

# RCRA Facility Investigation Report SWMU 3

Naval Station Roosevelt Roads  
RCRA/HSWA Permit No. PR2170027203  
Ceiba, Puerto Rico



Prepared For  
**Department of the Navy**  
**Atlantic Division**  
**Naval Facilities Engineering Command**  
**Norfolk, Virginia**

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Prepared by

**CH2M HILL**

Federal Group, Ltd.

**Baker**

Environmental, Inc.

**CDM**

Federal Programs Corp.

**REVISED FINAL**

**RCRA FACILITY INVESTIGATION REPORT  
SWMU 3**

**NAVAL STATION ROOSEVELT ROADS  
RCRA/HSWA PERMIT NO. PR2170027203  
CEIBA, PUERTO RICO**

**CONTRACT TASK ORDER 0099**

**MARCH 18, 2003**

*Prepared for:*

**DEPARTMENT OF THE NAVY  
ATLANTIC DIVISION  
NAVAL FACILITIES  
ENGINEERING COMMAND  
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*Under the:*

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*Prepared by:*

**CH2M Hill  
*Herndon, Virginia***

**BAKER ENVIRONMENTAL, INC.  
*Coraopolis, Pennsylvania***

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## ACRONYMS AND ABBREVIATIONS

AOC	Areas of Concern
Baker	Baker Environmental, Inc.
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CNO	Chief of Naval Operations
COPCs	chemicals of potential concern
CRQL	Contract Required Quantitation Limits
CTO	Contract Task Order
D	duplicate
DO	dissolved oxygen
DoN	Department of the Navy
DRMO	Defense Reutilization and Marketing Office
EPA	United States Environmental Protection Agency
EQB	Environmental Quality Board
ER	Equipment Rinsate
F	Fahrenheit
FB	Field Blank
HEA	Health and Environmental Assessment
HSWA	Hazardous and Solid Waste Amendments
IAS	Initial Assessment Study
IR	Installation Restoration
LANTDIV	Naval Facilities Engineering Command, Atlantic Division
µg/kg	micrograms per kilogram
MCL	Maximum Contaminant Level
mgd	million gallons per day
mg/L	milligrams per liter
MS/MSD	matrix spike\matrix spike duplicate
msl	mean sea level
MSWLFs	Municipal Solid Waste Landfills
NHSWR	Non-Hazardous Solid Waste Regulations
NSRR	Naval Station Roosevelt Roads
OP	organophosphorus
OU	Operable Unit
PCB	polychlorinated biphenyl
QA/QC	Quality Assurance/Quality Control

**ACRONYMS AND ABBREVIATIONS**  
**(Continued)**

QC	Quality Control
RBC	Risk Based Concentration
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SVOC	Semivolatile Organic Compound
SWMU	Solid Waste Management Unit
TB	Trip Blank
TOC	total organic carbon
UST	Underground Storage Tank
VOC	Volatile Organic Compound

## **EXECUTIVE SUMMARY**

### **INTRODUCTION**

This Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) evaluates the nature and extent of contamination at Solid Waste Management Unit (SWMU) 3 located at Naval Station Roosevelt Roads (NSRR), Ceiba, Puerto Rico. This document presents the results of the sampling conducted during the field investigation. The objective of the RFI is to summarize the results of the data gathered, evaluate the nature and extent of contamination at SWMU 3, as well as to provide recommendations for SWMU 3.

### **INVESTIGATION ACTIVITIES**

The field portion of this most recent RCRA Facility Investigation was conducted in March 2002. Field activities at the Base Landfill included the sampling of groundwater which was analyzed for the Appendix IX parameters including volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides/polychlorinated biphenyls (PCBs), organophosphorus (OP) pesticides, dioxins/furans, chlorinated herbicides, cyanide, sulfide, asbestos, explosives, total metals, and dissolved metals.

