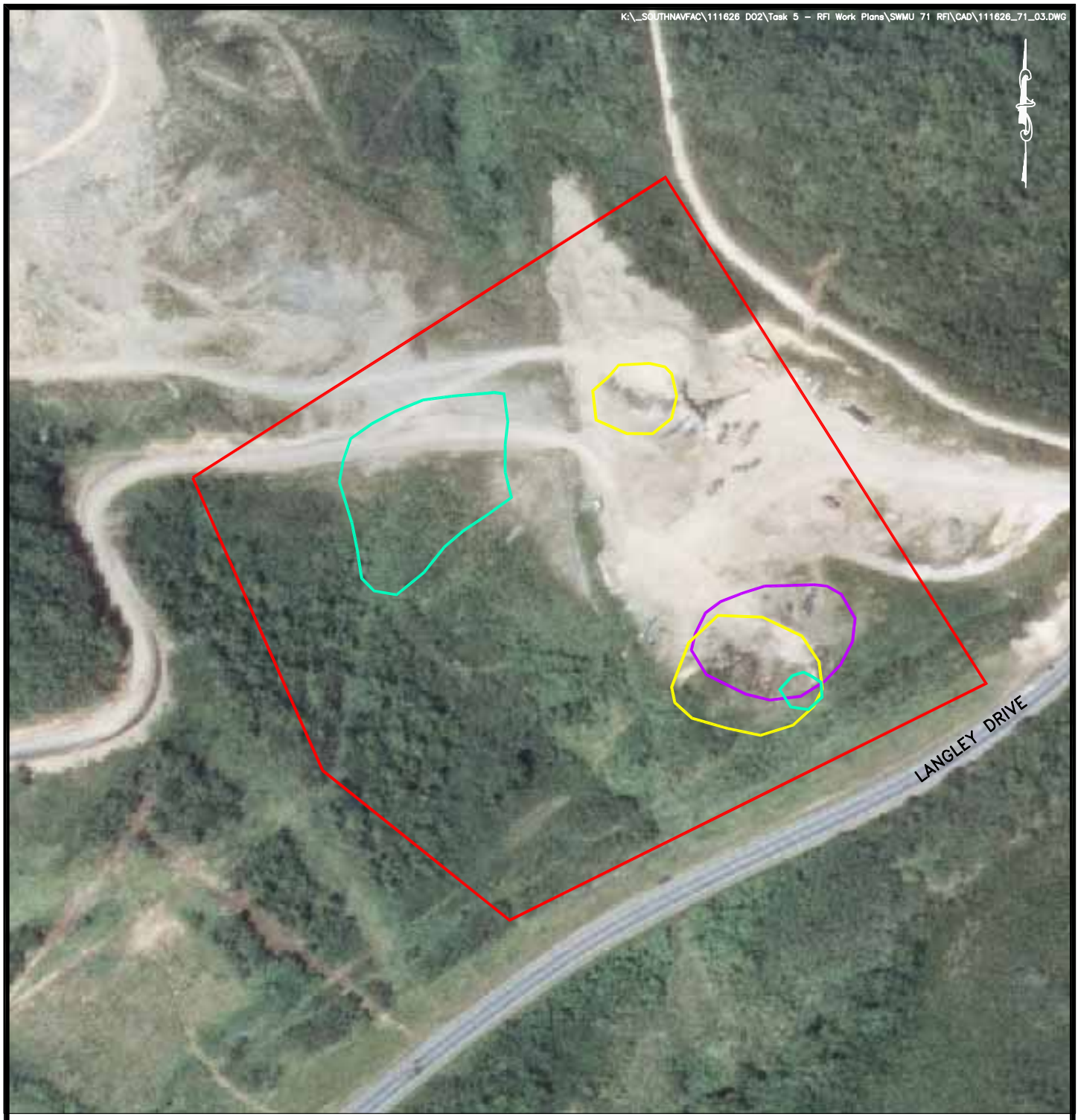
SOURCE: GEO-MARINE, INC., SEPTEMBER 6, 2000.

3000 0 1500 3000

1 inch = 3000 ft.

FIGURE 1-2
SWMU/AOC LOCATION MAP
SWMU 71-QUARRY DISPOSAL SITE
PHASE I RFI WORK PLAN

NAVAL ACTIVITY PUERTO RICO



200 0 100 200

1 inch = 200 ft.

