FINAL FULL RCRA FACILITY INVESTIGATION SWMU 27 – CAPEHART WASTEWATER TREATMENT PLANT SLUDGE DRYING BEDS

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:

Michael Baker Jr., Inc.
Moon Township, PA

Contract No. N62470-07-D-0502
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August 28, 2008

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

FINAL

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Prepared by:

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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.

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Name: David Criswell, P.E.

Title: Deputy Base Closure Manager

Date: August 28, 2008

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LIST OF ACRONYMS AND ABBREVIATIONS

AFWTF	Atlantic Fleet Weapons Training Facility
AOC	Areas of Concern
AQUIRE	Aquatic Toxicity Information Retrieval
Baker	Michael Baker Jr., Inc.
bgs	below ground surface
BRAC	Base Realignment and Closure
CCME	Canadian Council of Ministers of the Environment
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CMS	Corrective Measures Study
COPC	Chemicals of Potential Concern
CRQL	Contract Required Quantitation Limit
CSF	Carcinogenic Slope Factor
DoN	Department of the Navy
DPT	Direct Push Technology
DRMO	Defense Restoration and Marketing Office
EA	Environmental Assessment
Eco-SSLs	Ecological Soil Screening Levels
ECP	Environmental Condition of Property
EC_{50}	Median Effect Concentration
EPC	Exposure Point Concentration
ERA	Ecological Risk Assessment
E2SS3	Estuarine, Intertidal, Scrub-Shrub, Broad-Leaved Evergreen
F	Fahrenheit
FCV	Final Chronic Value
GPS	Global Positioning System
HI	Hazard Index
HSWA	Hazardous and Solid Waste Amendments (to RCRA)
IAS	Initial Assessment Study
ILCR	Incremental Lifetime Cancer Risk
Inc.	Incorporated
IR	Installation Restoration
LC_{50}	Median Lethal Concentration
LOEL	Lowest Observed Effects Level
LOEC	Lowest Observed Effect Concentration

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

MATC	Maximum Acceptable Toxicant Concentration
MCL	Maximum Contaminant Level
mgd	Million Gallons per Day
MHSPE	Ministry of Housing, Spatial Planning and Environment
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NAD	North American Datum
NAWQC	National Ambient Water Quality Criteria
NAPR	Naval Activity Puerto Rico
NAVFAC	Naval Facilities Engineering Command Atlantic Division
NEESA	Naval Energy and Environmental Support Activity
NFESC	Naval Facilities Engineering Service Center
NOAA	National Oceanic and Atmospheric Administration
NOEC	No Observed Effect Concentration
NSRR	Naval Station Roosevelt Roads
PAH	Polynuclear Aromatic Hydrocarbons
PID	Photoionization Detector
PMO	Program Management Office
ppt	parts per thousand
PRDRN	Puerto Rico Department of Natural Resources
PRG	Preliminary Remediation Goal
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
RfD	Reference Dose
RFI	RCRA Facility Investigation
RTK	Real-time Kinematic
SCV	Secondary Chronic Values
SDG	Sample Delivery Group
SQUIRTS	Screening Quick Reference Tables
SWMU	Solid Waste Management Unit
TGO	Trimble Geomatics Office
UNEP	United Nations Environmental Program
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UST	Underground Storage Tank
VOC	Volatile Organic Compound
WWTP	Wastewater Treatment Plant

1.0 INTRODUCTION

This Full RFI was prepared based on the results and recommendations of the Phase I Resource Conservation Recovery Act (RCRA) Facility Investigation (RFI) conducted in November 2006 at the Solid Waste Management Unit (SWMU) 27 - Capehart Waste Water Treatment Plant (WWTP) Sludge Drying Beds located at Naval Activity Puerto Rico (NAPR), Ceiba, Puerto Rico. This document contains the screening data collected from the Phase I investigation and the additional data collected during the Full RFI.

This document was prepared by Michael Baker Jr., Inc. (Baker), for the Navy Base Realignment and Closure (BRAC) Program Management Office (PMO) Southeast. This RFI Report is being developed under IQC for A/E Services for Multi-Media Environmental Compliance Engineering Support, Contract Number N62470-07-D-0502 Delivery Order 0002. This Full RFI Report 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 Purpose

This report has been prepared to document the findings of the 2008 Full RFI field work. All data is compared against current evaluation criteria to identify and delineate chemicals of potential concern (COPCs) and to conduct a screening against human health and ecological criteria.

1.2 Objectives

The objectives of the Full RFI are to delineate contaminants identified during the Phase I RFI from past operation of the Capehart WWTP Sludge Drying Beds, as described in the USEPA approved 2007 Full RFI Work Plan (Baker, 2007).

Specific elements of the 2008 field effort performed to support this Full RFI include:

- Surface soil sampling at nine locations;
- Subsurface soil sampling collected from five locations;
- The installation of five permanent monitoring wells at the five subsurface soil sampling locations;
- Groundwater sampling at the five monitoring wells;
- Performing slug tests at the five monitoring wells; and
- Surveying the monitoring wells.

1.3 Organization of the Full RFI Report

This report is organized into seven sections. Section 1.0 of this document discusses the purpose and objectives of this Full RFI. Section 2.0 provides a description of the current conditions of the site, including the history of SWMU 27, and a summary of previous investigations. Section 3.0 provides a description of the physical characteristics of the study area including climatology, topography, geology, hydrology, hydrogeology, and potential receptors. The scope of field investigation that was conducted in 2008 is provided in Section 4.0 (work plan summary) – this includes a surface and subsurface soil sampling and analysis program, a monitoring well

installation program, a groundwater sampling and analysis program, a quality assurance/quality control (QA/QC) sampling program, as well as other investigation considerations. The nature and extent of contamination as determined from the results is reported in Section 5.0. Section 6.0 presents the conclusions and recommendations from the Full RFI, while Section 7.0 lists relevant report references.

2.0 FACILITY BACKGROUND

This section provides the history and description of NAPR and SWMU 27, as well as the current conditions at SWMU 27.

2.1 NAPR Description and History

NAPR occupies over 8,890 acres of the northern portion of the east coast of Puerto Rico, 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. The northern entrance to NAPR is about 35 miles east along the coast road (Route 3) from San Juan (see Figure 2-1). 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.

The facility was commissioned in 1943 as a Naval Operations Base and re-designated Naval Station Roosevelt Roads (NSRR) in 1957. NSRR operated until March 31, 2004 when NSRR underwent operational closure. On April 1, 2004 NSRR was re-designated as NAPR. The current primary 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.

On October 20, 1994, a Final RCRA Part B permit was issued by USEPA Region II to NSRR. This permit listed 52 SWMUs and 4 Areas of Concern (AOCs) and contained requirements for RFI activities at 24 of these SWMUs and three of these AOCs. An additional 25 SWMUs and 2 AOCs were added to the program over the years. Figure 2-2 shows the locations of all SWMUs and AOCs at NAPR. Prior to 1993, environmental activities at NSRR, exclusive of underground storage tanks (USTs), were conducted in compliance with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) regulations under the Department of the Navy's Installation Restoration (IR) Program. The RCRA Part B permit, issued for the Defense Reutilization and Marketing Office (DRMO) at NSRR, included provisions for corrective action under the Hazardous and Solid Waste Amendments (HSWA) to RCRA.

The USEPA issued a RCRA 7003 Administrative Order on Consent (USEPA Docket No. RCRA-02-2007-7301), which became effective on January 29, 2007. SWMU 27 is identified as one of three SMWUs/treatment plants containing sludge drying beds that warrant Phase I RFIs, because of the NAPR closure. A Phase I RFI was conducted in November 2006 at SWMU 27 and based on the Phase I RFI data evaluation, a "Full" RFI was recommended by the Navy, and USEPA concurred in a comment letter dated June 28, 2007.

2.2 SWMU 27 Description and History

SWMU 27 consists of the domestic sewage treatment plant serving the Capehart housing area. The focus of this investigation is limited to the sludge drying beds located adjacent to the treatment plant. Based on information available (verbal statements, and Navy letters of August 31, 1993 and June 30, 1992), this unit does not manage or generate RCRA hazardous wastes or constituents. NAPR has no knowledge or evidence of systematic and routine releases of hazardous wastes or constituents from this SWMU.

2.3 Current Conditions/Site Usage

The Capehart sludge drying beds are used on a limited basis due to the minimal amount of flow moving through the plant since the operational closure of Naval Station Roosevelt Roads on March 31, 2004 and the transition of the facility into caretaker status. A total of four concrete sludge drying beds are located along the south eastern side of the plant as shown on Figure 2-3. The areas to the northwest and southwest sides of the drying beds are concrete, while the areas to the southeast and northeast are grass and secondary growth vegetation. The open water is located south of the plant.

2.4 Previous Investigations

SWMU 27 was identified in the RCRA/HSWA Permit dated October 20, 1994. No RFI was required for this SWMU based on verbal statements and Navy letters of August 31, 1993 and June 30, 1992 stating that no knowledge or evidence of systematic and routine releases of hazardous wastes or constituents was known from this SWMU. However, the NAPR RCRA § 7003 Administrative Order on Consent dated January 2007 required a Phase I RFI for all sludge drying beds at SWMUs 27, 28, and 29.

In anticipation of the requirements outlined in the NAPR RCRA § 7003 Administrative Order on Consent, a Phase I RFI Work Plan was developed. On September 15, 2006 the Phase I RFI Work Plans (Baker, 2006a) were developed and later approved by the USEPA on October 20, 2006. Mobilization for the RFI field activities occurred November 12, 2006 with demobilization on November 20, 2006.

The results of the Phase I RFI indicated that the bulk of the exceedances in the surface soils and groundwater were located to the northeast of the sludge drying beds. Both arsenic and zinc were above background levels as well as screening levels. Arsenic and zinc in the surface soil, arsenic in the subsurface soil, and barium in the groundwater are the primary contaminants of concern.

The subsurface soil did not exhibit much contamination above background for compounds that exceeded the human health or ecological screening criteria, with the exception of arsenic at location 27SB01-01 (human health criteria exceedance).

The highest groundwater concentrations were found in 27TW01, located northeast of the sludge drying beds. One VOC was detected in 27TW01 and 27TW02. No significant contamination was found in the groundwater near the open water in 27TW03. Barium exceeded the human health screening values and its respective background concentrations. It is likely that contamination from the operation of the SWMU has reached the groundwater at this site.

A Full RFI Investigation was recommended in order to delineate the Appendix IX metals site contamination above screening levels in surface soil, subsurface soil, and groundwater; investigate potential volatile organic compound (VOC) impacts to groundwater; as well as evaluate the potential for human health and ecological risk. The Full RFI Workplan for SWMU 27 was approved by USEPA in a comment letter dated January 07, 2008. Mobilization for the Full RFI field activities occurred on February 11, 2008 with demobilization on February 19, 2008. This document presents the results of the Full RFI for SWMU 27.

3.0 PHYSICAL CHARACTERISTICS OF STUDY AREA

The physical setting of NAPR was documented in the 1984 Initial Assessment Study (IAS) (Naval Energy and Environmental Support Activity [NEESA], 1984). This information is summarized in the paragraphs that follow. The physical results from the Phase I RFI and this Full RFI are incorporated into the description of the site-specific hydrogeology given in Section 3.3.4.

3.1 Climatology

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

Uniform temperatures prevail, with small diurnal ranges as a result of insular exposure and the relatively small land areas. The warmest months are August and September, while the coolest are January and February. Mean annual maximum temperatures range from 82.0° Fahrenheit (F) in January to 88.2° F in August. The mean annual minimum temperatures vary from 64.0° F in January to 73.2° F in June. The highest maximum temperature recorded was 95.0° F, while the lowest minimum was 59.0° F. Rain usually occurs at least nine days in every month, with an average of 60 inches per year although a dry winter season occurs from December through April. About 22 thunderstorm-days occur per year, with maximum frequencies of 3 days per month from May through October.

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

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

3.2 Topography

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

In the immediate area of NAPR, elevations range from sea level to approximately 295 feet. Immediately to the north of the NAPR boundary, the hills rise abruptly to heights of 800 to 1,050 feet above sea level, with the tallest peak located within 2 kilometers of the NAPR boundary. There is a series of three hilly areas on NAPR, two of which separate the southern airfield area from the Port/Industrial, Housing, and Personnel Support areas. The third set of hills is in the Bundy area. These ridgelines not only separate sections of NAPR, but also dictate the degree of allowable development. The ridgeline south of the airfield provides an excellent barrier, which effectively decreases the aircraft-generated noise reaching the Unaccompanied Enlisted Personnel Housing areas to an acceptable level. Relief is low along the shoreline and lagoons and mangrove swamps are common.

3.3 Geology, Hydrology, and Hydrogeology

Subsections 3.3.1 through 3.3.4 below present descriptions of the geologic, hydrologic, and hydrogeologic conditions across NAPR. These are generally applicable, but may or may not be specifically-applicable, to the SWMU 27 area. In 2004, Baker conducted a series of Phase II Environmental Condition of Property (ECP) investigations across NAPR. Subsection 3.3.4 discusses hydrogeologic information most relevant to SWMU 27 gained from the ECP investigations. Section 3.3.4 also incorporates the hydrogeologic information from the Phase I RFI, as well as from this Full RFI.

3.3.1 Soils

The soil associations found at NAPR are predominantly of two types typical of humid areas, namely the Swamps-Marshes Association and the Mabi-Rio-Arriba-Cayagua Association, as well as the Descalabrado-Guayama Association, which is typical of dry areas. In addition, isolated areas of the Caguabo-Mucara-Naranjito Association, the Coloso-Toa-Bajura Association, and the Jacana Amelia-Fraternidad Association are found at NAPR.

The Swamps-Marshes and Mabi-Rio-Arriba-Cayagua associations cover over one half of NAPR's surface area and are equally distributed. Primarily the Descalabrado-Guayama and Caguabo-Mucara-Naranjito associations cover the remaining area.

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

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

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

The Caguabo-Mucara-Naranjito Association consists generally of shallow and moderately deep, well drained, sloping to very steep soils on volcanic uplands. This association consists of soils that formed in residual material weathered from volcanic rocks. This association is represented at

NAPR by soils of the Sabana series, which are found on the side slopes and the hilly terrain west of Langley Drive in the Fort Bundy area. These soils are suited for pasture and woodland. Steep slopes, susceptibility to erosion, and depth to bedrock are the main limitations for farming and for recreation and urban areas.

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

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

3.3.2 Regional Geology

The underlying geology of NAPR area is predominantly volcanic (composed of lava and tuff), as well as sedimentary (rocks derived from discontinuous beds of limestone). These rocks all range in age from early Cretaceous to middle Eocene. The volcanic rocks and interbedded limestone have been complexly faulted, folded, metamorphosed, and variously intruded by dioritic rocks. This complex geological structuring occurred sometime after the deposition of the limestone during the middle Tertiary, when Puerto Rico was separated from the other major Antillean Islands by block faulting, and was arched, uplifted, and tilted to the northeast. Culebra, Vieques, and the Virgin Islands are part of the Puerto Rican block; they are separated from the main island simply because of the drowning that resulted from the tilting.

In addition to the predominant volcanic and sedimentary rock, unconsolidated alluvial and older deposits from the Quaternary period underlie the northwestern and western sectors of the base.

The primary geologic formations on and near NAPR are various beach deposits, alluvium, quartz diorite and granodiorite, quartz keratophyre, the Daguao Formation, and the Figuera Lava. The Peña Pobre fault zone traverses NAPR.

3.3.3 Regional Hydrology

The surface waters that flow across the northeastern plain of Puerto Rico, where NAPR is located, originate on the eastern slopes of the Sierra De Luquillo Mountains. Surface runoff is channeled into various rivers and streams that eventually flow into the Caribbean Sea. The Daguao River and Quebrada Seca Stream (a tributary to Rio Daguao) collect surface waters from the hills immediately north of NAPR and, in periods of heavy rain, flooding on NAPR occurs. The Daguao-Quebrada Seca watershed comprises an area of approximately 7.6 square miles (4,900 acres), and the river falls some 700 feet from its source to sea level. Increased development in the town of Ceiba, especially in areas adjacent to NAPR's northern boundary, has

significantly increased the surface runoff reaching NAPR, causing ponding and erosion in the Boxer Drive area. Boxer Drive, for a major portion of its length, is subject to surface water flooding, as are Hangar 200 and AIMD Hangar 379 and adjacent apron areas. This condition has been alleviated by the construction of a new highway (Route 3) immediately outside the fence and the realignment of Boxer Drive both with attendant storm water management features.

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

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

The quality of surface waters is variable, reflecting the drainage area through which the water flows. Generally, surface waters have high turbidities and bio-organics (naturally occurring organics, such as decay products of vegetable and animal matter) due to the periodic heavy rains that can easily erode soils from steep slopes, exposed areas and disturbed streambeds. Water from alluvial aquifers along the coast of NAPR is of a calcium bicarbonate type, and has high concentrations of iron and manganese. The source of these minerals is unknown, but they may be derived from buried swamp or lagoon deposits.

A seawater-freshwater interface is present in the aquifers throughout the coastal areas of Puerto Rico, usually within a short distance inland of the coastline.

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

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

3.3.4 Site-Specific Hydrogeology

In 2004, Baker conducted a Phase II ECP investigation involving 20 sites throughout NAPR (NAVFAC, 2004). Some consistent stratigraphic trends were observed during the ECP. The site-specific hydrogeology can be better understood in the context of NAPR regional geology. For the sake of simplicity, the NAPR regional geology can be divided into three regions:

- Upland areas
- Near-shore flat lands
- Inland flat lands

The upland areas of NAPR includes the hills encompassing the Tow Way Fuel Farm and hospital areas, and the hills encompassing the area behind the Exchange, the former Atlantic Fleet Weapons Training Facility (AFWTF) Command, and Fort Bundy area. These upland areas are underlain by bedrock (predominately Gabbro) and exhibit varying degrees of weathering. Typically, the bedrock is overlain be a relatively thin residual soil (i.e., residuum). Residuum is unconsolidated soil, originating from weathered-in-place bedrock. This residuum generally consists of sand, silt, and clay.

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

The inland flat land area generally encompasses the airfield and golf course areas. The inland flat land area is typically underlain by relatively thick residuum. The residuum generally consists predominately of clay. Fill material overlays the residuum in some areas, particularly the airfield, and generally consists of sand and gravel with lesser amounts of silt and clay.

SWMU 27 is located in the inland flat land area, but is immediately adjacent to a near shore area consisting of a mangrove swamp. Borings from both the Phase I RFI and this Full RFI indicate that the stratigraphic sequence of SWMU 27 varies across the site. Borings in the northern portion of the site, including 27SB01, 27SB02, 27SB04, 27SB05, 27SB06 and 27SB08 consisted of clay, silt, and sand (most likely the result of fill placement used to construct the WWTP), overlying peat and clay deposits of the mangrove swamp area adjacent to the drying beds. Borings in the southern portion of the site, including 27SB03 and 27SB07 encountered sand and shells resulting from beach deposits. The soil boring/monitoring well locations are shown on Figure 3-1. A geologic cross-section from southwest to northeast across the site is provided on Figure 3-2. This figure illustrates the sandy clay (fill) material underlain by silty clay and peat in the northeastern portion of the site and underlain by sand and gravel in the southern and southwestern portion of the site.

Figure 3-2 also illustrates that groundwater was encountered at shallow depths at this site. Static water levels, summarized on Table 3-1, were measured prior to sampling of the monitoring wells, prior to conducting slug tests on the wells, on May 18, 2008 and again on June 12, 2008. Groundwater contours developed from the groundwater level measurements collected from June 12, 2008 are shown on Figure 3-3. The overall groundwater flow direction from this data is predominately to the south towards the Caribbean Sea; while areas locally may flow east into the nearby mangrove. The hydraulic gradient was calculated as approximately 0.029 ft/ft to the south. The wells located near the mangrove 27GW05 and 27GW06 contained peat, clay, and high levels of tightly packed organic material, thus taking a long time for groundwater levels to equilibrate as shown on Table 3-1. In addition, rainfall at NAPR that is reported in the RCRA 7003 Quarterly Progress Report at the Tow Way Fuel Farm, reported low rainfall for the months of February, March and April. This helped compound the slow groundwater equilibration at these wells. Wells 27GW04 and 27GW08 contained mostly sand and gravel fill, and well 27GW07 is drilled in beach sand and shells. These differing lithologies are also represented in the slug test results shown on Table 3-2, with slow hydraulic conductivities within the tightly packed peat and clay at 27GW05 and 27GW06 when compared to the other three wells.

Rising and falling head slug tests were performed during the Full RFI field investigation in wells 27MW04 through 27MW08. Testing and evaluation procedures used for the slug tests are

described in Section 4.3. The hydraulic conductivity values calculated from the slug test data from each well are summarized on Table 3-2. Hydraulic conductivity values from the rising head slug tests ranged from 0.23 to 9.45 feet/day. Hydraulic conductivities from the falling head portion of the tests ranged from 0.01 to 14.99 feet/day. The average hydraulic conductivity for SWMU 27 was 3.11 feet/day (1.1×10^{-3} cm/sec). These hydraulic conductivities are typical of very fine sand or peat (Bear, 1972).

3.4 Potential Receptor Information

3.4.1 Human Receptors

NSRR underwent operational closure on March 31, 2004. On April 1, 2004, NSRR was re-designated as NAPR. The current primary 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. It is assumed that long-term plans for the facility would be similar to those that had been in place prior to closure with land use also generally the same. Based on information available regarding the physical features, site setting, site historical activities, and current and expected land uses, five potential human receptors have been selected for evaluation. These include:

- Current On-site Adult Trespasser
- Current On-site Adolescent Trespasser (9-15 years)
- Current/Future On-site Adult Workers
- Future Construction Worker

Presently, the wastewater treatment plant is operating on a limited basis. The land use at SWMU 27 is likely to remain the same in the future. What is known of the site history and some additional background information about this site can be found in Section 2.2 of this report. The following paragraphs are a general description of potential human receptor scenarios.

In the current scenario, it is conservatively assumed that on-site trespassers and on-site workers could access the site and potentially be exposed to COPCs at the site. Potential exposure via ingestion of and dermal contact with surface soil was considered for adult and adolescent trespassers. Additionally, the inhalation pathway (fugitive dusts) is considered for soil. The potential exposure pathways evaluated for the on-site worker include ingestion and dermal contact with surface soil and subsurface soil as well as inhalation of fugitive dusts from soil. Soil at this depth could be accessible to a current on-site worker performing grounds-keeping/site maintenance activities or a future on-site worker should the site become a commercial/industrial setting, in which case shallow subsurface soil could be disturbed and brought to the surface. Currently, groundwater is not used for potable purposes at the site; consequently exposure to groundwater in the current scenario would not be evaluated.

Future construction workers that may perform excavation and construction at the site are also considered for ingestion and dermal contact exposures to (as appropriate) excavated surface soil and subsurface soil, as well as the inhalation of fugitive dusts emanating from soil during excavation/construction activities. Dermal contact exposure with groundwater and inhalation of volatiles in groundwater during excavation activities were also considered as a conservative measure for the construction worker receptor.

Specifically, the following potential human receptor and exposure pathway combinations are identified for SWMU 27.

Current On-Site Adult/Adolescent Trespassers

- Ingestion of Surface Soil
- Dermal Contact with Surface Soil
- Inhalation of Fugitive Dusts

Current/Future On-Site Adult Workers

- Ingestion of Surface Soil and Subsurface Soil
- Dermal Contact with Surface Soil and Subsurface Soil
- Inhalation of Fugitive Dusts

Future Construction Workers

- Ingestion of Surface Soil and Subsurface Soil
- Dermal Contact with Surface Soil, Subsurface Soil, and Groundwater
- Inhalation of Fugitive Dusts in Soil and VOCs in Groundwater

3.4.2 Ecological Receptors

The sections that follow provide a brief description of the habitats occurring within and contiguous to SWMU 27, as well as the biota that may be present. The description of habitats and biota relies primarily on literature-based information for Puerto Rico and NAPR.

3.4.2.1 Terrestrial Habitats

The upland habitat bounded by NAPR is classified as subtropical dry forest (Ewel and Witmore, 1973). Similar to other forested areas of Puerto Rico, this region was previously clear-cut in the early part of the century, primarily for pastureland (Geo-Marine, Inc., 1998). After acquisition by the Navy, a secondary growth of thick scrub, dominated by lead tree (*Leucaena spp*.), Christmas tree (*Randia aculeate*), sweet acacia (*Acacia famesiana*), and Australian corkwood (*Sesbania grandiflora*) grew in the previously grazed sections (Geo-Marine, Inc., 1998). Secondary growth communities (upland coastal forest communities and coastal scrub forest communities) exist today throughout NAPR's undeveloped upland. The upland vegetative community at SWMU 27 is extremely limited due to the presence of paved surfaces and structures associated with domestic sewage treatment operations. The community is limited to patches of maintained grasses of unknown species composition (likely to include *Bothriochloa ischaemum, Chloris barbata*, and *Digitaria* sp. based on maintained grasses identified during a habitat characterization conducted at SWMU 45 in May 2000 [(Geo-Marine, Inc., 2000]). An upland coastal forest community is located north and west of SWMU 27 (see Figure 3-4). Identical to the maintained grassy areas within SWMU 27, the species composition of this community is not known. However, vegetation identified within upland coastal forest communities elsewhere at NAPR have included lead tree, almacigo (*Bursa simaruba*), Christmas tree, oxhorn bucida (*Bucida buceras*), basket wiss (*Trichostigma octandrum*), and common guayaba (*Psidium guajava*) (Geo-Marine, Inc., 2000). Many of these species are likely present with the upland coastal forest community adjacent SWMU 27.

Cobana negra (*Stahlia monosperma*), a federally threatened tree species, is known to occur between the boundary of black mangrove communities and coastal upland forest communities. This species is also known to occur in coastal forests of southeastern Puerto Rico (Little and Wadsworth, 1964). A single individual has been reported at NAPR. Although the location of the sighting was not documented, NAPR personnel believe the tree is located within the coastal forest

community behind the former Navy Exchange store, northwest of Langley Drive (approximately 2.0 miles north of SWMU 27).

3.4.2.2 Aquatic Habitats

Approximately 460 acres at NAPR are covered by palustrine habitat, which includes all freshwater wetlands. These wetlands include wet meadows and marshes, dominated by cattails (*Typha spp*.) and grasses (*Panicum spp*. and *Paspalum spp*.), as well as wet coastal scrub forests. The marine environment surrounding NAPR includes mudflats, mangroves and seagrass beds. The total area of mudflats, mangroves, and seagrass beds in the offshore environment is approximately 161 acres, 2,700 acres, and 1,900 acres, respectively (Geo-Marine, Inc., 1998). Coral reefs are also located in the offshore marine environment (see Figure 3-4). Coral reef types within the waters surrounding NAPR, as well as their associated acreage cover are provided within the table below (Department of the Navy [DoN], 2007).

Reef Habitat Type	Area (acres)
Colonized Bedrock	266
Linear reef	84
Patch Reef (Aggregated)	146
Patch reef (Individual)	175
Scattered Coral-Rock	5

Mangroves at NAPR mainly consist of red mangrove (*Rhizophora mangle*), black mangrove (*Avicenia germinans*), and white mangrove (*Laguncularia racemosa*) (Geo-Marine, Inc., 2000 and 2005). Red mangroves tolerate relatively deep water levels, grow in unstable, soft soil, and tolerate a salinity range of 10 to 55 parts per thousand (ppt). They develop large prop roots which usually extend above the water surface. Black and white mangroves generally grow in areas that are not inundated by water. Mangroves at NAPR are natural filters for upland runoff and protect the coastline from storm damage (Lewis, 1986). They also provide habitat for wildlife, fish, and benthic invertebrates. Lewis (1986) reported 112 species of birds that use the NAPR mangroves as habitat for feeding, nesting, and roosting. The red mangrove prop root habitat in Puerto Rico also is used by at least 13 species of fish (including the gray snapper [*Lutijanus griseus*], lane snapper [*Lutijanus synagris*], and gold and black tricolor [*Holocanthus tricolor*]), several crustaceans (including the flat tree oyster [*Isognomon alatus*]), gastropods (including the coffee bean snail [*Melampus coffeus*] and mangrove periwinkle [*Littorina angulifera*]), echinoids (including the long-spined sea urchin [*Diadema antillarum*] and pencil sea urchin [*Eucidaris tribuloides*]), sponges (including the fire sponge [*Tedania ignis*]), ascidians (including the black tunicate [*Acsidia nigra*]), and hydroids (including the feathered hydroid [*Halocordyle disticha*]) (Geo-Marine, Inc., 2005).

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

SWMU 27 borders the Atlantic Ocean to the south and a small estuarine wetland community to the east. A map showing the spatial relationship of SWMU 27 to these marine/estuarine habitats is provided as Figure 3-5. The figure includes freshwater and marine wetland units identified by

the Cowardin Wetland Classification System (Cowardin et al., 1979 [see Figure 3-6]). The wetlands depicted on Figure 3-5 were delineated by Geo-Marine, Inc. in December 1999 from 1993 color infrared and 1998 true color aerial photography. Twenty percent of the wetlands delineated by aerial photography were field checked to verify the accuracy of the delineations. Field verification was based on the 1987 Corps of Engineers wetland delineation manual (United States Army Corps of Engineers [USACE], 1987). There are no freshwater wetland units within or immediately contiguous to SWMU 27. However, as indicated above and depicted on Figure 3-5, SWMU 27 borders an estuarine wetland unit classified as Estuarine, Intertidal, Scrub-Shrub, Broad-Leaved Evergreen (E2SS3) by the Cowardian Wetland Classification System.

Seagrass beds (dominated by turtle grass) are found within the open water marine environment bordering SWMU 27 (see Figure 3-4). The seageass beds represent potential grazing areas for the West Indian manatee (*Trichechas manatus*), a federally endangered species throughout its range, and the green sea turtle (*Chelonia mydas*), a federally threatened species in Puerto Rico. In addition to sea grass habitat, coral reef habitat is located within the open water marine environment adjacent to SWMU 27. The nearest reef habitat is located approximately 300 feet from the shoreline bordering SWMU 27.

3.4.2.3 Biota

A description of the biota occurring within Puerto Rico and the landmass encompassed by NAPR is provided in the sections that follow. It is noted that the biota occurring at and immediately contiguous to SWMU 27 has not been documented during previous investigations.

3.4.2.3.1 Mammals

A total of 22 terrestrial mammal species are known historically from Puerto Rico; however, all mammals except bats (13 species) have been extirpated (United States Geological Survey [USGS], 1999). None of the bats found on Puerto Rico are exclusive to the island. The specific bat species known to occur on Puerto Rico are listed below:

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

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

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

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

The absence of fruit-bearing and flowering vegetation at SWMU 27 excludes potential exposures by fruit-eating species (Jamaican fruit bat, Antillean fruit bat, red fig-eating bat) and nectar-feeding species (brown flower bat and Greater Antillean long-tongued bat). It is noted that the upland coastal forest community north and west of SWMU 27 may provide foraging habitat for several of these species. Insectivorous bats (Antillean ghost-faced bat, Parnell's mustached bat, sooty mustached bat, big brown bat, red bat, velvety free-tailed bat, and Brazilian free-tailed bat) feed primarily on flying insects that would not be expected to have any appreciable exposure to soil contaminants At SWMU 27. Finally, the lack of any surface water body within SWMU 27

precludes potential exposures to chemicals detected in surface and subsurface soil by fish-eating bats (Mexican bulldog bat). However, the estuarine wetland community located east of SWMU 27 may provide foraging habitat for this piscivorous bat species.

Of the endangered/threatened marine mammals that may occur in Puerto Rico, only the West Indian manatee is known to occur in the marine environment surrounding NAPR (DoN, 2007). Manatee populations in Puerto Rico's coastal waters have been documented during three aerial surveys conducted from 1978 to 1979, 1984 to 1985, and in 1993 (United Nations Environmental Program [UNEP], 1995), a radio tracking study of manatee distribution and abundance (Reid and Kruer, 1998), and a year-long study of manatee distribution and abundance (Woods et al., 1984). Historical manatee sightings at NAPR are summarized on Figure 3-7. The figure (reproduced from DoN, 2007) includes information from most of the studies identified above. Feeding manatees are most often recorded within Pelican Cove and the Ensenada Honda (see Figure 3-7). They have also been commonly encountered within the offshore marine environment bordering SWMU 27.

Several mammals have been introduced into Puerto Rico, including the black rat (*Rattus rattus*), Norway rat (*Rattus norvegicus*), and mongoose (*Herpestes javanicus*). These nonindigenous mammals have been implicated in the decline of native bird and reptile populations (USGS, 1999 and United States Fish and Wildlife Service [USFWS], 1996a).

3.4.2.3.2 Birds

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

Numerous native and migratory bird species have been reported at NAPR (Geo-Marine, Inc., 1998). A list of bird species reported at NAPR or having the potential to occur is provided in Table 3-3. The list, compiled from literature-based information pre-dating 1990, includes the great blue heron (*Ardea herodias*), snowy egret (*Egretta thula*), little blue heron (*Florida caerulea*), black-crowned night heron (*Nycticorax nycticorax*), belted kingfisher (*Ceryle alcyon*), spotted sandpiper (*Actitis macularia*), greater yellowlegs (*Tringa melanoleauca*), black-bellied plover (*Squatarola squatarola*), clapper rail (*Rallus longirostris*), Royal tern (*Thalasseus maximus*), sandwich tern (*Thalasseus sandvicensis*), least tern (*Stema albifrons*), yellow warbler (*Dendroica petechia*), palm warbler (*Dendroica palmarum*), prairie warbler (*Dendroica discolar*), magnolia warbler (*Dendrocia magnolia*), mourning dove (*Zenaida macroura*), red-legged thrush (*Mimocichla plumbea*), common nighthawk (*Chordeiles minor*), and red-tailed hawk (*Buteo jamaicensis*). Endemic species reported from NAPR include the Puerto Rican lizard cuckoo (*Saurothera vieilloti*), Puerto Rican flycatcher (*Myiarchus antillarum*), Puerto Rican woodpecker (*Malanerpes portoricensis*), Puerto Rican emerald (*Chlorostilbon maugaeus*), and yellow-shouldered blackbird (*Agelaius xanthomus*).

The yellow-shouldered blackbird is a federally endangered species. One of the principal reasons for the status of this species is attributed to parasitism by the nonindigenous shiny cowbird, which lays its eggs in blackbird nests and sometimes punctures the host's eggs (USFWS, 1983). Other factors contributing to the status of this species include nest predation by the introduced black rat, Norway rat, and mongoose, as well as habitat modification and destruction (USFWS, 1996a). The entire land area of NAPR was declared critical habitat for the yellow-shouldered blackbird in

1976; however, a 1980 agreement with the USFWS exempted certain areas from this categorization (Geo-Marine, Inc., 1998). SWMU 27 is not located within the critical habitat designation. A study conducted by the Naval Facilities Engineering Command (NFESC, 1996) reported that the mangrove forests surrounding NAPR should be considered the most important nesting habitats for the yellow-shouldered blackbird. A survey conducted in July 2002 by the Puerto Rico Department of Natural Resources (PRDNR, 2002) reported fifteen yellow-shouldered blackbirds (including five juveniles) at NAPR. At the time of the survey, the birds were using the structures at the NAPR airport for resting cover (the nearest airport structure is approximately 3.1 miles northeast of SWMU 27). Although nesting pairs were not observed (the survey was not conducted during the breeding season), the airport structures contained several inactive nests. The inactive nests and juvenile birds indicate that a small breeding population is present at NAPR. As discussed in Section 3.4.2.1, the vegetative community at SWMU 27 is limited to maintained grasses of unknown species composition. Because yellow-shouldered blackbirds are arboreal feeders that forage within the canopy and sub-canopy of trees (USFWS, 1996a), they are not expected to forage within the available habitat at SWMU 27. However, the adjacent upland coastal forest community represents potential feeding habitat for this species.

Other federally listed bird species that occur or have the potential to occur at NAPR are the Caribbean brown pelican (*Pelecanus occidentalis occidentalis*), roseate tern (*Sterna dougallii dougallii*), and the piping plover (*Charadrius melodus*) (Geo-Marine, Inc., 1998). The piping plover is a rare, non-breeding winter visitor in Puerto Rico (Raffaele, 1989). This species breeds only in North America in three geographic regions (Atlantic Coast population [threatened], Great Lakes population [endangered], and Northern Great Plains population [threatened]; USFWS, 1996b). No piping plover observations were reported at NAPR during the 1990s or during sea turtle nesting surveys conducted in 2002 and 2004 (Geo-Marine, Inc., 2005). No historic evidence is available to indicate whether the roseate tern (threatened in Puerto Rico) has ever nested at NAPR and no roseate tern observations have been noted in or over coastal waters adjacent to NAPR (DoN, 2007). The nearest active roseate tern colony likely occurs on the eastern end of Vieques (more than 20 miles east of NAPR) (DoN, 2007). The Caribbean brown pelican (endangered in Puerto Rico) appears to be a seasonal resident at NAPR and in the surrounding coastal waters (Geo-Marine, Inc., 2005). Small numbers, primarily juveniles, have been seen day-roosting, feeding, and resting irregularly in onshore and near-shore habitats at NAPR; however, no brown pelican nesting colonies have been found at NAPR or on the small cays nearby (Geo-Marine, Inc., 2005). Based on the habitat preferences of these three species and observations recorded at NAPR, only the Caribbean brown pelican has the potential to use the offshore marine environment adjacent to SWMU 27 as a food source.

3.4.2.3.3 Reptiles and Amphibians

A total of 23 amphibians and 47 reptiles are known from Puerto Rico and the adjacent waters (USGS, 1999). Fifteen of the amphibians and 29 of the reptiles are endemic, while four amphibian species and three reptilian species have been introduced (USGS, 1999). Puerto Rico's native amphibian species include 16 species of tiny frogs commonly called coquis. On the coastal lowlands, almost all coqui species are arboreal. The only amphibians listed under provisions of the Endangered Species Act of 1973 are the Puerto Rican ridge-headed toad (*Peltophryene lemur*) and the golden coqui (*Eleutherodactylus jasperi*). Both species are listed as threatened. Distribution of the golden coqui is restricted to areas of dense bromeliad growth. All specimens to date have been collected from a small semicircular area of a 6-mile radius south of Cayey (approximately 30 miles southwest of NAPR), generally at elevations above 700 meters (USFWS, 1984). The Puerto Rican ridge-headed toad occurs at low elevations (below 200 meters) where there is exposed limestone or porous, well drained soil offering an abundance of fissures and cavities (USFWS, 1987). A single large population is known to exist from the

southwest coast in Guánica Commonwealth Forest, and a small population is believed to survive on the north coast near Quebradillas, Arecibo, Barceloneta, Vega Baja, and Bayamón (USFWS, 1987). It has also been collected on the southeastern coastal plain near Coamo (USFWS, 1987). Given the habitat preferences and locations of known occurrences, these two species are not expected to occur at NAPR.

Puerto Rico's native reptilian species include 31 lizards, 8 snakes, 1 freshwater turtle, and 5 sea turtles (USGS, 1999). Of the five sea turtles, only the green sea turtle, hawksbill sea turtle (*Eretmochelys imbricata*), and loggerhead sea turtle (*Dermochelys coriacea*) nest within Puerto Rico. These three sea turtles, as well as the leatherback sea turtle (*Caretta caretta)* are listed under the provisions of the Endangered Species Act of 1973 (hawksbill sea turtle and leatherback sea turtle are listed as endangered, while the green sea turtle [Caribbean population] and loggerhead sea turtle are listed as threatened) (USFWS, 2008). Aerial surveys of turtles were performed from March 1984 through March 1995 along the Puerto Rican Coast. This information was summarized by Geo-Marine, Inc. (2005) in the Draft NAPR Disposal Environmental Assessment (EA). Figures 3-8 and 3-9 (reproduced from Geo-Marine, Inc., 2005) present cumulative sea turtle sightings and potential turtle nesting sites at NAPR. Significant turtle observations were made near the mouth of the Ensenada Honda, the northern shore of Pineros Island, Pelican Bay, and the Medio Mundo Passage with the frequency of turtle observations listed as green > hawksbill > loggerhead > leatherback. Based on the life history information for each turtle species (summarized in Baker, 2006b and 2006c) and the availability of forage material (in the form of sea grasses, hard bottom corals, and most likely sponges), the green, hawksbill, and loggerhead sea turtles have the potential to forage within the off-shore marine environment adjacent to SWMU 27.