### **FINDINGS OF THE INVESTIGATION**

Based on the groundwater results from the March 2002 field investigation, benzo (a) pyrene, arsenic, and thallium were the only constituents found to exceed the Federal MCLs. Benzo (a) pyrene was found in monitor well R7GW01R, which is just southwest of the wastewater treatment plant and north of the landfill. It should be noted that the groundwater flow direction from this well is radially to the southwest, south, and southeast. Therefore groundwater flows from this monitor well towards the landfill. It is unlikely that this constituent is associated with SWMU 3. None of the VOCs, pesticides, or chlorinated herbicides detected was in excess of the Federal MCLs. No PCBs, OP-pesticides, dioxins/furans, or explosives were detected in any of the samples.

Total arsenic and total thallium was detected in monitor well R7GW04R in excess of the Federal MCL. Arsenic was not detected in the dissolved sample but thallium was detected in the

dissolved sample from this location. This monitor well is located in the extreme southwestern portion of the site. Total thallium was also detected in monitor well R7GW02R along the western side of the site. The dissolved fraction of thallium was not detected from this well.

Four inorganic constituents (copper, nickel, thallium, and zinc) were detected in the total groundwater samples in excess of the surface water screening values. Further evaluation of these constituents consistent with the CNO policy for conducting ecological risk assessments determined that no further evaluation is recommended.

No further action was proposed for sediment at SWMU 3 in the Draft RFI Report for Additional Investigations at OU 1, 6, and 7 (Baker, 1998a). The United States Environmental Protection Agency (EPA) responded to this recommendation by requesting the Navy address their comments, as well as to revise the risk assessment for this site. The Navy responded to the EPA's comments on November 24, 1998 with a response to comment letter including the revised risk assessment for this site. The Navy indicated in their response to comment letter that the primary risks identified in the Phase I HEA included the sediments from the end of the cooling water tunnel at Puerca Bay (SMWU 11/45), as well as the sediments associated with SWMU 2. After further review, the samples from SWMU 11/45 should not have been included in the HEA since they are not apart of the Ensenada Honda sediments. The sediment samples collected at SWMU 2 are near shore sediments, likely to have been impacted by erosion of the SWMU 2 soil. Therefore, it was Navy's technical opinion that these near shore sediment samples be addressed along with SWMU 2 during the CMS stage for this site. The Navy removed the sediment samples collected at SWMU 11/45 and SWMU 2 from the sediment database for AOC D. The Navy then performed a risk assessment on this new sediment database from AOC D (Baker, 1998b). This new risk assessment indicated that there were no unacceptable risks posed by the AOC D sediments, which includes SWMU 3 sediments. The EPA commented on the Navy's response to EPA comment letter by approving the Navy's no further action recommended for this site. This approval is based on the recommendation from the Navy that the sediment data for samples adjacent to SWMU 2 and samples adjoining the old power plant cooling water tunnel be excluded from the data set used in the risk assessment.

## **RECOMMENDATIONS**

The current round of groundwater sampling at the landfill facility does not indicate that the operation of the facility is negatively impacting the groundwater with respect to human health or the environment. This coupled with the fact that the landfill facility at NSRR is currently under operation in accordance with RCRA Subtitle D and groundwater is being monitored on a semi-annual basis. Therefore, pending approval of this RFI the Navy recommends that groundwater at SWMU 3 be continued to be monitored under the RCRA Subtitle D program to ensure that groundwater is not being impacted by landfill operations. The Navy also recommends that additional analysis of the following PAHs (benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene), SVOC (1,4-dioxane), along with the following pesticide (beta-BHC) be performed at this site during the next round of groundwater sampling to monitor the results of these constituents detected during the RFI investigation. This analysis will continue until these constituents are not detected for two consecutive Subtitle D investigations. The results of each RCRA Subtitle D investigation will be provided to both the EQB and EPA as required by 40 CFR Part 258.

No further action is required with respect to the sediment as discussed in the previous section.

With the completion of the groundwater investigation requirements, the RFI stage at SWMU 3 is now considered complete. Any further action following this RFI for this facility will be deferred until SWMU 3 is closed.