Baker

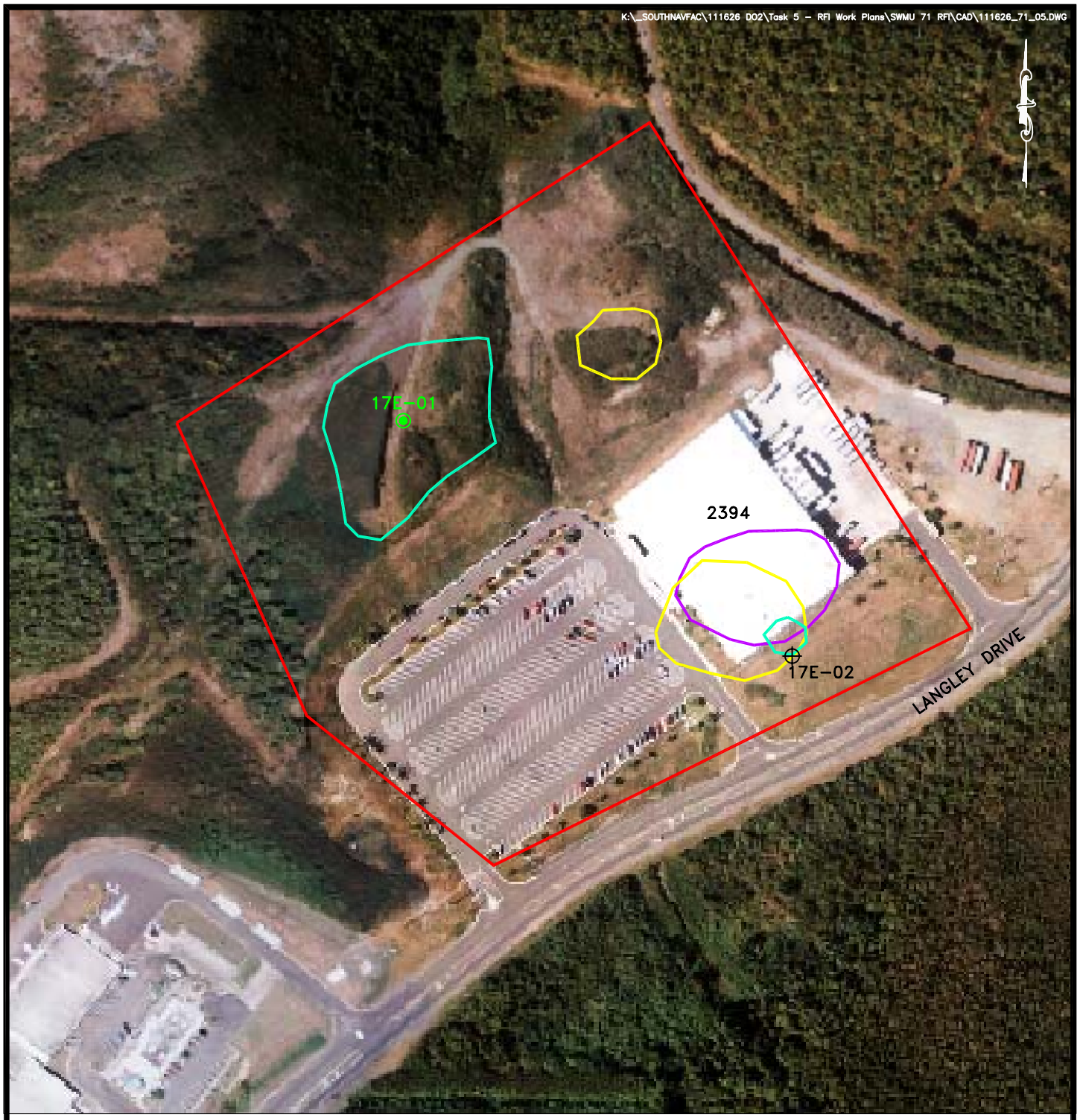
LEGEND

- 1976 POLYGON FEATURE
- 1977 POLYGON FEATURE
- 1985 POLYGON FEATURE
- SWMU BOUNDARY

SOURCE: GEO-MARINE, INC., HISTORIC 1976.

FIGURE 1-3
1976 AERIAL PHOTOGRAPH
SWMU 71-QUARRY DISPOSAL SITE
PHASE I RFI WORK PLAN

NAVAL ACTIVITY PUERTO RICO



200 0 100 200

1 inch = 200 ft.