The Puerto Rican boa (*Epicrates inornatus*) is a federally endangered species. Four Puerto Rican boa sightings were reported at NAPR prior to 1999 and an additional four occurrences were reported between 2001 and 2003 (Geo-Marine, Inc., 2005). However, no boas were observed during 211 man-hours of surveys conducted within potential boa habitat in 2004 (Tolson, 2004). The Puerto Rican boa uses a variety of habitats but is most commonly found in Karst forest habitat (forested limestone hills). Based on the absence of preferred habitat, there is low probability of occurrence of this species at SWMU 27 or the adjacent upland coastal forest community.

3.4.2.3.4 Fish and Aquatic Invertebrates

A diverse fish and invertebrate community can be found in the marine environment surrounding NAPR. This can be attributed to the varied habitats that include marine and estuarine open water habitat, mud flats, sea grass beds, and mangrove forests. The fish community is represented by stingrays, herrings, groupers, needlefish, mullets, barracudas, jacks, snappers, grunts, snooks, lizardfishes, parrotfishes, gobies, filefishes, wrasses, damselfishes, and butterflyfish (Geo-Marine, Inc., 1998). The benthic invertebrate community includes sponges, corals, anemones, sea cucumbers, sea stars, urchins, and crabs. Fish and invertebrate species inhabiting the marine/estuarine habitats contiguous to SWMU 27 have not been documented in the literature or during previous investigations.

4.0 2008 RCRA FACILITY INVESTIGATION ACTIVITIES

The areas around the WWTP drying beds at SWMU 27 were investigated in November 2006 during the Phase I RFI. A Full RFI Investigation was recommended based on the results of the Phase 1 RFI in order to delineate the Appendix IX metals site contamination above screening levels in surface soil, subsurface soil, and groundwater; investigate potential VOC impacts to groundwater; as well as evaluate the potential for human health and ecological risk. The following sections discuss the data collected during the Full RFI according to the 2007 Full RFI Work Plan (Baker, 2007). Section 4.1 discusses soil boring advancement and monitoring well installation. Section 4.2 discusses the groundwater level measurements and Section 4.3 explains the well head testing activities. Section 4.4 discusses the soil and groundwater sampling and analysis program. Section 4.5 presents a discussion of the QA/QC sampling programs involved with the Full RFI. Section 4.6 discusses how the sample locations were surveyed. The physical results of this investigation are presented in Section 3.3.4 and the analytical results are discussed in detail in Section 5.0. Figure 3-1 depicts the sampling locations at SWMU 27. The field notes from the various personnel involved with this investigation are provided in Appendix A.1.

4.1 Soil Boring Advancement and Monitoring Well Installation

Surface and subsurface soil samples were collected using direct-push technology (DPT) through the use of a Geoprobe® Macro Core Sampler in conjunction with a Geoprobe® 66DT track-mounted rig. GeoEnviroTech of San Juan, Puerto Rico was the DPT contractor. As presented in the Final Full RFI Work Plan (Baker, 2007), a total of five soil borings (27SB04 through 27SB08) were advanced at SWMU 27 (Figure 3-1). Surface soil samples were also collected at four additional locations (27SS04 to 27SS08) utilizing stainless steel spoons.

Five soil boring/monitoring wells were advanced at the following locations:

- One soil boring/monitoring well (27SB04/27MW04) was installed at an assumed upgradient location northeast of the site.

- One soil boring/monitoring well (27SB05/27MW05) was installed north of the sludge drying beds to investigate the potential release of 1,1,1,2-PCA.

- Two soil borings/monitoring wells (27SB06/27MW06 and 27SB07/27MW07) were installed along the eastern edge of the sludge drying beds to investigate the vertical extent of contamination and the potential VOC impacts.

- Soil boring/monitoring well 27SB08/27MW08 was installed west of the sludge drying beds to verify the western limit of potential contamination in soil and groundwater. It should be noted that the proposed location of this soil boring was thought to be on the concrete slab, when it was actually located within a small grass area west of the sludge drying beds. The work plan did not call for a surface soil sample to be collected at this location due to the believed concrete being present at this location. Due to the boring location being located in grass a surface soil sample was collected from this location and is described in the following pargraph.

Surface soil samples were collected at the above boring locations. Four additional surface soil samples were collected from the following locations:

- Three surface soil samples (27SS04, 27SS05 and 27SS06) were collected from near the northern edge of the sludge drying pits, including one location near the edge of the estuarine wetland.

- One surface soil sample (27SS07) was collected within a drainage area along the eastern edge of the sludge drying pits.

Each boring site was field located with a survey grade Global Positioning System (GPS) receiver. An elevation was obtained from the top of polyvinyl chloride (PVC) casing for water level

elevation calculations and a spot ground surface elevation was also obtained. Soil boring and well construction logs have been produced and are provided in Appendix A.2. No elevated photoionization detector (PID) measurements were observed at the boring/monitoring well locations.

After collection of the subsurface soil samples, the borings were augered using 4-1/4 inch diameter hollow stem augers. Permanent monitoring wells then were constructed in each boring using 1.5-inch diameter, Schedule 40, Geoprobe Prepack well screen threaded to 1.5-inch diameter, Schedule 40 PVC riser. Total boring depths at SWMU 27 were approximately 10 feet below ground surface (bgs). Screen lengths were cut to approximately 7.0 feet and located to straddle the water bearing zone. Each well was secured with a concreted flush mount wellhead.

The monitoring wells were developed after a period of approximately one day following installation to ensure the annular seal was properly cured and to assure that groundwater enters the well screen freely, thus yielding a representative groundwater sample and water level measurement, to remove water that may have been introduced during drilling and well installation, to remove very fine-grained sediment in the filter pack and nearby formation to minimize groundwater sample turbidity and silting of the well, and to maximize the efficiency of the filter pack for accurate aquifer hydraulic testing.

Monitoring wells were developed using dedicated bailers. Generally, water removal continued until the groundwater appeared to clear of fine sediments. Specific conductivity, pH and temperature were measured after the removal of each well volume of water. Turbidity of the removed water was visually noted. A record of the well development is provided in the field log in Appendix A.1.

4.2 Groundwater Level Measurements

Groundwater levels were measured in each monitoring well using an electronic water level meter to the nearest 0.01 foot. Measurements were taken immediately prior to collecting groundwater samples, prior to conducting the slug tests on May 18, 2008. Water level measurements and calculated groundwater elevations are presented on Table 3-1. Groundwater elevation contours are provided on Figure 3-3.

4.3 Aquifer Characterization Testing

Falling and rising head slug tests were performed at each of the newly installed permanent monitoring wells following completion of well installation, development and groundwater sampling. The purpose of the slug tests was to estimate the hydraulic conductivity of the saturated zone in the immediate vicinity of the monitoring well by measuring the aquifer response to a change in static conditions induced by introduction or removal of a slug of known volume from the well. For this test, a 1.5-inch diameter slug (approximately 1.5-inches in diameter by 3 foot long) slug was used.

Each test was initiated by measuring the static water level in the well. A pressure transducer attached to a computerized data logger was then installed in the well and the water levels allowed to re-equilibrate. The slug was introduced into the well and the change in the water level over time was measured for the falling head portion of the slug test. Measurements continued until water levels stabilized at which point the slug was removed from the well and the change in water level was again measured until the water levels stabilized for the rising head portion of the test.

The electronic water level measurements were processed using Microsoft Excel and AQTESOLV® for Windows®, version 3.5. The Bouwer and Rice method (Bouwer and Rice, 1976 and 1989) for analyzing slug test data in unconfined aquifers was selected as the solution method. A saturated thickness of 20 feet was used, based on observations made during drilling. The aquifer was assumed to be isotropic and therefore an anisotropy ratio of 1 was used. A boring radius of 0.19 ft and a casing radius of 0.08 ft were used as inputs for all well tests for calculating hydraulic conductivity. The remaining input parameters used for calculating hydraulic conductivity, in addition to the time and water level measurements, included initial displacement, total well penetration depth, static water column height and screen length. These parameters varied by well location based on well construction and water level. A summary of the input parameters used for calculating the hydraulic conductivity and the graphical analysis is provided in Appendix A.3. The hydraulic conductivity values calculated from the slug test data from each well are summarized on Table 3-2 and are discussed in Section 3.3.4.

4.4 Environmental Sampling and Analysis Program

Table 4-1 provides a summary of the soil and groundwater sampling and analytical program performed for the 2008 Full RFI at SWMU 27. In addition, this table shows information related to field duplicate and matrix spike/matrix spike duplicate (MS/MSD) samples (since these are collected concurrent with the environmental samples). Other QA/QC samples (trip blank, field blanks, and equipment rinsates) were collected and analyzed in accordance with Table 4-2. Also, analytical methods/descriptions, parameter lists, and Contract Required Quantitation Levels (CRQLs) are presented in Table 4-3. The chain-of custodies for the sampling at SWMU 27 are provided as Appendix A.4.

4.4.1 Surface and Subsurface Soils

Surface soil samples were collected at soil borings 27SB04 through 27SB08 and surface soil sample locations 27SS04 through 27SS07 from a depth of 0 to 1-foot bgs. Subsurface soil samples were collected at all soil borings from two-foot intervals from below the surface soil sample (specifically, 1 to 3 feet bgs and 3 to 5 feet bgs) to just above the water table (variable depth). This sampling scheme resulted in the collection of nine surface soil and ten subsurface soil primary environmental samples. These samples were submitted to Test America Laboratory in Savannah, Georgia for analysis of Appendix IX metals.

4.4.2 Groundwater

Five primary environmental groundwater samples (27GW04 through 27GW08) were collected, one from each of the permanent monitoring wells installed at SWMU 27 using low flow sampling techniques, as specified in the Full RFI Work Plan (Baker, 2007). Groundwater samples were given the GW designation in the sample name and the corresponding well number; for example, the groundwater sample collected from monitoring well 27MW05 was designated as 27GW05. Samples were submitted to the analytical laboratory for Appendix IX VOCs, and total and dissolved metals.

4.5 Quality Assurance/Quality Control Sampling and Analysis Program

Quality Assurance/Quality Control samples were collected throughout the field investigation to assist in evaluating the usability of the resultant soil and groundwater data. QA/QC samples collected for this investigation included field duplicates, trip blanks, matrix spike/matrix spike duplicates, field blanks and equipment rinsates. Each of these is discussed in the following sections.

4.5.1 Field Duplicates

A total of nineteen soil samples and five groundwater samples were collected as part of the 2008 Full RFI field sampling activity at SWMU 27. The Full RFI Work Plan specifies one duplicate sample to be collected for every ten primary soil samples collected. Thus, one field duplicate sample (27SS07D) was collected concurrently with the surface soil samples and one field duplicate (27SB08-02D) was collected concurrently with the subsurface soil samples. These samples were analyzed for Appendix IX metals. One groundwater duplicate sample (27GW08D) was collected and analyzed for Appendix IX VOCs and total and dissolved metals. Duplicate samples are useful in evaluating the field sampling methodology.

4.5.2 Matrix Spike/Matrix Spike Duplicates

A total of 19 soil samples and five groundwater samples were collected as part of the 2008 Full RFI field sampling activity. The Full RFI Work Plan specifies one matrix spike/matrix spike duplicate sample be collected for every 20 primary samples collected (for each matrix). Therefore, one QA/QC soil sample 27SS07MS/MSD, was collected from the surface soil to evaluate the matrix effect upon the analytical methodology. The soil sample was analyzed for Appendix IX metals. Separate MS and MSD samples of groundwater were collected at sample location 27MW08 (27GW08MS and 27GW08MSD). The groundwater samples were analyzed for Appendix IX VOCs, and total and dissolved metals.

4.5.3 Trip Blanks

One trip blank sample accompanied each cooler containing the groundwater samples for Appendix IX VOC analysis. One trip blank sample was prepared for this investigation: TB01. Trip blank sample results are used to determine whether cross-contamination occurred during sampling and/or shipping.

4.5.4 Field Blanks

Field blank samples were collected from two different source waters encountered during this investigation. One field blank sample (FB01) was collected from lab grade deionized water used as the source water for the equipment rinsate samples. The other field blank sample (FB02) was from a NAPR potable water source used for Geoprobe Macrocore soil sample collection equipment washing. No store bought distilled water was purchased during this investigation due to the disposable sampling equipment being used in the field, so a third field blank for store bought distilled water was not necessary.

Field blank samples are always analyzed for the same parameters as the related environmental samples. Therefore, both field blank samples were sent to the laboratory for analysis of Appendix IX VOCs and total metals. Field blank testing is useful in determining if other water sources used in the cleaning/decontamination procedures associated with the sampling event are free of contamination.

4.5.5 Equipment Rinsates

Three decontaminated equipment rinsate samples were collected, submitted, and analyzed as part of the QA/QC program. ER01 and ER02 are rinsates from the Macrocore® Acetate liner used during direct push soil sampling. ER05 is a rinsate from silicon/polyethylene tubing associated with groundwater sampling.

Equipment rinsate samples are always analyzed for the same parameters as the related environmental samples. Therefore, each equipment rinsate sample was analyzed for Appendix IX VOCs and total metals. Results from equipment rinsate samples are useful in determining if the sampling equipment was contaminant-free during the field investigation.

4.6 Surveying

Survey activities were performed using Real-Time Kinematic (RTK) GPS methods. RTK GPS surveying achieves better accuracy, which can be used specifically to produce groundwater contour mapping. RTK GPS surveying employs a GPS base station and a GPS rover that reads satellite carrier phase signals. Using the carrier phase signal in conjunction with a base station allows horizontal accuracy of approximately 0.1 feet and an elevation accuracy of approximately 0.02 feet. The specific coordinate system utilized for this activity included U.S. State Plane 1983, Puerto Rico/Virgin Is 5200, and the North American Datum (NAD) 1983, with units in survey feet.

Once installed, each monitoring well was surveyed using the RTK GPS method. An elevation was obtained from the top of polyvinyl chloride (PVC) casing for water level elevation calculations and a spot ground surface elevation was also obtained. All survey data was appropriately downloaded and processed using Trimble Geomatics Office (TGO). TGO is a software application tool used to convert survey data collected in the field into electronic files such as “AutoCAD” useful for application in the office.

5.0 NATURE AND EXTENT OF CONTAMINATION

This section discusses the nature of SWMU 27 contamination determined from chemical analysis of environmental samples from the February 2008 Full RFI. The laboratory analytical data went through a formal data validation process. Complete validated data tables for the 2008 Full RFI field effort are included in Appendix B; in addition, relevant portions of the data validation reports for the 2008 Full RFI Sample Delivery Groups (SDGs) are provided in Appendix C; a summary discussion of the necessary laboratory level data adjustments to the 2008 data is presented in Section 5.5.

The results of the 2006 Phase I RFI indicated that the bulk of the exceedances in the surface soils and groundwater were located to the northeast of the sludge drying beds. Arsenic, chromium, mercury, vanadium and zinc were above background levels as well as screening levels. Arsenic, mercury, and zinc in the surface soil, chromium in the subsurface soil, and barium and vanadium in the groundwater were the primary contaminants of concern.

The results of the 2006 Phase I RFI also indicated the subsurface soil did not exhibit much contamination above background for compounds that exceeded the human health or ecological screening criteria, with the exception of arsenic and cobalt at location 27SB01-01, and zinc at location 27SB02-01.

During the 2006 Phase I RFI, the highest groundwater concentrations were found in 27TW01, located northeast of the sludge drying beds. One VOC was detected in 27TW01 and 27TW02. No significant contamination was found in the groundwater near the open water in 27TW03. Barium exceeded the human health screening values and its respective background concentration. It is likely that contamination from the operation of the SWMU has reached the groundwater at this site.

The Full RFI was implemented to further define potential metals contamination and VOC impacts to groundwater within the surrounding area of the sludge drying beds.

5.1 Human Health and Ecological Screening Values

Detected results for surface soils, subsurface soils, and groundwater media are discussed in the following sections. Detected compounds for each media are compared to applicable regulatory and background criteria. These criteria, and the rationale for their usage for comparison to a specific media, are described in detail below.

5.1.1 Human Health

Applicable human health criteria for soils include USEPA Region IX Industrial Preliminary Remediation Goals (PRGs) and USEPA Region IX Residential PRGs (USEPA, 2004), and the upper limit of means background levels (inorganics only) (Baker, 2008). Applicable human health criteria for groundwater are USEPA Region IX Tap Water PRGs (USEPA, 2004), Federal Drinking Water Maximum Contaminant Levels (MCLs), and any inorganic background levels present in the groundwater at NAPR (Baker, 2008).

The USEPA Region IX PRGs are tools for determining preliminary COPCs for human health risk assessments as part of evaluating and cleaning up contaminated sites. They are risk based concentrations derived from standardized equations (representing ingestion, dermal contact, and inhalation exposure pathways), combining exposure information assumptions and USEPA toxicity data. The PRGs contained in the Region IX PRG Table are generic; they are calculated

without site-specific information. Region IX PRGs should be viewed as Agency guidelines, not legally enforceable standards. The PRGs for potentially carcinogenic chemicals are based on a target Incremental Lifetime Cancer Risk (ILCR) of $1x10^{-06}$. The PRGs for noncarcinogens are based on a target hazard quotient of 1.0. In order to account for cumulative risk from multiple chemicals in a medium, it is necessary to derive the PRGs based on a target hazard quotient of 0.1. Noncarcinogenic PRGs based on a target hazard quotient of 0.1 and the most recent toxicological criteria available, results in a set of values that can be used as screening criteria. In order to yield a hazard index (HI) of 0.1, the noncarcinogenic PRGs were divided by a factor of ten. For potential carcinogens, the toxicity criteria applicable to the derivation of PRG values are oral and inhalation Cancer Slope Factors (CSFs); for noncarcinogens, they are chronic oral and inhalation reference doses (RfDs). These toxicity criteria are subject to change as more updated information and results from the most recent toxicological/epidemiological studies become available. The PRG table is updated periodically to reflect such changes. It should be noted that the most recent update was in October 2004 (USEPA, 2004).

5.1.2 Ecological

5.1.2.1 Soil

USEPA ecological soil screening levels (Eco-SSLs) for terrestrial plants and invertebrates (available at http://www.epa.gov/ecotox/ecossl/) were preferentially used as soil screening values. For a given metal, if an Eco-SSL has been established for both terrestrial plants and invertebrates, the lowest value was selected as the soil screening value. For those chemicals lacking an Eco-SSL, the literature-based toxicological benchmarks listed below were used as soil screening values.

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

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

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

CCME soil quality guidelines were given the lowest preference since they are background-based values that do not represent effect concentrations.

In addition, the upper limit of means background levels (inorganics only) (Baker, 2008) were used to compare the soil concentrations to those present at NAPR in unimpacted soil. Both surface soil background levels and subsurface soil background levels for a silt soil type (most prevalent soil type at SWMU 27) were used in screening.

As a general rule, screening of soil results for ecological purposes would include surface soil, as well as subsurface soil results from the 1 – 2 foot depth range. At SWMU 27, five samples were collected at depths of 1- 3 feet (see Table 4-1). For the sake of completeness, these five samples will also undergo ecological screening.

5.1.2.2 Groundwater

Groundwater concentrations were compared to ecological surface water screening values in case of groundwater discharge to surface water. Chronic saltwater NAWQC (USEPA, 2006) were selected for use as surface water screening values. USEPA National Ambient Water Quality Criteria (NAWQC) for cadmium, copper, chromium, lead, mercury, selenium, and zinc are expressed as dissolved concentrations. As a measure of conservatism in this screening, they were converted to total recoverable concentrations using the appropriate conversion factors (USEPA, 2006). For those chemicals lacking a saltwater NAWQC, surface water screening values were identified from the following information listed in their order of decreasing preference:

- Final Chronic Values (FCVs) for saltwater contained in Ecotox Thresholds (USEPA, 1996a)

- Chronic screening values for saltwater contained in Ecological Risk Assessment Bulletins – Supplement to Risk Assessment Guidelines (Risk Assessment Guidance for Superfund [RAGS]) (USEPA, 2001)

- Minimum chronic toxicity test endpoints (No Observed Effect Concentration [NOEC] and Maximum Acceptable Toxicant Concentration [MATC] values) for saltwater species reported in the ECOTOX Database System (Aquatic Toxicity Information Retrieval [AQUIRE] database) (USEPA, 2003)

- Chronic Lowest Observable Effect Levels (LOELs) for saltwater contained in National Oceanic and Atmospheric Administration (NOAA) Screening Quick Reference Tables (SQUIRTs) (Buchman, 1999)

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

- Acute LOELs for saltwater contained in NOAA SQUIRTs (Buchman, 1999)

- Acute toxicity test endpoints (No Observed Effect Concentration [NOEC], Lowest Observed Effect Concentration [LOEC], median lethal concentration [LC_{50}], and median effective concentration [EC_{50}] values) for saltwater species contained in the ECOTOX Database System (AQUIRE database) (USEPA, 2003).

- LC_{50} values for saltwater species contained in Superfund Chemical Matrix (USEPA, 1996b)

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

- An uncertainty factor of 10 was used to convert an acute NOEC, LOEC, or LOEL to a chronic-based screening value.

- An uncertainty factor of 100 was used to convert an EC_{50} or LC_{50} to a chronic-based screening value.

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

For those chemicals lacking saltwater toxicological thresholds and literature values, surface water screening values were identified or developed from freshwater values using the sources and procedures discussed in the preceding paragraphs with one exception. This exception involved the consideration of freshwater Secondary Chronic Values (SCVs) developed by the USEPA (1996a) and Suter II (1996).

NAPR base wide groundwater background criteria (inorganics only) were also used in the comparison (Baker, 2008), when available.

5.2 Surface Soils

Nine surface soil samples and one duplicate were collected and analyzed during the 2008 Full RFI. All of the surface soil samples were analyzed for Appendix IX metals. Results are compared to USEPA Region IX Residential Soil PRGs, Industrial Soil PRGs, ecological surface soil screening values and NAPR Basewide Background (inorganics only) criteria. A detected results table for the inorganic surface soil data set is presented in Table 5-1.For comparison, the six 2006 Phase I RFI surface soil data is also presented on Table 5-1.

Twelve of the 16 detected metals exceeded one or more of the criteria. They are:

- Arsenic
- Cadmium
- Chromium
- Cobalt
- Copper
- Lead
- Nickel
- Selenium
- Tin
- Vanadium
- Zinc
- Mercury

The detected organic constituents from the 2006 Phase I RFI surface soils are presented on Table 5-2 for informational purposes. It should be noted that none of the positive detections exceeded any of the criteria.

Figure 5-1 presents the locations of the parameters that exceeded the USEPA Region IX Soil PRGs (Residential and Industrial) and NAPR Basewide background values for the combined 2006 Phase I RFI and 2008 Full RFI data. Arsenic exceeded the residential PRG at all locations, the industrial PRG at all but one location, and the background screening value at three locations (27SS01, 27SS03, and 27SS06). Vanadium exceeded the residential PRG at all locations and the industrial PRG at eight locations; however, the concentrations of vanadium did not exceed the background screening value. No other exceedances of human health criteria were present in the surface soil.

Figure 5-2 presents the locations of inorganic parameters that exceeded ecological screening criteria and NAPR basewide background values for the combined 2006 Phase I RFU and 2008 Full RFI data. Chromium, cobalt, copper, vanadium, zinc, and mercury exceeded ecological surface soil screening values, but only zinc and mercury also exceeded their background surface soil screening values. The highest background concentration exceedances were at 27SS05. The other exceedances of background may be representative of background at the detected concentrations.

Cadmium, lead, nickel, and tin exceeded their background concentrations at a few locations, but no other screening criteria.

Based on the exceedances of background and regulatory screening concentrations in the surface soil on the northeast edge of the drying beds, it appears that metals contamination (primarily mercury and zinc) may have occurred in the surface soil at SWMU 27 due to Navy activities. However, the lateral extent of this contamination has not been fully defined.

Additionally, potential human exposure to arsenic concentrations in surface soil were evaluated due to the exceedances of both the soil PRGs and background. However, to present a complete exposure scenario, exposure to all media with human health and background screening value exceedances were evaluated together. Therefore, the results of this evaluation are presented in Section 5.4 with the discussion of groundwater results.

5.3 Subsurface Soils

Ten subsurface soils samples plus one duplicate sample were collected and analyzed as part of the 2008 Full RFI. All subsurface soil samples were analyzed for Appendix IX metals. Results are compared to USEPA Region IX Residential Soil PRGs, Industrial Soil PRGs, and NAPR Basewide Background (metals only) criteria for silt subsurface soil. Selected sample results were also compared to the ecological surface soil screening concentrations due to the fact that the soil samples were obtained from depths of 1 to 3 feet, and anything above 2 feet bgs is ecologically significant. A detected results table for the inorganic subsurface soil data set is presented in Table 5-3. For comparison, the three 2006 Phase I RFI subsurface soil data is also presented on Table 5-3.

Eight of the 14 detected metals exceeded one or more of the criteria. They are:

- Arsenic
- Cadmium
- Chromium
- Cobalt
- Copper
- Lead

- Vanadium
- Zinc

The detected organic constituents from the 2006 Phase I RFI subsurface soils are presented on Table 5-4 for informational purposes. It should be noted that none of the positive detections exceeded any of the criteria.

None of the locations exceeded the USEPA Region IX Soil PRGs (Residential and Industrial) and NAPR Basewide background values for the combined 2006 Phase I RFI and 2008 Full RFI data. Arsenic exceeded the residential PRG at all locations and the industrial PRG at six locations. However, the concentrations of arsenic did not exceed the background screening value. Vanadium exceeded the residential PRG at all but one location and the industrial PRG at nine locations, but did not exceed its background screening value. No other exceedances of human health criteria were present in the subsurface soil.

Figure 5-3 presents the locations of inorganic parameters that exceeded ecological screening criteria and NAPR basewide background values. Chromium, cobalt, copper, vanadium, and zinc all exceeded the ecological surface soil screening levels in one or more locations. Chromium also exceeded its background screening value at four of these locations. Zinc also exceeded its background screening value at two of these locations while copper exceeded its background screening value in one of the locations. The subsurface soil did not exhibit contamination above background for metals that exceeded the ecological screening criteria with the exception of chromium copper and zinc.

5.4 Groundwater

Five groundwater samples plus one duplicate were collected and analyzed as part of the 2008 Full RFI field activities. All of the groundwater samples were submitted to the analytical laboratory for Appendix IX VOCs and total and dissolved metals. A detected results table for the groundwater data set is presented in Table 5-5. Results are compared to USEPA Region IX Tap Water PRGs, USEPA MCLs, ecological surface water screening values and NAPR Basewide Background criteria. For comparison, the 2006 Phase I RFI groundwater data are presented on Table 5-6.

Three VOCs were detected in the groundwater at low concentrations. Chloroform was detected at concentrations above the Region IX Tap Water PRG. As shown on Figure 5-4, the maximum chloroform concentration (1 µg/L) was detected at location 27MW06. All other detected concentrations were qualified as estimated.

Seven of the 11 detected total metals and four of the six detected dissolved metals exceeded one or more of the criteria for groundwater. These are:

- Arsenic
- Barium
- Chromium
- Copper
- Nickel
- Vanadium
- Mercury

Figure 5-4 presents the locations of the total and dissolved metals that exceeded the USEPA Region IX Tap Water PRGs and NAPR Basewide Background criteria. Total and dissolved

vanadium concentrations exceeded the tap water PRG at each of the sampling locations; however, the total concentrations did not exceed the corresponding basewide background screening value. Dissolved vanadium exceeded its basewide background screening value at two locations. Total arsenic exceeded the tap water PRG at two of the five locations, and dissolved arsenic exceeded the tap water PRG at one location. However, the concentrations of total and dissolved arsenic did not exceed corresponding basewide background values. Total and dissolved barium exceeded the tap water PRG at two locations (27MW05 and 27MW06). Of those two locations, total barium exceeded its basewide background value in one location 27MW06, while dissolved barium exceeded background in both locations. Total chromium exceeded the tap water PRG at three locations, but did not exceed the basewide background screening value.

None of the locations of total and dissolved metals that exceeded ecological screening criteria also exceeded the NAPR basewide background values.

It should be noted that total mercury exceeded its background concentration at two locations, but no other screening criteria.

For this Full RFI, potential human exposure to arsenic concentrations in the surface and subsurface soil and chloroform and barium in the groundwater at SWMU 27 were evaluated. Preliminary risk calculations were performed under a future residential exposure scenario in order to more fully evaluate potential human health risks due to exceedances of soil and tap water PRGs and background. As discussed above, arsenic in surface soil exceeded its residential PRG and background concentration (one location only) in the 2008 Full RFI. Arsenic concentrations in subsurface soil exceeded residential and/or industrial soil PRGs in several locations in the 2008 Full RFI but did not exceed the background concentration at any location. However, arsenic in subsurface soil did exceed both the soil PRGs and background at two locations in the 2006 Phase I RFI. As such, exposure to arsenic in subsurface soil was also included in the preliminary risk evaluation. Exposure to chloroform and barium in the groundwater were included in this preliminary risk evaluation due to the exceedances of tap water PRGs and background in the case of barium.

Although SWMU 27 is unlikely to become a residential property in the future, future residential adult and child receptors were chosen since primarily the residential soil and tap water PRGs were exceeded, and it represents the most conservative exposure scenario. To present a complete exposure scenario, analytical data from the Phase I RFI Report and the Full RFI were combined to form the surface soil and subsurface soil data sets. However, only the 2008 groundwater analytical data were used for this evaluation for two reasons: (1) the time lapse between the collection of the Phase I RFI and Full RFI data, and (2) the Phase I data were collected from temporary monitoring wells. USEPA ProUCL Version 4.00.02 software (USEPA, 2007a and 2007b) was used to determine the distribution of the data sets and calculate the soil exposure point concentrations (EPCs). The maximum detected concentrations were used for groundwater EPCs since there were only four data points in the data set.

The results of the preliminary risk calculations are presented in Appendix D. The distributions and EPCs (95 percent Upper Confidence Limits of the mean) are presented in Tables D-1 through D-3, while exposure parameters used in the preliminary risk calculations are presented in Table D-4. The results of the preliminary risk calculations are presented in Tables D-5 (future adult resident) and D-6 (future child resident). As shown on Table D-5, the carcinogenic risk for the future adult resident is 4.8×10^{-06}, and the hazard index is 0.4. As shown on Table D-6, the carcinogenic risk for the future child resident is 9.1×10^{-06}, and the hazard index is 1.1. The total lifetime carcinogenic risk (sum of adult and child carcinogenic risk) is 1.4×10^{-05}, which is also within USEPA's acceptable risk range. As evidenced by Table D-5 and D-6, there are no

unacceptable carcinogenic risks (i.e., risks in excess of USEPA's acceptable risk range of 1×10^{-06} to 1×10^{-04}) calculated for the future residents from potential exposure to arsenic in soil and chloroform in groundwater at SWMU 27. As evidenced by Table D-5, there are no unacceptable noncarcinogenic risks (i.e., HI greater than 1.0) calculated for the future residential adult. The total site HI of 1.1 for the future child resident was primarily due to ingestion of barium in groundwater. However, as evidenced by Table D-6, the individual target organ HIs do not exceed 1.0. USEPA guidance states that if the total HI is greater than 1.0 but the target organ specific HIs are not greater than 1.0, then no adverse health effects can be assumed (USEPA, 1989). Therefore, it is unlikely that adverse human health effects will occur from exposure to soil and groundwater at SWMU 27.

5.5 2008 Laboratory Data Validation Summary

A discussion of the compounds detected in the Field QA/QC samples is presented in Section 5.5.1. A summary of the data validation findings, as they relate to each SDG, are discussed in Sections 5.5.2 through 5.5.4 below. Data validation report summaries are included in Appendix C.1 through C.3. In addition, the Puerto Rican Chemist Certifications for each Test America SDG are presented in Appendix C.4.

5.5.1 Summary of Detected Compounds in Field QA/QC Samples

Field generated QA/QC samples for the 2008 field effort consisted of one trip blank, field blanks, equipment rinsates, and environmental duplicates. Trip blanks were only analyzed for VOCs. Other blanks were analyzed for all fractions requested in this investigation including Appendix IX VOCs and total and dissolved metals. Table 5-7 presents the detected compounds found in the trip blank, equipment rinsates, and field blanks.

There were no VOCs detected in the trip blank (TB01).

Two field blank samples were collected; FB01 representing laboratory grade de-ionized water and FB02, representing potable water. Detections in the field blank representing the potable water included three VOCs (chlorodibromomethane, chloroform, and dibromochloromethane) and three metals (barium, silver, and zinc).

Three equipment rinsate samples were collected as indicated on Table 4-2. Analysis of the three equipment rinsate samples resulted in the detection of two VOCs (chloromethane and toluene) in ER05, and two metals (barium and zinc) in ER01. There were no metals detected in ER02.

5.5.2 Test America Savannah SDG 34202-1

This SDG (34202-1) is relevant to the analytical findings associated with the surface and subsurface soil samples collected from SWMU 27 during the 2008 Full RFI field investigation. Laboratory analyses were performed by Test America – Savannah, Georgia. Validation services were provided by DataQual Environmental Services LLC, St. Louis, Missouri. Validation conclusions are as follows:

Metals

- Blank contamination was noted and qualification was required in the samples in this SDG. Details are provided in Appendix C.1.

- Two of the submitted MS/MSD pairs exhibited non-compliant recoveries for the analyte antimony. Reported results in the soil samples were qualified as estimated J/UJ.

Data Validation Summary for SDG 34202-1

Overall the data validity of this data package was very good. Holding times were met and the SDG was received complete and intact. The changes in the results due to the application of the data validation qualifiers are not expected to significantly compromise the data quality objectives for this SDG.

5.5.3 Test America Savannah SDG 34202-2

This SDG (34202-2) is relevant to the analytical findings associated with the 2008 QA/QC sampling, specifically the equipment rinsate samples ER01 and ER02. Laboratory analyses were performed by Test America – Savannah, Georgia. Validation services were provided by DataQual Environmental Services LLC, St. Louis, Missouri. Validation conclusions are as follows:

Metals

- Blank contamination was noted and qualification was required in the samples in the SDG. Chromium and copper were qualified as non-detect up to the reporting limit in ER01 and ER02. Additional details are provided in Appendix C.2.

Data Validation Summary for SDG 34202-2

Overall the data validity of this data package was very good. Holding times were met and the SDG was received complete and intact. The changes in the results due to the application of the data validation qualifiers are not expected to significantly compromise the data quality objectives for this SDG.

5.5.4 Test America Savannah SDG 34275

This SDG (34275) is relevant to the analytical findings associated with the groundwater samples collected from SWMU 27 during the 2008 Full RFI field investigation and the 2008 QA/QC sampling, specifically the equipment rinsate sample ER01 and the trip blank TB01. Laboratory analyses were performed by Test America – Savannah, Georgia. Validation services were provided by DataQual Environmental Services LLC, St. Louis, Missouri. Validation conclusions are as follows:

VOCs

- Calibration standards exhibited percent differences (%D) and RRF values that were noncompliant for acrylonitrile, pentachloroethane, isobutyl alcohol, and iodomethane. Reported results for acrylonitrile, pentachloroethane, and iodomethane were qualified as estimated J/UJ. Reported results for isobutyl alcohol were qualified as J/R.

- Sample ER05 was reanalyzed to confirm positive results that were detected in the initial analysis. The results were confirmed; therefore, the reanalysis was rejected and the initial analysis was used.

Metals

- Blank contamination was noted and qualification was required in the samples in the SDG. Three data points for zinc (27GW05, 27GW07, 27GW08, 27GW08D) were rejected due to significant field blank contamination for this analyte. Details are provided in Appendix C.3.

- The submitted MS/MSD pair for the total metals fraction exhibited noncompliant %Rs for the analytes copper and vanadium. Reported results in the total metals samples were qualified as estimated J/UJ for these analytes.

- The field duplicate pair exhibited noncompliant RPDs in the total metals analysis for the analytes barium, chromium, cobalt, copper, vanadium, and zinc. Based on Region II validation guidance the reported results for barium, chromium, and cobalt were flagged J in both samples, the analytes copper, vanadium, and zinc were rejected in the field sample and zinc was rejected in the field duplicate.

Data Validation Summary for SDG 34275

Overall the data validity of this data package was good. Holding times were met and the SDG was received complete and intact. However, resubmissions were required for an error in reported %R for the CCVs for the analyte antimony. This issue was resolved. The changes in the results due to the application of the data validation qualifiers are not expected to significantly compromise the data quality objectives for this SDG.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The objectives of the Full RFI were to:

- Further delineate VOCs and metals impact to the soil and/or groundwater identified to be present from operation of the Capehart WWTP sludge drying beds, to the extent practical, from the completion of field activities (surface soil, subsurface soil, and groundwater sampling) as described in the Full RFI Work Plan;

- Screen for potential human health risks posed by the site; and

- Screen for potential ecological risks posed by the site.

It is evident from the analyses of samples obtained during the Phase I RFI investigation and the Full RFI that there has been some impact on the environment due to Navy activities at SWMU 27.

The bulk of the exceedances in the surface soils were located to the northeast of the sludge drying beds. Only arsenic was above its background value at three locations, as well as screening levels.

The subsurface soil did not exhibit much contamination above background for compounds that exceeded the human health or ecological screening criteria, with the exception of chromium at three locations (ecological screening value exceedances).

The highest groundwater concentrations were found in locations 27MW05 and 27MW06, located northeast of the sludge drying beds. No significant contamination was found in the groundwater in the other monitoring wells. Barium exceeded the human health screening values and its respective background concentrations. It is likely that contamination from the operation of the SWMU has reached the groundwater at this site. However, it is unlikely that groundwater would be a pathway for human health risk due to the low yield.

6.2 Recommendations

The data generated during the Phase I RFI and the Full RFI indicated the surface soil, subsurface soil and groundwater were impacted by past activities at SWMU 27. The lateral extent of arsenic in surface soil and the source and extent of barium in groundwater have not been defined. A preliminary human health risk evaluation was conducted to address these exceedances. This evaluation demonstrated that the concentrations of arsenic in SWMU 27 soil, and chloroform and barium in groundwater would not cause unacceptable risks to human receptors. Therefore, no further action is recommended to address human health concerns. However, concentrations of zinc and mercury in surface soil and chromium in subsurface soil indicated the presence of contamination above their ecological screening values and background concentrations. Therefore, a Corrective Measures Study (CMS) is recommended to quantify potential risk to ecological receptors. The CMS will include an ecological risk assessment (ERA) (Steps 1, 2 and 3a of the Navy ERA process described at http://web.ead.anl.gov/ecorisk/).

It should be noted that USEPA issued new Regional Screening Levels (USEPA, 2008) on May 27, 2008. As recommended by the USEPA, these Screening Levels are to replace the Region IX PRGs. The Regional Screening Levels were developed to support the risk assessment screening process, while improving consistency across Regions and incorporating updated guidance in a

timely manner. The environmental data for this Full RFI were screened using the Region IX PRGs prior to the issuance of the Regional Screening Levels, and the screening criteria have not been revised for this version of the report. However, based on a review of the PRGs versus the Regional Screening Levels, it is expected that the results of the screening would not be significantly impacted and that the conclusions and recommendations of this Full RFI would remain the same upon replacement of PRGs with the Regional Screening Levels. None the less, in keeping with current USEPA guidance, the Regional Screening Levels will be incorporated in subsequent versions of this report.

7.0 REFERENCES

Baker Environmental, Inc. (Baker), 2008. Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds, Naval Activity Puerto Rico, Ceiba, Puerto Rico. February 29, 2008.

Baker, 2007. Michael Baker Jr., Inc. Draft Full RCRA Facility Investigation Work Plan – SWMU 27, 28 and 29. Naval Activity Puerto Rico, Ceiba, Puerto Rico.

Baker, 2006a. RCRA Facility Investigation Work Plan, SWMUs 16, 27, 28, 29, and 42, and AOC A. Naval Activity Puerto Rico, Ceiba, Puerto Rico.

Baker, 2006b. Final Steps 3b and 4 of the Baseline Ecological Risk Assessment for SWMU 45, Naval Activity Puerto Rico, Ceiba, Puerto Rico. Coraopolis, Pennsylvania. July 26, 2006.