## **1.0 INTRODUCTION**

This Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Report has been prepared by Baker Environmental, Inc. (Baker) under contract to the Atlantic Division, Naval Facilities Engineering Command (LANTDIV) Contract Number N62470-95-D-6007, Contract Task Order (CTO) 099. This report has been prepared to present results of the RCRA Facility Investigation at Solid Waste Management Unit (SWMU) 3 – Base Landfill at Naval Station Roosevelt Roads (NSRR), under the Corrective Action provisions of the Station's RCRA Part B Permit No. PR2170027203.

### **1.1 Investigation History**

On October 20, 1994, a Final RCRA Part B permit was issued by the United States Environmental Protection Agency (EPA) Region II to NSRR. This permit contains requirements for RFI activities at 24 SWMUs and three areas of concern (AOC). 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 (DoN'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) provisions of RCRA.

The various SWMUs and AOCs at NSRR have been grouped together into Operable Units (OUs) based on similarity of investigation scope, geography, or similarity of contaminants potentially released. This report pertains to SWMU 3 (Base Landfill), which has been utilized since the early 1960's as a disposal site for solid wastes. During the first round of the IR investigation (1986), eight groundwater monitor wells were installed. During both the first and second rounds (1986 and 1987, respectively) sampling of the groundwater found low levels of organic compounds, as well as metal concentrations which exceeded drinking water criteria (Baker, 1995)

The RCRA Part B Permit dated October 20, 1994 was issued to the Captain of Naval Station Roosevelt Roads. This document listed SWMU 3 as an area requiring a full RFI investigation. The proposed RFI investigation was to include soil, surface water, groundwater, and sediments.

The 1995 RFI Work Plan was submitted to the EPA by Baker on September 13, 1995. This document provided information on the investigations that were to be performed as required by the EPA in the RCRA Part B Permit. The work proposed in this document for SWMU 3 included a geophysical survey, surface soil sampling, subsurface soil sampling, surface water and sediment sampling on the landfill, leachate and sediment sampling associated with leachate breakouts, groundwater sampling, and offshore sediment sampling. Included in this document were the Final Project Management Plans, the Final Data Collection Quality Assurance Plan, and the Final Health and Safety Plan (Baker, 1995).

In October 1995, the first RFI investigation was conducted at SWMU 3. This investigation included the collection of fifteen offshore sediment samples along the perimeter of the Base Landfill. The remaining two sediment locations were not sampled since there was extensive filling in the area related to the CPO Hut. This filling covered the sediments such that a representative sample could not be obtained (Baker, 1995). The other media proposed in the 1995 RFI Work Plan were not sampled during this investigation. In July 1996, a Draft RFI Report for the Phase I Investigations at OU 1, 6, and 7 was submitted to the EPA (Baker, 1996). This report contained a summary of the results from the fifteen sediment samples, as well as figures showing chemicals of potential concern (COPCs) at SWMU 3 from the Phase I Investigation.

In September 1997, a Phase II investigation was conducted at SWMU 3. This investigation included the collection of two offshore sediment samples from the locations that were not collected during the October 1995 investigation activities. These samples were collected along the mid eastern shoreline of the landfill, samples were not able to be collected during the original sediment sampling due to construction activities in the area that were disturbing the sediments at these locations. The geophysical investigation was also performed at SWMU 3 during this investigation. Also during this investigation the landfill was inspected for the presence of any ground surface drainage features and/or leachate breakouts. None of these items were identified; therefore no samples were collected. On May 6, 1998, a Draft Additional Investigations Report for OU 1, 6, and 7 was submitted to the EPA (Baker, 1998a). This report contained a summary of the results from the two sediment samples collected along with those sediment samples from the initial RFI investigation, indicating that there were no constituents of concern detected. Therefore, the report recommended no further action for sediments offshore of SWMU 3.