Baker

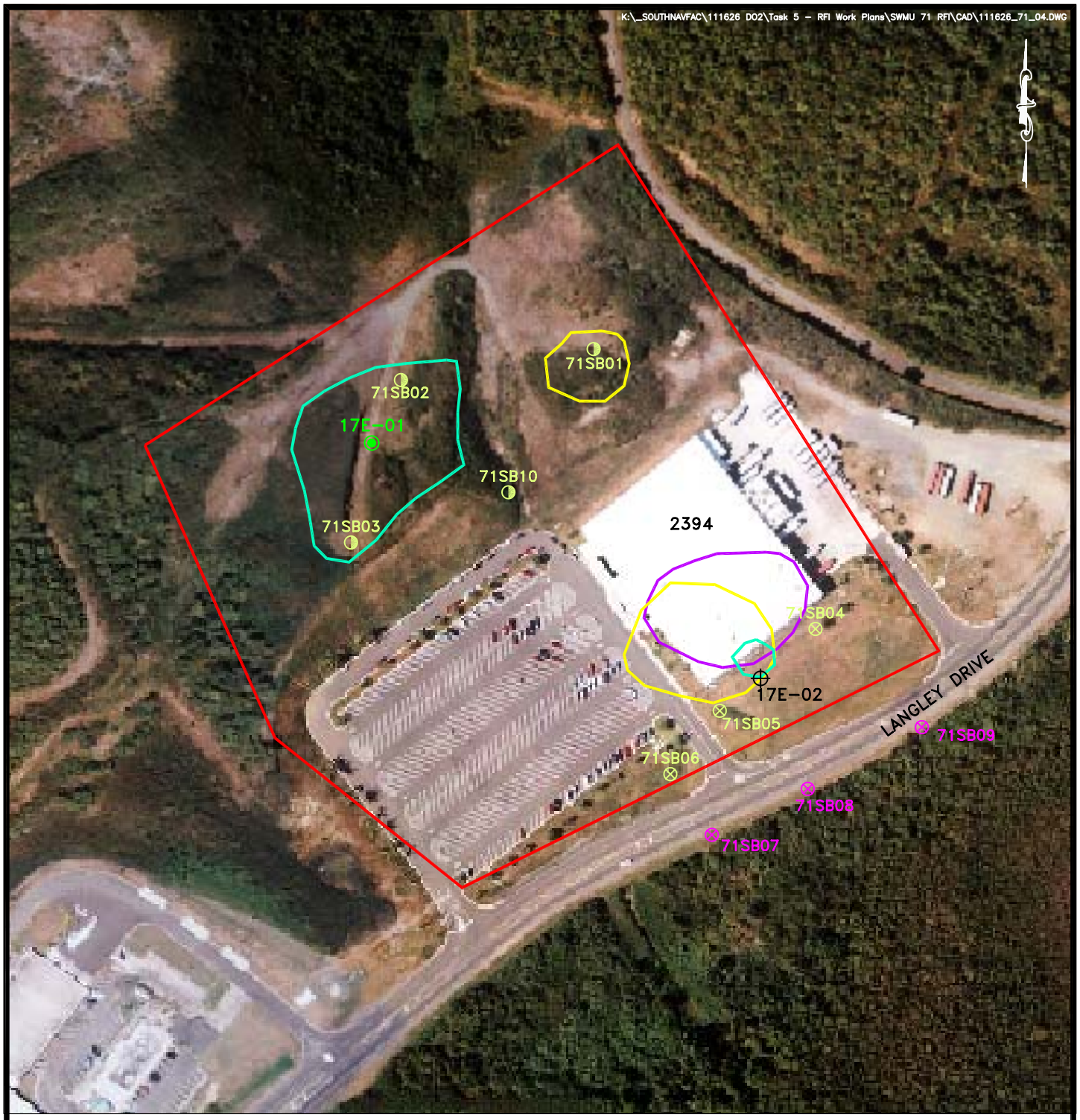
LEGEND

- 1976 POLYGON FEATURE
- 1977 POLYGON FEATURE
- 1985 POLYGON FEATURE
- SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (PHASE II ECP 2004)
- SURFACE SOIL AND SUBSURFACE SOIL SAMPLE LOCATION (PHASE II ECP 2004)
- SWMU BOUNDARY

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

FIGURE 1-4
SITE LAYOUT AND ECP SAMPLE LOCATION MAP
SWMU 71-QUARRY DISPOSAL SITE
PHASE I RFI WORK PLAN

NAVAL ACTIVITY PUERTO RICO



200 0 100 200

1 inch = 200 ft.