Baker, 2006c. Final Steps 3b and 4 of the Baseline Ecological Risk Assessment at SWMUs 1 and 2, Naval Activity Puerto Rico, Ceiba, Puerto Rico. Coraopolis, Pennsylvania. January 10, 2007.

Bear, J., 1972. Dynamics of Fluids in Porous Media. Dover Publications.

Bouwer, H., 1989. The Bouwer and Rice Slug Test--An Update, Ground Water, vol. 27, no. 3, pp. 304-309.

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

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

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

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe, 1979. Classification of Wetlands and Deepwater Habitats of the United States. FWS/OBS-79-31. Office of Biological Services, Fish and Wildlife Service, U.S. Department of the Interior, Washington, DC.

Department of the Navy (DoN), 2007. Environmental Assessment for the Disposal of Naval Activity Puerto Rico (Formally Naval Station Roosevelt Roads). April 2007.

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

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

Ewel, J.J., and J.L. Whitmore, 1973. The Ecological Life Zones of Puerto Rico and the U.S. Virgin Islands. Institute of Tropical Forestry, Rio Piedras, PR. (U.S. Forest Service Research Paper ITF-18).

Geo-Marine, Inc., 2005. Draft Environmental Assessment for the Disposal of Naval Activity Puerto Rico (formerly Naval Station Roosevelt Roads). Geo-Marin, Inc., Plano, TX. December 2005.

Geo-Marine, Inc., 2000. Habitat Characterization of Solid Waste Management Untis (SWMU) 1, SWMU 2, and SWMU 45, Naval Station Roosevelt Roads, Puerto Rico. Geo-Marine, Inc., Plano TX. October 11, 2000.

Geo-Marine, Inc., 1998. Integrated Natural Resource Management Plan for U.S. Naval Station Roosevelt Roads: Plan Years 1998-2007. Geo-Marine, Inc., Plano, TX.

Lewis, R.R., III, 1986. Status of Mangrove Forests, Roosevelt Roads Naval Station, Puerto Rico. Buffalo, New York: Ecology and Environment.

Little, E.L. and F.H. Wadsworth, 1964. Common Trees of Puerto Rico and the Virgin Islands. Agricultural U.S Department of Agriculture, Forest Department, Washington, D.C. Agricultural Handbook No. 249.

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

Naval Facilities Engineering Command (NAVFAC), 2004. Draft Phase II Environmental Condition of Property (ECP) Report, Naval Activity Puerto Rico, Ceiba Puerto Rico.

Naval Energy and Environmental Support Activity (NEESA), 1984. Initial Assessment Study of Naval Station Roosevelt Roads, Puerto Rico. NEESA 13-051.

Naval Facilities Engineering Service Center (NFESC), 1996. Survey of Potential Habitat for Yellow-Shouldered Blackbird on U.S. Naval Station Roosevelt Road, Puerto Rico. Naval Facilities Engineering Command, Atlantic Division, Norfolk, VA.

Puerto Rico Department of Natural Resources (PRDNR), 2002. Memorandum from Eduardo A. Ventosa-Febles to Jose L. Chabert, Director of Wildlife Devision. August 12, 2002.

Raffaele, H.A., 1989. A Guide to the Birds of Puerto Rico and the Virgin Islands. Princeton University Press, Princeton, N.J. 254 pp.

Reid, J.P., D. Easton, W.J. Kenworthy, 2001. Manatee and Seagrass Habitat Characterization in Puerto Rico. Department of the Navy and US Geological Survey Interagency Report, Agreement No. 320723L87. September 2001. 34 pp.

Reid, J.P. and C.R. Kruer, 1998. Mapping and Characterization of Nearshore Benthic Habitats around Vieques Island, Puerto Rico, Report to Navy. U.S. Geological Survey Biological Resource Discipline, Sirenia Project, Gainsville, Florida.

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

Tolson, P.J., 2004. Surveys for the Puerto Rican Boa, *Epicrates inornatus*, and the Virgin Islands Boa, *Epicrates monenis granti*, at the U.S. Naval Base, Roosevelt Roads, Puerto Rico. Prepared for Geo-Marine, Inc., Plano, Texas.

United Nations Environmental Program (UNEP), 1995. Regional Management Plan for the West Indian Manatee, Trichechus manata. Caribbean Environment Programme Technical Report No. 35.Kingston, Jamaica. Available at http://www.cep.unep.org/pubs/Techreports/tr35en/index.html.

United States Army Corps of Engineers (USACE), 1987. Corps of Engineers Wetlands Delineation Manual. Technical Report Y-87-1. U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS.

United States Environmental Protection Agency (USEPA), 2008. Regional Screening Levels. http://epa-prgs.ornl.gov/chemicals/index.shtml

USEPA, 2007a. ProUCLVersion 4.00.02. http://www.epa.gov/esd/tsc/software.htm April 2007.

USEPA, 2007b. ProUCLVersion 4.00.02 User Guide. EPA/600/R07/038. http://www.epa.gov/esd/tsc/images/proucl-4-0-02-user.pdf April 2007.

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

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

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

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

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

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

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

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

United States Fish and Wildlife Service (USFWS), 2008. Threatened and Endangered Animals and Plants. Species Information. Available at http://www.fws.gov/endangered/wildlife.html. Accessed: May 30, 2008.

USFWS, 1996a. Recovery Plan for the Yellow-Shouldered Blackbird (*Agelaius xanthomus*). USFWS, Southeast Region, Atlanta, GA.

USFWS, 1996b. Revised Recovery Plan for the Atlantic Coast Population of the Piping Plover (*Charadrius melodus*). USFWS, Region 5, Hadley, MA

USFWS, 1987. Endangered and Threatened Wildlife and Plants: Determination of Threatened Status for the Puerto Rican Crested Toad. Federal Register, 52 (149): 28828-28831.

USFWS, 1984. Recovery Plan for the Golden Coqui (Eleutherodactylus jasperi). USFWS, Southeast Region, Atlanta, GA.

USFWS, 1983. Yellow-Shouldered Blackbird Recovery Plan. USFWS, Southeast Region, Atlanta, GA.

United States Geological Survey (USGS), 1999. Status and Trends of the Nation's Biological Resources. Available at: http://biology.usgs.gov/s+t/SNT/index.htm

Woods, C.A., G.B. Rathbun, T. Carr, and N. Carr, 1984. Distribution and Abundance of Manatees and Sea Turtles at Roosevelt Roads Naval Station, Puerto Rico, Progress Report. U.S. Navy Facilities Planning and Real Estate Division, Norfolk, Virginia.

TABLES

TABLE 3-1

GROUNDWATER ELEVATION SUMMARY
SWMU 27 - CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Well Identification	Northing	Easting	Elevation (msl) Top of PVC	Total Well Depth (ft)	Depth to Groundwater on 2/13/2008 (ft)	Groundwater Elevation on 2/13/2008 (ft, msl)	Depth to Groundwater on 2/17/2008 (ft)	Groundwater Elevation on 2/17/2008 (ft, msl)
27MW04	790493.4	928456.9	106.05	10.0	3.45	102.6	3.55	102.5
27MW05	790434.3	928424.6	105.14	10.0	2	103.14	1.85	103.29
27MW06	790365.6	928453.3	104.21	10.0	9.12	95.09	6.81	97.4
27MW07	790235	928350.4	106.05	10.0	4.24	101.81	4.25	101.8
27MW08	790362.7	928331.1	106.35	10.0	1.1	105.25	1.94	104.41

Well Identification	Northing	Easting	Elevation (msl) Top of PVC	Total Well Depth (ft)	Depth to Groundwater on 5/18/2008 (ft)	Groundwater Elevation on 5/18/2008 (ft, msl)	Depth to Groundwater on 6/12/2008 (ft)	Groundwater Elevation on 6/12/2008 (ft, msl)
27MW04	790493.4	928456.9	106.05	10.0	3.2	102.85	2.89	103.08
27MW05	790434.3	928424.6	105.14	10.0	1.8	103.34	0.98	104.05
27MW06	790365.6	928453.3	104.21	10.0	1.5	102.71	0.31	103.78
27MW07	790235	928350.4	106.05	10.0	4.35	101.7	4.32	101.73
27MW08	790362.7	928331.1	106.35	10.0	2	104.35	2.05	104.13

NA - not measured
msl - mean sea level; elevations shown are mean sea level plus 100 feet
ft - feet

TABLE 3-2

SUMMARY OF SLUG TEST RESULTS
SWMU 27 CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Location	Date	Rising Head Test (feet/day)	Falling Head Test (feet/day)	Average Hydraulic Conductivity (feet/day)	Comment
27MW04	2/17/2008	2.00	2.77	2.39	Water within screened interval
27MW05	2/18/2008	0.23	0.17	0.20	
27MW06	2/18/2008	(1)	0.01	0.01	Water within screened interval
27MW07	2/18/2008	1.00	0.43	0.72	Water within screened interval
27MW08	2/17/2008	9.45	14.99	12.22	
Average				**3.11**	

Notes:
(1) Due to slow recovery, falling test was the only test performed.

TABLE 3-3
LIST OF BIRDS REPORTED FROM OR HAVING THE POTENTIAL TO OCCUR AT
NAVAL ACTIVITY PUERTO RICO
SWMU 27 – CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Common Name [1]		
Pied-billed grebe	Red-billed tropicbird	Brown pelican [2]
Brown booby	Magnificent frigatebird	Great blue heron
Louisiana heron	Snowy egret	Great egret
Striated heron	Little blue heron	Cattle egret
Least bittern	Yellow-crowned night heron	Black-crowned night heron
White-cheeked pintail	Blue-winged teal	American widgeon
Red-tailed hawk	Osprey	Merlin
Clapper rail	American coot	Caribbean coot
Common gallinule	Piping plover [3][4]	Semipalmated plover
Black-bellied plover	Wilson's plover	Killdeer
Ruddy turnstone	Black-necked stilt	Whimbrel
Spotted sandpiper	Semipalmated sandpiper	Short-billed dowitcher
Greater yellowlegs	Lesser yellowlegs	Willet
Stilt sandpiper	Pectoral sandpiper	Laughing gull
Royal tern	Sandwich tern	Bridled tern
Least tern	Brown noddy	White-winged dove
Zenaida dove	White-crowned pigeon	Mourning dove
Red-necked pigeon	Common ground dove	Bridled quail dove
Ruddy quail dove	Caribbean parakeet	Smooth-billed ani
Yellow-billed cuckoo	Mangrove cockoo	Short-eared owl
Chuck-will's-widow	Common nighthawk	Antillean crested hummingbird
Green-throated carib	Antillean mango	Belted kingfisher

TABLE 3-3
LIST OF BIRDS REPORTED FROM OR HAVING THE POTENTIAL TO OCCUR AT
NAVAL ACTIVITY PUERTO RICO
SWMU 27 – CAPEHART WWTP SLUDGE DRUING BEDS
FULL RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Common Name [1]		
Gray kingbird	Loggerhead kingbird	Stolid flycatcher
Caribbean elaenia	Purple martin	Cave swallow
Barn swallow	Northern mockingbird	Pearly-eyed thrasher
Red-legged thrush	Black-whiskered vireo	American redstart
Parula warbler	Prairie warbler	Yellow warbler
Magnolia warbler	Cape May warbler	Black-throated blue warbler
Adelaide's warbler	Palm warbler	Black and white warbler
Ovenbird	Northern water thrush	Bananaquit
Striped-headed tanager	Shiny cowbird	Black-cowled oriole
Greater Antillean grackle	Yellow-shouldered blackbird [2]	Hooded mannikin
Yellow-faced grassquit	Black-faced grassquit	Least sandpiper
Western sandpiper	Puerto Rican woodpecker	Rock dove
Puerto Rican emerald	Puerto Rican flycatcher	Pin-tailed whydah
Spice finch	Ruddy duck	Peregrine falcon
Marbled godwit	Puerto Rican lizard cuckoo	Prothonotary warbler
Green-winged teal	Orange-cheeked waxbill	Roseate tern [3][4]
Least grebe	West Indian whistling duck	Puerto Rican screech owl
Puerto Rican tody		

Notes:

[1] List of birds taken from Geo-Marine, Inc. (1998).
[2] Federally-designated endangered species.
[3] Federally-designated threatened species.
[4] Species has the potential to occur at Naval Activity Puerto Rico.

TABLE 4-1

SUMMARY OF 2008 SURFACE SOIL, SUBSURFACE SOIL, AND GROUNDWATER SAMPLING AND ANALYSIS
SWMU 27 - CAPEHART WWTP SLUDGE DRYING BEDS
FULL FRI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

				Analysis Requested			
Sample Media	Site ID	Sample ID	Sample Depth (ft bgs)	App. IX VOCs	App. IX Metals (Total)	App. IX Metals (Dissolved)	Comments
Surface Soil	27SB04	27SB04-00	0.0 - 1.0		X		
	27SB05	27SB05-00	0.0 - 1.0		X		
	27SB06	27SB06-00	0.0 - 1.0		X		
	27SB07	27SB07-00	0.0 - 1.0		X		
	27SB08	27SB08-00	0.0 - 1.0		X		
	27SS04	27SS04	0.0 - 1.0		X		Chain of custody had 27SS04-00
	27SS05	27SS05	0.0 - 1.0		X		Chain of custody had 27SS05-00
	27SS06	27SS06	0.0 -1.0		X		Chain of custody had 27SS05-00
	27SS07	27SS07	0.0 -1.0		X		Chain of custody had 27SS07-00
		27SS07D	0.0 -1.0		X		Duplicate
		27SS07MS	0.0 -1.0		X		Matrix Spike
		27SS07MSD	0.0 -1.0		X		Matrix Spike Duplicate
Subsurface Soil	27SB04	27SB04-01	1.0 - 3.0		X		
		27SB04-02	3.0 - 5.0		X		
	27SB05	27SB05-01	1.0 - 3.0		X		
		27SB05-02	3.0 - 5.0		X		
	27SB06	27SB06-01	1.0 - 3.0		X		
		27SB06-02	3.0 - 5.0		X		
	27SB07	27SB07-01	1.0 - 3.0		X		
		27SB07-02	3.0 - 5.0		X		
	27SB08	27SB08-01	1.0 - 3.0		X		
		27SB08-02	3.0 - 5.0		X		
		27SB08-02D	3.0 - 5.0		X		Duplicate

TABLE 4-1

SUMMARY OF 2008 SURFACE SOIL, SUBSURFACE SOIL, AND GROUNDWATER SAMPLING AND ANALYSIS
SWMU 27 - CAPEHART WWTP SLUDGE DRYING BEDS
FULL FRI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

				Analysis Requested			
Sample Media	Site ID	Sample ID	Sample Depth (ft bgs)	App. IX VOCs	App. IX Metals (Total)	App. IX Metals (Dissolved)	Comments
Groundwater	27MW04	27GW04	NA	X	X	X	
	27MW05	27GW05	NA	X	X	X	
	27MW06	27GW06	NA	X	X	X	
	27MW07	27GW07	NA	X	X	X	
	27MW08	27GW08	NA	X	X	X	
		27GW08D	NA	X	X	X	Duplicate
		27GW08MS	NA	X	X	X	Matrix Spike
		27GW08MSD	NA	X	X	X	Matrix Spike Duplicate

Notes:
ft bgs - feet below ground surface
NA - Not Applicable

TABLE 4-2

SUMMARY OF 2008 RFI QUALITY ASSURANCE / QUALITY CONTROL SAMPLING AND ANALYSIS
SWMU 27 - CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

	Analysis Requested			
Sample ID	App. IX VOCs	App. IX Metals (Total)	App. IX Metals (Dissolved)	Comments
Trip Blank Samples				
TB01	X			
Equipment Rinsate Samples				
ER01		X		Macro Core Acetate Liner
ER02		X		Macro Core Acetate Liner
ER05	X	X	X	Silicon/Polyethylene Tubing
Field Blank Samples				
FB01	X	X		Lab Grade Deionized Water
FB02	X	X		NAPR Potable Water

TABLE 4-3

PARAMETER LISTS AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)
SWMU 27 - CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

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

TABLE 4-3

PARAMETER LISTS AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)
SWMU 27 - CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Appendix IX - VOCs	Quantitation Limits*		Method Number (Description)
	Water (µg/L)	Low Soil (µg/kg)	
Trichlorofluoromethane	1.0	5.0	8260B (5030)(low level)
1,2,3-Trichloropropane	1.0	5.0	8260B (5030)(low level)
Vinyl Acetate	2.0	10	8260B (5030)(low level)
Vinyl Chloride	1.0	10	8260B (5030)(low level)
Xylene	2.0	10	8260B (5030)(low level)
Appendix IX - Metals (Total)	**Quantitation Limits***		**Method Number (Description)**
	Water (µg/L)	**Low Soil (mg/kg)**	
Antimony	20	2.0	6010 (Inductively Coupled Plasma)
Arsenic	10	1.0	6010 (Inductively Coupled Plasma)
Barium	10	1.0	6010 (Inductively Coupled Plasma)
Beryllium	4.0	0.4	6010 (Inductively Coupled Plasma)
Cadmium	5.0	0.5	6010 (Inductively Coupled Plasma)
Chromium	10	1.0	6010 (Inductively Coupled Plasma)
Cobalt	10	1.0	6010 (Inductively Coupled Plasma)
Copper	20	2.0	6010 (Inductively Coupled Plasma)
Lead	5.0	0.5	6010 (Inductively Coupled Plasma)
Mercury	0.2	0.02	7470/7471 (Cold Vapor AA)
Nickel	40	4.0	6010 (Inductively Coupled Plasma)
Selenium	10	1.0	6010 (Inductively Coupled Plasma)
Silver	10	1.0	6010 (Inductively Coupled Plasma)
Thallium	10	1.0	6010 (Inductively Coupled Plasma)
Tin	10	5.0	6010 (Inductively Coupled Plasma)
Vanadium	10	1.0	6010 (Inductively Coupled Plasma)
Cyanide	0.010	1.0	9012 (Colorimetric)
Sulfide	1.0	25	9030 (Titrimetric, Iodine)
Zinc	20	2.0	6010 (Inductively Coupled Plasma)

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

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

TABLE 5-1

SUMMARY OF DETECTED INORGANIC RESULTS - SURFACE SOIL
SWMU 27 - CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

					Phase I RFI 2006						
Site ID	**USEPA**	*USEPA*	Selected	NAPR	**27SS01**	**27SS02**	**27SS03**	**27SB01**	**27SB02**	**27SB03**	**27SB03**
Sample ID	**Region IX**	*Region IX*	Ecological	Basewide	**27SS01**	**27SS02**	**27SS03**	**27SB01-00**	**27SB02-00**	**27SB03-00**	**27SB03-00D**
Sample Depth (ft bgs)	**Residential**	*Industrial*	Surface Soil	Background	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Sampling Date	**Soil PRGs**	*Soil PRGs*	Screening Values		**11/17/06**	**11/17/06**	**11/17/06**	**11/16/06**	**11/16/06**	**11/16/06**	**11/16/06**
Metals (mg/kg)											
Antimony	3.1 (2)	41 (2)	78 (8)	3.17	0.91 J	4.9 U	5.5 U	4.5 U	4.6 U	4.1 U	4.2 U
Arsenic	0.39	1.59	18 (4)	2.65	***5.1***	***2.2*** J	***4.2***	***2.2*** J	***2.6***	***2.3***	***1.7*** J
Barium	537 (2)	6658 (2)	330 (5)	199	190 J	77 J	150 J	150 J	130 J	89 J	88 J
Beryllium	15.44 (2)	1941 (3)	40 (5)	0.59	0.32 J	0.15 J	0.34 J	0.29 J	0.3 J	0.22 J	0.18 J
Cadmium	3.7 (2)	45.14 (2)	32 (4)	1.02	1.4 J	1.3	0.58 J	0.12 J	0.11 J	0.16 J	0.15 J
Chromium	211	448	0.4 (6)	49.8	36 J	18 J	44 J	38 J	31 J	20 J	25 J
Cobalt	903	1921	13 (4)	46.2	20	10	22	26 J	15 J	20 J	16 J
Copper	313 (2)	4088 (2)	70 (4)	168	140 J	56 J	140 J	120 J	89 J	120 J	110 J
Lead	400 (3)	800 (3)	120 (4)	22	32	9	17	4.8 J	11 J	6 J	4.2 J
Nickel	156 (2)	2043 (2)	38 (4)	20.7	18	14	22	19 J	16 J	13 J	14 J
Selenium	39 (2)	511 (2)	0.52 (4)	1.48	0.64 J	0.25 J	0.68 J	0.48 J	0.28 J	0.33 J	0.42 J
Silver	39	511	560	NE	0.66 J	0.15 J	0.52 J	2.3 U	0.24 J	0.32 J	0.16 J
Tin	4700 (2)	10,000	50 (7)	3.76	15 UJ	12 UJ	14 UJ	11 UJ	11 UJ	10 UJ	10 UJ
Vanadium	7.82 (2)	102 (2)	2 (7)	259	***120*** J	***68*** J	***130*** J	***150*** J	***110***	***150*** J	***140*** J
Zinc	2346 (2)	100,000	120 (5)	115	420 J	120 J	290 J	85	120	100	130
Mercury	2.35 (2)	30.7 (2)	0.1 (6)	0.109	0.27	0.2	0.61	0.071	0.15	0.049 J	0.12 J
Sulfide - 9034	NE	NE	NE	NE	38 U	33 U	37 U	41	30 U	28 U	28 U

TABLE 5-1

SUMMARY OF DETECTED INORGANIC RESULTS - SURFACE SOIL
SWMU 27 - CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

					Full RFI 2008									
Site ID	**USEPA**	*USEPA*	Selected	NAPR	**27SS04**	**27SS05**	**27SS06**	**27SS07**	**27SS07**	**27SB04**	**27SB05**	**27SB06**	**27SB07**	**27SB08**
Sample ID	**Region IX**	*Region IX*	Ecological	Basewide	**27SS04**	**27SS05**	**27SS06**	**27SS07**	**27SS07D**	**27SB04-00**	**27SB05-00**	**27SB06-00**	**27SB07-00**	**27SB08-00**
Sample Depth (ft bgs)	**Residential**	*Industrial*	Surface Soil	Background	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Sampling Date	**Soil PRGs**	*Soil PRGs*	Screening Values		**02/12/08**	**02/12/08**	**02/12/08**	**02/12/08**	**02/12/08**	**02/11/08**	**02/11/08**	**02/12/08**	**02/12/08**	**02/12/08**
Metals (mg/kg)														
Antimony	3.1 (2)	41 (2)	78 (8)	3.17	0.22 UJ	0.3 UJ	0.93 J	0.22 UJ	0.22 UJ	0.21 UJ	0.21 UJ	0.21 UJ	0.22 UJ	0.2 UJ
Arsenic	0.39	1.59	18 (4)	2.65	***1.8***	***1.6***	***3.9***	***2.5***	***1.8***	**0.98** J	***1.6***	***2.1***	***1.7***	***2.3***
Barium	537 (2)	6658 (2)	330 (5)	199	96	120	76	64	64	67	70	71	81	83
Beryllium	15.44 (2)	1941 (3)	40 (5)	0.59	0.26 J	0.3 J	0.3 J	0.18 J	0.19 J	0.17 J	0.18 J	0.2 J	0.18 J	0.32 J
Cadmium	3.7 (2)	45.14 (2)	32 (4)	1.02	1.1	1.7	1.2	0.75	0.84	0.73	0.85	0.78	0.94	0.61
Chromium	211	448	0.4 (6)	49.8	25	32	40	23	27	29	19	29	16	14
Cobalt	903	1921	13 (4)	46.2	17	16	18	13	12	13	11	12	16	13
Copper	313 (2)	4088 (2)	70 (4)	168	100	130	120	75	83	82	72	80	84	46
Lead	400 (3)	800 (3)	120 (4)	22	8.9	19	32	16	17	2.2	4	7.2	3.4	13
Nickel	156 (2)	2043 (2)	38 (4)	20.7	14	16	16	11	11	17	8.8	12	10	5.5
Selenium	39 (2)	511 (2)	0.52 (4)	1.48	0.36 J	0.3 U	0.24 U	0.21 U	0.21 U	0.2 U	0.2 U	0.2 U	0.21 U	0.19 U
Silver	39	511	560	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tin	4700 (2)	10,000	50 (7)	3.76	4.3 U	13 J	4.8 U	4.2 U	4.3 U	4 U	3.9 U	4.1 U	4.2 U	3.8 U
Vanadium	7.82 (2)	102 (2)	2 (7)	259	***130***	**100**	***110***	**89**	**97**	**100**	**87**	**92**	***110***	**80**
Zinc	2346 (2)	100,000	120 (5)	115	170 J	290	160 J	89 J	100 B	97 J	74 J	70 J	84 J	46 J
Mercury	2.35 (2)	30.7 (2)	0.1 (6)	0.109	0.1	1.3	0.21	0.08	0.08	0.016 J	0.13	0.01 J	0.04	0.019 J
Sulfide - 9034	NE	NE	NE	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 5-1

SUMMARY OF DETECTED INORGANIC RESULTS - SURFACE SOIL
SWMU 27 - CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

Notes/Qualifiers:

NA - Not Analyzed
J - Estimated: The analyte was positively identified; the quantitation is an estimation
U - Undetected at the Limit of Detection.
UJ - Reported quantitation limit is qualified as estimated
ft bgs - feet below ground surface
mg/kg - miligrams per kilogram
NE: Not Established
PRG - Preliminary Remedial Goal
NAPR - Naval Activity Puerto Rico
USEPA - United States Environmental Protection Agency

(1) NAPR basewide background surface soil screening value (upper limit of the means concentration [mean plus two standard deviations]) (Baker, 2008)

(2) Noncarcinogenic PRGs based on a target hazard quotient of 0.1 for conservative screening purposes

(2a) Naphthalene used as a surrogate

(3) USEPA Action Level for lead in soils

(4) Plant-based ecological soil screening level (USEPA,, 2005a [arsenic]; USEPA, 2005b [cadmium]; USEPA, 2005c [cobalt]; USEPA, 2005d [lead]; USEPA, 2007a [copper]; USEPA, 2007b [nickel]; USEPA, 2007c [selenium])

(5) Invertebrate-based ecological soil screening level (USEPA, 2005e [antimony]; USEPA, 2005f [barium]; USEPA, 2005g [beryllium]; USEPA, 2007e [zinc])

(6) Toxicological threshold for earthworms (Efroymson et al., 1997a)

(7) Toxicogical threshold for plants (Efroymson et al., 1997b)

(8) Ecological soil screening level (http://www.epa.gov/ecotox/ecossl/)

TABLE 5-1

SUMMARY OF DETECTED INORGANIC RESULTS - SURFACE SOIL
SWMU 27 - CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

Table References:

Baker Environmental, Inc, (2008). Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds, Puerto Activity Puerto Rico, Ceiba, Puerto Rico. February 29, 2008.

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

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

USEPA. 2007a. Ecological Soil Screening Levels for Copper (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-68.

USEPA. 2007b. Ecological Soil Screening Levels for Nickel (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-76.

USEPA. 2007c. Ecological Soil Screening Levels for Selenium (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-72.

USEPA. 2007e. Ecological Soil Screening Levels for Zinc (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-72.

USEPA. 2005a. Ecological Soil Screening Levels for Arsenic (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C.

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

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

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

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

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

TABLE 5-2

SUMMARY OF DETECTED ORGANIC RESULTS - 2006 SURFACE SOIL
SWMU 27 - CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	USEPA	*USEPA*	Selected		27SS01	27SS02	27SS03	27SB01	27SB02	27SB03	27SB03
Sample ID	**Region IX**	*Region IX*	Ecological	NAPR [1]	**27SS01**	**27SS02**	**27SS03**	**27SB01-00**	**27SB02-00**	**27SB03-00**	**27SB03-00D**
Sample Depth (ft bgs)	**Residential**	*Industrial*	Surface Soil	Basewide	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Sampling Date	**Soil PRGs**	*Soil PRGs*	Screening Values	Background	**11/17/06**	**11/17/06**	**11/17/06**	**11/16/06**	**11/16/06**	**11/16/06**	**11/16/06**
Volatiles (ug/kg)											
Acetone	1,412,657	5,432,098	NE	NE	55 J	150 J	350 J	59 J	87 J	72 J	130 J
Carbon disulfide	35,534	720,000	NE	NE	8.5	3.5 J	4.1 J	1.1 J	8.0	10	14
Methyl Ethyl Ketone	2,231,120	11,326,440	NE	NE	23 J	20 J	23 J	9.2 J	9.5 J	11 J	19 J
Styrene	1,700,000	1,700,000	10,010	NE	1.4 J	6.1 U	7.2 U	5.2 U	4.8 U	4.8 U	3.8 U
Semivolatiles (ug/kg)											
Bis(2-ethylhexyl) phthalate	34,741	123,121	6,010	NE	240 J	51 J	500 U	400 U	400 U	370 U	370 U
Di-n-butyl phthalate	611,030	6,156,063	200,000	NE	500 U	50 J	500 U	400 U	400 U	39 J	370 U
PAHs (ug/kg)											
1-Methylnaphthalene	5,590	18,770	1,200	NE	10 U	8.8 U	10 U	41 U	8.1 U	2.3 J	7.6 U
2-Methylnaphthalene	5,590	18,770	1,200	NE	10 U	8.8 U	10 U	41 U	8.1 U	2.0 J	7.6 U
Anthracene	2,189,610	100,000,000	1,200	NE	10 U	1.7 J	10 U	41 U	8.1 U	7.6 U	7.6 U
Benzo[a]anthracene	621	2,110	1,200	NE	10 J	5.6 J	2.2 J	41 U	8.1 U	7.6 U	7.6 U
Benzo[a]pyrene	60	210	1,200	NE	9.4 J	8.8 U	10 UJ	41 U	8.1 U	7.6 U	7.6 U
Benzo[b]fluoranthene	620	2,110	1,200	NE	13	8.8 U	10 U	41 U	8.1 U	7.6 U	7.6 U
Benzo[ghi]perylene	NE	NE	1,200	NE	9.8 J	8.8 U	10 U	41 U	8.1 U	7.6 U	7.6 U
Benzo[k]fluoranthene	6,210	21,100	1,200	NE	9.5 J	8.8 U	10 U	41 U	8.1 U	7.6 U	7.6 U
Chrysene	62,146	210,962	1,200	NE	9.0 J	8.6 J	2.0 J	41 U	8.1 U	7.6 U	7.6 U
Indeno[1,2,3-cd]pyrene	620	2,110	1,200	NE	9.3 J	8.8 U	10 U	41 U	8.1 U	7.6 U	7.6 U
Phenanthrene	NE	NE	1,200	NE	2.3 J	1.9 J	10 U	41 U	8.1 U	7.6 U	7.6 U
Pyrene	231,595	2,912,620	1,200	NE	11	5.9 J	2.7 J	41 U	8.1 U	7.6 U	7.6 U
PCBs (ug/kg)											
Aroclor 1260	220	740	2,510	NE	50 U	43 U	50 U	40 J	9.9 J	37 J	37 U
TPH (mg/kg)											
Diesel Range Organics	NE	NE	NE	NE	26	9.8 U	8.8 U	4.0 U	4.0 U	3.7 U	3.7 U
Gasoline Range Organics	NE	NE	NE	NE	0.11 J	0.30 U	0.15 J	0.24 U	0.19 U	0.19 J	0.098 J

TABLE 5-2

SUMMARY OF DETECTED ORGANIC RESULTS - 2006 SURFACE SOIL
SWMU 27 - CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	USEPA	*USEPA*	Selected		27SS01	27SS02	27SS03	27SB01	27SB02	27SB03	27SB03
Sample ID	Region IX	*Region IX*	Ecological	NAPR [1]	27SS01	27SS02	27SS03	27SB01-00	27SB02-00	27SB03-00	27SB03-00D
Sample Depth (ft bgs)	Residential	*Industrial*	Surface Soil	Basewide	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0	0.0 - 1.0
Sampling Date	Soil PRGs	*Soil PRGs*	Screening Values	Background	11/17/06	11/17/06	11/17/06	11/16/06	11/16/06	11/16/06	11/16/06

Notes:

[1] NAPR Basewide Surface Soil Background - Upper Limit of Means (Mean + 2 standard deviations) Draft Summary Report for Environmental Background Concentrations of Inorganic Compounds, Naval Activity Puerto Rico, Ceiba, PR, Baker, September 2006

[2] USEPA action level for lead in soils

UJ - Reported quantitation limit is qualified as estimated
J - Analyte present - Reported value is estimated
U - Not detected
NA - Not Analyzed
ND - Not Detected
NE - Not Established
PRG - Preliminary Remedial Goal
NAPR - Naval Activity Puerto Rico
ft bgs - feet below ground surface

TABLE 5-3

SUMMARY OF DETECTED INORGANIC RESULTS - SUBSURFACE SOIL
SWMU 27 - CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

Site ID	USEPA	*USEPA*	Selected Ecological		Phase I RFI 2006			Full RFI 2008			
Sample ID	**Region IX**	*Region IX*	Surface Soil	NAPR [1]	**27SB01**	**27SB02**	**27SB03**	**27SB04**	**27SB04**	**27SB05**	**27SB05**
Sample Depth (ft bgs)	**Residential**	*Industrial*	Screening	Basewide	**27SB01-01**	**27SB02-01**	**27SB03-01**	**27SB04-01**	**27SB04-02**	**27SB05-01**	**27SB05-02**
Sampling Date	**Soil PRGs**	*Soil PRGs*	Values	Background	**(1.0 - 3.0) 11/16/06**	**(1.0 - 3.0) 11/16/06**	**(2.0 - 4.0) 11/16/06**	**1.0 - 3.0 02/11/08**	**3.0 - 5.0 02/11/08**	**1.0 - 3.0 02/11/08**	**3.0 - 5.0 02/11/08**
Metals (mg/kg)											
Antimony	3.1 [2]	41 [2]	78 [8]	7.44	4.5 U	4.4 U	3.9 U	0.57 J	0.63 J	0.69 J	0.24 UJ
Arsenic	0.39	1.59	18 [4]	6.66	***2.9***	**1.1** J	***1.8*** J	***1.6***	**0.97** J	**1.1** J	**1.3**
Barium	537 [2]	6658 [2]	330 [5]	207	82 J	71 J	55 J	110	52	110	120
Beryllium	15.44 [2]	1941	40 [5]	0.933	0.24 J	0.2 J	0.082 J	0.32 J	0.27 J	0.38 J	0.32 J
Cadmium	3.7	45.14 [2]	32 [4]	0.57	0.088 J	0.12 J	0.97 U	1.1	0.89	0.87	0.94
Chromium	211	448	0.4 [6]	47.9	39 J	63 J	10 J	58	53	110	49
Cobalt	903	1921	13 [4]	63.1	32 J	20 J	4.4 J	28	13	12	20
Copper	313 [2]	4088 [2]	70 [4]	120	98 J	150 J	29 J	120	94	120	150
Lead	400 [3]	800 [3]	120 [4]	6.2	2.1 J	0.9 J	0.84 J	1.3	3.5	1.6	1
Nickel	156 [2]	2043 [2]	38 [4]	26.5	21	23 J	4.6 J	19	16	20	19
Selenium	39 [2]	511 [2]	0.52 [4]	1.19	0.35 J	2.2 U	1.9 U	0.23 U	0.35 J	0.29 J	0.23 U
Vanadium	7.82 [2]	102 [2]	2 [7]	256	***130*** J	***130*** J	40 U	***150***	***150***	***180***	***140***
Zinc	2346 [2]	100,000	120 [5]	92	61	98	25	99 J	53 J	80 J	79 J
Mercury	2.35 [2]	30.7 [2]	0.1 [6]	0.067	0.033	0.021 U	0.032	0.012 J	0.037	0.017 J	0.008 J
Sulfide -9034	NE	NE	NE	NE	37	29 U	27 U	NA	NA	NA	NA

TABLE 5-3

SUMMARY OF DETECTED INORGANIC RESULTS - SUBSURFACE SOIL
SWMU 27 - CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

Site ID	USEPA	*USEPA*	Selected Ecological		Full RFI 2008						
Sample ID	**Region IX**	*Region IX*	Surface Soil	NAPR [1]	**27SB06**	**27SB06**	**27SB07**	**27SB07**	**27SB08**	**27SB08**	**27SB08**
Sample Depth (ft bgs)	**Residential**	*Industrial*	Screening	Basewide	**27SB06-01**	**27SB06-02**	**27SB07-01**	**27SB07-02**	**27SB08-01**	**27SB08-02**	**27SB08-02D**
Sampling Date	**Soil PRGs**	*Soil PRGs*	Values	Background	**1.0 - 3.0**	**3.0 - 5.0**	**1.0 - 3.0**	**3.0 - 5.0**	**1.0 - 3.0**	**3.0 - 5.0**	**3.0 - 5.0**
					02/12/08	**02/12/08**	**02/12/08**	**02/12/08**	**02/12/08**	**02/12/08**	**02/12/08**
Metals (mg/kg)											
Antimony	3.1 [2]	41 [2]	78 [8]	7.44	0.3 J	0.23 UJ	0.2 UJ	0.2 UJ	0.38 J	0.21 UJ	0.22 UJ
Arsenic	0.39	1.59	18 [4]	6.66	**0.97** J	***1.6***	***2.8***	***3.2***	**0.67** J	**0.77** J	0.96 U
Barium	537 [2]	6658 [2]	330 [5]	207	88	89	35	36	63	82	70
Beryllium	15.44 [2]	1941	40 [5]	0.933	0.31 J	0.24 J	0.1 J	0.11 J	0.22 J	0.26 J	0.25 J
Cadmium	3.7	45.14 [2]	32 [4]	0.57	0.94	0.59	0.5	0.56	0.6	1.1	1
Chromium	211	448	0.4 [6]	47.9	48	43	11	10	16	14	14
Cobalt	903	1921	13 [4]	63.1	14	15	5.8	6.7	25	22	20
Copper	313 [2]	4088 [2]	70 [4]	120	88	94	40	37	110	98	91
Lead	400 [3]	800 [3]	120 [4]	6.2	6.9	2	4.2	0.84	1	1.1	0.87
Nickel	156 [2]	2043 [2]	38 [4]	26.5	14	16 U	5.5	5.5	7.8	6.7	6.9
Selenium	39 [2]	511 [2]	0.52 [4]	1.19	0.26 J	0.22 U	0.19 U	0.19 U	0.2 U	0.2 U	0.21 U
Vanadium	7.82 [2]	102 [2]	2 [7]	256	***120***	***110***	**63**	**61**	**100**	***120***	***120***
Zinc	2346 [2]	100,000	120 [5]	92	66 J	70 J	23 J	26 J	74 J	73 J	67 J
Mercury	2.35 [2]	30.7 [2]	0.1 [6]	0.067	0.02 J	0.016 J	0.0074 J	0.0058 J	0.0046 J	0.0044 U	0.004 U
Sulfide -9034	NE	NE	NE	NE	NA	NA	NA	NA	NA	NA	NA

TABLE 5-3

SUMMARY OF DETECTED RESULTS - 2008 SUBSURFACE SOIL
SWMU 27 - CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

Notes/Qualifiers:

J - Estimated: The analyte was positively identified; the quantitation is an estimation
U - Undetected at the Limit of Detection.
UJ - Reported quantitation limit is qualified as estimated
ft bgs - feet below ground surface
mg/kg - miligrams per kilogram
NA - Not Analyzed
PRG - Preliminary Remedial Goal
NAPR - Naval Activity Puerto Rico
USEPA - United States Environmental Protection Agency

(1) NAPR basewide background surface soil screening value (upper limit of the means concentration [mean plus two standard deviations]) for fine sand/silt, Table 3-7 (Baker, 2008)

(2) Noncarcinogenic PRGs based on a target hazard quotient of 0.1 for conservative screening purposes

(3) USEPA Action Level for lead in soils

(4) Plant-based ecological soil screening level (USEPA,, 2005a [arsenic]; USEPA, 2005b [cadmium]; USEPA, 2005c [cobalt]; USEPA, 2005d [lead]; USEPA, 2007a [copper]; USEPA, 2007b [nickel]; USEPA, 2007c [selenium])

(5) Invertebrate-based ecological soil screening level (USEPA, 2005e [antimony]; USEPA, 2005f [barium]; USEPA, 2005g [beryllium]; USEPA, 2007e [zinc])

(6) Toxicological threshold for earthworms (Efroymson et al., 1997a)

(7) Toxicogical threshold for plants (Efroymson et al., 1997b)

(8) Ecological soil screening level (http://www.epa.gov/ecotox/ecossl/)

TABLE 5-3

SUMMARY OF DETECTED RESULTS - 2008 SUBSURFACE SOIL
SWMU 27 - CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

Table References:

Baker Environmental, Inc, (2008). Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds, Activity Puerto Rico, Ceiba, Puerto Rico. February 29, 2008.