On February 11, 1998, the EPA sent a comment letter to the Navy dealing with the RFI Quarterly Report for period August 1, 1997 – October 31, 1997. This quarterly report contained Attachment 1 (March 1997 and July 1997 addendum) Groundwater Monitoring System Implementation Plan for the Base Landfill (SWMU 3). The EPA requested that the Navy demonstrate the integrity of all wells that will be utilized to satisfy the groundwater investigation requirements of the 1995 EPA approved RFI work plan, as well as the requirements of monitoring landfills under the Subtitle D portion of the Code of Federal regulations (CFR). The EPA stated in their comment letter that “it is EPA’s understanding that completion of the groundwater investigation requirements, completes the SWMU Number 3 investigation requirements of the September 1995 RFI Work Plan”.

On May 6, 1998, the Navy responded to the EPA’s February 11, 1998 comment letter. The Navy stated that three new monitor wells would be installed initially, with the remaining six monitor wells installed at a rate of two per year. The Navy also stated that two sets of samples would be collected during the initial round of sampling. One set would satisfy the requirements of the Puerto Rico Environmental Quality Board (EQB’s) Subtitle D Solid Waste Program, and the second set would satisfy the September 1995 approved RFI Work Plan. Any additional work required to satisfy the RCRA Part B Permit would be addressed in a separate RFI Groundwater Investigation Work Plan and a Final RFI Report.

Baker installed the remaining six replacement wells proposed in the Navy’s May 6, 1998 response to EPA’s comment letter in December 2000.

On November 20, 2001, the Navy and the EPA held a conference call to discuss the upcoming fieldwork at SWMU 3. Both parties agreed that a complete round of groundwater samples should be collected and analyzed for the full Appendix IX list, as well as for explosives and asbestos as proposed in the EPA approved 1995 RFI Work Plan. This action will then complete requirements of the RFI investigation for SWMU 3.

On January 24, 2002, the Navy submitted to the EPA the Final RCRA Facility Investigation Work Plan for SWMU 3 (Baker, 2002). The EPA approved this work plan in their comment letter dated March 8, 2002. In March 2002, an additional RCRA Facility Investigation was conducted at the base landfill and involved the collection of groundwater from all nine groundwater monitor wells.

## **1.2 Scope and Objectives**

The scope of the RFI included completion of a field investigation at SWMU 3 to determine whether groundwater quality has been affected by the landfill activities, as well as to establish the groundwater flow directions through the interpretation of groundwater elevation measurements obtained from the nine existing monitor wells. This document presents the results of the sampling conducted during the field investigation. The objective of the RFI is to summarize the results of the data gathered, evaluate the nature and extent of contamination at SWMU 3, as well as to provide recommendations for SWMU 3.

## **1.3 Report Organization**

Section 1.0 of this document includes the investigation history and the scope and objectives of this RFI Report. Section 2.0 provides a description of the facility, as well as a description of SWMU 3. This section also describes the RCRA Subtitle D Groundwater Monitoring Program currently ongoing at SWMU 3. Section 3.0 provides a description of the physical characteristics of NSRR, including climatology, topography, geology and hydrology, as well as site specific information for SWMU 3. Section 4.0 describes the field activities conducted during the RFI at SWMU 3. This section also describes the sampling procedures, sampling locations for all media, and quality control (QC) conducted during sampling activities. Section 5.0 discusses the nature and extent of contamination detected in the environmental samples from each media sampled. A summary of findings and conclusions is presented in Section 6.0 along with recommendations for SWMU 3. The report references are listed in Section 7.0.

## **2.0 FACILITY BACKGROUND**

This section contains a description of the physical layout and background history of NSRR, as well as a description of the physical layout of SWMU 3.

### **2.1 Facility Description**

NSRR occupies over 33,500 acres on the northern side of the east coast of Puerto Rico, along Vieques Passage with Vieques Island lying to the east about 10 miles off the harbor entrance. The north entrance to NSRR is about 35 miles east along the coast road (Route 3) from San Juan. The closest large town is Fajardo (population approximately 37,000), which is about 10 miles north of NSRR off Route 3. Ceiba (population approximately 17,000) adjoins the west boundary of NSRR (Figure 2-1).