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

Baker

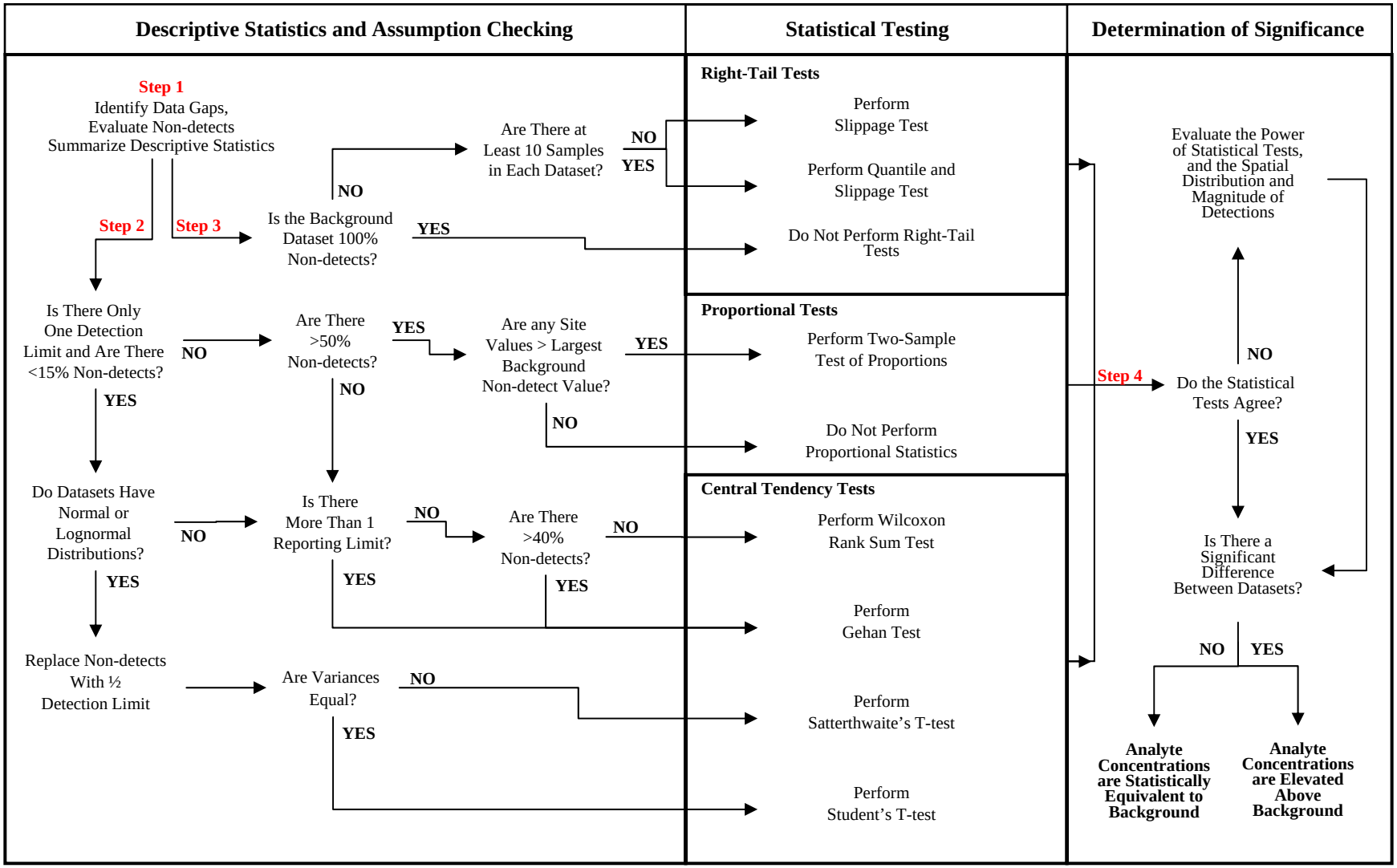
LEGEND

- 1976 POLYGON FEATURE
- 1977 POLYGON FEATURE
- 1985 POLYGON FEATURE
- EXISTING SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATION (PHASE II ECP 2004)
- EXISTING SURFACE SOIL AND SUBSURFACE SOIL SAMPLE LOCATION (PHASE II ECP 2004)
- PROPOSED SURFACE AND SUBSURFACE SAMPLING LOCATIONS
- PROPOSED SUBSURFACE SOIL AND GROUNDWATER SAMPLING LOCATIONS
- PROPOSED SURFACE SOIL AND SECOND TIER SUBSURFACE SOIL AND GROUNDWATER SAMPLING LOCATIONS
- SWMU BOUNDARY

FIGURE 3-1
PROPOSED SAMPLE LOCATION MAP
SWMU 71-QUARRY DISPOSAL SITE
PHASE I RFI WORK PLAN

NAVAL ACTIVITY PUERTO RICO

FIGURE 4-1
STATISTICAL ANALYSIS PROCESS
SWMU 71 – QUARRY DISPOSAL SITE
PHASE I RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO

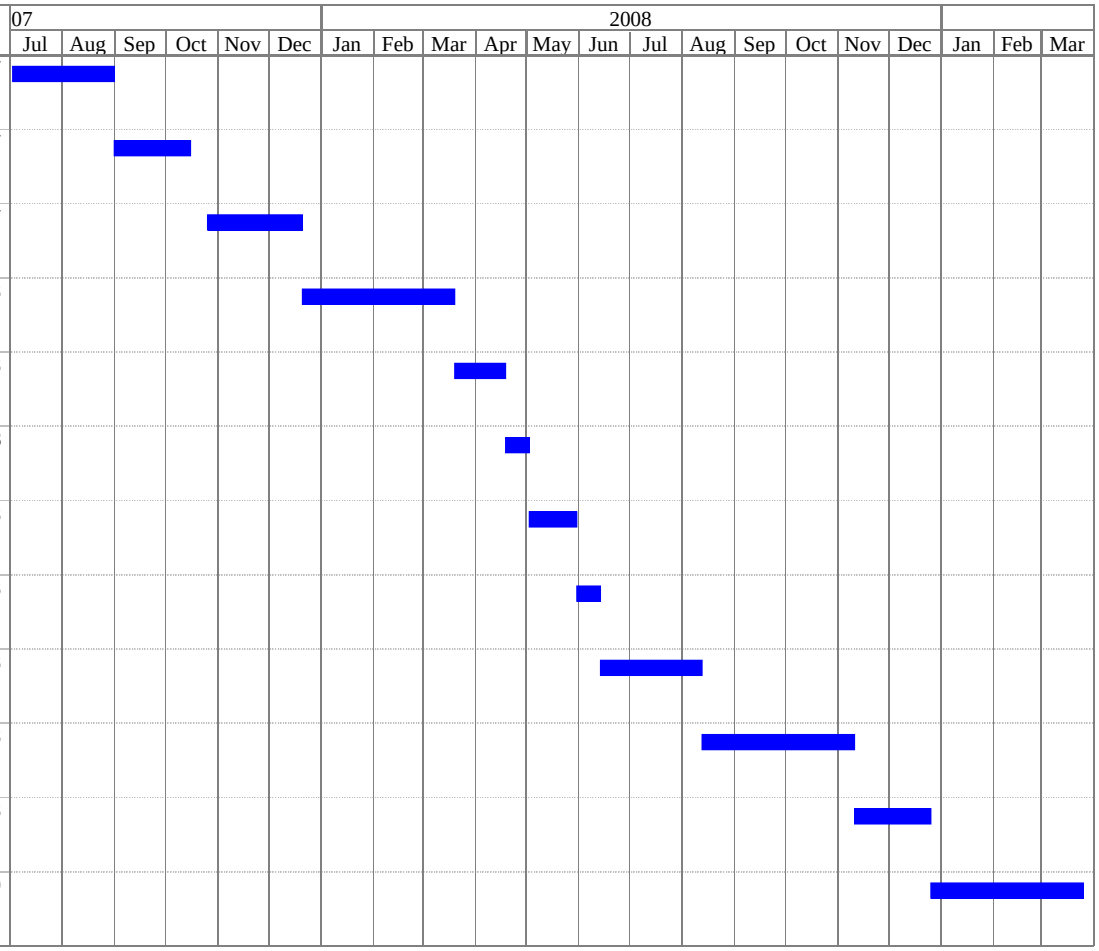


T-tests performed on log-transformed data if datasets have lognormal distributions.

Revised: December 20, 2007

FIGURE 5-1
PROPOSED PROJECT SCHEDULE
SWMU 71- QUARRY DISPOSAL AREA
PHASE I RFI WORK PLAN
NAVAL ACTIVITY PUERTO RICO

ID	Task Name	Duration	Start	Finish
1	Draft RFI Work Plan to the EPA	60 edays	7/2/07	8/31/07
2	EPA Review	48 edays	8/31/07	10/18/07
3	Final RFI Work Plan to the EPA	56 edays	10/25/07	12/20/07
4	EPA Review & Approval	90 edays	12/21/07	3/20/08
5	Initiate Field Work	30 edays	3/20/08	4/19/08
6	Field Investigation	14 edays	4/19/08	5/3/08
7	Laboratory Analysis	28 edays	5/3/08	5/31/08
8	Data Validation	14 edays	5/31/08	6/14/08
9	Draft Phase I RFI Report for SWMU 71 to EPA	60 edays	6/14/08	8/13/08
10	EPA Review	90 edays	8/13/08	11/11/08
11	Final Phase I RFI Report for SWMU 71 to EPA	45 edays	11/11/08	12/26/08
12	EPA Review & Approval	90 edays	12/26/08	3/26/09