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

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

USEPA. 2007a. Ecological Soil Screening Levels for Copper (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-68.

USEPA. 2007b. Ecological Soil Screening Levels for Nickel (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-76.

USEPA. 2007c. Ecological Soil Screening Levels for Selenium (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-72.

USEPA. 2007e. Ecological Soil Screening Levels for Zinc (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9285.7-72.

USEPA. 2005a. Ecological Soil Screening Levels for Arsenic (Interim Final). Office of Solid Waste and Emergency Response, Washington, D.C.

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

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

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

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

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

TABLE 5-4

SUMMARY OF DETECTED ORGANIC RESULTS - 2006 SUBSURFACE SOIL
SWMU 27 - CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID	USEPA	*USEPA*	Selected Ecological		27SB01	27SB02	27SB03
Sample ID	**Region IX**	*Region IX*	Surface Soil	NAPR [2]	**27SB01-01**	**27SB02-01**	**27SB03-01**
Sample Depth (ft bgs)	**Residential**	*Industrial*	Screening	Basewide	**(1.0 - 3.0)**	**(1.0 - 3.0)**	**(2.0 - 4.0)**
Sampling Date	**Soil PRGs**	*Soil PRGs*	Values [1]	Background	**11/16/06**	**11/16/06**	**11/16/06**
Volatiles (ug/kg)							
Acetone	1,412,657	5,432,098	NE	NE	21 J	36 J	55 J
Carbon disulfide	35,534	720,000	NE	NE	4.1 U	2.7 J	1.9 J
Methyl Ethyl Ketone	2,231,120	11,326,440	NE	NE	5.6 J	23 U	8.3 J
Semivolatiles (ug/kg)	**(none detected)**						
PAHs (ug/kg)							
Benzo[a]anthracene	621	2,110	1,200	NE	410 U	7.7 U	6.9 J
Benzo[a]pyrene	60	210	1,200	NE	410 U	7.7 U	6.6 J
Benzo[b]fluoranthene	620	2,110	1,200	NE	410 U	7.7 U	8.8
Benzo[ghi]perylene	NE	NE	1,200	NE	410 U	7.7 U	6.7 J
Benzo[k]fluoranthene	6,210	21,100	1,200	NE	410 U	7.7 U	6.9 J
Chrysene	62,146	210,962	1,200	NE	410 U	7.7 U	10
Indeno[1,2,3-cd]pyrene	620	2,110	1,200	NE	410 U	7.7 U	5.7 J
Phenanthrene	NE	NE	1,200	NE	410 U	7.7 U	4.1 J
Pyrene	231,595	2,912,620	1,200	NE	410 U	7.7 U	11
PCBs (ug/kg)							
Aroclor 1260	220	740	2,510	NE	40 J	38 J	35 UJ
TPH (mg/kg)							
Diesel Range Organics	NE	NE	NE	NE	9.9	3.8 U	3.5 U

Notes:

[1] Surface Soil Screening values compared to 27SB01-01, and 27SB02-01 only, since they were from 1 to 3 feet bgs, and anything above 2 feet is ecologically significant

[2] NAPR Basewide Subsurface Soil Background - CLAY - Upper Limit of Means Draft Summary Report for Environmental Background Concentrations of Inorganic Compounds, Naval Activity Puerto Rico, Ceiba, PR, Baker, September 2006

[3] USEPA action level for lead in soils

U - Not detected
UJ - Reported quantitation limit is qualified as estimated
J - Analyte present - Reported value is estimated
R - Validator rejected analytical result
PRG - Preliminary Remedial Goal
NE - Not Established
NAPR - Naval Activity Puerto Rico
ft bgs - feet below ground surface

TABLE 5-4

SUMMARY OF DETECTED ORGANIC RESULTS - 2006 SUBSURFACE SOIL
SWMU 27 - CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Notes/Qualifiers

J - Estimated: The analyte was positively identified; the quantitation is an estimation
U - Undetected at the Limit of Detection.
ug/L - micrograms per liter
NE - Not Established

(1) NAPR Basewide Groundwater Background - Upper Limit of Means (Mean + 2 standard deviations) Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds, Naval Activity Puerto Rico, Ceiba, PR, Baker Environmental, 2008.

(2) Minimun acute value (96-hour LC_{50} for Lumbriculus variegatus [oligochaete])with a safety factor of 100.

(3) USEPA National recommended water quality criterion (total recoverable saltwater CCC derived by dividing the dissolved CCC value by the USEPA recommended conversion factor) (USEPA, 2006).

(4) Minimum acute value (96-hour LC_{50} for *Americanysis bahia* [opposum shrimp]) with a safety factor of 100 (values expressed as a total recoverable concentration) (USEPA, 2003).

(5) Minimum acute value (96-hour LC_{50} for *Fundulus heteroclitus* [mummichog]) with a safety factor of 100 (value expressed as a total recoverable concentration) (USEPA, 2003).

(6) Minimum acute value (96-hour LC_{50} for *Nitocra spinipes* [Harpacticoid copepod]) with a safety factor of 100 (value expressed as a total recoverable concentration) (USEPA, 2003).

(7) USEPA Region 4 chronic screening value (USEPA, 2001).

(8) Minimum chronic value (28-day NOEC for *Pimephales promelas* [fathead minnow]) based on growth (value expressed as a total recoverable concentration) (USEPA, 2003).

(9) Proposed CCC (value expressed asa total recoverable concentration) (Buchman, 1999).

(10) USEPA National recommended water quality criterion (dissolved saltwater CCC) (USEPA, 2006).

(11) Noncarcinogenic PRGs based on a target hazard quotient of 0.1 for conservative screening purposes.

(12) Tap-Water PRG value for hexavalent chromium presented.

(13) USEPA Action Level for lead in drinking water.

TABLE 5-5

SUMMARY OF DETECTED RESULTS - 2008 GROUNDWATER
SWMU 27 - CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

Site ID **Sample ID** **Sampling Date**	**USEPA Region IX Tap Water PRGs**	*USEPA MCLs*	Selected Ecological Surface Water Screening Values	NAPR [1] Basewide Background	**27MW04** **27GW04** **02/14/08**	**27MW05** **27GW05** **02/14/08**	**27MW06** **27GW06** **02/14/08**	**27MW07** **27GW07** **02/14/08**	**27MW08** **27GW08** **02/14/08**	**27MW08** **27GW08D** **02/14/08**
VOCs (ug/L)										
Acetone	550	NE	1,000	NE	5 U	5.6 J	14 J	5 U	5 U	5 U
Carbon disulfide	100	NE	650	NE	0.17 U	0.7 J	2.4	0.71 J	0.27 J	0.17 U
Chloroform	0.166	NE	815	NE	**0.38** J	0.29 U	**1**	0.29 U	**0.4** J	**0.36** J
Total Metals (ug/L)										
Arsenic	0.045	10	36 [3]	18.89	5.9 U	5.9 U	**8.2** J	***13*** J	5.9 U	5.9 U
Barium	260 [11]	2,000	50,000 [4]	686	180	**450**	**900**	240	230 J	99 J
Beryllium	7 [11]	4	310 [5]	2.21	0.2 U	0.2 U	0.2 U	0.34 J	0.36 J	0.2 U
Cadmium	1.8 [11]	5	8.85 [3]	16.62	0.53 U	0.9 U	0.53 U	1.6 J	1.1 U	0.53 U
Chromium	11 [11,12]	100	50.4 [3]	162.41	1.9 U	**12**	4.4 U	**28**	**45** J	5.2 UJ
Cobalt	73 [11]	NE	45 [6]	633.21	1.2 U	8.6 J	2.7 J	26	27 J	1.7 J
Copper	150 [11]	1,300.00	3.73 [3]	324	10 UJ	30 J	3.9 UJ	96 B	150 J	14 R
Lead	NE	15 [13]	8.52 [3]	26.25	2.3 U	2.3 U	2.3 U	4.8 J	2.3 U	2.3 U
Nickel	73 [11]	NE	8.28 [3]	95.7	1.6 U	8.7 U	4.1 U	22 J	17 J	1.6 U
Vanadium	3.6 [11]	NE	120 [8]	484.66	**11** J	**73** J	**43** J	**150** J	**190** J	24 R
Mercury	1.1 [11]	2.00	1.11 [3]	0.15	0.08 U	0.15 J	0.097 J	0.23 J	0.08 U	0.08 U
Dissolved Metals (ug/L)										
Arsenic	0.05	10	36 [10]	14.03	3.7 U	5.6 U	***11***	3.9 U	2.3 U	3.1 U
Barium	260 [11]	2,000	50,000 [4]	260	180	**410**	**880**	140	76	89
Copper	150 [11]	1,300.00	3.1 [3]	29.0	9.7 J	4.9 U	4.2 U	3.4 U	3.5 U	2.7 U
Nickel	73 [11]	NE	8.2 [3]	84.1	2.8 J	5.2 J	7.6 J	2 U	2 U	2 U
Vanadium	3.6 [11]	NE	120 [8]	20.96	**10**	**47** J	**29** J	**4.8** J	**8.8** J	**9.9** J
Mercury	1.1 [11]	2.00	0394 [3]	0.157	0.08 U	0.084 J	0.08 U	0.08 U	0.08 U	0.08 U

TABLE 5-5

SUMMARY OF DETECTED RESULTS - 2008 GROUNDWATER
SWMU 27 - CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

Notes/Qualifiers

J - Estimated: The analyte was positively identified; the quantitation is an estimation
U - Undetected at the Limit of Detection.
ug/L - micrograms per liter
NE - Not Established

(1) NAPR Basewide Groundwater Background - Upper Limit of Means (Mean + 2 standard deviations) Revised Final II Summary Report for Environmental Background Concentrations of Inorganic Compounds, Naval Activity Puerto Rico, Ceiba, PR, Baker Environmental, Inc. February 19, 2008.

(2) Minimun acute value (96-hour LC_{50} for Lumbriculus variegatus [oligochaete])with a safety factor of 100.

(3) USEPA National recommended water quality criterion (total recoverable saltwater CCC derived by dividing the dissolved CCC value by the USEPA recommended conversion factor) (USEPA, 2006).

(4) Minimum acute value (96-hour LC_{50} for *Americanysis bahia* [opposum shrimp]) with a safety factor of 100 (values expressed as a total recoverable concentration) (USEPA, 2003).

(5) Minimum acute value (96-hour LC_{50} for *Fundulus heteroclitus* [mummichog]) with a safety factor of 100 (value expressed as a total recoverable concentration) (USEPA, 2003).

(6) Minimum acute value (96-hour LC_{50} for *Nitocra spinipes* [Harpacticoid copepod]) with a safety factor of 100 (value expressed as a total recoverable concentration) (USEPA, 2003).

(7) USEPA Region 4 chronic screening value (USEPA, 2001)

(8) Minimum chronic value (28-day NOEC for *Pimephales promelas* [fathead minnow]) based on growth (value expressed as a total recoverable concentration) (USEPA, 2003).

(9) Proposed CCC (value expressed asa total recoverable concentration) (Buchman, 1999).

(10) USEPA National recommended water quality criterion (dissolved saltwater CCC) (USEPA, 2006).

(11) Noncarcinogenic PRGs based on a target hazard quotient of 0.1 for conservative screening purposes

(12) Tap-Water PRG value for hexavalent chromium presented

(13) USEPA Action Level for lead in drinking water

TABLE 5-6

SUMMARY OF DETECTED RESULTS - 2006 GROUNDWATER
SWMU 27 - CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Sampling Date	USEPA Region IX Tap Water PRGs	*USEPA MCLs*	Selected Ecological Surface Water Screening Values	NAPR [1] Basewide Background	27TW01 27TW01 11/17/06	27TW02 27TW02 11/17/06	27TW03 27TW03 11/17/06	27TW03 27TW03D 11/17/06
Volatiles (ug/L)								
1,1,1,2-Tetrachloroethane	0.432	NE	902	NE	**1.0**	**1.0**	1.0 U	1.0 U
Semivolatiles (ug/L)	**(none detected)**							
PAHs (ug/L)	**(none detected)**							
PCBs (ug/L)	**(none detected)**							
TPH (ug/L)								
Diesel Range Organics	NE	NE	NE	NE	3.4	0.23	0.94 U	0.10 U

Notes:

[1] NAPR Basewide Groundwater Background - Upper Limit of Means (Mean + 2 standard deviations) Draft Summary Report for Environmental Background Concentrations of Inorganic Compounds, Naval Activity Puerto Rico, Ceiba, PR, Baker, September 2006

[2] USEPA action level for lead in water

U - Not detected
UJ - Reported quantitation limit is qualified as estimated
J - Analyte present - Reported value is estimated
NA - Not Analyzed
ND - Not Detected
NE - Not Established
PRG - Preliminary Remedial Goal
NAPR - Naval Activity Puerto Rico

TABLE 5-6

SUMMARY OF DETECTED RESULTS - 2006 GROUNDWATER
SWMU 27 - CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Site ID Sample ID Sampling Date	USEPA Region IX Tap Water PRGs	*USEPA MCLs*	Selected Ecological Surface Water Screening Values	NAPR [1] Basewide Background	27TW01 27TW01 11/17/06	27TW02 27TW02 11/17/06	27TW03 27TW03 11/17/06	27TW03 27TW03D 11/17/06
Inorganics (ug/L)								
Arsenic	0.045	10	36	18.89	10 UJ	10 U	**2.8 J**	**3.2 J**
Barium	260	2,000	50,000	686	***4300***	**280**	46	46
Beryllium	7	4	310	2.21	4.0 U	0.75 J	4.0 U	4.0 U
Cadmium	1.80	5	8.8	55.83	0.13 J	0.86 J	5.0 U	5.0 U
Chromium	5,470	100	50.0	162.41	5.8 J	120	10 U	10 U
Cobalt	73	NE	45	633.21	9.9 J	54	2.5 J	3 J
Copper	150	1,300	3.1	593.00	20 U	**410 J**	20 UJ	20 UJ
Lead	NE	15 [2]	8.1	26.25	5.0 U	8.5	5.0 U	5.0 U
Nickel	70	NE	8.2	84.1	2.8 J	56	40 U	40 U
Selenium	18	50	71.0	33.98	1.6 J	0.73 J	1.1 J	0.75 J
Tin	2,190	NE	NE	20.68	10 UJ	1.8 J	10 UJ	10 UJ
Vanadium	3.60	NE	120	484.66	**16**	**410**	**16 J**	**19 J**
Zinc	1,090	NE	81.0	547.53	26 J	330 J	7.5 J	8.7 J
Mercury - 7470A (ug/L)	0.36	2	0.94	0.29	0.20 UJ	0.085 J	0.20 U	0.20 U
Cyanide Total - 9012A	730	200	NE	NE	0.032	NA	0.0088 J	0.0052 J
Arsenic, Dissolved	0.045	10	36	20.41	**5.4 J**	**1.5 J**	**6.2 J**	**6.2 J**
Barium, Dissolved	260	2,000	50,000	260	***3900***	95	47	45
Cadmium, Dissolved	1.80	5	8.8	55.83	0.12 J	5.0 U	0.12 J	5.0 U
Chromium, Dissolved	5,470	100	50.0	9.0	2.7 J	1.7 J	10 U	10 U
Cobalt, Dissolved	73	NE	45	580.5	11	9.3 J	7.8 J	2.4 J
Nickel, Dissolved	73	NE	8.2	84.1	40 U	40 U	2.4 J	1.3 J
Selenium, Dissolved	18	50	71.0	33.98	1.5 J	10 UJ	1 J	1 J
Vanadium, Dissolved	3.60	NE	120	265.61	**7.2 J**	**41**	**17 J**	**15 J**
Zinc, Dissolved	1,090	NE	81.0	360.64	15 J	6.4 J	8.1 J	9.1 J

TABLE 5-7

SUMMARY OF DETECTED RESULTS - 2008 QUALITY ASSURANCE/QUALITY CONTROL SAMPLES
SWMU 27 - CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

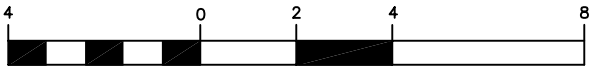
	Field Blanks		Trip Blank	Equipment Rinsates		
Sample ID	**FB01**	**FB02**	**TB01**	**ER01**	**ER02**	**ER05**
Sampling Date	**02/16/08**	**02/16/08**	**02/14/08**	**02/11/08**	**02/12/08**	**02/14/08**
VOCs (ug/L)						
Chlorodibromomethane	0.3 U	3.9	0.3 U	NA	NA	0.3 U
Chloroform	0.29 U	77	0.29 U	NA	NA	0.29 U
Chloromethane	0.28 U	0.28 U	0.28 U	NA	NA	1.4
Dichlorobromomethane	0.34 U	13	0.34 U	NA	NA	0.34 U
Toluene	0.31 U	0.31 U	0.31 U	NA	NA	3.4
Metals (ug/L)						
Barium	2 U	2.3 J	NA	2.6 J	2 U	2 U
Silver	0.51 U	0.77 J	NA	0.51 U	0.51 U	0.51 U
Zinc	8.4 U	160	NA	18 J	8.4 U	8.4 U

Qualifiers/Notes:

J - Estimated: The analyte was positively identified; the quantitation is an estimation
NA - Not Analyzed
U - Not Detected
ug/l - micrograms per liter

FIGURES

K:_SOUTHNAVFAC\111626 D02\Task 9 – Phase II RFIs\SWMU 27 Full RFI Report\CAD\111626_27FUL-01



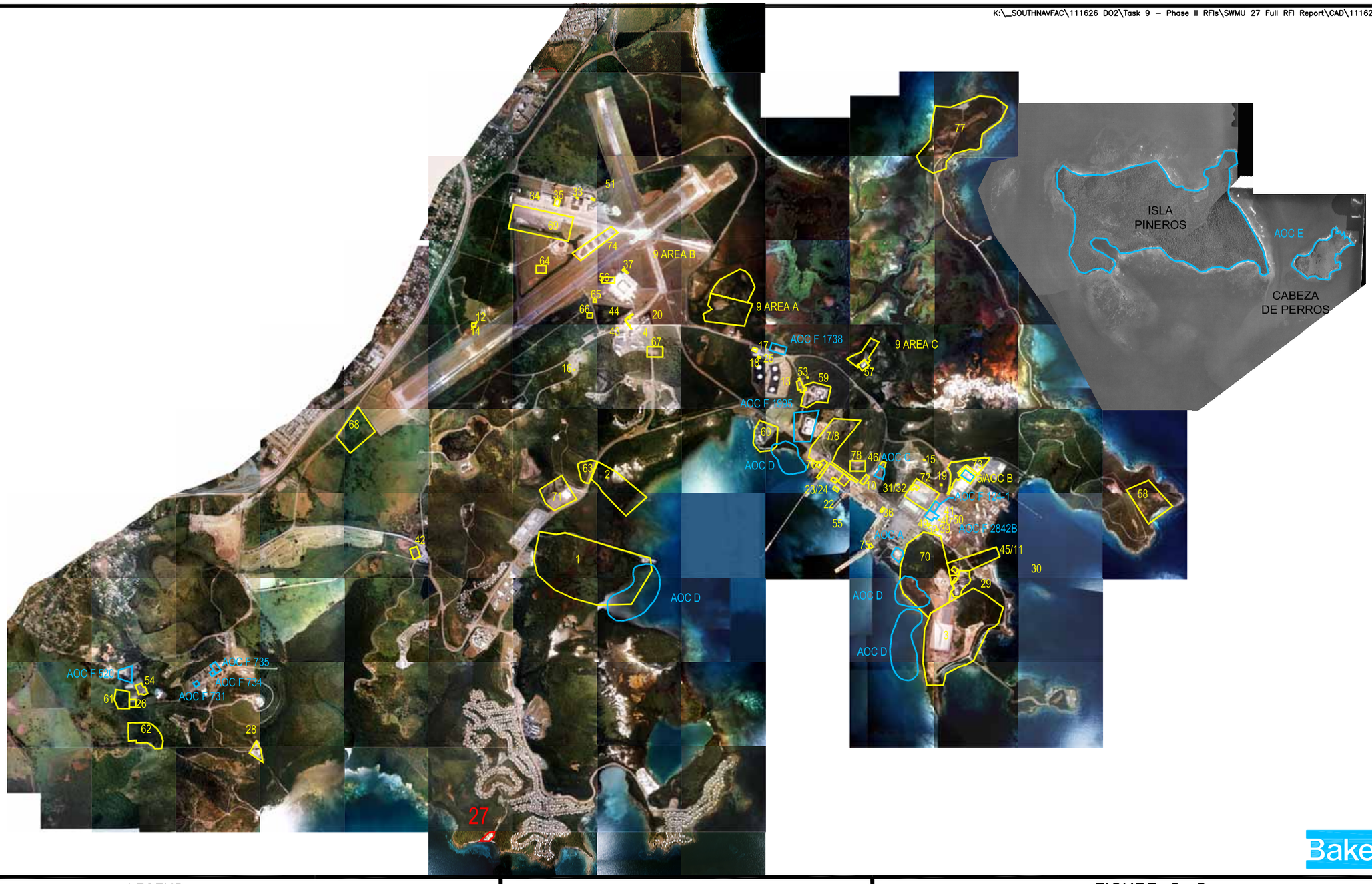
Baker

FIGURE 2-1
REGIONAL LOCATION MAP
SWMU 27
CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI

SOURCE: METRODATA, INC., 1999.

NAVAL ACTIVITY PUERTO RICO

K:_SOUTHNAVFAC\111626 DO2\Task 9 – Phase II RFIs\SWMU 27 Full RFI Report\CAD\111626_27FUL–02



Baker

LEGEND

1 – SWMUs

AOC D – AOCs

– AREA TO WHICH THIS INVESTIGATION PERTAINS

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

3000 0 1500 3000

1 inch = 3000 ft.

FIGURE 2–2
SWMU/AOC LOCATION MAP
SWMU 27–CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI

NAVAL ACTIVITY PUERTO RICO

LEGEND

◇ – SITE BOUNDARY

– WETLAND DELINEATION

—S— – SHEETPILE SEAWALL

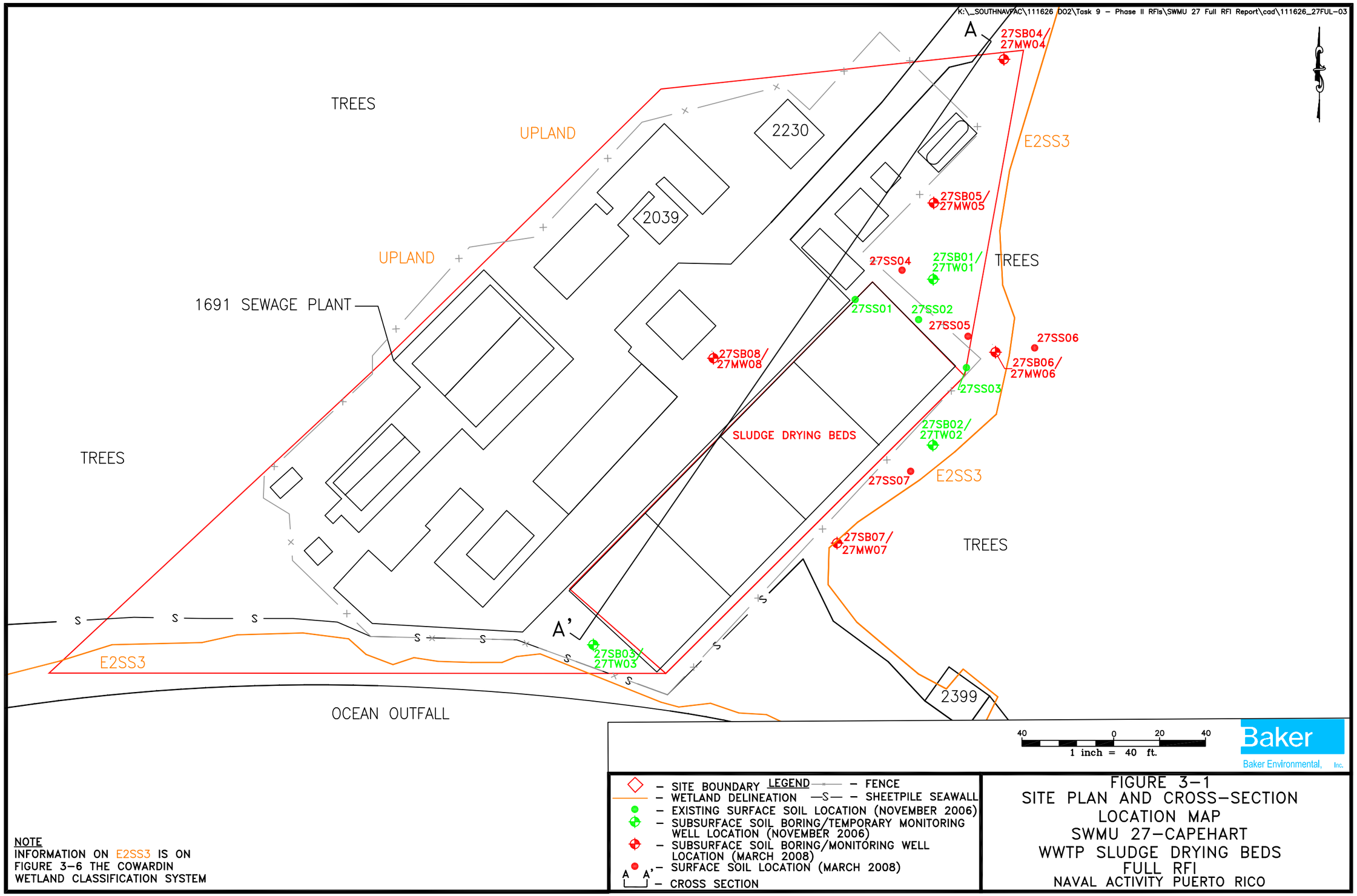
NOTE
INFORMATION ON E2SS3 IS ON FIGURE 3–6 THE COWARDIN WETLAND CLASSIFICATION SYSTEM

FIGURE 2–3
SWMU 27 LOCATION MAP

SWMU 27–CAPEHART WWTP SLUDGE DRYING BEDS FULL RFI

NAVAL ACTIVITY PUERTO RICO

k:_SOUTHNAVFAC\111626_D02\Task 9 – Phase II RFIs\SWMU 27 Full RFI Report\cad\111626_27FUL-03



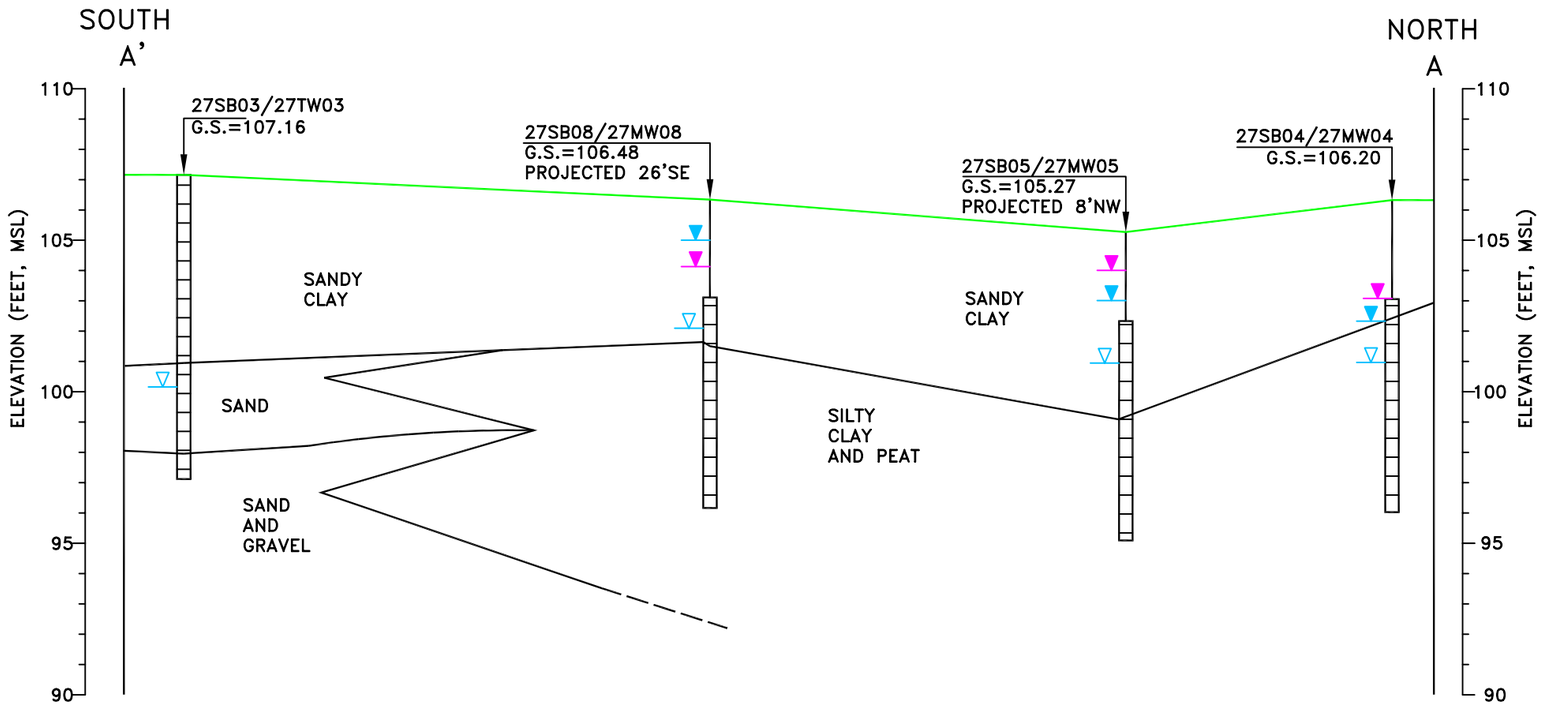
NOTE
INFORMATION ON E2SS3 IS ON FIGURE 3-6 THE COWARDIN WETLAND CLASSIFICATION SYSTEM

LEGEND

- SITE BOUNDARY
- WETLAND DELINEATION
- EXISTING SURFACE SOIL LOCATION (NOVEMBER 2006)
- SUBSURFACE SOIL BORING/TEMPORARY MONITORING WELL LOCATION (NOVEMBER 2006)
- SUBSURFACE SOIL BORING/MONITORING WELL LOCATION (MARCH 2008)
- SURFACE SOIL LOCATION (MARCH 2008)
- CROSS SECTION
- FENCE
- SHEETPILE SEAWALL

FIGURE 3-1
SITE PLAN AND CROSS-SECTION LOCATION MAP
SWMU 27-CAPEHART WWTP SLUDGE DRYING BEDS FULL RFI
NAVAL ACTIVITY PUERTO RICO

K:_SOUTHNAVFAC\111626 D02\Task 9 – Phase II RFIs\SWMU 27 Full RFI Report\CAD\111626_27FUL-05.DWG



GEOLOGIC CROSS-SECTION A-A'
LOOKING NORTHWEST

5 0 2.5 5
1 inch = 5 ft.
VERTICAL SCALE
EXACGERATION 8x

40 0 20 40
1 inch = 40 ft.
HORIZONTAL SCALE

Baker

LEGEND

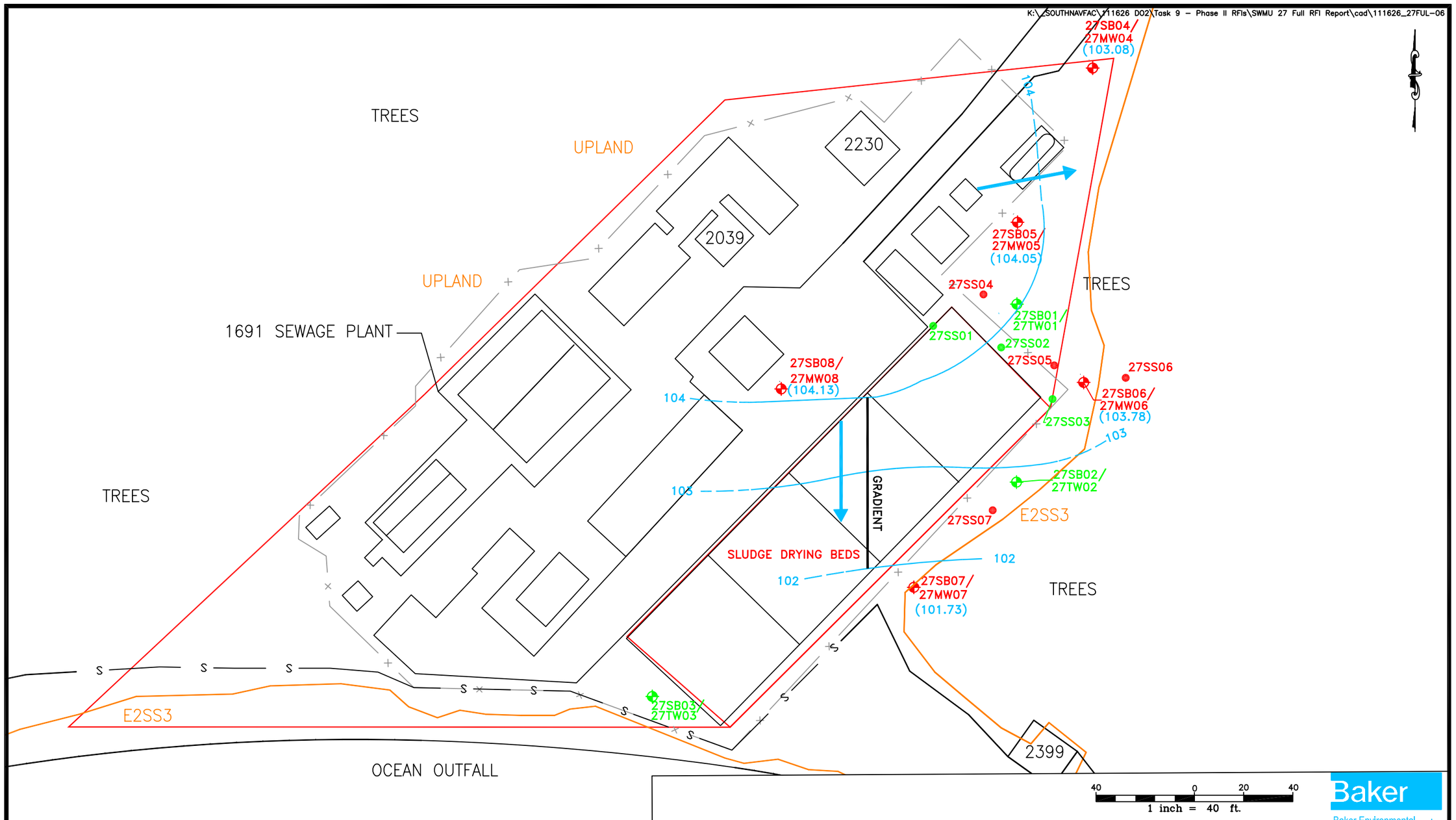
ft.	FEET	I	WELL RISER
msl	MEAN SEA LEVEL	▯	WELL SCREEN INTERVAL
———	ESTIMATED	– – –	PROJECTED
G.S.	GROUND SURFACE, ft. msl		
▼	GROUNDWATER SURFACE (FEBRUARY 13, 2008)		
▼	GROUNDWATER SURFACE (JUNE 13, 2008)		
▽	GROUNDWATER ENCOUNTERED DURING DRILLING		

ALL ELEVATIONS SHOWN ARE MEAN SEA LEVEL PLUS 100 FEET

THE SOIL BORING INFORMATION IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS. SUBSURFACE CONDITIONS INTERPOLATED BETWEEN BORINGS ARE ESTIMATED BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND GEOLOGIC JUDGEMENT.

FIGURE 3-2
GEOLOGIC CROSS-SECTION A-A'
SWMU 27-CAPEHART
WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO

K:_SOUTHNAVFAC\111626 D02\Task 9 – Phase II RFIs\SWMU 27 Full RFI Report\cad\111626_27FUL–06



Baker
Baker Environmental, Inc.

$$\text{GRADIENT}\quad i = \frac{\Delta H}{\Delta L} = \frac{2'}{69'} = 0.029\ \text{ft/ft}\ S\ \text{(MAGNITUDE AND DIRECTION VARY)}$$

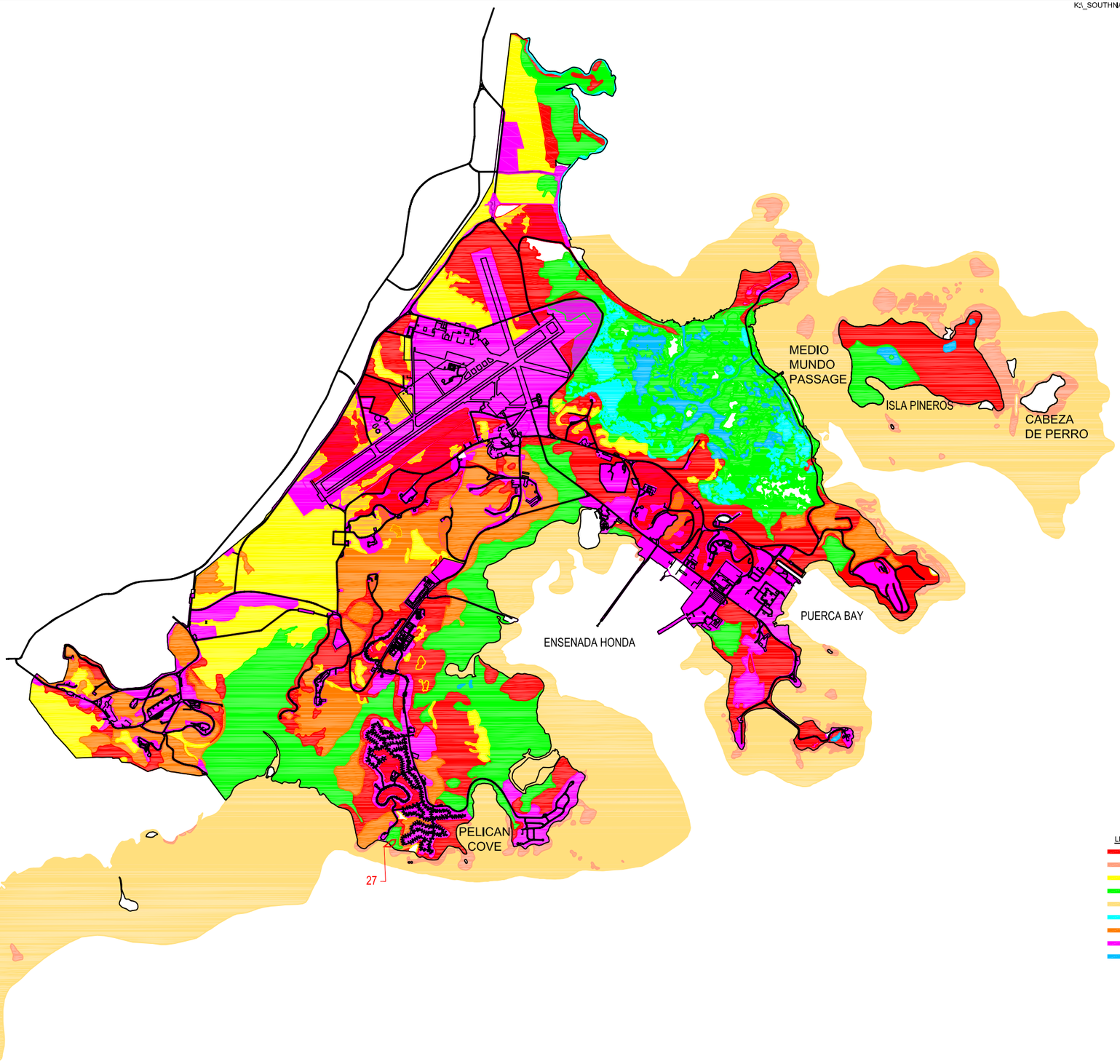
NOTE
INFORMATION ON E2SS3 IS ON FIGURE 3–6 THE COWARDIN WETLAND CLASSIFICATION SYSTEM

LEGEND

- ◇ – SITE BOUNDARY
- — – WETLAND DELINEATION
- ● – EXISTING SURFACE SOIL LOCATION (NOVEMBER 2006)
- ⊕ – SUBSURFACE SOIL BORING/TEMPORARY MONITORING WELL LOCATION (NOVEMBER 2006)
- ⊕ – SUBSURFACE SOIL BORING/MONITORING WELL LOCATION (MARCH 2008)
- ● – SURFACE SOIL LOCATION (MARCH 2008)
- (104.13) – GROUNDWATER ELEVATION, ft. msl (ELEVATIONS ARE MEAN SEA LEVEL PLUS 100 FEET)
- → – GROUNDWATER FLOW
- 104 – GROUNDWATER ELEVATION CONTOUR, ft. msl
- –x– – FENCE
- —S— – SHEETPILE SEAWALL

FIGURE 3–3
GROUNDWATER CONTOUR MAP (JUNE 12, 2008)
SWMU 27–CAPEHART WWTP SLUDGE DRYING BEDS FULL RFI
NAVAL ACTIVITY PUERTO RICO

K:_SOUTHNAVFAC\111626 DO2\Task 9 - Phase II RFIs\SWMU 27 Full RFI Report\cad\111626_27FUL-12



SOURCE: GEO-MARINE, INC, 1998

REVISIONS		NORTH		SWMU 27-CAPEHART WWTP SLUDGE DRYING BEDS NAVAL ACTIVITY PUERTO RICO	Baker	"TERRESTRIAL AND AQUATIC HABITAT OCCURRING AT NAVAL ACTIVITY PUERTO RICO" FULL RCRA FACILITY INVESTIGATION	FIGURE
	DRAWN RRR REVIEWED MEK S.O.# 111626 CADD# 111626_27FUL-12.dwg			BAKER ENVIRONMENTAL, Inc. Coraopolis, Pennsylvania		SCALE FULLSIZE 1" = 600' DATE JUNE 2008	3-4

0 62.5 125 250 Feet

0 25 50 100 Meters

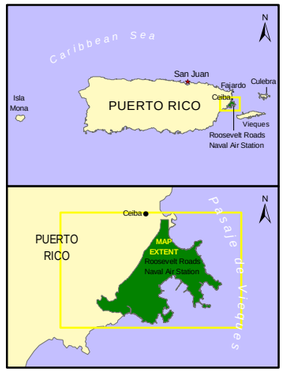


Figure 3-5
Naval Activity Puerto Rico
Wetlands Delineation
North and East Sections

This certifies that this plat identifies potential waters and wetlands regulated persuant to Section 404 of the Clean Water Act. Wetlands were delineated in December, 1999 from 1993 color infrared and 1998 true color aerial photography.