NSRR was commissioned in 1943 as a Naval Operations Base and redesignated as a Naval Station in 1957. The current primary mission of NSRR is provision of full support for Atlantic Fleet weapons training and development activities. NSRR has administrative and command responsibilities for some operations separated from the main base on Vieques Island.

### **2.2 SWMU 3 – Base Landfill**

SWMU 3, a part of OU 4, is currently an active landfill that has been in operation since the early 1960s and is located south of the Forrestal Wastewater Treatment Plant (Building 1758) and SWMU 30 (Former Incinerator Area), as presented on Figure 2-2. The landfill is still operating and accepting wastes in accordance with the Puerto Rico EQB Solid Waste Management regulations. The landfill covers 85 acres, and was separated into several disposal areas (A.T. Kearney, Inc., 1988). Information regarding previous investigations performed at this site can be found within the 1995 RFI Work Plan submitted by Baker (Baker, 1995). It should be noted that a new vertical cell of two acres was finished in March 1999 at the Base Landfill, and was placed into operation in June 2000 in accordance with the EQB Solid Waste Management regulations. The design of the new cell included a 2-foot clay liner, and a run on/off collection pond.

Figures 2-3 through 2-6 present a site plan of the Base Landfill operational areas during the years 1977, 1983, 1991, and 1994, respectively. Within these figures are graphical presentations of the size and shape of the operational areas of the landfill during the above mentioned time frame.

The design of the new vertical cell and intermediate landfill cover completed in March 1999 has been overlaid on these figures to provide a reference point.

### **2.3 RCRA Subtitle D Groundwater Monitoring**

The NSRR Landfill is currently being operated in accordance with local and Federal Regulations under RCRA Subtitle D. Part of the operation of the landfill includes groundwater monitoring and is described in this subsection.

According to the Groundwater Sampling and Analysis Plan for the Naval Station Roosevelt Roads Base Landfill (Burns & McDonnell, 1999), the United States EPA developed standards for new and existing municipal solid waste landfills (MSWLFs) under RCRA Subtitle D in October 1991. These standards established criteria for such aspects as location, design, operation, cleanup, and closure of MSWLFs under 40 CFR Part 258 (Burns & McDonnell, 1999).

The Puerto Rico EQB developed Non-Hazardous Solid Waste Regulations (NHSWR), which comply with 40 CFR Part 258. Chapter VII of the NHSWR regulates the MSW facilities in Puerto Rico. These regulations were developed to help protect the public health, prevent nuisances, and meet applicable environmental standards (Burns & McDonnell, 1999).

Burns & McDonnell, under Chapter VII of the Non-Hazardous Solid Waste Regulations, replaced in June 1998 the original wells 7GW03 and 7GW06 for wells 7GW09 and 7GW10, due to poor physical and functioning conditions of the original wells. Burns and McDonnell also installed on the same date a new upgradient well 7GW11. A total of four rounds (June 1998, February 2000, May 2000, and August 2000) of groundwater sampling were performed by Burns & McDonnell from all nine monitor wells (7GW01, 7GW02, 7GW04, 7GW05, 7GW07 through 7GW11) associated with SWMU 3. The remaining six original monitor wells (7GW01, 7GW02, 7GW04, 7GW05, 7GW07, and 7MW08) were replaced by Baker in December 2000 and January 2001 because the integrity and construction details of these wells could not be verified. These wells were designated with an R to identify that they were replaced (7GW01R, 7GW02R, 7GW04R, 7GW05R, 7GW07R, and 7MW08R).

### **3.0 PHYSICAL CHARACTERISTICS OF STUDY AREA**

The physical setting of NSRR was documented in the 1984 Initial Assessment Study (IAS) (NEESA, 1984). This information is summarized below.

#### **3.1 Climatology**

The climate of the Roosevelt Roads area 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° North, 30° 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 9 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 June through November; 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 Roosevelt Roads 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° are common.