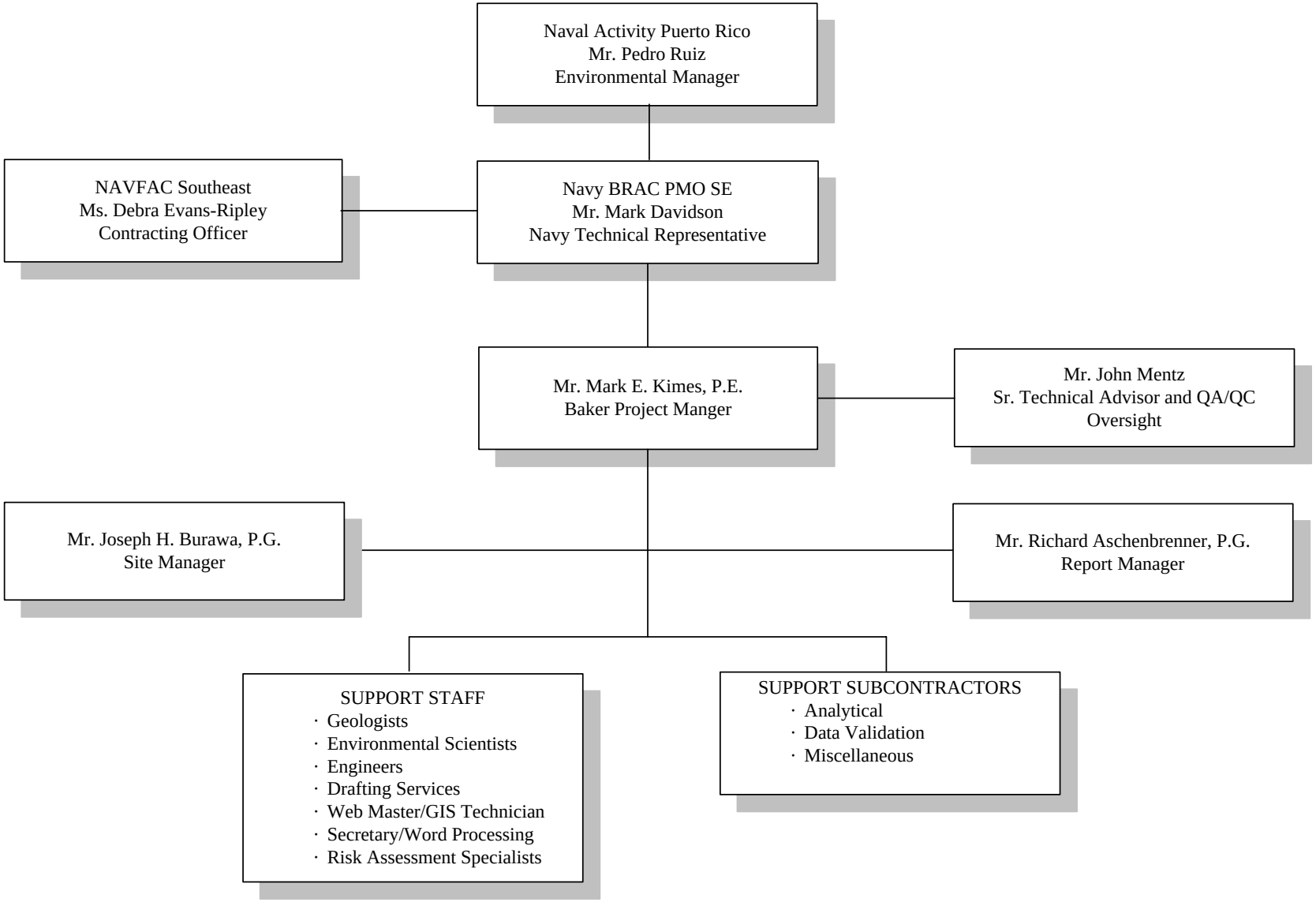


Project:Phase I RFI Work Plan
Date: 12/19/07

Task

Revised: December 20, 2007

FIGURE 6-1
PROJECT ORGANIZATION
PHASE I RFI WORK PLAN – SWMU 71
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



APPENDIX A
Photograph of SWMU 71 – Quarry Disposal Area

SWMU 71 – Quarry Disposal Site

Photograph A-1: Secondary Growth Vegetation and Hillside in Background of Site

APPENDIX B
Summary of Analytical Results from Phase II ECP Study

TABLE B-1

SUMMARY OF ORGANIC DETECTIONS IN SURFACE SOIL
SWMU 71 - QUARRY DISPOSAL SITE
PHASE II ECP STUDY
NAVAL ACTIVITY 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)	17E-01 17E-SS01 05/06/04 0.00 - 1.00	17E-01 17E-SS01D 05/06/04 0.00 - 1.00	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	1.2 J	1.1 J	0/2		0/2		17E-SS01
Chlorobenzene	2,000,000	160,000	2 J	5.3 U	0/2		0/2		17E-SS01
Ethylbenzene	10,000,000	780,000	1.2 J	5.3 U	0/2		0/2		17E-SS01
Tetrachloroethene	5,300	1,200	1.8 J	5.3 U	0/2		0/2		17E-SS01
Xylene	20,000,000	1,600,000	6.6 J	10 U	0/2		0/2		17E-SS01
Semivolatile Organic Compounds (ug/kg)									
Benzo(a)anthracene	3,900	870	390 U	51 J	0/2		0/2		17E-SS01D
Benzo(b)fluoranthene	3,900	870	390 U	38 J	0/2		0/2		17E-SS01D
Benzo(k)fluoranthene	39,000	8,700	390 U	48 J	0/2		0/2		17E-SS01D
Benzo(g,h,i)perylene	NE	NE	75 J	78 J	NE		NE		17E-SS01D
Benzo(a)pyrene	390	87	390 U	42 J	0/2		0/2		17E-SS01D
Chrysene	390,000	87,000	390 U	48 J	0/2		0/2		17E-SS01D
Dibenzo(a,h)anthracene	390	87	52 J	52 J	0/2		0/2		17E-SS01, 17E-SS01D
Fluoranthene	4,100,000	310,000	390 U	82 J	0/2		0/2		17E-SS01D
Indeno(1,2,3-cd)pyrene	3,900	870	57 J	69 J	0/2		0/2		17E-SS01D
Pyrene	3,100,000	230,000	28 J	74 J	0/2		0/2		17E-SS01D
Pesticides/PCBs (ug/kg) Not Detected									
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.
NE - Not Established.
ft bgs - feet below ground surface.
ug/kg - micrograms per kilogram.

TABLE B-2

Revised: December 20, 2007

SUMMARY OF INORGANIC DETECTIONS IN SURFACE SOIL
SWMU 71 - QUARRY DISPOSAL SITE
PHASE II ECP STUDY
NAVAL ACTIVITY 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)	17E-01 17E-SS01 05/06/04 0.00 - 1.00	17E-01 17E-SS01D 05/06/04 0.00 - 1.00	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)												
Barium	7,200	550	181	60	47	0/2		0/2		0/2		17E-SS01
Beryllium	200	16	0.45	0.18 B	0.15 B	0/2		0/2		0/2		17E-SS01
Chromium	310	23	59.3	16	15	0/2		0/2		0/2		17E-SS01
Cobalt	2,000	160	44.0	21	21	0/2		0/2		0/2		17E-SS01, 17E-SS01D
Copper	4,100	310	234.2	120	95	0/2		0/2		0/2		17E-SS01
Lead	400[1]	400[1]	15.25	5.3	3.8	0/2		0/2		0/2		17E-SS01
Mercury	31[2]	2.3[2]	0.11	0.03 S	0.022	0/2		0/2		0/2		17E-SS01
Nickel	2,000	160	16.55	15	17	0/2		0/2		1/2	17	17E-SS01D
Silver	510	39	0.37	1.1 B	0.55 B	0/2		0/2		2/2	0.55B - 1.1B	17E-SS01
Tin	61,000	4,700	2.43	3.4 B	3.3 B	0/2		0/2		2/2	3.3B - 3.4B	17E-SS01
Vanadium	100	7.8	354.5	**140**	**120**	2/2	120 - 140	2/2	120 - 140	0/2		17E-SS01
Zinc	31,000	2,300	125.2	62	68	0/2		0/2		0/2		17E-SS01D

Notes:

B - The reported result is an estimated concentration that is less than the PQL, but greater than or equal to the MDL.
S - The result was determined by Method of Standard Addition.
[1] - 1996 Soil Screening Guidance.
[2] - Value based on the RBC for Mercuric Chloride.
ft bgs - feet below ground surface.
mg/kg - milligrams per kilogram.