Data form locations
Roosevelt Roads base boundary
Wetland boundaries
SWMU's

N

Source: Geo-Marine, Inc., September 6, 2000

0 1,500 3,000 6,000 Feet

0 750 1,500 3,000 Meters

FIGURE 3-6
THE COWARDIN WETLAND CLASSIFICATION SYSTEM
SWMU 27-CAPEHART WWTP SLUDGE DRYING BEDS
FULL RCRA FACILITY INVESTIGATION
NAVAL ACTIVITY PUERTO RICO

SYSTEM: M - MARINE

SUBSYSTEM: 1 - SUBTIDAL

CLASS	RB - Rock Bottom	UB - Uncon-solidated Bottom	AB - Aquatic Bed	RF - Reef	OW - Open Water (unknown bottom)
Subclass	1 Bedrock 2 Rubble	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic	1 Algal 3 Rooted Vasc 5 Unknown	1 Coral 3 Worm	

SUBSYSTEM: 2 - INTERTIDAL

CLASS	AB - Aquatic Bed	RF - Reef	RS - Rocky Shore	US - Uncon-solidated Shore
Subclass	1 Algal 3 Rooted Vasc 5 Unknown	1 Coral 3 Worm	1 Bedrock 2 Rubble	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic

SYSTEM: E - ESTUARINE

SUBSYSTEM: 1 - SUBTIDAL

CLASS	RB - Rock Bottom	UB - Uncon-solidated Bottom	AB - Aquatic Bed	RF - Reef	OW - Open Water (unknown bottom)
Subclass	1 Bedrock 2 Rubble	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic	1 Algal 3 Rooted Vasc 4 Floating Vasc 5 *Unknown Submerg.* 6 *Unknown Surface*	2 Mollusk 3 Worm	

SUBSYSTEM: 2 - INTERTIDAL

CLASS	AB - Aquatic Bed	RF - Reef	SB - Streambed	RS - Rocky Shore	US - Uncon-solidated Shore	EM - Emergent	SS - Scrub-Shrub	FO - Forested
Subclass	1 Algal 3 Rooted Vasc 4 Floating Vasc 5 *Unknown Submerg.* 6 *Unknown Surface*	2 Mollusk 3 Worm	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic	1 Bedrock 2 Rubble	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic 5 Dead	1 Persistent 2 Nonpersistent	1 Broad-leaved Decid. 2 Needle-leaved Decid. 3 Broad-leaved Everg. 4 Needle-leaved Everg. 5 Dead 6 *Deciduous* 7 *Evergreen*	1 Broad-leaved Decid. 2 Needle-leaved Decid. 3 Broad-leaved Everg. 4 Needle-leaved Everg. 5 Dead 6 *Deciduous* 7 *Evergreen*

SYSTEM: R - RIVERINE

SUBSYSTEM: 1 - TIDAL

CLASS	RB - Rock	UB - Uncon-solidated Bottom	SB - Streambed	AB - Aquatic Bed	RS - Rocky Shore
Subclass	1 Bedrock 2 Rubble	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic	1 Bedrock 2 Rubble 3 Cobble - Gravel 4 Sand 5 Mud 6 Organic 7 Vegetated	1 Algal 2 Aquatic Moss 3 Rooted Vasc 4 Floating Vasc 5 *Unknown Submerg.* 6 *Unknown Surface*	1 Bedrock 2 Rubble

SUBSYSTEM: 2 - LOWER PERENNIAL

SUBSYSTEM: 3 - UPPER PERENNIAL

SUBSYSTEM: 4 INTERMITTENT

CLASS	US - Uncon-solidated Shore	OW - Open Water (unknown bottom)	**EM - Emergent
Subclass	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic		2 Nonpersistent

SUBSYSTEM: 5 - UNKNOWN PERENNIAL

SYSTEM: L - LACUSTRINE

SUBSYSTEM: 1 - LIMNETIC

CLASS	RB - Rock Bottom	UB - Uncon-solidated Bottom	AB - Aquatic Bed	OW - Open Water (unknown bottom)
Subclass	1 Bedrock 2 Rubble	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic	1 Algal 2 Aquatic Moss 3 Rooted Vasc 4 Floating Vasc 5 *Unknown Submerg.* 6 *Unknown Surface*	

SUBSYSTEM: 2 - LITTORAL

CLASS	RS - Rocky Shore	UB - Uncon-solidated Bottom	AB - Aquatic Bed	US - Uncon-solidated Shore	EM - Emergent	OW - Open Water (unknown bottom)
Subclass	1 Bedrock 2 Rubble	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic	1 Algal 2 Aquatic Moss 3 Rooted Vasc 4 Floating Vasc 5 *Unknown Submerg.* 6 *Unknown Surface*	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated	2 Nonpersistent	

SYSTEM: P - PALUSTRINE

CLASS	RB - Rock Bottom	UB - Uncon-solidated Bottom	AB - Aquatic Bed	US - Uncon-solidated Shore	ML - Moss-Lichen	EM - Emergent	SS - Scrub-Shrub	FO - Forested	OW - Open Water (unknown bottom)
Subclass	1 Bedrock 2 Rubble	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic	1 Algal 2 Aquatic Moss 3 Rooted Vasc 4 Floating Vasc 5 *Unknown Submerg.* 6 *Unknown Surface*	1 Cobble - Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated	1 Moss 2 Lichen	1 Persistent 2 Nonpersistent	1 Broad-leaved Decid. 2 Needle-leaved Decid. 3 Broad-leaved Everg. 4 Needle-leaved Everg. 5 Deed 6 *Deciduous* 7 *Evergreen*	1 Broad-leaved Decid. 2 Needle-leaved Decid. 3 Broad-leaved Everg. 4 Needle-leaved Everg. 5 Dead 6 *Deciduous* 7 *Evergreen*	

MODIFIERS

WATER REGIME

Non-Tidal		Tidal	
A Temp. Flooded	H Permanently Flooded	K Artificially Flooded	*S Temporary-Tidal
B Saturated	J Intermittently Flooded	L Subtidal	*R Seasonal-Tidal
C Seasonally Flooded	K Artificially Flooded	M Irregularly Flooded	*T Semipermanent- Tidal
D Seasonally Flooded/ Well Drained	W Intermittently Flooded/ Temporary	N Regularly Flooded	*V Permanent-Tidal
E Seasonally Flooded/ Saturated	Y Saturated/Semipermanent/ Seasonal	P Irregularly Flooded	U Unknown
F Semipermanently Flooded	Z Intermittently Exposed	* These water regimes are only used in tidally influenced, freshwater systems.	
G Intermittently Exposed	Permanent		
	U Unknown		

WATER CHEMISTRY

Coastal Halinity	Inland Salinity	pH (fresh water)
1 Hyperhaline	7 Hypersaline	a Acid
2 Euhaline	8 Eusaline	t circumneutral
3 Mixohaline	9 Mixosaline	i Alkaline
4 Folyhaline	0 Fresh	
5 Mesohaline		
6 Oligohaline		
0 Fresh		

SOIL

g	Organic
n	Mineral

SPECIAL

b	Beaver
d	partially drained/ditched
f	Farmed
h	Diked/Impounded
r	Artificial Substrate
s	Spoil
x	Excavated

SOURCE: UNITED STATES, FISH AND WILDLIFE SERVICE. CLASSIFICATION OF WETLANDS AND DEEPWATER HABITATS OF THE UNITED STATES, 1985

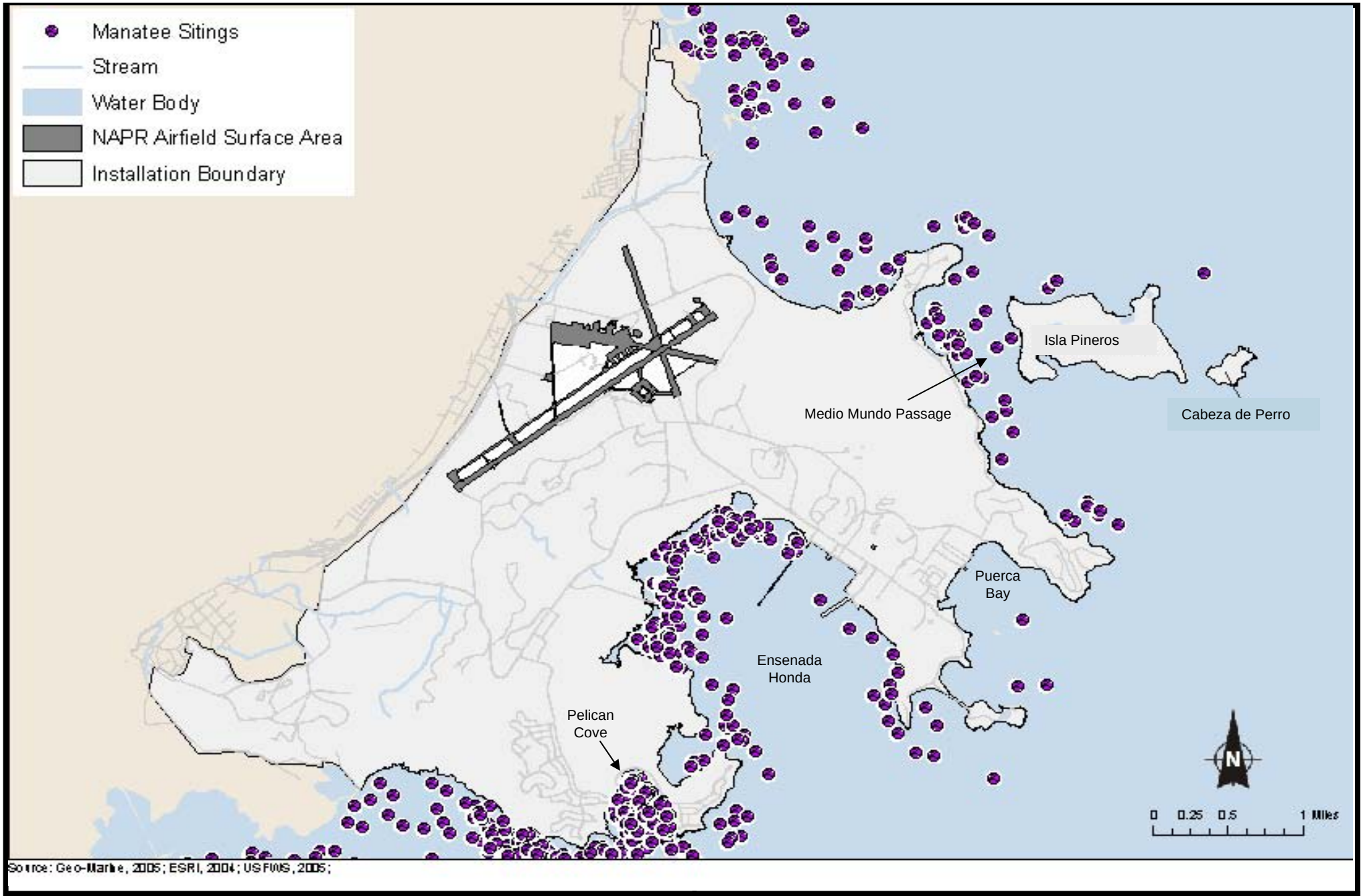
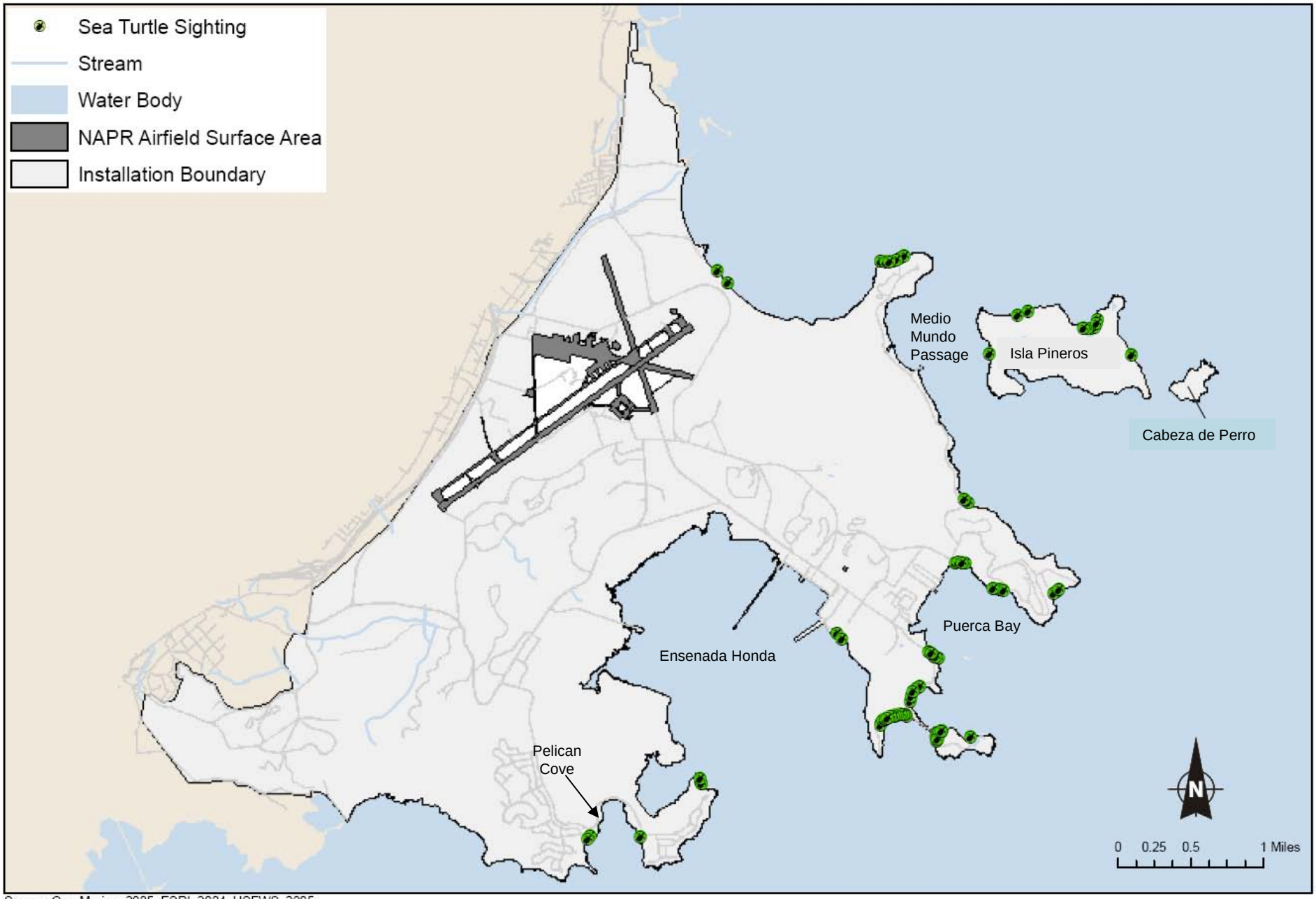


Figure from: Department of the Navy (DoN). 2007. *Environmental Assessment for the Disposal of Naval Activity Puerto Rico (formerly Naval Station Roosevelt Roads).* April 2007.

FIGURE 3-7
HISTORICAL MANATEE SIGHTINGS IN EASTERN PUERTO RICO
SWMU 27 – CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO



Cumulative sea turtle sightings from March 1984 through March 1995 obtained from weekly aerial surveys of the Former Naval station Roosevelt Roads.

Figure from: Department of the Navy (DoN). 2007. *Environmental Assessment for the Disposal of Naval Activity Puerto Rico (formerly Naval Station Roosevelt Roads).* April 2007.

FIGURE 3-8
SEA TURTLE SIGHTINGS AT NAVAL ACTIVITY PUERTO RICO
SWMU 27 – CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

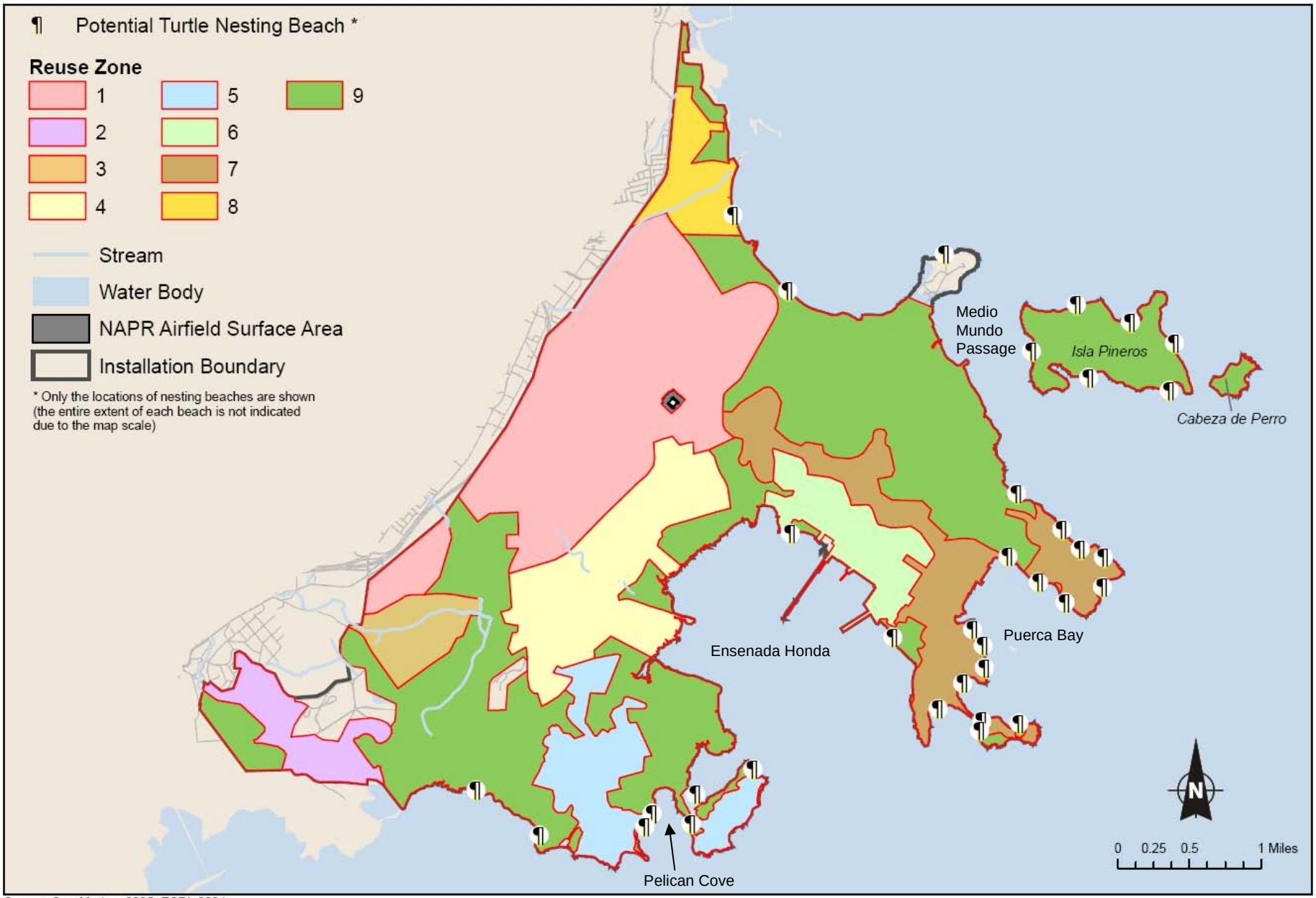


Figure from: Department of Navy (DoN). 2007. *Environmental Assessment for the Disposal of Naval Activity Puerto Rico (formerly Naval Station Roosevelt Roads).* April 2007

FIGURE 3-9
POTENTIAL TURTLE NESTING SITES
SWMU 27 – CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI REPORT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

K:_SOUTHNAVFAC\111626_002\Task 9 - Phase II RFIs\SWMU 27 Full RFI Report\cad\111626_27FUL-09(surface soil)

Site ID	27SS01
Sample ID	27SS01
Depth (ft bgs)	0.0-1.0
Sampling Date	11/17/06
Metals (mg/kg)	
Arsenic	***5.1***

Site ID	27SS06
Sample ID	27SS06
Sample Depth	0.0 - 1.0
Sampling Date	02/12/08
Metals (mg/kg)	
Arsenic	***3.9***

Site ID	27SS03
Sample ID	27SS03
Depth (ft bgs)	0.0-1.0
Sampling Date	11/17/06
Metals (mg/kg)	
Arsenic	***4.2***

UPLAND
TREES
UPLAND
1691 SEWAGE PLANT
TREES
E2SS3
OCEAN OUTFALL
SLUDGE DRYING BEDS
TREES
E2SS3
TREES
2230
2039
2399
27SB04/ 27MW04
27SB05/ 27MW05
27SB01/ 27TW01
27SS04
27SS01
27SS02
27SS05
27SS06
27SB06/ 27MW06
27SS03
27SB08/ 27MW08
27SB02/ 27TW02
27SS07
27SB07/ 27MW07
27SB03/ 27TW03
S

40 0 20 40
1 inch = 40 ft.

Baker
Baker Environmental, Inc.

NOTE
INFORMATION ON E2SS3 IS ON FIGURE 3-6 THE COWARDIN WETLAND CLASSIFICATION SYSTEM

J:	Estimated: The analyte was positively identified; the quantitation is an estimation
U:	Undetected at the Limit of Detection.
BOLD	Exceeds USEPA Region IX Residential Soil PRGs
ITALIC	Exceeds Region IX Industrial Soil PRGs
UNDERLINE	Exceeds NAPR Basewide Background
Sample Depth	Feet Below Ground Surface

LEGEND

- SITE BOUNDARY
- FENCE
- EXISTING SURFACE SOIL LOCATION (NOVEMBER 2006)
- SUBSURFACE SOIL BORING/TEMPORARY MONITORING WELL LOCATION (NOVEMBER 2006)
- SUBSURFACE SOIL BORING/MONITORING WELL LOCATION (MARCH 2008)
- SURFACE SOIL LOCATION (MARCH 2008)
- SHEETPILE SEAWALL
- WETLAND DELINEATION

FIGURE 5-1
EXCEEDANCE OF HUMAN HEALTH SCREENING CRITERIA AND BACKGROUND FOR SURFACE SOIL
SWMU 27-CAPEHART WWTP SLUDGE DRYING BEDS FULL RFI
NAVAL ACTIVITY PUERTO RICO

K:_SOUTHNAVFAC\111626_D02\Task 9 - Phase II RFIs\SWMU 27 Full RFI Report\cad\111626_27FUL-08(Surface Soil)

Site ID	27SB02/27TW02
Sample ID	27SB02-00
Sample Depth	0.0-1.0
Sampling Date	11/17/06
Metals (mg/kg)	
Mercury	0.15

Site ID	27SS01
Sample ID	27SS01
Sample Depth	0.0-1.0
Sampling Date	11/17/06
Metals (mg/kg)	
Zinc	420 J
Mercury	0.27

Site ID	27SS02
Sample ID	27SS02
Sample Depth	0.0-1.0
Sampling Date	11/17/06
Metals (mg/kg)	
Zinc	120 J
Mercury	0.20

Site ID	27SB05/27MW05
Sample ID	27SB05-00
Sample Depth	0.0 - 1.0
Sampling Date	02/11/08
Metals (mg/kg)	
Mercury	0.13

Site ID	27SS04
Sample ID	27SS04
Sample Depth	0.0 - 1.0
Sampling Date	02/12/08
Metals (mg/kg)	
Zinc	170 J

Site ID	27SS05
Sample ID	27SS05
Sample Depth	0.0 - 1.0
Sampling Date	02/12/08
Metals (mg/kg)	
Zinc	290
Mercury	1.3

Site ID	27SS06
Sample ID	27SS06
Sample Depth	0.0 - 1.0
Sampling Date	02/12/08
Metals (mg/kg)	
Zinc	160 J
Mercury	0.21

Site ID	27SS03
Sample ID	27SS03
Sample Depth	0.0-1.0
Sampling Date	11/17/06
Inorganics (ug/L)	
Zinc	290 J
Mercury	0.61

Site ID	27SB03/27TW03
Sample ID	27SB03-00D
Sample Depth	0.0-1.0
Sampling Date	11/17/06
Metals (mg/kg)	
Zinc	130 J
Mercury	0.12 J

UPLAND
TREES
UPLAND
1691 SEWAGE PLANT
TREES
E2SS3
OCEAN OUTFALL
2230
2039
2399
SLUDGE DRYING BEDS
E2SS3
TREES
27SB04/27MW04
27SB05/27MW05
27SB01/27TW01
27SS04
27SS01
27SS02
27SS05
27SS06
27SB06/27MW06
27SS03
27SB02/27TW02
27SS07
27SB07/27MW07
27SB08/27MW08
27SB03/27TW03

40 0 20 40
1 inch = 40 ft.

Baker
Baker Environmental, Inc.

NOTE
INFORMATION ON E2SS3 IS ON FIGURE 3-6 THE COWARDIN WETLAND CLASSIFICATION SYSTEM

J:	Estimated: The analyte was positively identified; the quantitation is an estimation
U:	Undetected at the Limit of Detection.
BOLD	Exceeds USEPA Region IX Residential Soil PRGs
ITALIC	Exceeds Region IX Industrial Soil PRGs
SHADE	Exceeds Selected Ecological Surface Soil Screening Values
UNDERLINE	NAPR Basewide Background
Sample Depth	Feet Below Ground Surface

LEGEND

- SITE BOUNDARY
- FENCE
- EXISTING SURFACE SOIL LOCATION (NOVEMBER 2006)
- SUBSURFACE SOIL BORING/TEMPORARY MONITORING WELL LOCATION (NOVEMBER 2006)
- SUBSURFACE SOIL BORING/MONITORING WELL LOCATION (MARCH 2008)
- SURFACE SOIL LOCATION (MARCH 2008)
- SHEETPILE SEAWALL
- WETLAND DELINEATION

FIGURE 5-2
EXCEEDANCES OF ECOLOGICAL SCREENING CRITERIA AND BACKGROUND FOR SURFACE SOIL
SWMU 27-CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO

K:_SOUTHNAVFAC\111626 D02\Task 9 - Phase II RFIs\SWMU 27 Full RFI Report\cad\111626_27FUL-08(SUB SURFACE)

UPLAND

TREES

UPLAND

1691 SEWAGE PLANT

2230

2039

27SB04/
27MW04

Site ID	27SB04/27MW04
Sample ID	27SB04-01
Sample Depth	1.0 - 3.0
Sampling Date	02/11/08
Metals (mg/kg)	
Chromium	58
zinc	99 J

27SB05/
27MW05

Site ID	27SB05/27MW05
Sample ID	27SB05-01
Sample Depth	1.0 - 3.0
Sampling Date	02/11/08
Metals (mg/kg)	
Chromium	110

27SS04

27SB01/
27TW01

27SS01

27SS02

27SS05

27SS06

27SB06/
27MW06

27SB08/
27MW08

27SS03

TREES

Site ID	27SB06/27MW06
Sample ID	27SB06-01
Sample Depth	1.0 - 3.0
Sampling Date	02/12/08
Metals (mg/kg)	
Chromium	48

SLUDGE DRYING
BEDS

27SB02/
27TW02

27SS07

E2SS3

Site ID	27SB02/27TW02
Sample ID	27SB02-01
Sample Depth	1.0-3.0
Sampling Date	11/16/06
Metals (mg/kg)	
Copper	63 J
Chromium	150 J
Zinc	98

27SB07/
27MW07

TREES

TREES

S S S

27SB03/
27TW03

S S S S S S

E2SS3

2399

OCEAN OUTFALL

40 0 20 40
1 inch = 40 ft.

Baker
Baker Environmental, Inc.

NOTE
INFORMATION ON E2SS3 IS ON FIGURE 3-6 THE COWARDIN WETLAND CLASSIFICATION SYSTEM

J:	Estimated: The analyte was positively identified; the quantitation is an estimation
U:	Undetected at the Limit of Detection.
BOLD	Exceeds USEPA Region IX Residential Soil PRGs
ITALIC	Exceeds Region IX Industrial Soil PRGs
SHADE	Exceeds Selected Ecological Surface Soil Screening Values
UNDERLINE	Exceeds NAPR Basewide Background
Sample Depth	Feet Below Ground Surface

LEGEND

- SITE BOUNDARY
- FENCE
- EXISTING SURFACE SOIL LOCATION (NOVEMBER 2006)
- SUBSURFACE SOIL BORING/TEMPORARY MONITORING WELL LOCATION (NOVEMBER 2006)
- SUBSURFACE SOIL BORING/MONITORING WELL LOCATION (MARCH 2008)
- SURFACE SOIL LOCATION (MARCH 2008)
- SHEETPILE SEAWALL
- WETLAND DELINEATION

FIGURE 5-3
EXCEEDANCES OF ECOLOGICAL SCREENING CRITERIA AND BACKGROUND FOR SUBSURFACE SOIL
SWMU 27-CAPEHART
WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO

K:_SOUTHNAVFAC\111626 002\Task 9 – Phase II RFIs\SWMU 27 Full RFI Report\cad\111626_27FUL–11

Site ID	27SB05/27MW05
Sample ID	27GW05
Sampling Date	02/14/08
Dissolved Metals (ug/L)	
Barium	**410**
Vanadium	**47 J**

Site ID	27SB01/27TW01
Sample ID	27TW01
Sampling Date	11/17/06
Total Metals (ug/L)	
Barium	***4300***
Dissolved Metals (ug/L)	
Barium	***3900***

Site ID	27SB06/27MW06
Sample ID	27GW06
Sampling Date	02/14/08
Total Metals (ug/L)	
Barium	**900**
Dissolved Metals (ug/L)	
Barium	**880**
Vanadium	**29 J**

UPLAND
TREES
UPLAND
1691 SEWAGE PLANT
2230
2039
27SB04/27MW04
27SB05/27MW05
27SS04
27SB01/27TW01
27SS01
27SS02
27SS05
27SS06
TREES
27SB08/27MW08
27SB06/27MW06
27SS03
SLUDGE DRYING BEDS
27SB02/27TW02
27SS07
E2SS3
27SB07/27MW07
TREES
TREES
27SB03/27TW03
E2SS3
2399
OCEAN OUTFALL

40 0 20 40
1 inch = 40 ft.

Baker
Baker Environmental, Inc.

NOTE
INFORMATION ON E2SS3 IS ON FIGURE 3–6 THE COWARDIN WETLAND CLASSIFICATION SYSTEM

J:	Estimated: The analyte was positively identified; the quantitation is an estimation
U:	Undetected at the Limit of Detection.
BOLD	Exceeds USEPA Region IX Tap Water PRGs
ITALIC	Exceeds USEPA MCL
UNDERLINE	Exceeds NAPR Basewide Background
Sample Depth	Feet Below Ground Surface

LEGEND

- ◇ – SITE BOUNDARY
- —x— – FENCE
- ● – EXISTING SURFACE SOIL LOCATION (NOVEMBER 2006)
- ◈ – SUBSURFACE SOIL BORING/TEMPORARY MONITORING WELL LOCATION (NOVEMBER 2006)
- ⊕ – SUBSURFACE SOIL BORING/MONITORING WELL LOCATION (MARCH 2008)
- ● – SURFACE SOIL LOCATION (MARCH 2008)
- —S— – SHEETPILE SEAWALL
- ——— – WETLAND DELINEATION

FIGURE 5–4
EXCEEDANCE OF HUMAN HEALTH SCREENING CRITERIA AND BACKGROUND FOR GROUNDWATER
SWMU 27–CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO

APPENDIX A
2008 FIELD ACTIVITIES

APPENDIX A.1
SWMU 27 FIELD LOG BOOK NOTES

2/11/08

0715 JHB and ADG on-site through Security @ GATE 3

Go to Public Works check in to room and meet with Pedro Ruiz Equipment and Sample Bottles delivered to Security Office not Public Works.

800 Retrieve equipment and bottles from Security bring to Public Works Unpack

8:45 Drive to SWMU 27 meet w/ operator and locate well points. Remove section of Fence for Access.

9:40 Meet GeoEnviroSci on-site Lead to SWMU 27, check utility maps and have safety meeting. Drillers unload and set-up.

27-SB04 (Upgradient well)

0-4' Light Brown Sandy Gravel
3.1 Rec. Dry, loose, rake 1.2'
PID hard gray
<1 ppm @1.4' Med. Brown Sandy Clay
0-4' dry to damp, hard
becomes Med Brown silty clay
@ 3.0' very soft moist to wet

4-8' becomes gray/black, very
4.0' Rec soft, moist to wet
PID some gravel throughout
6' = 200 ppm silty clay, organic plant debris
7.5 = 1500 ppm saturated @ Approx. 5' bgs

Set well @ 10' Bgs
7 feet of 0.010" Slot PVC Screen
Sand to 2' Bgs
Bentonite to 1' Bgs

Collect samples

27SB04-00	Surface Soil
27SB04-01	1-3' Bgs
27SB04-02	3-5' Bgs

Check water level at 1630
≈ 4' Bgs

27SB05

0-4' Top 6" Sandy Loam Some 2.8' Rec. Gravel. Dry. Loose. Med. Grayish Brown.

1-3' Sandy clay. dry to dmp. gravel throughout. Light Brown - Med. Brown.

3-4' Greenish-grey Sandy clay. dmp to Moist.

4-5' Greenish grey. Sandy clay. Very wet. Very Soft.

6-8' Black. Moist to wet. high organic decaying plant Material. Silty clay.

(6-7' PPM=10) Around 6-7 ft. PID Reading of @ 10 ppm.

Set well at 10' Bgs
7' of 2" 0.010" Slot PVC Screen
Flushmount, Sand to 2'
Bentonite to 1'

Collect Samples

27SB05-00	Surface Soil
27SB05-01	1-3' Bgs
27SB05-02	3-5' Bgs

Collect Equipment Rinsate
ER01 Rinse of Geoprobe Sleeve

27-SB06

0-4' Sand and Gravel, mod loose
3.2' Rec damp to dry, brownish gray

1.5' Becomes med brown silty clay with some sand, mod stiff, damp to dry trace gravel

3.5' Med greenish brown sandy clay, mod soft, damp to moist
4-8' med grained sand, organic material
3.5' Rec.

4.5' Greenish gray sandy clay with organic material, moist to wet.
5.5' Silty clay with some sand greenish black, organic plant material, wet

Set well ~~at~~ 10' with 7 Sweep Bgs. 2" PVC - 0.010" - Slot
Sand to 2' Bent to 1'
Flushmount

2/12/08
Tuesday

700 am JHB, ADG on-site meet with Security to gain a weekly pass.

Prepare sample bottles and equipment for the day
Meet Geo Enviro Sc. @ 8:30 at Copehart
Collect Surface Soil Samples at SWMU 27 and begin clearing path to 27SB07 with Machete.

ADG goes to SWMU 28 to collect surface soil samples.

Collect Samples at 27SB06

27SB06-00	Surface Soil
27SB06-01	1'-3' Bgs
27SB06-02	3-5' Bgs

Collect Equipment Rinsate Sample
Geoprobe Sleeve ER02

27-SB07

0-4'
3.1' Rec — Sand, shells, and rounded rocks to 2.5' dry, loose. then well sorted sand, med to coarse grained, damp to dry loose, shells, coral frags

4-8'
2.5' Rec. — Becomes wet sand at 4.5' some silt, shells, well sorted mod hard / compact

↓

Set well @ 10' Bgs
7' Screen 2" - 0.010" slot
Sand to 2 Bent. to 1
Flushmount

Collected Samples

27SB07-00	Surface Soil
27SB07-01	1-3' Bgs
27SB07-02	3-5' Bgs

27-SB08

0-4'
Rec. 3.3'

Top soil first 6" med brown silt Loam, damp, mod stiff then gravel and rounded rocks and shells to 1.0'
@ 1.0' Med. brown sandy clay. mod. stiff, damp to dry

cobble @ 3.3'

4-8'
Recovery 2.6'

Light brown sand and clay very wet, very soft and 4.5' changes to dark gray silty clay with peat, soft and wet.

Set well at 10'
7' Screen 2" - 0.010" slot
sand to 2, Bent. to 1'
Flushmount

Collected Samples at 27SB08

27SB08-00	Surface Soil
27SB08-01	1-3' Bgs
27SB08-02	3-5' Bgs
27SB08-02D	3-5' Bgs Duplicate

Collected Equipment Rinsate Sample
ER03 Stainless Steel Spoon
Metals + PCBs

2/12/08

1715

27GW04

V 3.45

TD 10.02

First Gallon

pH 6.73

Cond. 8.100 mS/cm turbid

Temp. 27.39 °C

Scnd Gallon

6.85

7.282 yellow

27.08

Third Gallon

6.76

7.910

27.18

27GW08

V 1.10

TD 9.98

	1st Gallon	2nd Gallon	3rd Gallon
pH	7.51	7.48	7.44
cond.	3.064	3.489	3.374
Temp	28.64	28.63	28.54

27GW05

V 2.0

TD 10.05

27GW06

V 0.12

TD 10.0

27 GW07
WL 4.24
TD 9.90

GW05 -

2-13-09

1st gallon -
PH - 6.47
Cond - 38.84
Temp 28.32

2nd gallon -
PH - 6.49
cond - 38.78
Temp - 27.47

2nd gallon -
PH - 6.51
cond - 39.10
Temp - 27.44

2-13-08

GW06 -

1st gallon -
PH - 6.56
Cond - 35.44
Temp - 27.08 °C

2nd gallon -
PH - 6.75
Cond - 35.66
Temp - 27.00 °C

dry

GW07 -

All three gallons contained an large amt. of silt.