In the immediate area of the Station, elevations range from sea level to approximately 295 feet. Immediately to the north of the NSRR 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 Station boundary. There is a series of three hilly areas on the Station, 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 the Station, 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**

The following subsections present a description of the general geology at NSRR and site-specific geologic information obtained at SWMU 3.

#### **3.3.1 Soils**

The soil associations found at NSRR 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 NSRR.

The Swamps-Marshes and Mabi-Rio-Arriba-Cayagua associations cover over one half of NSRR'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 NSRR 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 the Station 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 NSRR 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 NSRR 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 NSRR area is predominantly volcanic (composed of lava and tuff), as well as sedimentary (rocks derived from discontinuous beds of limestone). These rock all range in age from early Cretaceous to middle Eocene. The volcanic rocks and interbedded limestones 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 NSRR are various beach deposits, alluvium, quartz diorite and granodiorite, quartz keratophyre, the Daguao Formation, and the Figuera Lava. The Peña Pobre fault zone traverses NSRR.

### **3.3.3 Site Geology SWMU 3 – Base Landfill**

The underlying geology of the area at NSRR is predominantly volcanic as well as sedimentary. The volcanic rocks and interbedded limestone have been complexly faulted, folded, metamorphosed and variously intruded by dioritic rocks. The primary geologic formations on and near NSRR are various beach deposits, alluvium, quartz diorite and granodiorite, aquartz keratophyre, the Daguao Formation, and the Figuera Lava.

The geology in the area of the Base Landfill can be divided into three general units:

1. Surficial fill material
2. Boulders
3. Marine sediments

The surficial fill material is present in both the northern and southern ends of the Base Landfill. The fill is generally composed of fine to medium grained sand with varying amounts of silt and clay. Areas of fill material to the north and south also contain some rock fragments varying in size from gravel to cobble size. The fill material is generally encountered at the ground surface to depths below the ground surface ranging from 2 feet to 10 feet below ground surface. The source of the fill material has not been definitively determined but it is most likely either natural soil excavated during the construction of the new landfill cell, or dredge material from Ensenada Honda.

The second zone, consisting of boulders, was identified at monitor well R7GW04R. This zone was identified at depths ranging from 14 feet to 28 feet below ground surface. An air hammer was used to proceed through these boulders due to auger refusal.

A third zone, consisting of unconsolidated material, was identified when the six replacement wells were installed in December 2000 by Baker. This material consists of naturally occurring marine sediments, primarily silt with lesser amounts of sand and clay with coral and shell fragments. The unconsolidated fill material is generally encountered at a depth ranging from 2 feet to 13 feet below ground surface.

### **3.4 Hydrology**

The following sections present a description of the hydrologic conditions that exist at NSRR. Both regional conditions and site-specific conditions at SWMU 3 are discussed.

#### **3.4.1 Regional Hydrology**

The surface waters that flow across the northeastern plain of Puerto Rico, where the Station 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 the Station and, in periods of heavy rain, on-Station flooding 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 towns of Naguabo and Ceiba, especially in areas adjacent to the Station's northern boundary, has significantly increased the surface runoff reaching the Station, 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 stormwater management features.

In the low-lying shore areas, seawater flooding results from storms, wind, and abnormally high tides. The tidal ranges in the Roosevelt Roads 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 the Station.

Little information exists concerning the geohydrology of NSRR. 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 base from these layers. Some wells had been developed upgradient of the Station 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 the Station 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 NSRR 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 Station boundary. A raw water reservoir is located at the water treatment plant and has a 45-million gallon capacity. Additionally, there are 2 fire protection storage reservoirs with a total capacity of 520,000 gallons.

The base 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.

The single potable water supply system provides water to all industrial operations at the facility. The water supply is low in hardness, and, therefore, is an excellent source for industrial uses, particularly in boiler operation and maintenance.

Three hundred acres are used for pasture near Gate 1 and are irrigated as needed. Extensive sprinkling of lawns and green areas is evident throughout the base.