Shading indicates exceedance of EPA Region III Industrial BCs
Bold indicates exceedance of EPA Region III Residential RBCs
Underline indicates exceedance of 2 x Average Detected Background

TABLE B-3

Revised: December 20, 2007

SUMMARY OF ORGANIC DETECTIONS IN SUBSURFACE SOIL
SWMU 71 - QUARRY DISPOSAL SITE
PHASE II ECP STUDY
NAVAL ACTIVITY 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)	17E-01 17E-SB01-01 05/06/04 1.00 - 1.3	17E-02 17E-SB02-01 05/06/04 1.00 - 3.00	17E-02 17E-SB02-04 05/06/04 7.00 - 9.00	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)										
Acetone	92,000,000	7,000,000	53 U	50 U	27 J	0/3		0/3		17E-SB02-04
Benzene	52,000	12,000	5.3 U	5 U	8.6	0/3		0/3		17E-SB02-04
Carbon tetrachloride	22,000	4,900	3.7 J	5 U	4.4	0/3		0/3		17E-SB02-04
Ethylbenzene	10,000,000	780,000	5.3 U	5 U	150	0/3		0/3		17E-SB02-04
Xylene	20,000,000	1,600,000	11 U	10 U	24	0/3		0/3		17E-SB02-04
Semivolatile Organic Compounds (ug/kg)										
Acenaphthene	6,100,000	470,000	170 J	370 U	8,000 U	0/3		0/3		17E-SB01-01
Anthracene	31,000,000	2,300,000	230 J	370 U	8,000 U	0/3		0/3		17E-SB01-01
Benzo(a)anthracene	3,900	870	530	370 U	8,000 U	0/3		0/3		17E-SB01-01
Benzo(b)fluoranthene	3,900	870	310 J	38 J	8,000 U	0/3		0/3		17E-SB01-01
Benzo(k)fluoranthene	39,000	8,700	410	24 J	8,000 U	0/3		0/3		17E-SB01-01
Benzo(g,h,i)perylene	NE	NE	240 J	62 J	8,000 U	NE		NE		17E-SB01-01
Benzo(a)pyrene	390	87	**370**	370 U	8,000 U	0/3		1/3	370	17E-SB01-01
Chrysene	390,000	87,000	530	36 J	8,000 U	0/3		0/3		17E-SB01-01
Dibenzofuran	200,000	16,000	78 J	370 U	8,000 U	0/3		0/3		17E-SB01-01
Dibenzo(a,h)anthracene	390	87	**110** J	37 J	8,000 U	0/3		1/3	110J	17E-SB01-01
Fluoranthene	4,100,000	310,000	1,100	370 U	8,000 U	0/3		0/3		17E-SB01-01
Fluorene	4,100,000	310,000	120 J	370 U	8,000 U	0/3		0/3		17E-SB01-01
Indeno(1,2,3-cd)pyrene	3,900	870	240 J	53 J	8,000 U	0/3		0/3		17E-SB01-01
2-Methylnaphthalene	410,000	31,000	63 J	370 U	2,500 J	0/3		0/3		17E-SB02-04
Phenanthrene	NE	NE	830	370 U	8,000 U	NE		NE		17E-SB01-01
Pyrene	3,100,000	230,000	920	19 J	8,000 U	0/3		0/3		17E-SB01-01

TABLE B-3

Revised: December 20, 2007

SUMMARY OF ORGANIC DETECTIONS IN SUBSURFACE SOIL
SWMU 71 - QUARRY DISPOSAL SITE
PHASE II ECP STUDY
NAVAL ACTIVITY 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)	17E-01 17E-SB01-01 05/06/04 1.00 - 1.3	17E-02 17E-SB02-01 05/06/04 1.00 - 3.00	17E-02 17E-SB02-04 05/06/04 7.00 - 9.00	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
Pesticides/PCBs (ug/kg)										
4,4'-DDE	8,400	1,900	3.7 U	0.81 J	4 U	0/3		0/3		17E-SB02-01
4,4'-DDT	8,400	1,900	3.7 U	0.53 J	4 U	0/3		0/3		17E-SB02-01
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.
NE - Not Established.
ft bgs - feet below ground surface.
ug/kg - micrograms per kilogram.