1st gallon -
PH - 7.23
cond - 6.431
Temp - 27.55

2nd gallon -
PH - 7.24
cond - 6.583
Temp - 27.21

3rd gallon -
PH - 7.27
Cond - 6.506
Temp - 27.23

2-14-08

Ground Water Sampling - SUMC 27

GW04 - Sample time 1025
Static Water Level - 3.48
pH - 6.92
Temp - 27.21°C
Cond - 6.227
Turbidity - 18.1

GW05 - Sample time 1045
Static Water Level - 2.11
pH - 6.56
Temp - 27.38
Cond - 39.94
Turbidity - 18.8

When sampling - acid reacted with water and produced a large amount of bubbles.

GW06 - Sample time 1410
Static Water Level 8.81
pH - 6.64
Temp. - 28.02
Cond. - 41.61
Turb. - 47.8

A.G

continued →

GW07 - Sample time 1107
Static Water Level - 4.27
pH - 7.38
Temp - 27.45
Cond - 5.975
Turb - greater than 1,000

GW08 - Sample Time 930
Static Water Level - 1.90
pH - 7.53
Temp - 28.46
Cond - 3.866
Turb - 34.8

2-16-08

Collected Equipment Rinsates

ER08 Pan Rinsate
PAHs and Metals

ER09 Bucket Auger Rinsate
PAHs and Metals
used a new clean auger for each sample.

Also collected Field Blank

LAB DI Water - Metals
VOCs
PCBs
PAHs

NAPR TAP Water - Metals
VOCs
PCBs
PAHs

3.14

28SB07 II initial

Sample @ 1150
pH - 8.93
spec. Cond - 1.047
Temp - 27.08
Turbidity - ER 2 (greater 1,000)

27SB08 II - 1.94 Initial

27SB04 II - 3.55 Initial.

2-18-08

27SB05 II 1.85 static
7.50 slug Test Falling and Rising

27SB06 II 6.81 static

27SB07 II 4.25 static

APPENDIX A.2
SOIL BORING LOGS AND WELL CONSTRUCTION RECORDS

Baker

Michael Baker Jr., Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	Roosevelt Roads Puerto Rico SWMU 27 (Capehart)			
PROJ. NO.:	111626		BORING NO.:	27SB04/MW04
COORDINATES:	EAST:	928456.9	NORTH:	790493.4
ELEVATION:	SURFACE:	106.20	TOP OF PVC CASING:	105.97

Rig:	Geoprobe 66DT				**Date**	**Progress (Ft.)**	**Weather**	**Depth to Water (Ft.)**
	MC Sampler	**Casing**	**Augers**	**Core Barrel**				
Size (ID)	2.5"	--	4-1/4"	--	2/11/2008	0.0 - 10.0	Sunny 82	4'
Length	4'	--	5'	--				
Type	--	--	HSA	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks:

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

WELL INFORMATION

Type	Dam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Schedule 40 PVC Riser	2"	0	3.0
Schedule 40 PVC Screen	2"	3.0	10.0

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
1				27SB04-00 (0-12")		SANDY GRAVEL; light brown; dry; loose; hard, rock at 1.2'	Bentonite; 2" PVC Riser	
2	D-1	3.1 78%		27SB04-01 (1-3')	<1	SANDY CLAY; medium brown; dry to damp; hard (1.4)		104.80
3						(3.0)	2" -Dia. PVC Screen	103.20
4	4.0			27SB04-02		SILTY CLAY; medium brown; moist to wet; very soft (4.0)		102.20
5				(3-5')		grey/black; very soft, moist to wet, some gravel throughout; organic plant debris, saturated at 5'		
6	D-2	4.0 100%			200.0		Silica Sand	
7					1500.0			
8	8.0							
9		A	NA					
10	10.0						10'	96.20
						End of Boring at 10.0'		

DRILLING CO.:	GeoEnviroTech, Inc.	BAKER REP.:	Joe Burawa
DRILLER:	Abraham Nunez	BORING NO.:	27SB04/MW04 SHEET 1 OF 1

Baker

Michael Baker Jr., Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	Roosevelt Roads Puerto Rico SWMU 27 (Capehart)			
PROJ. NO.:	111626		BORING NO.:	27SB05/MW05
COORDINATES:	EAST:	928424.6	NORTH:	790434.3
ELEVATION:	SURFACE:	105.27	TOP OF PVC CASING:	105.03

Rig: Geoprobe 66DT	MC Sampler	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	2.5"	--	4-1/4"	--	2/11/2008	0.0 - 10.0	Sunny 82	4
Length	4'	--	5'	--				
Type	--	--	HSA	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks:

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Schedule 40 PVC Riser	2"	0	3.0
Schedule 40 PVC Screen	2"	3.0	10.0

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
1				27SB05-00 (0-12")		TOP SOIL (sandy loam) 1.0	Bentonite	104.27
2		D-1	2.8 70%	27SB05-01 (1-3')	<1	SANDY CLAY; light-medium brown; gravel throughout; dry to damp	2" PVC Riser	
3						3.0		102.27
4	4.0			27SB05-02 (3-5')		greenish-grey; damp to moist	2" - Dia. PVC Screen	
5						damp to very wet and soft		
6		D-2	1.2 30%		10.0	6.0		99.27
7						SILTY CLAY; black; high organic decaying plant material; moist to wet	Silica Sand	
8	8.0					8.0		97.27
9		A	N/A					
10	10.0						10'	95.27
						End of Boring at 10.0'		

DRILLING CO.:	GeoEnviroTech, Inc.	BAKER REP.:	Joe Burawa
DRILLER:	Abraham Nunez	BORING NO.:	27SB05/MW05 SHEET 1 OF 1

Baker

Michael Baker Jr., Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	Roosevelt Roads Puerto Rico SWMU 27 (Capehart)			
PROJ. NO.:	111626		BORING NO.:	27SB06/MW06
COORDINATES:	EAST:	928453.3	NORTH:	790365.6
ELEVATION:	SURFACE:	104.43	TOP OF PVC CASING:	104.09

Rig: Geoprobe 66DT	MC Sampler	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	2.5"	--	4-1/4"	--	2/11/2008	0.0 - 10.0	Sunny 82	5.5
Length	4'	--	5'	--				
Type	--	--	HSA	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks:

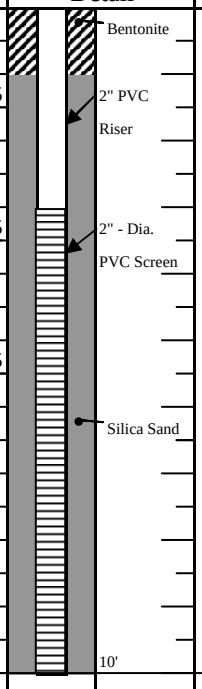
SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Schedule 40 PVC Riser	2"	0	3.0
Schedule 40 PVC Screen	2"	3.0	10.0

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Elevation (Ft. MSL)
1				27SB06-00 (0-12")		SAND/GRAVEL; brownish gray mod. loose; damp to dry	
1.5							102.9
2	D-1	3.2 80%		27SB06-01 (1-3')	<1	SILTY CLAY; medium brown; some sand; trace gravel; moderately stiff damp to dry	
3							
3.5							100.9
4	4.0			27SB06-02 (3-5')		SANDY CLAY; greenish brown; medium grained sand; organic material; moderately soft; damp to moist, then moist to wet at 4.5'	
5							
5.5							98.93
6	D-2	3.5 88%			<1	SILTY CLAY; greenish black; some sand; organic plant material; wet	
7							
8	8.0						
9		A	N/A				
10	10.0						94.43
						End of Boring at 10.0'	



DRILLING CO.:	GeoEnviroTech, Inc.	BAKER REP.:	Joe Burawa
DRILLER:	Abraham Nunez	BORING NO.:	27SB06/MW06 SHEET 1 OF 1

Baker

Michael Baker Jr., Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	Roosevelt Roads Puerto Rico SWMU 27 (Capehart)			
PROJ. NO.:	111626		BORING NO.:	27SB07/MW07
COORDINATES:	EAST:	928350.4000	NORTH:	790235
ELEVATION:	SURFACE:	106.33	TOP OF PVC CASING:	106.05

Rig: Geoprobe 66DT	MC Sampler	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	2.5"	--	4-1/4"	--	2/12/2008	0.0 - 10.0	Sunny 82	4.5
Length	4'	--	5'	--				
Type	--	--	HSA	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks:

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Schedule 40 PVC Riser	2"	0	3.0
Schedule 40 PVC Screen	2"	3.0	10.0

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
1				27SB07-00 (0-12")		SAND, SHELLS AND ROUNDED ROCKS, dry, loose	Bentonite; 2" PVC Riser	
2	D-1	3.1 78%		27SB07-01 (1-3')	<1			
2.5								103.83
3						SAND (well sorted), med. to course grained, damp to dry, loose, shells, coral frags		
4	4.0			27SB07-02 (3-5')			2" - Dia. PVC Screen	
4.5								101.83
5						SAND, wet, some silt, shells, well sorted, mod. hard/compact		
6	D-2	2.5 63%			<1			
7							Silica Sand	
8	8.0							
9	A	N/A						
10	10.0						10'	96.33
						End of Boring at 10.0'		

DRILLING CO.:	GeoEnviroTech, Inc.	BAKER REP.:	Joe Burawa	
DRILLER:	Abraham Nunez	BORING NO.:	27SB07/MW07	SHEET 1 OF 1

Baker

Michael Baker Jr., Inc.

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	Roosevelt Roads Puerto Rico SWMU 27 (Capehart)			
PROJ. NO.:	111626		BORING NO.:	27SB08/MW08
COORDINATES:	EAST:	928331.1	NORTH:	790362.7
ELEVATION:	SURFACE:	106.48	TOP OF PVC CASING:	106.18

Rig: Geoprobe 66DT	**MC Sampler**	**Casing**	**Augers**	**Core Barrel**	**Date**	**Progress (Ft.)**	**Weather**	**Depth to Water (Ft.)**
Size (ID)	2.5"	--	4-1/4"	--	2/12/2008	0.0 - 10.0	Sunny 82	4.5
Length	4'	--	5'	--				
Type	--	--	HSA	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks:

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Direct Push P = Piston
N = No Sample

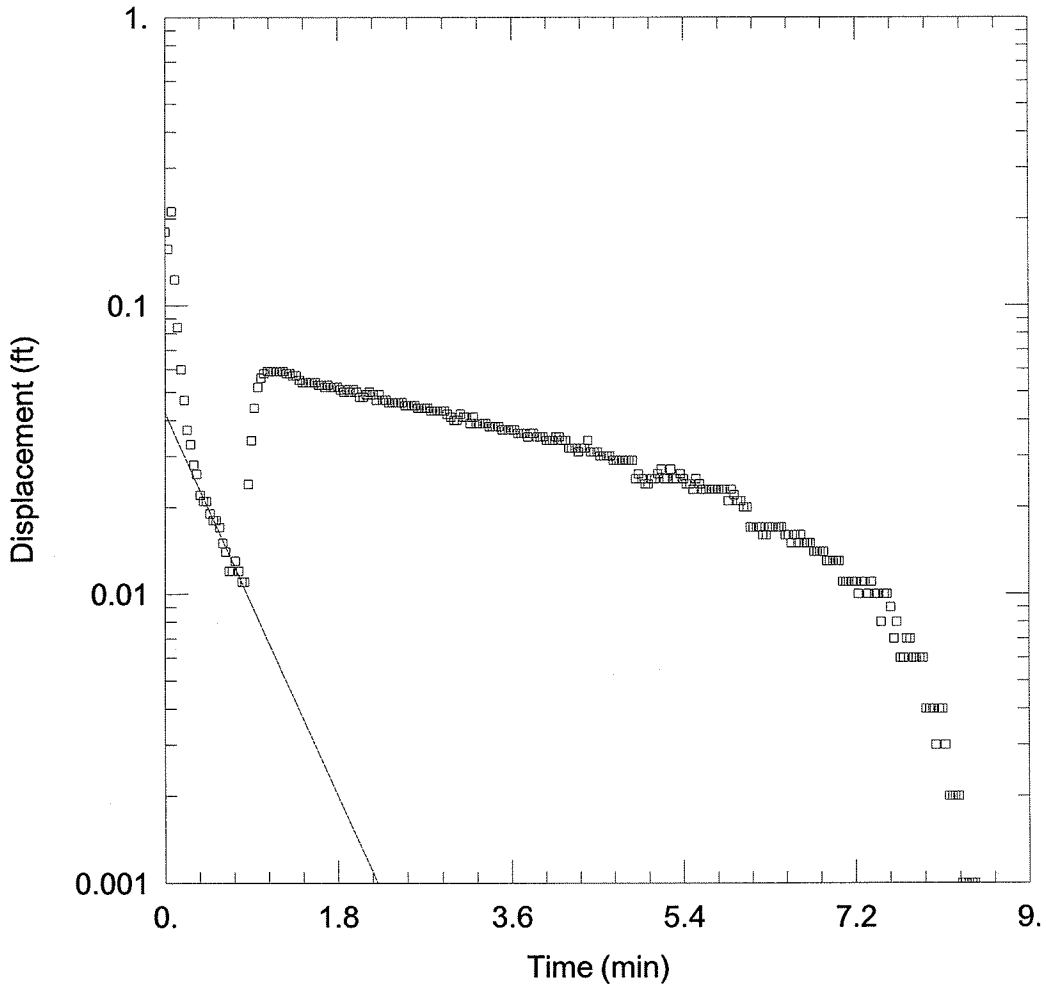
WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Schedule 40 PVC Riser	2"	0	3.0
Schedule 40 PVC Screen	2"	3.0	10.0

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm)	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
1				27SB08-00 (0-12")		TOP SOIL, then GRAVEL and rounded stones and shells 1.0	Bentonite	105.48
2		D-1	3.3 83%	27SB08-01 (1-3')	<1	SANDY CLAY, med. brown, mod. stiff, damp to dry, cobble at 3.3'	2" PVC Riser	
3								
4	4.0			27SB08-02 (3-5')		cobble at 3.3'	2" - Dia. PVC Screen	
5				27SB08-02D (3-5')		SAND and CLAY, light brown, very soft, very wet, at 4.5' - SILTY CLAY, dark gray, peat, wet, soft.		101.98
6		D-2	2.6 65%		<1			
7							Silica Sand	
8	8.0							
9		A	N/A					
10	10.0						10'	96.48
						End of Boring at 10.0'		

DRILLING CO.:	GeoEnviroTech, Inc.	BAKER REP.:	Joe Burawa
DRILLER:	Abraham Nunez	BORING NO.:	27SB08/MW08 SHEET 1 OF 1

APPENDIX A.3
WELL HEAD (SLUG) TEST RESULTS AND ANALYSIS



27MW04F

Data Set: K:\...\27MW04f.aqt
Date: 05/29/08 Time: 10:10:20

PROJECT INFORMATION

Test Well: 27MW04f
Test Date: 3-17-08

AQUIFER DATA

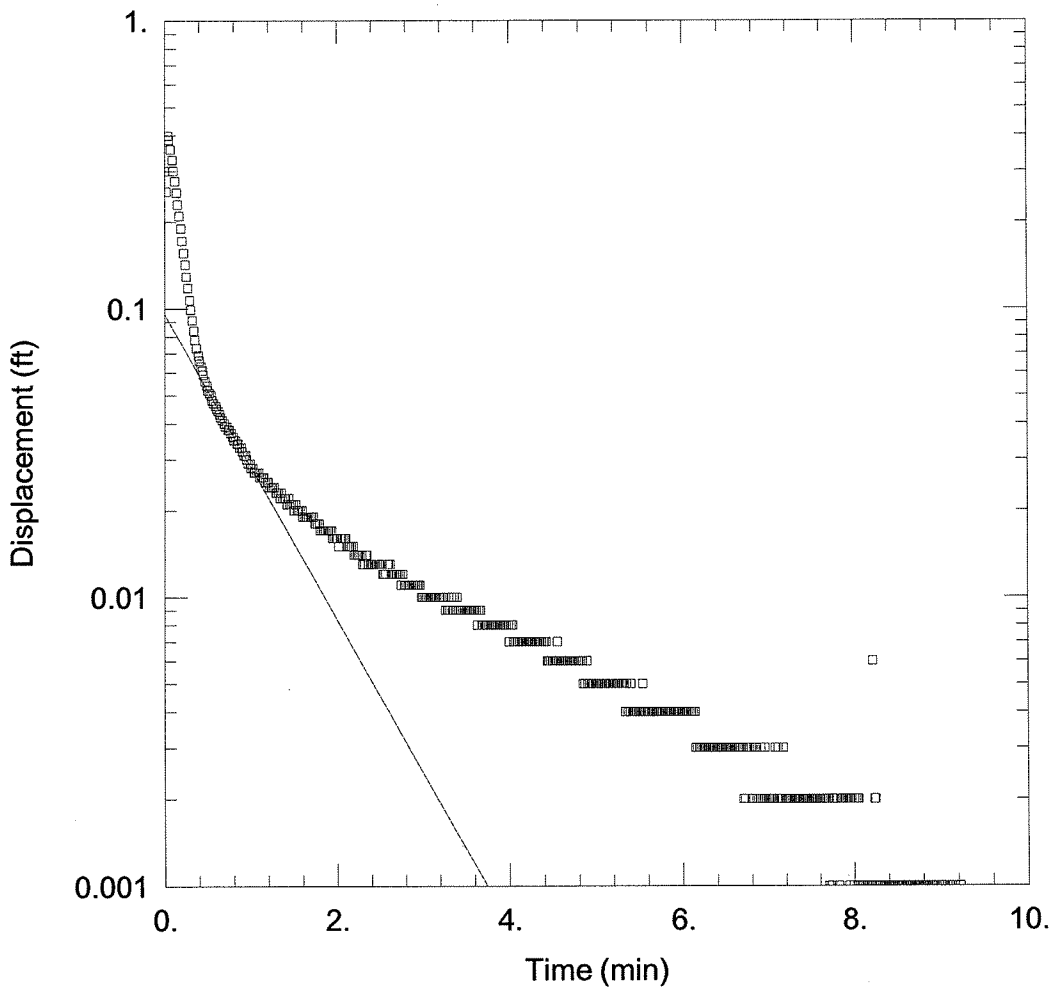
Saturated Thickness: 20. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (27MW04f)

Initial Displacement: 0.18 ft
Total Well Penetration Depth: 6.57 ft
Casing Radius: 0.083 ft
Static Water Column Height: 6.57 ft
Screen Length: 7. ft
Wellbore Radius: 0.19 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.001925 ft/min
y0 = 0.04238 ft



27MW04R

Data Set: K:\...\27MW04r.aqt
Date: 05/29/08 Time: 10:11:14

PROJECT INFORMATION

Test Well: 27MW04r

AQUIFER DATA

Saturated Thickness: 20. ft Anisotropy Ratio (Kz/Kr): 1.

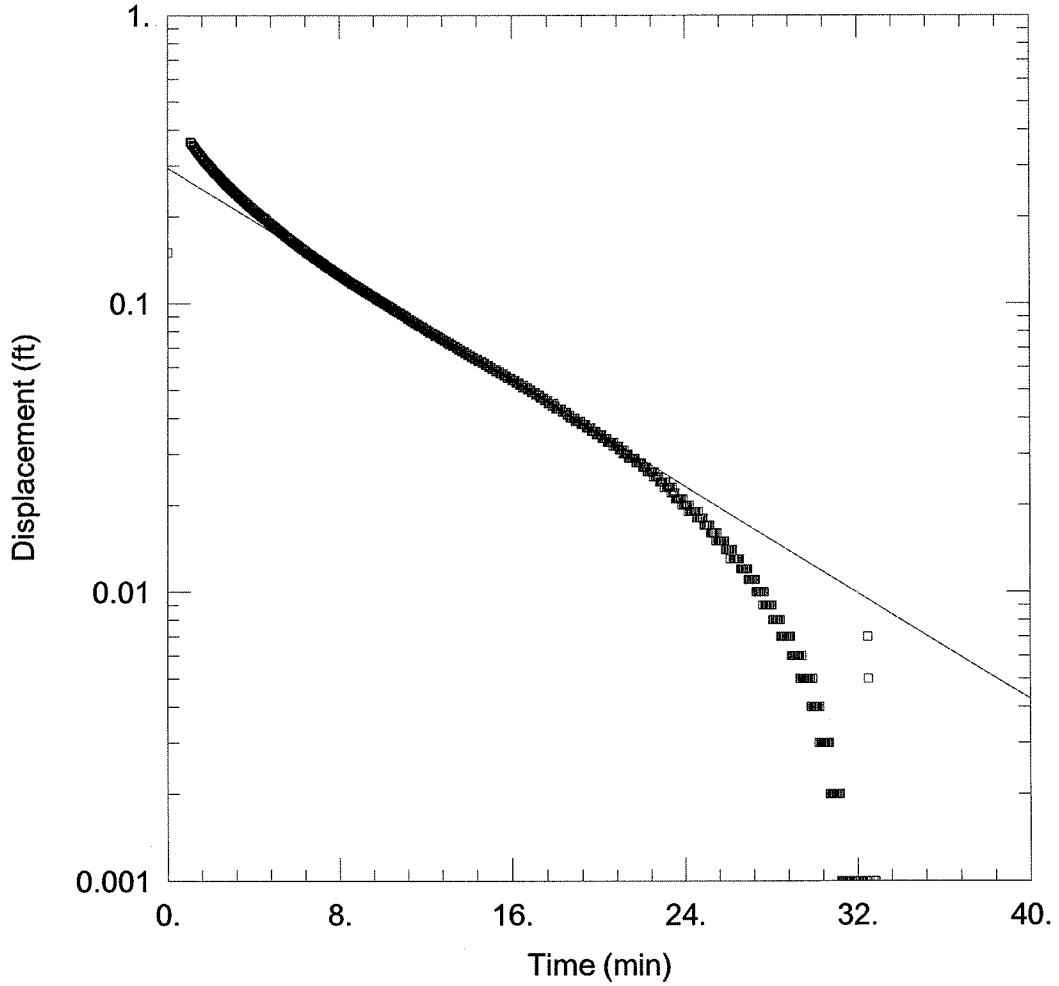
WELL DATA (27MW04r)

Initial Displacement: 0.3 ft
Total Well Penetration Depth: 6.57 ft
Casing Radius: 0.083 ft
Static Water Column Height: 6.57 ft
Screen Length: 7. ft
Wellbore Radius: 0.19 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.001385 ft/min y0 = 0.09555 ft



WELL TEST ANALYSIS

Data Set: K:\...\27MW05f.aqt
Date: 05/29/08 Time: 10:12:09

PROJECT INFORMATION

Test Well: 27MW05f

AQUIFER DATA

Saturated Thickness: 20. ft Anisotropy Ratio (Kz/Kr): 1.

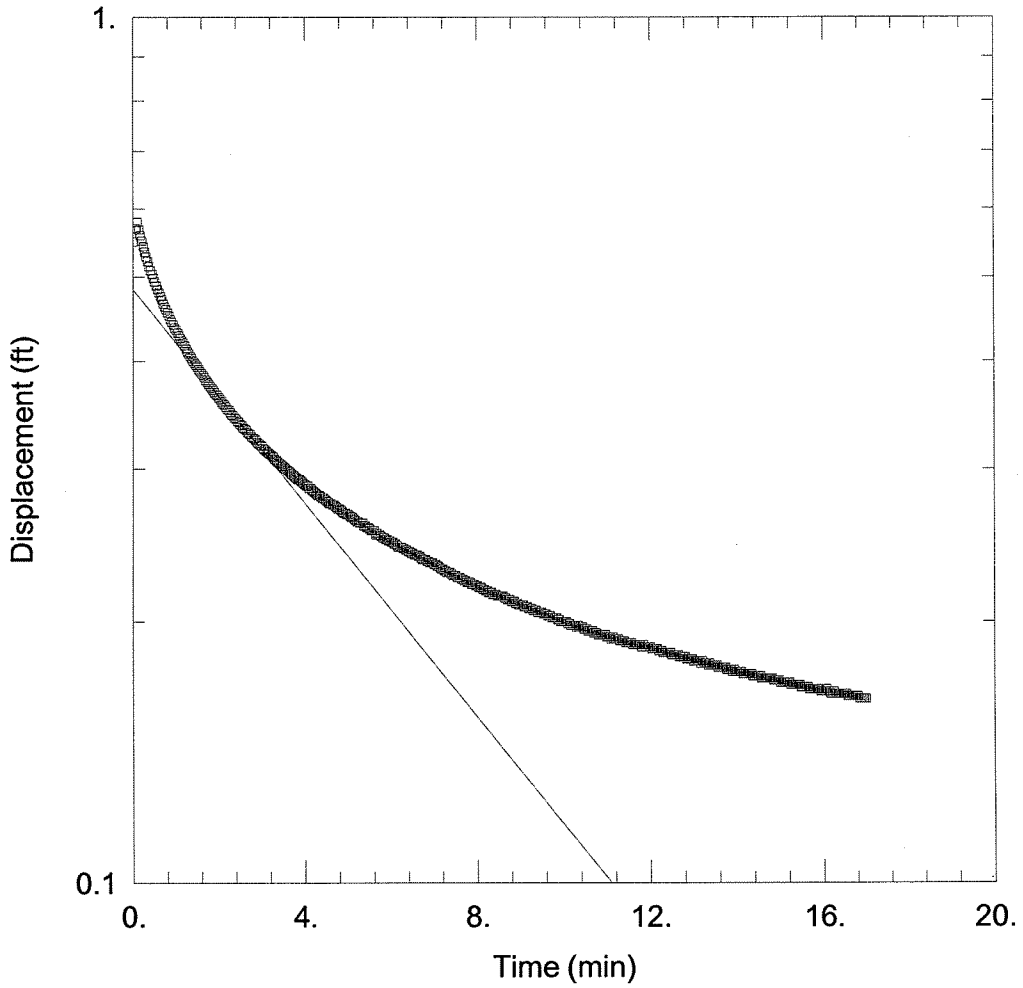
WELL DATA (27MW05f)

Initial Displacement: 0.15 ft
Total Well Penetration Depth: 8.05 ft
Casing Radius: 0.08 ft
Static Water Column Height: 8.05 ft
Screen Length: 7. ft
Wellbore Radius: 0.19 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.0001168 ft/min y0 = 0.2948 ft



27MW05R

Data Set: K:\...\27MW05r.aqt
Date: 05/29/08 Time: 10:12:51

PROJECT INFORMATION

Test Well: 27MW05r

AQUIFER DATA

Saturated Thickness: 20. ft Anisotropy Ratio (Kz/Kr): 1.

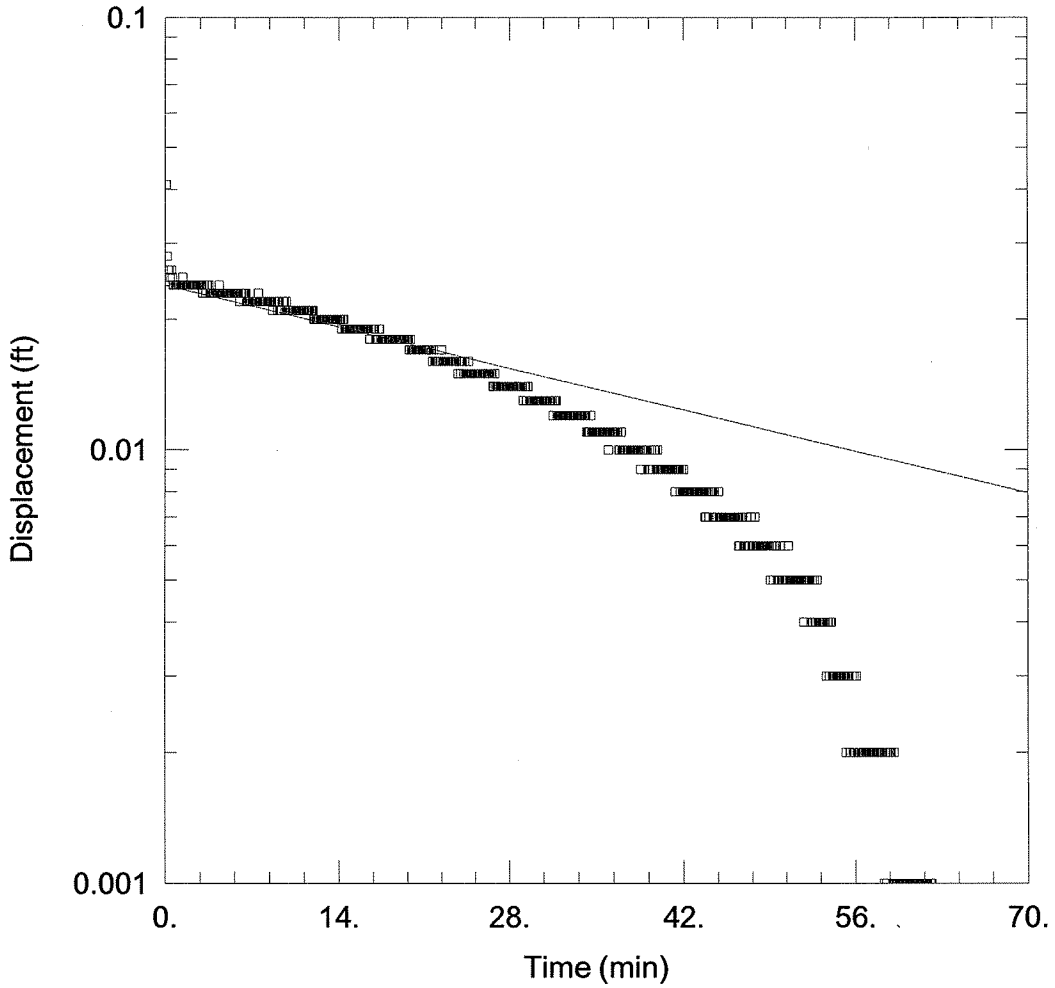
WELL DATA (27MW5r)

Initial Displacement: 0.55 ft
Total Well Penetration Depth: 8.05 ft
Casing Radius: 0.08 ft
Static Water Column Height: 8.05 ft
Screen Length: 7. ft
Wellbore Radius: 0.19 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.0001567 ft/min y0 = 0.4839 ft



27MW06F

Data Set: K:\...\27MW06f.aqt
Date: 05/29/08 Time: 10:13:40

PROJECT INFORMATION

Test Well: 27MW06f

AQUIFER DATA

Saturated Thickness: 20. ft Anisotropy Ratio (Kz/Kr): 1.

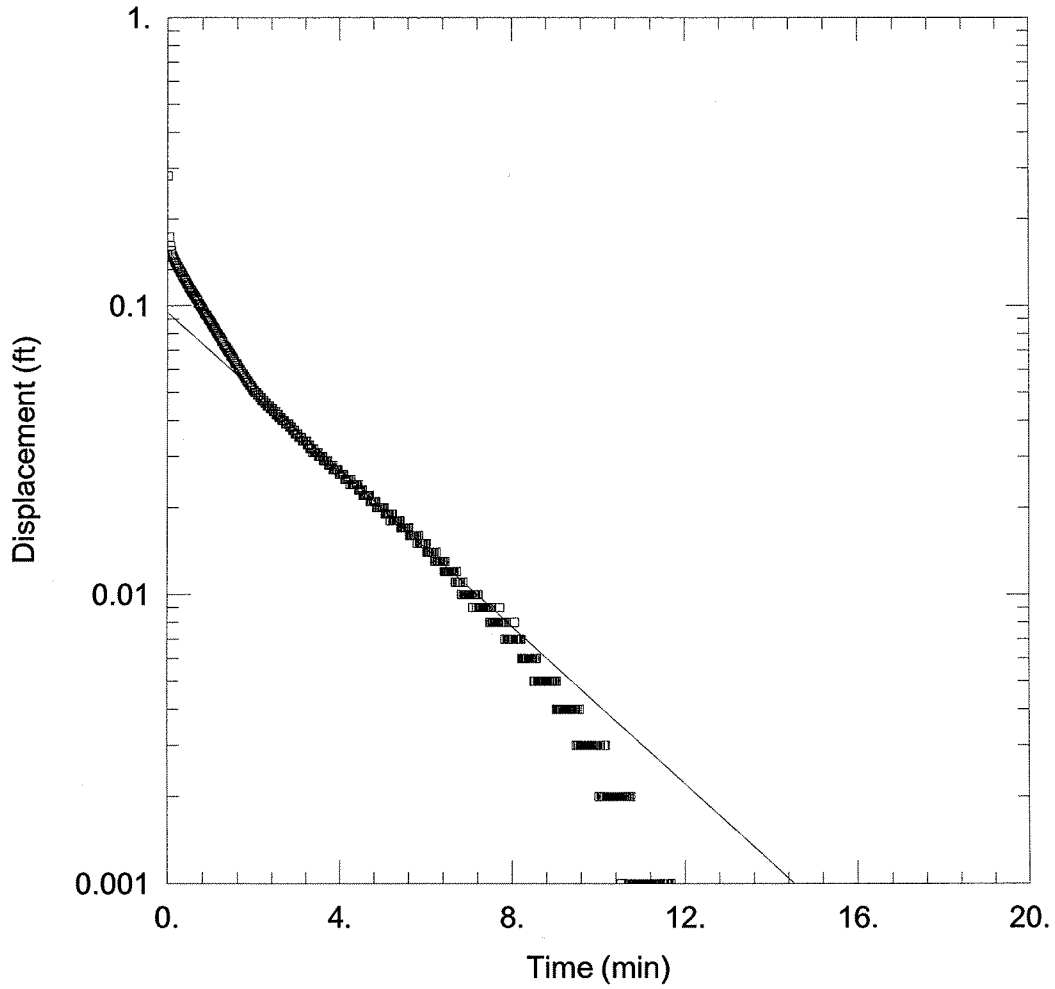
WELL DATA (27MW06f)

Initial Displacement: 0.4 ft
Total Well Penetration Depth: 0.88 ft
Casing Radius: 0.08 ft
Static Water Column Height: 0.88 ft
Screen Length: 7. ft
Wellbore Radius: 0.19 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 8.539E-06 ft/min y0 = 0.02396 ft



27MW07F

Data Set: K:\...\27MW07f.aqt
Date: 05/29/08 Time: 10:14:30

PROJECT INFORMATION

Test Well: 27MW07f

AQUIFER DATA

Saturated Thickness: 20. ft Anisotropy Ratio (Kz/Kr): 1.

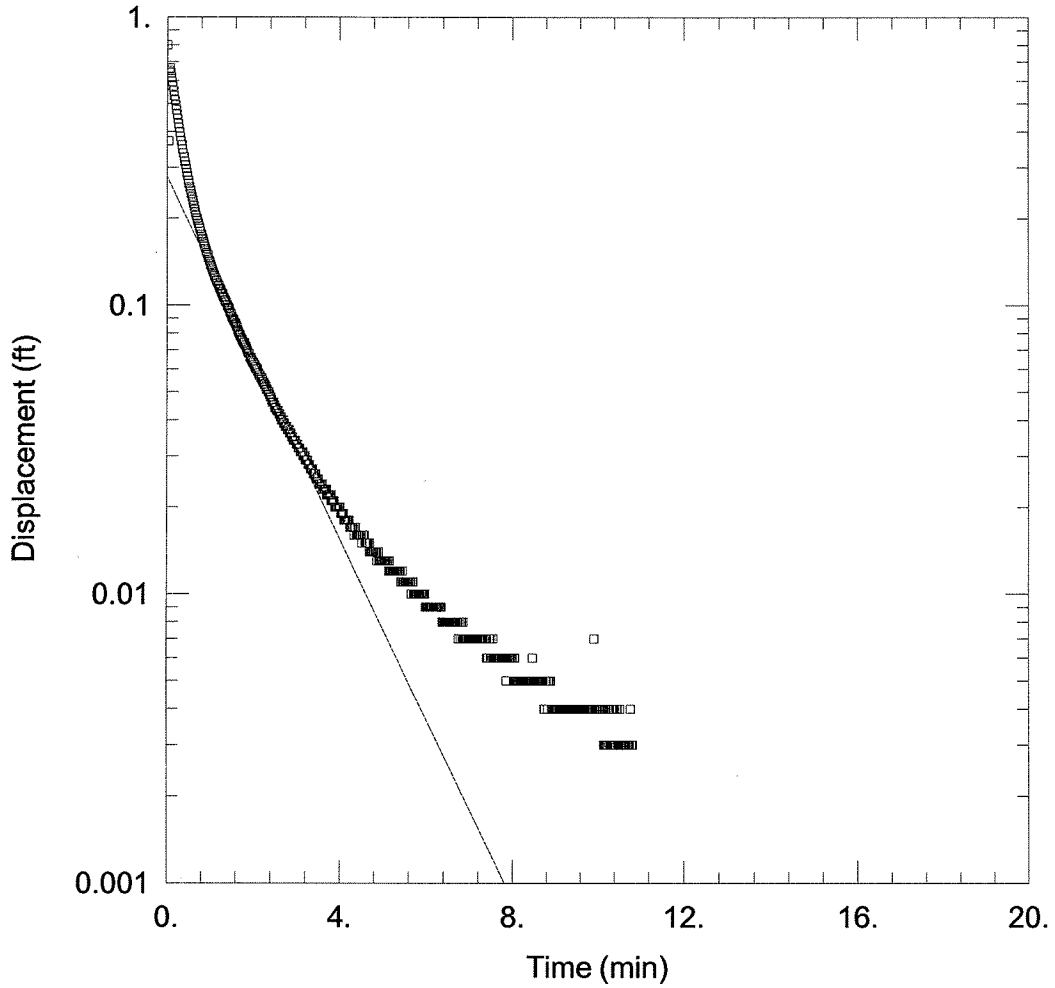
WELL DATA (27MW07f)

Initial Displacement: 0.15 ft
Total Well Penetration Depth: 4.24 ft
Casing Radius: 0.08 ft
Static Water Column Height: 4.24 ft
Screen Length: 7. ft
Wellbore Radius: 0.19 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.000299 ft/min y0 = 0.0947 ft



27MW07R

Data Set: K:\...\27MW07r.aqt
Date: 05/29/08 Time: 10:15:13

PROJECT INFORMATION

Test Well: 27MW07r

AQUIFER DATA

Saturated Thickness: 20. ft Anisotropy Ratio (Kz/Kr): 1.

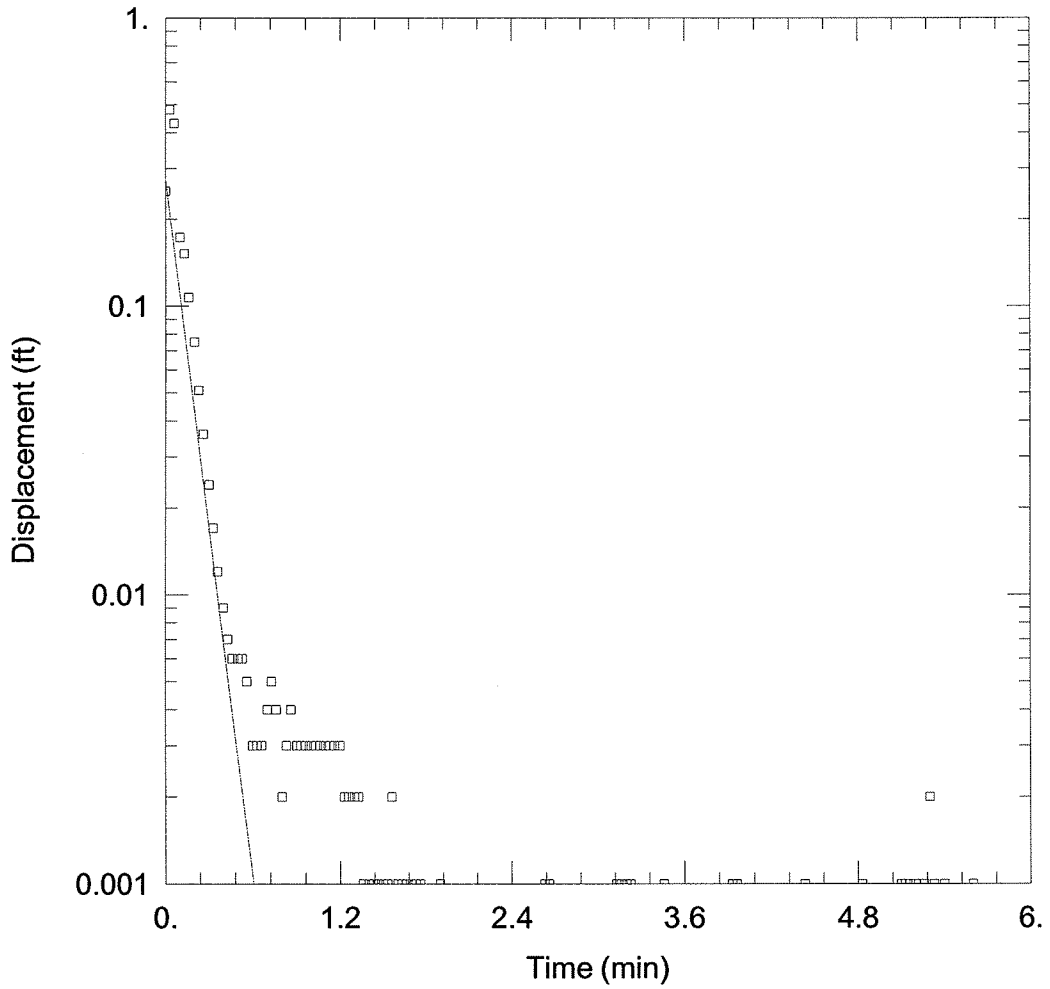
WELL DATA (27MW07r)

Initial Displacement: 0.8 ft
Total Well Penetration Depth: 4.24 ft
Casing Radius: 0.08 ft
Static Water Column Height: 4.24 ft
Screen Length: 7. ft
Wellbore Radius: 0.19 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.000689 ft/min y0 = 0.2787 ft



27MW08F

Data Set: K:\...\27MW08f.aqt
Date: 05/29/08 Time: 10:15:57

PROJECT INFORMATION

Test Well: 27MW08f

AQUIFER DATA

Saturated Thickness: 20. ft Anisotropy Ratio (Kz/Kr): 1.

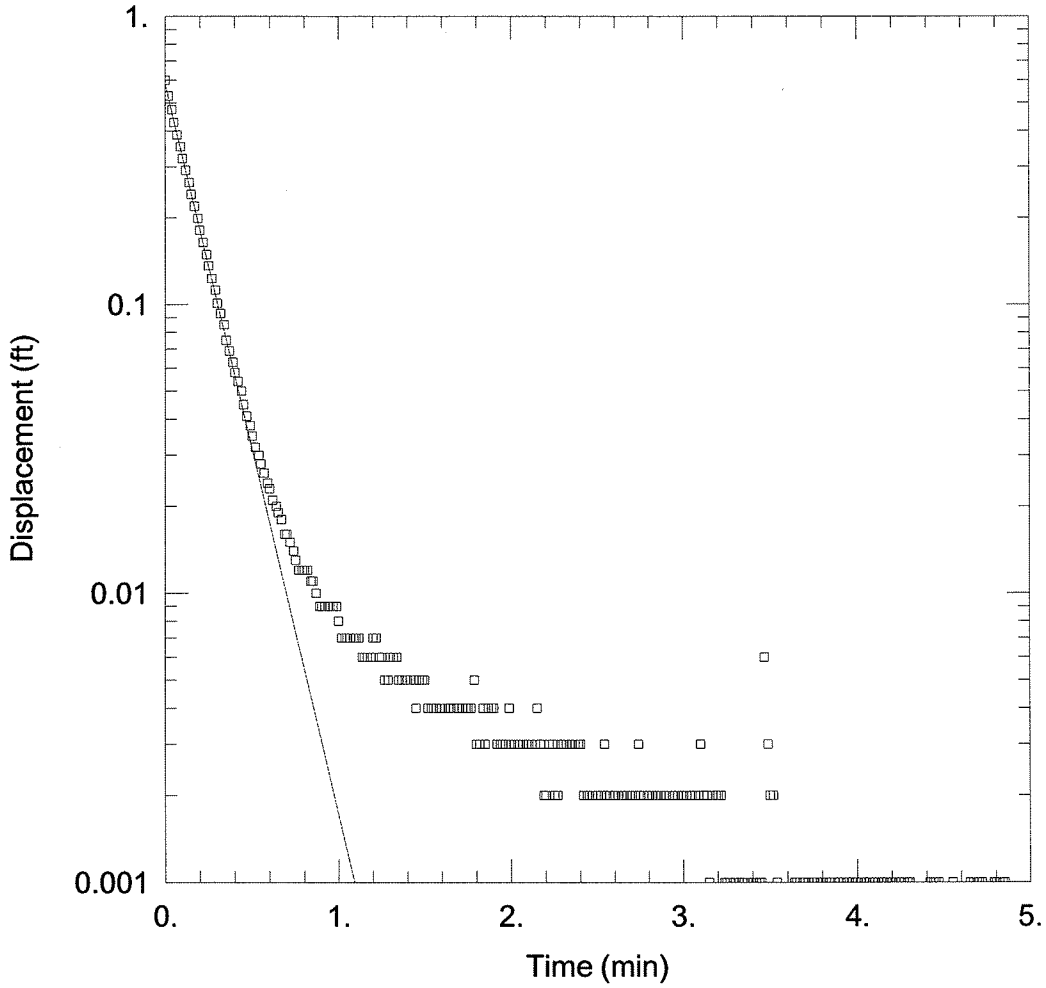
WELL DATA (27MW08f)

Initial Displacement: 0.25 ft
Total Well Penetration Depth: 8.88 ft
Casing Radius: 0.08 ft
Static Water Column Height: 8.88 ft
Screen Length: 7. ft
Wellbore Radius: 0.19 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.01041 ft/min
y0 = 0.2774 ft



27MW08R

Data Set: K:\...\27MW08r.aqt
Date: 05/29/08 Time: 10:16:41

PROJECT INFORMATION

Test Well: 27MW08r

AQUIFER DATA

Saturated Thickness: 20. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (27MW08r)

Initial Displacement: 0.6 ft
Static Water Column Height: 8.88 ft
Total Well Penetration Depth: 8.88 ft
Screen Length: 7. ft
Casing Radius: 0.08 ft
Wellbore Radius: 0.19 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.006564 ft/min
y0 = 0.5856 ft

APPENDIX A.4
CHAIN-OF-CUSTODY FORMS

Serial Number 000497

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

● TestAmerica Savannah
5102 LaRoche Avenue
Savannah, GA 31404
Website: www.testamericainc.com
Phone: (912) 354-7858
Fax: (912) 352-0165

○ Alternate Laboratory Name/Location
Phone:
Fax:

PROJECT REFERENCE	PROJECT NO.	PROJECT LOCATION (STATE)	MATRIX TYPE	REQUIRED ANALYSIS	PAGE
Sumu 27	111626 9.2	PR			1 of 2

TAL (LAB) PROJECT MANAGER	P.O. NUMBER	CONTRACT NO.
Kathy Smith		

CLIENT (SITE) PM	CLIENT PHONE	CLIENT FAX
Mark Kimes	412-337-7465	

CLIENT NAME	CLIENT E-MAIL
Michael Baker Jr., Inc.	mkimes@mbakercorp.com

CLIENT ADDRESS
100 Airside Drive, Moon Twp., PA 15108

COMPANY CONTRACTING THIS WORK (If applicable)

STANDARD REPORT DELIVERY ●
DATE DUE _____
EXPEDITED REPORT DELIVERY (SURCHARGE) ○
DATE DUE _____
NUMBER OF COOLERS SUBMITTED PER SHIPMENT:

SAMPLE DATE	SAMPLE TIME	SAMPLE IDENTIFICATION	COMPOSITE (C) OR GRAB (G) /INDICATE	AQUEOUS (WATER)	SOLID OR SEMISOLID	AIR	NONAQUEOUS LIQUID (OIL, SOLVENT, ...)	Appendix IX Metals	PRESERVATIVE	NUMBER OF CONTAINERS SUBMITTED	REMARKS
2/12/08	815	27SS04-00			X					1	
2/12/08	825	27SS05-00			X					1	
2/12/08	835	27SS06-00			X					1	
2/12/08	845	27SS07-00			X					1	
2/12/08	845	27SS07-00D			X					1	Duplicate
2/12/08	845	27SS07-00MS			X					1	Matrix Spike
2/12/08	845	27SS07-00MSD			X					1	Matrix Spike Dup
2/11/08	1115	27SB04-00			X					1	
2/11/08	1130	27SB04-01			X					1	
2/11/08	1135	27SB04-02			X					1	
2/11/08	130	27SB05-00			X					1	
2/11/08	145	27SB05-01			X					1	

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME
[signature]	2/12/08	1530						
RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME

LABORATORY USE ONLY

RECEIVED FOR LABORATORY BY: (SIGNATURE)	DATE	TIME	CUSTODY INTACT	CUSTODY SEAL NO.	SAVANNAH LOG NO.	LABORATORY REMARKS
KARL I HALL [signature]	021408	0917	YES ○ NO ○		680340 02	

TAL 8240-680 (1207)

2029

Serial Number 000500

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

● TestAmerica Savannah
5102 LaRoche Avenue
Savannah, GA 31404
Website: www.testamericainc.com
Phone: (912) 354-7858
Fax: (912) 352-0165

○ Alternate Laboratory Name/Location
Phone:
Fax:

PROJECT REFERENCE	PROJECT NO.	PROJECT LOCATION (STATE)
SWMU 27	111626 9.2	PR
TAL (LAB) PROJECT MANAGER: Kathy Smith	P.O. NUMBER	CONTRACT NO.
CLIENT (SITE) PM: Mark Kimes	CLIENT PHONE: 412-337-7465	CLIENT FAX
CLIENT NAME: Michael Baker Jr., Inc.	CLIENT E-MAIL: mkimes@mbakercorp.com	
CLIENT ADDRESS: 100 Airside Drive, Moon Twp., PA 15108		
COMPANY CONTRACTING THIS WORK (if applicable)		

PAGE 2 OF 2

STANDARD REPORT DELIVERY ●
DATE DUE _____
EXPEDITED REPORT DELIVERY (SURCHARGE) ○
DATE DUE _____

SAMPLE DATE	SAMPLE TIME	SAMPLE IDENTIFICATION	MATRIX: COMPOSITE (C) OR GRAB (G) INDICATE	MATRIX: AQUEOUS (WATER)	MATRIX: SOLID OR SEMISOLID	MATRIX: AIR	MATRIX: NONAQUEOUS LIQUID (OIL, SOLVENT, ...)	REQUIRED ANALYSIS: Appendix IX Metals	PRESERVATIVE	NUMBER OF CONTAINERS SUBMITTED	REMARKS
2/11/08	155	27SB05-02			X			X		1	
2/12/08	900	27SB06-00			X			X		1	
2/12/08	915	27SB06-01			X			X		1	
2/12/08	930	27SB06-02			X			X		1	
2/12/08	1030	27SB07-00			X			X		1	
2/12/08	1045	27SB07-01			X			X		1	
2/12/08	1100	27SB07-02			X			X		1	
2/12/08	135	27SB08-00			X			X		1	
2/12/08	145	27SB08-01			X			X		1	
2/12/08	155	27SB08-02			X			X		1	
2/12/08	155	27SB08-02D			X			X		1	Duplicate
2/11/08	400	ER01		X				X		1	Sleeve Rinse

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME
[signature]	2/12/08	1530						
RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME
[signature]								

LABORATORY USE ONLY

RECEIVED FOR LABORATORY BY: (SIGNATURE)	DATE	TIME	CUSTODY INTACT	CUSTODY SEAL NO.	SAVANNAH LOG NO.	LABORATORY REMARKS
KARL I HALL [signature]	021408	0917	YES ○ NO ○		68034202	

TAL8240-680 (1207)

3030

Serial Number 000498

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

● TestAmerica Savannah
5102 LaRoche Avenue
Savannah, GA 31404

Website: www.testamericainc.com
Phone: (912) 354-7858
Fax: (912) 352-0165

○ Alternate Laboratory Name/Location

Phone:
Fax:

PROJECT REFERENCE	PROJECT NO.	PROJECT LOCATION (STATE)
SWMU 27	111626 9.2	PR

TAL (LAB) PROJECT MANAGER	P.O. NUMBER	CONTRACT NO.
Kathy Smith		

CLIENT (SITE) PM	CLIENT PHONE	CLIENT FAX
Mark Kimes	412-337-7465	

CLIENT NAME	CLIENT E-MAIL
Michael Baker Jr., Inc.	mkimes@mbakercorp.com

CLIENT ADDRESS: 100 Airside Drive, Moon Twp., PA 15108

COMPANY CONTRACTING THIS WORK (if applicable)

PAGE 3 OF 3

STANDARD REPORT DELIVERY ●

DATE DUE _____

EXPEDITED REPORT DELIVERY (SURCHARGE) ○

DATE DUE _____

NUMBER OF COOLERS SUBMITTED PER SHIPMENT:

SAMPLE DATE	SAMPLE TIME	SAMPLE IDENTIFICATION	MATRIX: COMPOSITE (C) OR GRAB (G) INDICATE	MATRIX: AQUEOUS (WATER)	MATRIX: SOLID OR SEMISOLID	MATRIX: AIR	MATRIX: NONAQUEOUS LIQUID (OIL, SOLVENT, ...)	REQUIRED ANALYSIS: Append A + Metals	NUMBER OF CONTAINERS SUBMITTED	REMARKS
2/12/08	1445	ER62		X					1	Sleeve Rinse

PRESERVATIVE

4,0/4,1

TEMP

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME
Joe Burns	2/12/08	1530						
RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME
KARL J HALL								

LABORATORY USE ONLY

RECEIVED FOR LABORATORY BY: (SIGNATURE)	DATE	TIME	CUSTODY INTACT	CUSTODY SEAL NO.	SAVANNAH LOG NO.	LABORATORY REMARKS
Karl A. Hall	021408	0917	YES ○ NO ○		6803478	

TAL8240-880 (1207)

4031

Serial Number 86967

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

SEVERN TRENT **STL**

STL Savannah
5102 LaRoche Avenue
Savannah, GA 31404
Website: www.stl-inc.com
Phone: (912) 354-7858
Fax: (912) 352-0165

Alternate Laboratory Name/Location
Phone:
Fax:

PROJECT REFERENCE	PROJECT NO.	PROJECT LOCATION (STATE)	PAGE	OF
NAPR Swmu 28	11626 93	PR	1	1

STL (LAB) PROJECT MANAGER	P.O. NUMBER	CONTRACT NO.
Kathy Smith		

CLIENT (SITE) PM	CLIENT PHONE	CLIENT FAX
Mark Kimes	412-337-7465	

CLIENT NAME	CLIENT E-MAIL
Michael Baker Jr., Inc.	mkimes@mbakercorp.com

CLIENT ADDRESS: 100 Airside Drive, Moon Twp., PA 15108

COMPANY CONTRACTING THIS WORK (if applicable)

STANDARD REPORT DELIVERY ●
DATE DUE
EXPEDITED REPORT DELIVERY (SURCHARGE) ○
DATE DUE
NUMBER OF COOLERS SUBMITTED PER SHIPMENT:

SAMPLE DATE	SAMPLE TIME	SAMPLE IDENTIFICATION	MATRIX: COMPOSITE (C) OR GRAB (G) INDICATE	AQUEOUS (WATER)	SOLID OR SEMISOLID	AIR	NONAQUEOUS LIQUID (OIL, SOLVENT,...)	REQUIRED ANALYSIS: App IX VOCs	App IX Metals Dissolved	App IX Metals Total	NUMBER OF CONTAINERS SUBMITTED			REMARKS
2-14-08	1025	276W04		X				3	1	1				
	1045	276W05		X				3	1	1				
	1410	276W06		X				3	1	1				
	1107	276W07		X				3	1	1				
	930	276W08		X				3	1	1				
	930	276W08D		X				3	1	1				
	930	276W08MS		X				3	1	1				
	930	276W08MSD		X				3	1	1				
2-14-08	1430	ER05		X				3	1	1				Rinsate
2-14-08		TB01		X				3						

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME
[signature]	2-15-08	1200						
RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME

LABORATORY USE ONLY

RECEIVED FOR LABORATORY BY: (SIGNATURE)	DATE	TIME	CUSTODY INTACT YES ○ NO ○	CUSTODY SEAL NO.	STL SAVANNAH LOG NO.	LABORATORY REMARKS
KARL E HALL [signature]	021608	0930			680-34275	

STL-8240-680 (12/02)

2044

APPENDIX B
LABORATORY ANALYTICAL RESULTS

APPENDIX B.1
SURFACE SOIL

APPENDIX B.1

SURFACE SOIL ANALYTICAL RESUILTS
SWMU 27 - CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

Site ID	**27SS04**	**27SS05**	**27SS06**	**27SS07**	**27SS07**	**27SB04**	**27SB05**
Sample ID	**27SS04**	**27SS05**	**27SS06**	**27SS07**	**27SS07D**	**27SB04-00**	**27SB05-00**
Sample Depth (ft bgs)	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Sampling Date	**02/12/08**	**02/12/08**	**02/12/08**	**02/12/08**	**02/12/08**	**02/11/08**	**02/11/08**
Metals (mg/kg)							
Antimony	0.22 UJ	0.26 UJ	0.93 J	0.22 UJ	0.22 UJ	0.21 UJ	0.21 UJ
Arsenic	1.8	1.6	3.9	2.5	1.8	0.98 J	1.6
Barium	96	120	76	64	64	67	70
Beryllium	0.26 J	0.26 J	0.3 J	0.18 J	0.19 J	0.17 J	0.18 J
Cadmium	1.1	1.7	1.2	0.75	0.84	0.73	0.85
Chromium	25	32	40	23	27	29	19
Cobalt	17	16	18	13	12	13	11
Copper	100	130	120	75	83	82	72
Lead	8.9	19	32	16	17	2.2	4
Nickel	14	16	16	11	11	17	8.8
Selenium	0.36 J	0.25 U	0.24 U	0.21 U	0.21 U	0.2 U	0.2 U
Silver	0.16 U	0.8 U	0.27 U	0.16 U	0.13 U	0.11 U	0.11 U
Thallium	0.5 U	0.58 U	0.56 U	0.49 U	0.5 U	0.47 U	0.46 U
Tin	4.3 U	13 J	4.8 U	4.2 U	4.3 U	4 U	3.9 U
Vanadium	130	100	110	89	97	100	87
Zinc	170 J	290	160 J	89 J	100 B	97 J	74 J
Mercury	0.1	1.3	0.21	0.08	0.082	0.016 J	0.13

APPENDIX B.1

SURFACE SOIL ANALYTICAL RESUILTS
SWMU 27 - CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

Site ID	**27SB06**	**27SB07**	**27SB08**
Sample ID	**27SB06-00**	**27SB07-00**	**27SB08-00**
Sample Depth (ft bgs)	**0.0 - 1.0**	**0.0 - 1.0**	**0.0 - 1.0**
Sampling Date	**02/12/08**	**02/12/08**	**02/12/08**
Metals (mg/kg)			
Antimony	0.21 UJ	0.22 UJ	0.2 UJ
Arsenic	2.1	1.7	2.3
Barium	71	81	83
Beryllium	0.2 J	0.18 J	0.32 J
Cadmium	0.78	0.94	0.61
Chromium	29	16	14
Cobalt	12	16	13
Copper	80	84	46
Lead	7.2	3.4	13
Nickel	12	10	5.5
Selenium	0.2 U	0.21 U	0.19 U
Silver	0.068 U	0.16 U	0.085 U
Thallium	0.48 U	0.49 U	0.45 U
Tin	4.1 U	4.2 U	3.8 U
Vanadium	92	110	80
Zinc	70 J	84 J	46 J
Mercury	0.01 J	0.04	0.019 J

APPENDIX B.2
SUBSURFACE SOIL

APPENDIX B.2

SUBSURFACE SOIL ANALYTICAL RESUILTS
SWMU 27 - CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

Site ID	**27SB04**	**27SB04**	**27SB05**	**27SB05**	**27SB06**	**27SB06**	**27SB07**	**27SB07**
Sample ID	**27SB04-01**	**27SB04-02**	**27SB05-01**	**27SB05-02**	**27SB06-01**	**27SB06-02**	**27SB07-01**	**27SB07-02**
Sample Depth (ft bgs)	**1.0 - 3.0**	**3.0 - 5.0**	**1.0 - 3.0**	**3.0 - 5.0**	**1.0 - 3.0**	**3.0 - 5.0**	**1.0 - 3.0**	**3.0 - 5.0**
Sampling Date	**02/11/08**	**02/11/08**	**02/11/08**	**02/11/08**	**02/12/08**	**02/12/08**	**02/12/08**	**02/12/08**
Metals (mg/kg)								
Antimony	0.57 J	0.63 J	0.69 J	0.24 UJ	0.3 J	0.23 UJ	0.2 UJ	0.2 UJ
Arsenic	1.6	0.97 J	1.1 J	1.3	0.97 J	1.6	2.8	3.2
Barium	110	52	110	120	88	89	35	36
Beryllium	0.32 J	0.27 J	0.38 J	0.32 J	0.31 J	0.24 J	0.1 J	0.11 J
Cadmium	1.1	0.89	0.87	0.94	0.94	0.59	0.5	0.56
Chromium	58	53	110	49	48	43	11	10
Cobalt	28	13	12	20	14	15	5.8	6.7
Copper	120	94	120	150	88	94	40	37
Lead	1.3	3.5	1.6	1	6.9	2	4.2	0.84
Nickel	19	16	20	19	14	16 U	5.5	5.5
Selenium	0.23 U	0.35 J	0.29 J	0.23 U	0.26 J	0.22 U	0.19 U	0.19 U
Silver	0.087 U	0.084 U	0.046 U	0.046 U	0.087 U	0.044 U	0.038 U	0.044 U
Thallium	0.53 U	0.63 U	0.54 U	0.54 U	0.56 U	0.51 U	0.44 U	0.45 U
Tin	4.5 U	5.4 U	4.6 U	4.6 U	4.7 U	4.4 U	3.8 U	3.9 U
Vanadium	150	150	180	140	120	110	63	61
Zinc	99 J	53 J	80 J	79 J	66 B	70 J	23 J	26 J
Mercury	0.012 J	0.037	0.017 J	0.0081 J	0.02 J	0.016 J	0.0074 J	0.0058 J

APPENDIX B.2

SUBSURFACE SOIL ANALYTICAL RESUILTS
SWMU 27 - CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

Site ID	**27SB08**	**27SB08**	**27SB08**
Sample ID	**27SB08-01**	**27SB08-02**	**27SB08-02D**
Sample Depth (ft bgs)	**1.0 - 3.0**	**3.0 - 5.0**	**3.0 - 5.0**
Sampling Date	**02/12/08**	**02/12/08**	**02/12/08**
Metals (mg/kg)			
Antimony	0.38 J	0.21 UJ	0.22 UJ
Arsenic	0.67 J	0.77 J	0.96 U
Barium	63	82	70
Beryllium	0.22 J	0.26 J	0.25 J
Cadmium	0.6	1.1	1
Chromium	16	14	14
Cobalt	25	22	20
Copper	110	98	91
Lead	1	1.1	0.87
Nickel	7.8	6.7	6.9
Selenium	0.2 U	0.2 U	0.21 U
Silver	0.04 U	0.075 U	0.091 U
Thallium	0.46 U	0.48 U	0.48 U
Tin	4 U	4.1 U	4.1 U
Vanadium	100	120	120
Zinc	74 J	73 J	67 J
Mercury	0.0046 J	0.0044 U	0.004 U

APPENDIX B.3
GROUNDWATER

APPENDIX B.3

GROUNDWATER ANALYTICAL RESULTS
SWMU 27 - CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

Site ID	**27MW04**	**27MW05**	**27MW06**	**27MW07**	**27MW08**	**27MW08**
Sample ID	**27GW04**	**27GW05**	**27GW06**	**27GW07**	**27GW08**	**27GW08D**
Sampling Date	**02/14/08**	**02/14/08**	**02/14/08**	**02/14/08**	**02/14/08**	**02/14/08**
VOCs (ug/L)						
Acetone	5 U	5.6 J	14 J	5 U	5 U	5 U
Acetonitrile	15 U	15 U	15 U	15 U	15 U	15 U
Acrolein	18 U	18 U	18 U	18 U	18 U	18 U
Acrylonitrile	3.8 U	3.8 U	3.8 UJ	3.8 UJ	3.8 UJ	3.8 UJ
Benzene	0.32 U	0.32 U	0.32 U	0.32 U	0.32 U	0.32 U
Bromoform	0.41 U	0.41 U	0.41 U	0.41 U	0.41 U	0.41 U
Bromomethane	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
2-Butanone (MEK)	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U
Carbon disulfide	0.17 U	0.7 J	2.4	0.71 J	0.27 J	0.17 U
Carbon tetrachloride	0.27 U	0.27 U	0.27 U	0.27 U	0.27 U	0.27 U
Chlorobenzene	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
2-Chloro-1,3-butadiene	0.35 U	0.35 U	0.35 U	0.35 U	0.35 U	0.35 U
Chlorodibromomethane	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U
Chloroethane	1 U	1 U	1 U	1 U	1 U	1 U
Chloroform	0.38 J	0.29 U	1	0.29 U	0.4 J	0.36 J
Chloromethane	0.28 U	0.28 U	0.28 U	0.28 U	0.28 U	0.28 U
3-Chloro-1-propene	0.46 U	0.46 U	0.46 U	0.46 U	0.46 U	0.46 U
cis-1,3-Dichloropropene	0.37 U	0.37 U	0.37 U	0.37 U	0.37 U	0.37 U
1,2-Dibromo-3-Chloropropane	0.48 U	0.48 U	0.48 U	0.48 U	0.48 U	0.48 U
Dibromomethane	0.29 U	0.29 U	0.29 U	0.29 U	0.29 U	0.29 U
Dichlorobromomethane	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U	0.34 U
Dichlorodifluoromethane	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U
1,1-Dichloroethane	0.32 U	0.32 U	0.32 U	0.32 U	0.32 U	0.32 U
1,2-Dichloroethane	0.31 U	0.31 U	0.31 U	0.31 U	0.31 U	0.31 U
1,1-Dichloroethene	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U
1,2-Dichloropropane	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U
Ethylbenzene	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U
Ethylene Dibromide	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U
Ethyl methacrylate	1 U	1 U	1 U	1 U	1 U	1 U

APPENDIX B.3

GROUNDWATER ANALYTICAL RESULTS
SWMU 27 - CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

Site ID	**27MW04**	**27MW05**	**27MW06**	**27MW07**	**27MW08**	**27MW08**
Sample ID	**27GW04**	**27GW05**	**27GW06**	**27GW07**	**27GW08**	**27GW08D**
Sampling Date	**02/14/08**	**02/14/08**	**02/14/08**	**02/14/08**	**02/14/08**	**02/14/08**
VOCs (ug/L) (continued)						
2-Hexanone	0.68 U	0.68 U	0.68 U	0.68 U	0.68 U	0.68 U
Iodomethane	1 UJ	1 UJ	1 U	1 U	1 U	1 U
Isobutyl alcohol	19 R	19 R	19 R	19 R	19 R	19 R
Methacrylonitrile	6.6 U	6.6 U	6.6 U	6.6 U	6.6 U	6.6 U
Methylene Chloride	1 U	1 U	1 U	1 U	1 U	1 U
Methyl methacrylate	0.38 U	0.38 U	0.38 U	0.38 U	0.38 U	0.38 U
4-Methyl-2-pentanone (MIBK)	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U	0.6 U
Pentachloroethane	1.3 U	1.3 U	1.3 UJ	1.3 UJ	1.3 UJ	1.3 UJ
Propionitrile	9.2 U	9.2 U	9.2 U	9.2 U	9.2 U	9.2 U
Styrene	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U
1,1,1,2-Tetrachloroethane	0.29 U	0.29 U	0.29 U	0.29 U	0.29 U	0.29 U
1,1,2,2-Tetrachloroethane	0.26 U	0.26 U	0.26 U	0.26 U	0.26 U	0.26 U
Tetrachloroethene	0.28 U	0.28 U	0.28 U	0.28 U	0.28 U	0.28 U
Toluene	0.31 U	0.31 U	0.31 U	0.31 U	0.31 U	0.31 U
trans-1,4-Dichloro-2-butene	0.83 U	0.83 U	0.83 U	0.83 U	0.83 U	0.83 U
trans-1,2-Dichloroethene	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U
trans-1,3-Dichloropropene	0.27 U	0.27 U	0.27 U	0.27 U	0.27 U	0.27 U
1,1,1-Trichloroethane	0.39 U	0.39 U	0.39 U	0.39 U	0.39 U	0.39 U
1,1,2-Trichloroethane	0.51 U	0.51 U	0.51 U	0.51 U	0.51 U	0.51 U
Trichloroethene	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Trichlorofluoromethane	0.29 U	0.29 U	0.29 U	0.29 U	0.29 U	0.29 U
1,2,3-Trichloropropane	0.42 U	0.42 U	0.42 U	0.42 U	0.42 U	0.42 U
Vinyl acetate	0.62 U	0.62 U	0.62 U	0.62 U	0.62 U	0.62 U
Vinyl chloride	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Xylenes, Total	0.87 U	0.87 U	0.87 U	0.87 U	0.87 U	0.87 U

APPENDIX B.3

GROUNDWATER ANALYTICAL RESULTS
SWMU 27 - CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PR

Site ID	**27MW04**	**27MW05**	**27MW06**	**27MW07**	**27MW08**	**27MW08**
Sample ID	**27GW04**	**27GW05**	**27GW06**	**27GW07**	**27GW08**	**27GW08D**
Sampling Date	**02/14/08**	**02/14/08**	**02/14/08**	**02/14/08**	**02/14/08**	**02/14/08**
Total Metals (ug/L)						
Antimony	3.7 U	3.7 U	3.7 U	3.7 U	3.7 U	3.7 U
Arsenic	5.9 U	5.9 U	8.2 J	13 J	5.9 U	5.9 U
Barium	180	450	900	240	230 J	99 J
Beryllium	0.2 U	0.2 U	0.2 U	0.34 J	0.36 J	0.2 U
Cadmium	0.53 U	0.9 U	0.53 U	1.6 J	1.1 U	0.53 U
Chromium	1.9 U	12	4.4 U	28	45 J	5.2 UJ
Cobalt	1.2 U	8.6 J	2.7 J	26	27 J	1.7 J
Copper	10 UJ	30 J	3.9 UJ	96 B	150 J	14 R
Lead	2.3 U	2.3 U	2.3 U	4.8 J	2.3 U	2.3 U
Nickel	1.6 U	8.7 U	4.1 U	22 J	17 J	1.6 U
Selenium	3.6 U	3.6 U	3.6 U	3.6 U	3.6 U	3.6 U
Silver	0.51 U	0.51 U	0.51 U	0.54 U	0.66 U	0.51 U
Thallium	4.6 U	4.6 U	4.6 U	4.6 U	4.6 U	4.6 U
Tin	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U	3.2 U
Vanadium	11 J	73 J	43 J	150 J	190 J	24 R
Zinc	9.3 U	27 R	8.4 U	87 R	120 R	15 R
Mercury	0.08 U	0.15 J	0.097 J	0.23 J	0.08 U	0.08 U
Dissolved Metals (ug/L)						
Antimony	5.1 U	5.1 U	5.1 U	5.1 U	5.1 U	5.1 U
Arsenic	3.7 U	5.6 U	11	3.9 U	2.3 U	3.1 U
Barium	180	410	880	140	76	89
Beryllium	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Cadmium	0.72 U	0.72 U	0.72 U	0.72 U	0.72 U	0.72 U
Chromium	1.1 U	5.1 U	4.1 U	1.1 U	1.1 U	1.1 U
Cobalt	3.1 U	9.4 U	6 U	2 U	0.9 U	4.9 U
Copper	9.7 J	4.9 U	4.2 U	3.4 U	3.5 U	2.7 U
Lead	2.1 U	2.1 U	2.1 U	2.1 U	2.1 U	2.1 U
Nickel	2.8 J	5.2 J	7.6 J	2 U	2 U	2 U
Selenium	5.5 U	5.5 U	5.5 U	5.5 U	5.5 U	5.5 U
Silver	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	0.7 U
Thallium	3.6 U	3.6 U	3.6 U	3.6 U	3.6 U	3.6 U
Tin	3.4 U	3.4 U	3.4 U	3.4 U	3.4 U	3.4 U
Vanadium	10	47 J	29 J	4.8 J	8.8 J	9.9 J
Zinc	8.9 U	11 U	7.4 U	7.5 U	4.7 U	4.7 U
Mercury	0.08 U	0.084 J	0.08 U	0.08 U	0.08 U	0.08 U

APPENDIX B.4
QUALITY ASSURANCE / QUALITY CONTROL

APPENDIX B.4

QUALITY ASSURANCE/QUALITY CONTROL ANALYTICAL RESULTS
SWMU 27 - CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACIVITY PUERTO RICO, CEIBA, PR

Sample ID	FB01	FB02	TB01	ER01	ER02	ER05
Sampling Date	02/16/08	02/16/08	02/14/08	02/11/08	02/12/08	02/14/08
VOCs (ug/L)						
Acetone	5 U	5 U	5 U	NA	NA	5 U
Acetonitrile	15 U	15 U	15 U	NA	NA	15 U
Acrolein	18 U	18 U	18 U	NA	NA	18 U
Acrylonitrile	3.8 U	3.8 U	3.8 U	NA	NA	3.8 UJ
Benzene	0.32 U	0.32 U	0.32 U	NA	NA	0.32 U
Bromoform	0.41 U	0.41 U	0.41 U	NA	NA	0.41 U
Bromomethane	0.5 U	0.5 U	0.5 U	NA	NA	0.5 U
2-Butanone (MEK)	0.6 U	0.6 U	0.6 U	NA	NA	0.6 U
Carbon disulfide	0.17 U	0.17 U	0.17 U	NA	NA	0.17 U
Carbon tetrachloride	0.27 U	0.27 U	0.27 U	NA	NA	0.27 U
Chlorobenzene	0.34 U	0.34 U	0.34 U	NA	NA	0.34 U
2-Chloro-1,3-butadiene	0.35 U	0.35 U	0.35 U	NA	NA	0.35 U
Chlorodibromomethane	0.3 U	3.9	0.3 U	NA	NA	0.3 U
Chloroethane	1 U	1 U	1 U	NA	NA	1 U
Chloroform	0.29 U	77	0.29 U	NA	NA	0.29 U
Chloromethane	0.28 U	0.28 U	0.28 U	NA	NA	1.4
3-Chloro-1-propene	0.46 U	0.46 U	0.46 U	NA	NA	0.46 U
cis-1,3-Dichloropropene	0.37 U	0.37 U	0.37 U	NA	NA	0.37 U
1,2-Dibromo-3-Chloropropane	0.48 U	0.48 U	0.48 U	NA	NA	0.48 U
Dibromomethane	0.29 U	0.29 U	0.29 U	NA	NA	0.29 U
Dichlorobromomethane	0.34 U	13	0.34 U	NA	NA	0.34 U
Dichlorodifluoromethane	0.33 U	0.33 U	0.33 U	NA	NA	0.33 U
1,1-Dichloroethane	0.32 U	0.32 U	0.32 U	NA	NA	0.32 U
1,2-Dichloroethane	0.31 U	0.31 U	0.31 U	NA	NA	0.31 U
1,1-Dichloroethene	0.36 U	0.36 U	0.36 U	NA	NA	0.36 U
1,2-Dichloropropane	0.36 U	0.36 U	0.36 U	NA	NA	0.36 U
Ethylbenzene	0.3 U	0.3 U	0.3 U	NA	NA	0.3 U
Ethylene Dibromide	0.3 U	0.3 U	0.3 U	NA	NA	0.3 U
Ethyl methacrylate	1 U	1 U	1 U	NA	NA	1 U
2-Hexanone	0.68 U	0.68 U	0.68 U	NA	NA	0.68 U
Iodomethane	1 UJ	1 UJ	1 UJ	NA	NA	1 U
Isobutyl alcohol	19 R	19 R	19 R	NA	NA	19 R
Methacrylonitrile	6.6 U	6.6 U	6.6 U	NA	NA	6.6 U
Methylene Chloride	1 U	1 U	1 U	NA	NA	1 U
Methyl methacrylate	0.38 U	0.38 U	0.38 U	NA	NA	0.38 U
4-Methyl-2-pentanone (MIBK)	0.6 U	0.6 U	0.6 U	NA	NA	0.6 U
Pentachloroethane	1.3 U	1.3 U	1.3 U	NA	NA	1.3 UJ
Propionitrile	9.2 U	9.2 U	9.2 U	NA	NA	9.2 U
Styrene	0.36 U	0.36 U	0.36 U	NA	NA	0.36 U
1,1,1,2-Tetrachloroethane	0.29 U	0.29 U	0.29 U	NA	NA	0.29 U
1,1,2,2-Tetrachloroethane	0.26 U	0.26 U	0.26 U	NA	NA	0.26 U
Tetrachloroethene	0.28 U	0.28 U	0.28 U	NA	NA	0.28 U
Toluene	0.31 U	0.31 U	0.31 U	NA	NA	3.4
trans-1,4-Dichloro-2-butene	0.83 U	0.83 U	0.83 U	NA	NA	0.83 U
trans-1,2-Dichloroethene	0.3 U	0.3 U	0.3 U	NA	NA	0.3 U
trans-1,3-Dichloropropene	0.27 U	0.27 U	0.27 U	NA	NA	0.27 U
1,1,1-Trichloroethane	0.39 U	0.39 U	0.39 U	NA	NA	0.39 U

APPENDIX B.4

QUALITY ASSURANCE/QUALITY CONTROL ANALYTICAL RESULTS
SWMU 27 - CAPEHART WWTP SLUDGE DRYING BEDS
FULL RFI
NAVAL ACIVITY PUERTO RICO, CEIBA, PR

Sample ID	FB01	FB02	TB01	ER01	ER02	ER05
Sampling Date	**02/16/08**	**02/16/08**	**02/14/08**	**02/11/08**	**02/12/08**	**02/14/08**
VOCs (ug/L) (continued)						
1,1,2-Trichloroethane	0.51 U	0.51 U	0.51 U	NA	NA	0.51 U
Trichloroethene	0.4 U	0.4 U	0.4 U	NA	NA	0.4 U
Trichlorofluoromethane	0.29 U	0.29 U	0.29 U	NA	NA	0.29 U
1,2,3-Trichloropropane	0.42 U	0.42 U	0.42 U	NA	NA	0.42 U
Vinyl acetate	0.62 U	0.62 U	0.62 U	NA	NA	0.62 U
Vinyl chloride	0.2 U	0.2 U	0.2 U	NA	NA	0.2 U
Xylenes, Total	0.87 U	0.87 U	0.87 U	NA	NA	0.87 U
Metals (ug/L)						
Antimony	3.7 U	3.7 U	NA	3.7 U	3.7 U	3.7 U
Arsenic	5.9 U	5.9 U	NA	5.9 U	5.9 U	5.9 U
Barium	2 U	2.3 J	NA	2.6 J	2 U	2 U
Beryllium	0.2 U	0.2 U	NA	0.2 U	0.2 U	0.2 U
Cadmium	0.53 U	0.53 U	NA	0.53 U	0.53 U	0.53 U
Chromium	1.3 U	1.7 U	NA	1.3 U	1.3 U	1.3 U
Cobalt	1.2 U	1.2 U	NA	1.2 U	1.2 U	1.2 U
Copper	2.8 U	9.2 U	NA	3.9 U	2.6 U	2.2 U
Lead	2.3 U	2.3 U	NA	2.3 U	2.3 U	2.3 U
Nickel	1.6 U	1.6 U	NA	1.6 U	1.6 U	1.6 U
Selenium	3.6 U	3.6 U	NA	3.6 U	3.6 U	3.6 U
Silver	0.51 U	0.77 J	NA	0.51 U	0.51 U	0.51 U
Thallium	4.6 U	4.6 U	NA	4.6 U	4.6 U	4.6 U
Tin	3.2 U	3.2 U	NA	3.2 U	3.2 U	3.2 U
Vanadium	1.8 U	1.8 U	NA	1.8 U	1.8 U	1.8 U
Zinc	8.4 U	160	NA	18 J	8.4 U	8.4 U
Mercury	0.08 U	0.08 U	NA	0.08 U	0.08 U	0.08 U
Dissolved Metals (ug/L)						
Antimony	NA	NA	NA	NA	NA	5.1 U
Arsenic	NA	NA	NA	NA	NA	2.3 U
Barium	NA	NA	NA	NA	NA	2 U
Beryllium	NA	NA	NA	NA	NA	0.2 U
Cadmium	NA	NA	NA	NA	NA	0.72 U
Chromium	NA	NA	NA	NA	NA	1.1 U
Cobalt	NA	NA	NA	NA	NA	1.6 U
Copper	NA	NA	NA	NA	NA	2.2 U
Lead	NA	NA	NA	NA	NA	2.1 U
Nickel	NA	NA	NA	NA	NA	2 U
Selenium	NA	NA	NA	NA	NA	5.5 U
Silver	NA	NA	NA	NA	NA	0.7 U
Thallium	NA	NA	NA	NA	NA	3.6 U
Tin	NA	NA	NA	NA	NA	3.4 U
Vanadium	NA	NA	NA	NA	NA	1.5 U
Zinc	NA	NA	NA	NA	NA	4.7 U
Mercury	NA	NA	NA	NA	NA	0.08 U

APPENDIX C
2008 RFI DATA VALIDATION SUMMARIES

APPENDIX C.1
TEST AMERICA SAVANNAH SDG 34202-1

DataQual

Environmental Services, LLC

Michael Baker, Jr., Inc.
Airside Business Park
100 Airside Drive
Moon Township, PA 15108

April 9, 2008
SDG# SWMU34202-1, Test America-Savannah
NAPR SWMU 27, Puerto Rico

Dear Mr. Kimes,

The following Data Validation report is provided as requested for the parameters noted in the table below for SDG # SWMU34202-1. The data validation was performed in accordance with the SW-846 methods utilized by the laboratory and professional judgment. The methods in this SDG do not have an applicable Region II checklist SOP (SW-846 methods 6010B, 7471A and 7470A for appendix IX metals). Therefore worksheets were provided. Specific method requirements, Region II flagging conventions and professional judgment were used to validate the metals results. All areas of concern are discussed in the body of the report and a summary of data qualifications is provided.