Bold indicates exceedance of EPA Region III Residential RBCs

TABLE B-4

Revised: December 20, 2007

SUMMARY OF INORGANIC DETECTIONS IN SUBSURFACE SOIL
SWMU 71 - QUARRY DISPOSAL SITE
PHASE II ECP STUDY
NAVAL ACTIVITY 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)	17E-01 17E-SB01-01 05/06/04 1.00 - 1.3	17E-02 17E-SB02-01 05/06/04 1.00 - 3.00	17E-02 17E-SB02-04 05/06/04 7.00 - 9.00	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)													
Arsenic	1.9	0.43	2.05	1.1 U	**0.9** B	1.1 U	0/3		1/3	0.9B	0/3		17E-SB02-01
Barium	7,200	550	222	57	72	81	0/3		0/3		0/3		17E-SB02-04
Beryllium	200	16	0.74	0.18 B	0.2 B	0.26 B	0/3		0/3		0/3		17E-SB02-04
Chromium	310	23	133	16	19	**57**	0/3		1/3	57	0/3		17E-SB02-04
Cobalt	2,000	160	30.0	20	18	22	0/3		0/3		0/3		17E-SB02-04
Copper	4,100	310	193	100	76	100	0/3		0/3		0/3		17E-SB01-01, 17E-SB02-04
Lead	400[(1)]	400[(1)]	8.68	4.5	2.7	3.6	0/3		0/3		0/3		17E-SB01-01
Mercury	31[(2)]	2.3[(2)]	0.093	0.01 B	0.0085 B	0.016 B	0/3		0/3		0/3		17E-SB02-04
Nickel	2,000	160	31.9	13	14	27	0/3		0/3		0/3		17E-SB02-04
Silver	510	39	0.46	0.32 B	1.1 U	1.1 U	0/3		0/3		0/3		17E-SB01-01
Tin	61,000	4,700	2.96	2.6 B	2.7 B	2.7 B	0/3		0/3		0/3		17E-SB02-01, 17E-SB02-04
Vanadium	100	7.8	462	**130**	**100**	**150**	2/3	130 - 150	3/3	100 - 150	0/3		17E-SB02-04
Zinc	31,000	2,300	88.6	60	39	42	0/3		0/3		0/3		17E-SB01-01

Notes:

U - The compound was analyzed for, but was not detected at or above the MDL/PQL.

B - The reported result is an estimated concentration that is less than the PQL, but greater than or equal to the MDL.

(1) - 1996 Soil Screening Guidance.

(2) - Value based on the RBC for Mercuric Chloride.

ft bgs - feet below ground surface.

mg/kg - milligrams per kilogram.

Shading indicates exceedance of EPA Region III Industrial BCs

Bold indicates exceedance of EPA Region III Residential RBCs

TABLE B-5

Revised: December 20, 2007

SUMMARY OF ORGANIC DETECTIONS IN GROUNDWATER
SWMU 71 - QUARRY DISPOSAL SITE
PHASE II ECP STUDY
NAVAL ACTIVITY 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)	17E-02 17E-GW02 05/09/04	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)											
Acetone	NE	550	NE	6.8 J	NE		0/1		NE		17E-GW01
2-Butanone	NE	700	NE	1.9 J	NE		0/1		NE		17E-GW01
Ethylbenzene	700	130	700	3	0/1		0/1		0/1		17E-GW01
Semivolatile Organic Compounds (ug/L)											
Cresol, m & p	NE	NE	NE	1.8 J	NE		NE		NE		17E-GW01
Naphthalene	NE	0.65	NE	**1.3** J	NE		1/1	1.3J	NE		17E-GW01
Pesticides/PCBs (ug/L) Not Detected											
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.
ug/L - micrograms per liter.
NE - Not Established. **Bold** indicates exceedance of EPA Region III Tap Water RBCs

TABLE B-6

Revised: December 20, 2007

SUMMARY OF INORGANIC (DISSOLVED) DETECTIONS IN GROUNDWATER
SWMU 71 - QUARRY DISPOSAL SITE
PHASE II ECP STUDY
NAVAL ACTIVITY PUERTO RICO

Site ID Sample ID Sample Date	Federal MCLs (mg/L)	**EPA Region III Tap Water RBCs** (mg/L)	PR Water Quality Standards (mg/L)	17E-02 17E-GW02 05/09/04	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 Inorganics (mg/L)											
Barium	2	0.26	NE	0.1	0/1		0/1		NE		17E-GW01
Chromium	0.1	0.011	NE	0.0013 B	0/1		0/1		NE		17E-GW01
Cobalt	NE	0.073	NE	0.0039 B	NE		0/1		NE		17E-GW01
Copper	1.3[(1)]	0.15	1.3	0.0041 B	0/1		0/1		0/1		17E-GW01
Mercury	0.002	0.0011[(2)]	0.002	0.00049 B	0/1		0/1		0/1		17E-GW01
Nickel	NE	0.073	NE	0.0033 B	NE		0/1		NE		17E-GW01
Vanadium	NE	0.0037	NE	**0.012**	NE		1/1	0.012	NE		17E-GW01

Notes:

B - The reported result is an estimated concentration that is less than the PQL, but greater than or equal to the MDL.

(1) - EPA action level.

(2) - Value based on the Tap Water RBC for Mercuric Chloride.

NE - Not Established.

mg/L - milligrams per liter. **Bold** indicates exceedance of EPA Region III Tap Water RBCs

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

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