Sample ID	Lab ID	Matrix	Metals
27SS04-00	680-34202-1	soil	X
27SS05-00	680-34202-2	soil	X
27SS06-00	680-34202-3	soil	X
27SS07-00	680-34202-4	soil	X
27SS07-00MS	680-34202-4MS	soil	X
27SS07-00MSD	680-34202-4MSD	soil	X
27SS07-00-D	680-34202-5	soil	X
27SB04-00	680-34202-6	soil	X
27SB04-01	680-34202-7	soil	X
27SB04-02	680-34202-8	soil	X
27SB05-00	680-34202-9	soil	X
27SB05-01	680-34202-10	soil	X
27SB05-02	680-34202-11	soil	X
27SB06-00	680-34202-12	soil	X
27SB06-01	680-34202-13	soil	X
27SB06-02	680-34202-14	soil	X
27SB07-00	680-34202-15	soil	X
27SB07-01	680-34202-16	soil	X
27SB07-02	680-34202-17	soil	X
27SB08-00	680-34202-18	soil	X
27SB08-01	680-34202-19	soil	X
27SB08-02	680-34202-20	soil	X
27SB08-02D	680-34202-21	soil	X

The following quality control samples were provided with this SDG: sample 27SS07-00D-field duplicate of sample 27SS07-00; sample 27SB08-02D-field duplicate of sample 27SB08-02.

The samples were evaluated based on the following criteria:

- Data Completeness *
- Technical Holding Times *
- Initial/Continuing Calibrations *
- CRDL Standards *
- ICSA/ICSAB Standards *
- Blanks
- Laboratory Control Samples *
- Matrix Spike Recoveries
- Matrix Duplicate RPDs *
- Serial Dilutions *
- Field Duplicates *
- Identification/Quantitation *
- Reporting Limits *

* - indicates that qualifications were not required based on this criteria

Overall Evaluation of Data/Potential Usability Issues

A summary of qualifications applied to the sample results are noted below for the fractions validated. Specific details regarding qualification of the data are addressed in the Specific Evaluation section of this narrative. If an issue is not addressed there were no actions required based on unmet quality criteria. When more than one qualifier is associated with a compound/analyte the validator has chosen the qualifier that best indicates possible bias in the results and flagged the data accordingly. However, information regarding all quality control issues is provided in the body of the report and on the qualification summary page.

Metals

Blank contamination was noted and qualification was required in the samples in this SDG.

Two of the submitted MS/MSD pairs exhibited non-compliant recoveries for the analyte antimony. Reported results in the soil samples were qualified as estimated J/UJ.

Specific Evaluation of Data

Data Completeness

The SDG was received complete and intact. Resubmissions were not required.

Technical Holding Times

According to chain of custody records, sampling was performed on 2/11/08 through 2/12/08, and samples were received at the laboratory 2/14/08. Sample preparation and analysis was performed within Region II and/or method holding time requirements.

Blanks

Metals

Associated blanks exhibited contamination as noted in the following table. The laboratory reported non-detect results to the MDL for this project. Therefore, the blank flagging actions were modified to take this into consideration.

Blank ID	Analyte	Concentration	Action Level	Q Flag
PBlk 2 – soils	arsenic	0.341J mg/Kg	RL	U at reported value
ICB – soils	silver	0.532J ug/L – 0.0532 mg/Kg	RL	U at reported value
FB02	zinc	160 ug/L – 16 mg/Kg	>MDL up to RL > RL up to Blank Level Blank Level up to 10X Blank Level	U at reported value R J

Please note, when qualifying samples for CCB contamination, associated samples are those just prior to or just following a CCB. Therefore, not all analytes in all samples are flagged for CCB contamination.

Associated samples and required qualifications are noted in the following table.

Sample ID	Analyte	Q Flag
all samples	silver	U
27SB08-02D	arsenic	U
all samples except 27SS05-00	zinc	J

Matrix Spike

Metals

The matrix spikes of samples 28SS12 and 27SS07-00 exhibited non-compliant recoveries for antimony that required qualification in the field samples. A summary of this non-compliances and affected samples are noted in the following table.

MS/SD	Analytes	Samples	%R	Q Flag
28SS12 (SDG SWMU34206)	antimony	all soil samples	71%/74%	J/UJ
27SS07-00	antimony		74%	

A summary of qualifications required is provided on the following page. Please do not hesitate to contact DataQual ES with any questions regarding this validation report.

Sincerely,

Jacqueline Cleveland

Jacqueline Cleveland
Vice President

Summary of Data Qualifications

Metals

Sample ID	Analyte	Results	Q flag
all samples	silver	+J	U at reported value
27SB08-02D	arsenic		
all samples except 27SS05-00	zinc	+ up to 10X blank value (16 mg/Kg)	J
all soil samples	antimony	+/-	J/UJ

Glossary of Qualification Flags and Abbreviations

Qualification Flags (Q-Flags)

U	not detected above the reported sample quantitation limit
J	estimated value
UJ	reported quantitation limit is qualified as estimated
-	analyte has been tentatively identified
JN	analyte has been tentatively identified, estimated value
R	result is rejected; the presence or absence of the analyte cannot be verified

Method/Preparation Blank Qualification Flags (Q-Flags)

Organic Methods

NA	The sample result for the blank contaminant is greater than the sample RL and is greater than 5X (10X for common laboratory contaminants) the blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.
U	The sample result for the blank contaminant is greater than the sample RL and is less than 5X (10X for common laboratory contaminants) the blank value.
CRQL	The sample result for the blank contaminant is less than the sample RL and is less than 5X (10X for common laboratory contaminants) the blank value.

Inorganic Methods

ICB/CCB/PB Action:

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U -	The sample result is greater than or equal to the MDL but less than or equal to the RL, result is reported as non-detect at the reported concentration, when the ICB/CCB/PB result is less than the RL.
R -	Sample result is greater than the RL and less than the ICB/CCB value when the ICB/CCB/PB value is greater than the RL.
J -	Sample result is greater than the ICB/CCB/PB value but less than 10X the ICB/CCB/PB value when ICB/CCB/PB value is greater than the RL.
J/UJ -	Sample result is less than 10X RL when blank result is below the negative RL.

Glossary of Qualification Flags and Abbreviations

Field QC Blank action:

Note – Use field blanks to qualify data only if field blank results are greater than prep blank results.
Do not use rinsate blank associated with soils to qualify water samples and vice versa.

No Action - The sample result is greater than the RL and greater than ten times (10X) the blank value.

U - The sample result is greater than or equal to the MDL but less than or equal to the RL when the field blank result is greater than the RL - result is reported as non-detect at the reported concentration.

R - Sample result is greater than the RL and less than the field blank value when the field blank result is greater than the RL.

J - Sample result is greater than the field blank value but less than 10X the field blank value when field blank result is greater than the RL.

General Abbreviations

RL	reporting limit
IDL	instrument detection limit
MDL	method detection limit
CRDL	contract required detection limit
CRQL	contract required quantitation limit
+	positive result
-	non-detect result

APPENDIX C.2
TEST AMERICA SAVANNAH SDG 34202-2

DataQual

Environmental Services, LLC

Michael Baker, Jr., Inc.
Airside Business Park
100 Airside Drive
Moon Township, PA 15108

April 9, 2008

SDG# SWMU34202-2, Test America-Savannah
NAPR SWMU27, Puerto Rico

Dear Mr. Kimes,

The following Data Validation report is provided as requested for the parameters noted in the table below for SDG # SWMU34202-2. The data validation was performed in accordance with the SW-846 methods utilized by the laboratory and professional judgment. Region II has not developed a validation checklist SOP for the methods used to assess the samples in this SDG (SW-846 methods 6010B & 7470A). Therefore, alternative worksheets were provided. Region II flagging conventions were used. All areas of concern are discussed in the body of the report and a summary of data qualifications is provided.

Sample ID	Lab ID	Matrix	App IX Metals
ER01	680-34202-22	water	X
ER02	680-34202-23	water	X

The following quality control samples were provided with this SDG: samples ER01 and ER02-equipment blanks.

The samples were evaluated based on the following criteria:

- Data Completeness *
- Technical Holding Times *
- Initial/Continuing Calibrations *
- CRDL Standards *
- ICSA/ICSAB Standards *
- Blanks
- Laboratory Control Samples *
- Matrix Spike Recoveries *
- Matrix Duplicate RPDs *
- Serial Dilutions *
- Field Duplicates *
- Identification/Quantitation *
- Reporting Limits *

* - indicates that qualifications were not required based on this criteria

Overall Evaluation of Data/Potential Usability Issues

A summary of qualifications applied to the sample results are noted below for the fractions validated. Specific details regarding qualification of the data are addressed in the Specific Evaluation section of this narrative. If an issue is not addressed there were no actions required based on unmet quality criteria. When more than one qualifier is associated with a compound/analyte the validator has chosen the qualifier that best indicates possible bias in the results and flagged the data accordingly. However, information regarding all quality control issues is provided in the body of the report and on the qualification summary page.

Metals

Blank qualification was required in the field QC blank samples in this SDG.

Specific Evaluation of Data

Data Completeness

The SDG was received complete and intact. No resubmissions were required.

Technical Holding Times

According to chain of custody records, sampling was performed on 2/11-12/08 and samples were received at the laboratory 2/14/08. Sample preparation and analysis was performed within Region II and/or method holding time requirements.

Blanks

Metals

Two associated calibration blanks exhibited contamination as noted in the following table. The laboratory reported non-detect results to the MDL for this project. Therefore, the blank flagging actions were modified to take this into consideration.

Blank ID	Analyte	Concentration	Action Level	Q Flag
CCB	chromium	1.412J ug/L	RL	U at reported value
	copper	2.727J ug/L	RL	U at reported value

Please note, when qualifying samples for CCB contamination, associated samples are those just prior to or just following a CCB. Therefore, not all analytes in all samples are flagged for CCB contamination.

Associated samples and required qualifications are noted in the following table.

Sample ID	Analyte	Q Flag
ER01, ER02	chromium	U
ER01, ER02	copper	U

A summary of qualifications required is provided on the following page. Please do not hesitate to contact DataQual ES with any questions regarding this validation report.

Sincerely,

Jacqueline Cleveland

Jacqueline Cleveland
Vice President

Summary of Data Qualifications

Metals

Sample ID	Analyte	Results	Q flag
ER01, ER02	chromium	+JB	U at reported value
ER01, ER02	copper	+JB	

Glossary of Qualification Flags and Abbreviations

Qualification Flags (Q-Flags)

U	not detected above the reported sample quantitation limit
J	estimated value
UJ	reported quantitation limit is qualified as estimated
-	analyte has been tentatively identified
JN	analyte has been tentatively identified, estimated value
R	result is rejected; the presence or absence of the analyte cannot be verified

Method/Preparation Blank Qualification Flags (Q-Flags)

Organic Methods

NA	The sample result for the blank contaminant is greater than the sample RL and is greater than 5X (10X for common laboratory contaminants) the blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.
U	The sample result for the blank contaminant is greater than the sample RL and is less than 5X (10X for common laboratory contaminants) the blank value.
CRQL	The sample result for the blank contaminant is less than the sample RL and is less than 5X (10X for common laboratory contaminants) the blank value.

Inorganic Methods

ICB/CCB/PB Action:

No Action -	The sample result is greater than the RL and greater than ten times (10X) the blank value.
U -	The sample result is greater than or equal to the MDL but less than or equal to the RL, result is reported as non-detect at the reported concentration, when the ICB/CCB/PB result is less than the RL.
R -	Sample result is greater than the RL and less than the ICB/CCB value when the ICB/CCB/PB value is greater than the RL.
J -	Sample result is greater than the ICB/CCB/PB value but less than 10X the ICB/CCB/PB value when ICB/CCB/PB value is greater than the RL.
J/UJ -	Sample result is less than 10X RL when blank result is below the negative RL.

Glossary of Qualification Flags and Abbreviations

Field QC Blank action:

Note – Use field blanks to qualify data only if field blank results are greater than prep blank results.
Do not use rinsate blank associated with soils to qualify water samples and vice versa.

No Action - The sample result is greater than the RL and greater than ten times (10X) the blank value.

U - The sample result is greater than or equal to the MDL but less than or equal to the RL when the field blank result is greater than the RL - result is reported as non-detect at the reported concentration.

R - Sample result is greater than the RL and less than the field blank value when the field blank result is greater than the RL.

J - Sample result is greater than the field blank value but less than 10X the field blank value when field blank result is greater than the RL.

General Abbreviations

RL	reporting limit
IDL	instrument detection limit
MDL	method detection limit
CRDL	contract required detection limit
CRQL	contract required quantitation limit
+	positive result
-	non-detect result

APPENDIX C.3
TEST AMERICA SAVANNAH SDG 34275

DataQual

Environmental Services, LLC

Michael Baker, Jr., Inc.
Airside Business Park
100 Airside Drive
Moon Township, PA 15108

April 9, 2008
SDG# SWMU34275, Test America-Savannah
NAPR SWMU27, Puerto Rico

Dear Mr. Kimes,

The following Data Validation report is provided as requested for the parameters noted in the table below for SDG # SWMU34275. The data validation was performed in accordance with the SW-846 methods utilized by the laboratory, the Region II Standard Operating Procedures for the Validation of Organic Data Acquired Using SW-846 Methods (for 8260B: Rev 2, October 2006-SOP #HW-24), and professional judgment. For those methods that do not have an applicable Region II checklist SOP (SW-846 methods 6010B, 7471A and 7470A for appendix IX metals), worksheets were provided. Region II flagging conventions were used. All areas of concern are discussed in the body of the report and a summary of data qualifications is provided. Please note that in the body and summary of this narrative an F has been added to the sample ID to distinguish dissolved metals from total metals.

Sample ID	Lab ID	Matrix	VOA App IX	Total Metals	Dissolved Metals
27GW04	680-34275-1	water	X	X	X
27GW05	680-34275-2	water	X	X	X
27GW06	680-34275-3	water	X	X	X
27GW07	680-34275-4	water	X	X	X
27GW08	680-34275-5	water	X	X	X
27GW08 MS	680-34275-5MS	water	X	X	X
27GW08 MSD	680-34275-5MSD	water	X	X	X
27GW08D	680-34275-6	water	X	X	X
ER05	680-34275-7	water	X	X	
TB01	680-34275-8	water	X		

The following quality control samples were provided with this SDG: sample ER05-equipment blank; sample TB01-trip blank; sample 27GW08D-field duplicate of sample 27GW08.

The samples were evaluated based on the following criteria:

- Data Completeness *
- Technical Holding Times *
- GC/MS Tuning *
- Initial/Continuing Calibrations
- Blanks *

- Internal Standards *
- Surrogate Recoveries *
- Laboratory Control Samples *
- Matrix Spike Recoveries
- Matrix Duplicate RPDs *
- Field Duplicates
- Identification/Quantitation
- Reporting Limits *
- Tentatively Identified Compounds NA

* - indicates that qualifications were not required based on this criteria

Overall Evaluation of Data/Potential Usability Issues

A summary of qualifications applied to the sample results are noted below for the fractions validated. Specific details regarding qualification of the data are addressed in the Specific Evaluation section of this narrative. If an issue is not addressed there were no actions required based on unmet quality criteria.

VOA

The continuing calibration exhibited compounds with high %D and low RRF values that resulted in qualifications to the data.

Positive results were exhibited in one of the field blanks, the laboratory re-analyzed the sample to confirm the results. The results were confirmed; the results were used from the initial analysis.

Metals

Blank contamination was noted and qualification was required in the samples in this SDG. Due to significant field blank contamination for the analyte zinc three total metals zinc results were rejected based on Region II validation guidance.

The submitted MS/MSD pair for the total metals fraction exhibited non-compliant %Rs for the analytes copper and vanadium. Reported results in the total metals samples were qualified as estimated J/UJ for these analytes.

The field duplicate pair exhibited non-compliant RPD in the total metals analysis for the analytes barium, chromium, cobalt, copper, vanadium and zinc. Based on Region II validation guidance the reported results for barium, chromium and cobalt were flagged J in both samples, the analytes copper, vanadium and zinc were rejected in the field sample and zinc was rejected in the field duplicate.

Specific Evaluation of Data

Data Completeness

The SDG was received complete and intact. Resubmissions were required for an error in reported %Recoveries for the CCVs for the analyte antimony. A copy of the e-mail correspondence is included in the validation worksheets portion of this report.

Technical Holding Times

According to chain of custody records, sampling was performed on 02/14/08 and samples were received at the laboratory 02/16/08. All sample preparation and analysis was performed within Region II and/or method holding time requirements.

Initial/Continuing Calibration

VOA

Calibration standards exhibited %Ds and RRFs that were non-compliant. A summary of these non-compliances and affected samples are noted in the following table. Sample results are qualified as indicated.

Standard ID	Compound(s)	RRF, %RSD, %D	Samples	Q Flag
CC 02/22/08	acrylonitrile	33.4%	27GW06, 27GW07, 27GW08, 27GW08D, ER05	J/UJ
	pentachloroethane	20.3%		
	isobutyl alcohol	0.02008		J/R
CC 02/25/08	iodomethane	26.5%	TB01, 27GW04, 27GW05	J/UJ
	isobutyl alcohol	0.01715		J/R

Blanks

Metals

Associated blanks exhibited contamination as noted in the following table. The laboratory reported non-detect results to the MDL for this project. Therefore, the blank flagging actions were modified to take this into consideration. Three data points for zinc required rejection due to significant field blank contamination for this analyte.

Blank ID	Analyte	Concentration	Action Level	Q Flag
ICB – dissolved	arsenic	3.126J ug/L	RL	U at reported value
CCB – dissolved	chromium	1.412J ug/L	RL	U at reported value
	copper	2.727J ug/L	RL	U at reported value
CCB – total	nickel	1.639J ug/L	RL	U at reported value
	cadmium	0.720J ug/L	RL	U at reported value
	chromium	1.733J ug/L	RL	U at reported value
	copper	2.727J ug/L	RL	U at reported value

Blank ID	Analyte	Concentration	Action Level	Q Flag
ER05F	cobalt	1.6J ug/L	RL	U at reported value
FB02	silver	0.77J ug/L	RL	U at reported value
	zinc	160 ug/L	RL	U at reported value
			>RL up to Blank value	R

See validation report for specific samples and qualifications. Only those analytes requiring action are listed here. Negative contamination in a prep blank or CCB, if less than the analyte CRDL, is qualified based on professional judgment. Field QC blank associations are determined using tracking provided by the client. Flags are applied to samples based on these associations.

Associated samples and required qualifications are noted in the following table.

Sample ID	Analyte	Q Flag
27GW04, 27GW06, 27GW08, 27GW08D, ER05, 27GW05F, 27GW06F	chromium	U up to action level
27GW04, 27GW06, 27GW08D, 27GW04F, 27GW05F, 27GW06F, 27GW07, 27GW08F, 27GW08DF	copper	
27GW05, 27GW06	nickel	
27GW05, 27GW08	cadmium	
27GW04F, 27GW05F, 27GW07F, 27GW08DF	arsenic	
27GW04F, 27GW05F, 27GW06F, 27GW07F, 27GW08DF	cobalt	
27GW07, 27GW08	silver	
27GW04, 27GW04F, 27GW05F, 27GW06F, 27GW07F,	zinc	
27GW05, 27GW07, 27GW08, 27GW08D	zinc	R up to 10X blank level

Matrix Spike Recoveries

Total Metals

The matrix spike pair of sample 27GW08 analyzed for total metals exhibited non-compliant recoveries for the analytes copper and vanadium that required qualification in the field samples. A summary of this non-compliance and affected samples are noted in the following table.

MS	Analytes	Samples	RPD	Q Flag
27GW08	copper	all total metals samples	57/54%	J/UJ
	vanadium		72%/72%	

Field Duplicates

Total Metals

The field duplicate pair exhibited non-compliant RPDs or absolute differences in the total metals analysis for the analytes barium (80% RPD), chromium (39.8 abs difference), cobalt (25.3 abs difference), copper (136 abs difference), vanadium (166 abs difference) and zinc (105 abs difference). Based on Region II validation guidance the reported results for barium, chromium and cobalt were flagged J in both samples, the analytes copper and vanadium were flagged J in the field sample, copper, vanadium and zinc were

rejected in the field sample and zinc was rejected in the field duplicate. (Region II Guidelines: RPD >35% but less than 120% when results are both >5X CRDL flag both sample and duplicate J; when sample and/or duplicate results are <5X CRDL the following guidance applies: absolute difference >2X but <4X CRDL flag result J; absolute difference >4X CRDL with result <5X CRDL flag R).

Identification/Quantitation

VOA

Sample ER05 was reanalyzed to confirm positive results that were detected in the initial analysis. The results were confirmed; therefore the reanalysis was rejected and the initial analysis was used.

A summary of qualifications required is provided on the following page. Please do not hesitate to contact DataQual ES with any questions regarding this validation report.

Sincerely,

Jacqueline Cleveland

Jacqueline Cleveland
Vice President

Summary of Data Qualifications

VOA

Sample ID	Compound	Results	Q-Flag
27GW06, 27GW07, 27GW08, 27GW08D, ER05	acrylonitrile pentachloroethane	+/-	J/UJ
27GW06, 27GW07, 27GW08, 27GW08D, ER05	isobutyl alcohol	+/-	J/R
TB01, 27GW04, 27GW05	iodomethane	+/-	J/UJ
TB01, 27GW04, 27GW05	isobutyl alcohol	+/-	J/R
ER05RE	all results	+/-	R

Total & Dissolved Metals

Sample ID	Analyte	Results	Q flag
27GW04, 27GW06, 27GW08, 27GW08D, ER05, 27GW05F, 27GW06F	chromium	+J up to action level	U at reported value
27GW04, 27GW06, 27GW08D, 27GW04F, 27GW05F, 27GW06F, 27GW07, 27GW08F, 27GW08DF	copper		
27GW05, 27GW06	nickel		
27GW05, 27GW08	cadmium		
27GW04F, 27GW05F, 27GW07F, 27GW08DF	arsenic		
27GW04F, 27GW05F, 27GW06F, 27GW07F, 27GW08DF	cobalt		
27GW07, 27GW08	silver		
27GW04, 27GW04F, 27GW05F, 27GW06F, 27GW07F,	zinc		
27GW05, 27GW07, 27GW08, 27GW08D	zinc	+ up to blank level	R
all total samples	copper vanadium	+/-	J/UJ
27GW08, 27GW08D	barium chromium cobalt	+	J
27GW08D	copper vanadium	+	J
27GW08	copper vanadium zinc	+	R
27GW08D	zinc	+	R

Glossary of Qualification Flags and Abbreviations

Qualification Flags (Q-Flags)

U	not detected above the reported sample quantitation limit
J	estimated value
UJ	reported quantitation limit is qualified as estimated
R	result is rejected; the presence or absence of the analyte cannot be verified
D	result value is based on dilution analysis result
NJ	analyte has been tentatively identified, estimated value
L	analyte present, biased low
UL	not detected, quantitation limit is probably higher
K	analyte present, biased high

Method/Preparation Blank Qualification Flags (Q-Flags)

Organic Methods

NA	The sample result for the blank contaminant is greater than the sample RL and is greater than 5X (10X for common laboratory contaminants) the blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.
U	The sample result for the blank contaminant is greater than the sample RL and is less than 5X (10X for common laboratory contaminants) the blank value.
CRQL	The sample result for the blank contaminant is less than the sample RL and is less than 5X (10X for common laboratory contaminants) the blank value.

General Abbreviations

RL	reporting limit
IDL	instrument detection limit
MDL	method detection limit
CRDL	contract required detection limit
CRQL	contract required quantitation limit
+	positive result
-	non-detect result

APPENDIX C.4
PUERTO RICAN CHEMIST CERTIFICATIONS

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

PUERTO RICO CERTIFICATION

I Herby certify that I have reviewed the Quality Assurance Data for Project Number **680-34202-1,** and to the best of my knowledge, the results are correct and reliable.

Abraham Ortiz

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

PUERTO RICO CERTIFICATION

I Herby certify that I have reviewed the Quality Assurance Data for Project Number **680-34202-2,** and to the best of my knowledge, the results are correct and reliable.

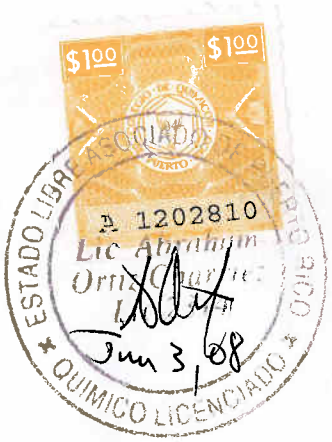
Abraham Ortiz

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

PUERTO RICO CERTIFICATION

I Herby certify that I have reviewed the Quality Assurance Data for Project Number **680-34275-1,** and to the best of my knowledge, the results are correct and reliable.

Abraham Ortiz



APPENDIX D
PRELIMINARY HUMAN HEALTH RISK CALCULATIONS

TABLE D-1
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
SWMU 27 (CAPEHART WWTP SLUDGE DRYING BEDS)
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution) (1)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic (2)	Rationale (ProUCL)
Surface Soil	Arsenic	mg/kg	2.47	3.03 (G)	5.1	3.03	mg/kg	95% UCL (G)	95% Approximate Gamma UCL

EPC = Exposure Point Concentration
UCL = Upper Confidence Level
For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.

(1) Distribution and 95% UCL were calculated by ProUCL and are indicated as follows:
(G) - Gamma distribution and 95% UCL

(2) Exposure point concentration statistic will be the 95% UCL (as calculated by ProUCL).

TABLE D-2
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
SWMU 27 (CAPEHART WWTP SLUDGE DRYING BEDS)
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution) (1)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic (2)	Rationale (ProUCL)
Subsurface Soil	Arsenic	mg/kg	1.60	2.09 (G)	3.2	2.09	mg/kg	95% UCL (G)	95% Approximate Gamma UCL

EPC = Exposure Point Concentration
UCL = Upper Confidence Level
For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.

(1) Distribution and 95% UCL were calculated by ProUCL and are indicated as follows:
(G) - Gamma distribution and 95% UCL

(2) Exposure point concentration statistic will be the 95% UCL (as calculated by ProUCL).

TABLE D-3
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
SWMU 27 (CAPEHART WWTP SLUDGE DRYING BEDS)
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution) (1)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic (2)	Rationale
Groundwater									
	Chloroform	µg/L	0.414	Not Calculated	1	0.001	mg/L	Max	Conservative Estimate
	Barium	µg/L	400	Not Calculated	900	0.90	mg/L	Max	Conservative Estimate
	d-Barium	µg/L	340	Not Calculated	880	0.880	mg/L	Max	Conservative Estimate

EPC = Exposure Point Concentration
UCL = Upper Confidence Level
For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.

(1) Distribution and 95% UCL were not calculated; using the maximum as a conservative estimate. ProUCL 4.00.02 recommends a minimum of 8 sample points to calculate a UCL.

(2) Conservative estimate using the maximum concentration

TABLE D-4

SUMMARY OF EXPOSURE PARAMETERS
SWMU 27 (CAPEHART WWTP SLUDGE DRYING BEDS)
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Parameter	Units	Future Adult Residents RME	Future Young Child Residents RME
Soil			
Ingestion Rate of Soil (IR-S)	mg/day	100 USEPA, 1991	200 USEPA, 1991
Fraction Ingested from Source (Fi)	NA	1 Prof Judge	1 Prof Judge
Exposure Frequency (EF)	days/year	350 USEPA, 1991	350 USEPA, 1991
Exposure Duration (ED)	years	24 USEPA, 1997	6 USEPA, 1997
Exposure Time (ET)	hours/day	24 Prof Judge	24 Prof Judge
Surface Area Available for Contact (SA)	cm2/day	5,700 USEPA, 2004	2,800 USEPA, 2004
Respiration Rate (RR)	m3/hour	1.27 USEPA, 1997	0.69 USEPA, 1997
Conversion Factor (CF)	kg/mg	1.00E-06 USEPA, 1989	1.00E-06 USEPA, 1989
Averaging Time (Non-Cancer) (AT-N)	days	8,760 USEPA, 1989	2,190 USEPA, 1989
Groundwater			
Ingestion Rate of Groundwater (IR-W)	L/day	2 USEPA, 1989	1 USEPA, 1989
Exposure Frequency (EF)	days/year	350 USEPA, 1991	350 USEPA, 1993
Exposure Duration (ED)	years	24 USEPA, 1997	6 USEPA, 1997
Exposure Time (ET)	hours/day	0.58 USEPA, 2004	1 USEPA, 2004
Surface Area Available for Contact (SA)	cm2	18000 USEPA, 2004	6600 USEPA, 2004
Respiration Rate (RR)	m3/hour	1.27 USEPA, 1997	0.69 USEPA, 1997
Conversion Factor (CF)	L/cm3	0.001 USEPA, 1989	0.001 USEPA, 1989
Averaging Time (Non-Cancer) (AT-N)	days	8760 USEPA, 1989	2190 USEPA, 1989
Other Parameters			
Body Weight (BW)	kg	70 USEPA, 1997	15 USEPA, 1997
Soil to Skin Adherence Factor (AF)	mg/cm2	0.07 USEPA, 1997	0.2 USEPA, 1997
Particulate Emission Factor (PEF)	m3/kg	1.32E+09 Cowherd, et al., 1995	1.32E+09 Cowherd, et al., 1995
Averaging Time (Cancer) (AT-C)	days	25,550 USEPA, 1989	25,550 USEPA, 1989

Notes:

RME - Reasonalble Maximum Exposure
Prof Judge - Professional Judgment

Cowherd, et al., 1995: Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination. OHEA. EPA/600/8-85/002.
USEPA, 1989. Risk Assessment Guidance for Superfund, Volume I - Human Health Evaluation Manual (Part A) Interim Final.
USEPA, 1991. Risk Assessment Guidance for Superfund, Volume I - Human Health Evaluation Manual Supplemental Gudiance. "Standard Default Exposure Factor
USEPA, 1997. Exposure Factors Handbook. Vol. 1: General Factors. ORD. EPA/600/P-95/002Fa.
USEPA, 2004: Risk Assessment Guidance for Superfund Vol 1, Human Health Evaluation Manual
(Part E, Supplemental Guidance for Dermal Risk Assessment). EPA/540/R-99/005.

TABLE D-5
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 27 (CAPEHART WWTP SLUDGE DRYING BEDS)
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	Arsenic	2.1E-06	--	2.6E-07	--	2.4E-06	Skin / CVS	0.01	--	<0.01	0.02
			Chemical Total	2.1E-06	--	2.6E-07	--	2.4E-06		0.01	--	<0.01	0.02
		Exposure Point Total						2.4E-06					0.02
	Exposure Medium Total							2.4E-06					0.02
	Air	Fugative Dust	Arsenic	--	4.9E-09	--	--	4.9E-09	NA	--	--	--	--
			Chemical Total	--	4.9E-09	--	--	4.9E-09		--	--	--	--
		Exposure Point Total						4.9E-09					--
	Exposure Medium Total							4.9E-09					--
Surface Soil Total								**2.40E-06**					**0.02**
Subsurface Soil	Subsurface Soil	Subsurface Soil	Arsenic	1.5E-06	--	1.8E-07	--	1.6E-06	Skin / CVS	<0.01	--	<0.01	0.01
			Chemical Total	1.5E-06	--	1.8E-07	--	1.6E-06		<0.01	--	<0.01	0.01
		Exposure Point Total						1.6E-06					0.01
	Exposure Medium Total							1.6E-06					0.01
	Air	Fugative Dust	Arsenic	--	3.4E-09	--	--	3.4E-09	NA	--	--	--	--
			Chemical Total	--	3.4E-09	--	--	3.4E-09		--	--	--	--
		Exposure Point Total						3.4E-09					--
	Exposure Medium Total							3.4E-09					--
Subsurface Soil Total								**1.65E-06**					**0.01**

TABLE D-5
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 27 (CAPEHART WWTP SLUDGE DRYING BEDS)
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Tap	Chloroform	--	--	--	--	--	Liver	<0.01	--	<0.01	<0.01
			Barium	--	--	--	--	--	Kidney	0.35	--	0.03	0.38
			Chemical Total	--	--	--	--	--		0.35	--	0.03	0.38
		Exposure Point Total						--					0.38
	Exposure Medium Total							--					0.38
	Air	Water Vapors from Showerhead	Chloroform	--	7.9E-07	--	--	7.94E-07	NA	--	<0.01	--	<0.01
			Chemical Total	--	7.9E-07	--	0.0E+00	7.9E-07		--	<0.01	--	<0.01
		Exposure Point Total						7.9E-07					<0.01
	Exposure Medium Total							7.9E-07					<0.01
Groundwater Total								**7.94E-07**					**0.38**
Adult Residents Total								**4.84E-06**					**0.41**

Total Risk Across Surface Soil	2.4E-06	Total Hazard Index Across Surface Soil	0.0
Total Risk Across Subsurface Soil	1.7E-06	Total Hazard Index Across Subsurface Soil	0.0
Total Risk Across Groundwater	7.9E-07	Total Hazard Index Across Groundwater	0.4
Total Risk Across All Media and All Exposure Routes	4.8E-06	Total Hazard Index Across All Media and All Exposure Routes	0.4

Oral and Dermal Exposure Routes:

Oral / Dermal Cardiovascular System HI =	0.03
Oral / Dermal Skin HI =	0.03
Oral / Dermal Kidney HI =	0.4
Oral / Dermal Liver HI =	<0.01

Notes:
Target Organ Abbreviations:
CVS = Cardiovascular System

Soil Ingestion Pathway Intake:
CDI (mg/kg-day) = C x IR x CF x Fi x EF x ED x 1/BW x 1/AT

Soil Dermal Contact Pathway Intake:
CDI (mg/kg-day) = C x CF x SA x AF x ABS x EF x ED x 1/BW x1/AT

Soil Inhalation Pathway Intake:
CDI (mg/kg-day) = Ca x RR x ET x EF x ED x 1/PEF x 1/BW x1/AT

Groundwater Ingestion Pathway Intake:
CDI (mg/kg-day) = C x IR-W x EF x ED x 1/BW x 1/AT

Groundwater Dermal Contact Pathway Intake (Inorganics only):
CDI (mg/kg-day) = (C*CF*Kp*SA*EF*ED*ET)/(BW*AT)

Groundwater Inhalation Pathway Intake:
CDI (mg/kg-day) = C x IR-W x EF x ED x 1/BW x 1/AT

Carcinogenic Risk =
ILCR = ∑CDI*CSF

Noncarcinogenic Risk =
HQ = ∑CDI/RfD

TABLE D-6
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 27 (CAPEHART WWTP SLUDGE DRYING BEDS)
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Young Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	Arsenic	5.0E-06	--	4.2E-07	--	5.4E-06	Skin / CVS	0.13	--	0.01	0.14
			Chemical Total	5.0E-06	--	4.2E-07	--	5.4E-06		0.13	--	0.01	0.14
		Exposure Point Total						5.4E-06					0.14
	Exposure Medium Total							5.4E-06					0.14
	Air	Fugative Dust	Arsenic	--	3.1E-09	--	--	3.1E-09	NA	--	--	--	--
			Chemical Total	--	3.1E-09	--	--	3.1E-09		--	--	--	--
		Exposure Point Total						3.1E-09					--
	Exposure Medium Total							3.1E-09					--
Surface Soil Total								**5.40E-06**					**0.14**
Subsurface Soil	Subsurface Soil	Subsurface Soil	Arsenic	3.4E-06	--	2.9E-07	--	3.7E-06	Skin / CVS	0.09	--	<0.01	0.10
			Chemical Total	3.4E-06	--	2.9E-07	--	3.7E-06		0.09	--	<0.01	0.10
		Exposure Point Total						3.7E-06					0.10
	Exposure Medium Total							3.7E-06					0.10
	Air	Fugative Dust	Arsenic	--	2.2E-09	--	--	2.2E-09	NA	--	--	--	--
			Chemical Total	--	2.2E-09	--	--	2.2E-09		--	--	--	--
		Exposure Point Total						2.2E-09					--
	Exposure Medium Total							2.2E-09					--
Subsurface Soil Total								**3.73E-06**					**0.10**

TABLE D-6
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SWMU 27 (CAPEHART WWTP SLUDGE DRYING BEDS)
FULL RFI
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Scenario Timeframe: Future
Receptor Population: Residents
Receptor Age: Young Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Tap	Chloroform	--	--	--	--	--	Liver	<0.01	--	<0.01	<0.01
			Barium	--	--	--	--	--	Kidney	0.82	--	0.08	0.90
			Chemical Total	--	--	--	--	--		0.83	--	0.08	0.91
		Exposure Point Total						--					0.91
	Exposure Medium Total							--					0.91
Groundwater Total								**0.00E+00**					**0.91**
Young Child Residents Total								**9.13E-06**					**1.14**

Total Risk Across Surface Soil	5.4E-06	Total Hazard Index Across Surface Soil	0.1
Total Risk Across Subsurface Soil	3.7E-06	Total Hazard Index Across Subsurface Soil	0.1
Total Risk Across Groundwater	0.0E+00	Total Hazard Index Across Groundwater	0.9
Total Risk Across All Media and All Exposure Routes	9.1E-06	Total Hazard Index Across All Media and All Exposure Routes	**1.1**

Oral and Dermal Exposure Routes:

Oral / Dermal Cardiovascular System HI =	0.2
Oral / Dermal Skin HI =	0.2
Oral / Dermal Kidney HI =	0.9
Oral / Dermal Liver HI =	<0.01

Notes:
Target Organ Abbreviations:
CVS = Cardiovascular System

Soil Ingestion Pathway Intake:
CDI (mg/kg-day) = C x IR x CF x Fi x EF x ED x 1/BW x 1/AT

Soil Dermal Contact Pathway Intake:
CDI (mg/kg-day) = C x CF x SA x AF x ABS x EF x ED x 1/BW x1/AT

Soil Inhalation Pathway Intake:
CDI (mg/kg-day) = Ca x RR x ET x EF x ED x 1/PEF x 1/BW x1/AT

Groundwater Ingestion Pathway Intake:
CDI (mg/kg-day) = C x IR-W x EF x ED x 1/BW x 1/AT

Groundwater Dermal Contact Pathway Intake (Inorganics only):
CDI (mg/kg-day) = (C*CF*Kp*SA*EF*ED*ET)/(BW*AT)

Groundwater Inhalation Pathway Intake:
CDI (mg/kg-day) = C x IR-W x EF x ED x 1/BW x 1/AT

Carcinogenic Risk =
ILCR = ∑CDI*CSF

Noncarcinogenic Risk =
HQ = ∑CDI/RfD