### **3.4.2 SWMU 3 Hydrology**

The groundwater elevations were collected at the Solid Waste Landfill Facility at two different times during this investigation. The measurements were taken on 2/28/2002 between 9:00 am and 10:00 am and on 3/12/2002 between 8:00 am and 9:00 am. Table 3-1 shows a summary of

the groundwater elevation information from these two rounds. It should be noted that the datum used is the mean sea level (msl) + 100 feet.

Figures 3-1 and 3-2 depict the groundwater elevations in the form of contours on a site map. The contours were developed numerically using the inverse distance weighted algorithm with a quadratic nodal function interpolation scheme. Some control points of 100 feet msl were added along the coast. As shown, the highest groundwater elevation is located at R7GW11. This is to be expected because this well is located the furthest inland. Consistent highs at this location have been noted throughout the Subtitle D groundwater monitoring events. Another local groundwater high is seen at R7GW01R, near the Forrestal Wastewater Treatment Plant. This well is also at an inland location. Radial groundwater flow occurs from this location toward the coasts in the west, south, and east directions. The average difference in groundwater elevations between the two measured events taken at this sampling event is about two and one-half inches, with the 2/28/2002 level consistently higher than the 3/12/2002 level.

As shown on Table 3-1, some groundwater elevations are below sea level. This is most likely due to tidal fluctuations at the coast. In particular, R7GW05R had below sea level elevations during both sampling events. The following web site, [http://co-ops.nos.noaa.gov/tides/get\\_pred.shtml?stn=5371+San+Juan&secstn=Roosevelt+Roads&thh=+0&thm=02&tlh=+0&tlm=20&hh=\\*0.63&hl=\\*0.63](http://co-ops.nos.noaa.gov/tides/get_pred.shtml?stn=5371+San+Juan&secstn=Roosevelt+Roads&thh=+0&thm=02&tlh=+0&tlm=20&hh=*0.63&hl=*0.63), lists the water levels at high and low tides for the year 2002. During both measuring events, the tide was going from low to high tide. The groundwater elevation lag at the coast in response to the tides provides one explanation for the groundwater levels at RGW05R being below sea level.

Hydraulic gradients vary spatially across the base landfill. Hydraulic gradients were calculated from both rounds of groundwater elevations as shown in Table 3-2. The lines used to calculate the hydraulic gradients are shown on Figures 3-1 and 3-2. The hydraulic gradients calculated from the 2/28/2002 measurements ranged from 0.00055 feet per foot (feet/foot) to 0.00245 feet/foot, while the gradients from 3/12/2002 ranged from 0.00054 feet/foot to 0.00271 feet/foot.

**SECTION 3.0**  
**TABLES**

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**TABLE 3-1**

**SUMMARY OF GROUNDWATER ELEVATIONS  
SWMU 3 - BASE LANDFILL  
MARCH 2002 RCRA FACILITY INVESTIGATION  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Well No.	Top of PVC Elevation (feet msl)	February 28, 2002		March 12, 2002	
		Depth to Water (feet from top of PVC)	Groundwater Elevation (feet msl)	Depth to Water (feet from top of PVC)	Groundwater Elevation (feet msl)
R7GW01R	108.90	7.15	101.75	7.43	101.47
R7GW02R	105.11	5.07	100.04	5.50	99.61
R7GW04R	112.39	12.20	100.19	12.44	99.95
R7GW05R	113.73	14.30	99.43	14.48	99.25
R7GW07R	114.94	14.79	100.15	14.86	100.08
R7GW08R	111.33	11.12	100.21	11.26	100.07
R7GW09	109.69	9.33	100.36	9.60	100.09
R7GW10	113.96	13.58	100.38	13.79	100.17
R7GW11	110.20	6.92	103.28	7.03	103.17

**Notes:**

msl - mean sea level + 100 feet.

PVC - Polyvinyl Chloride.

**TABLE 3-2**

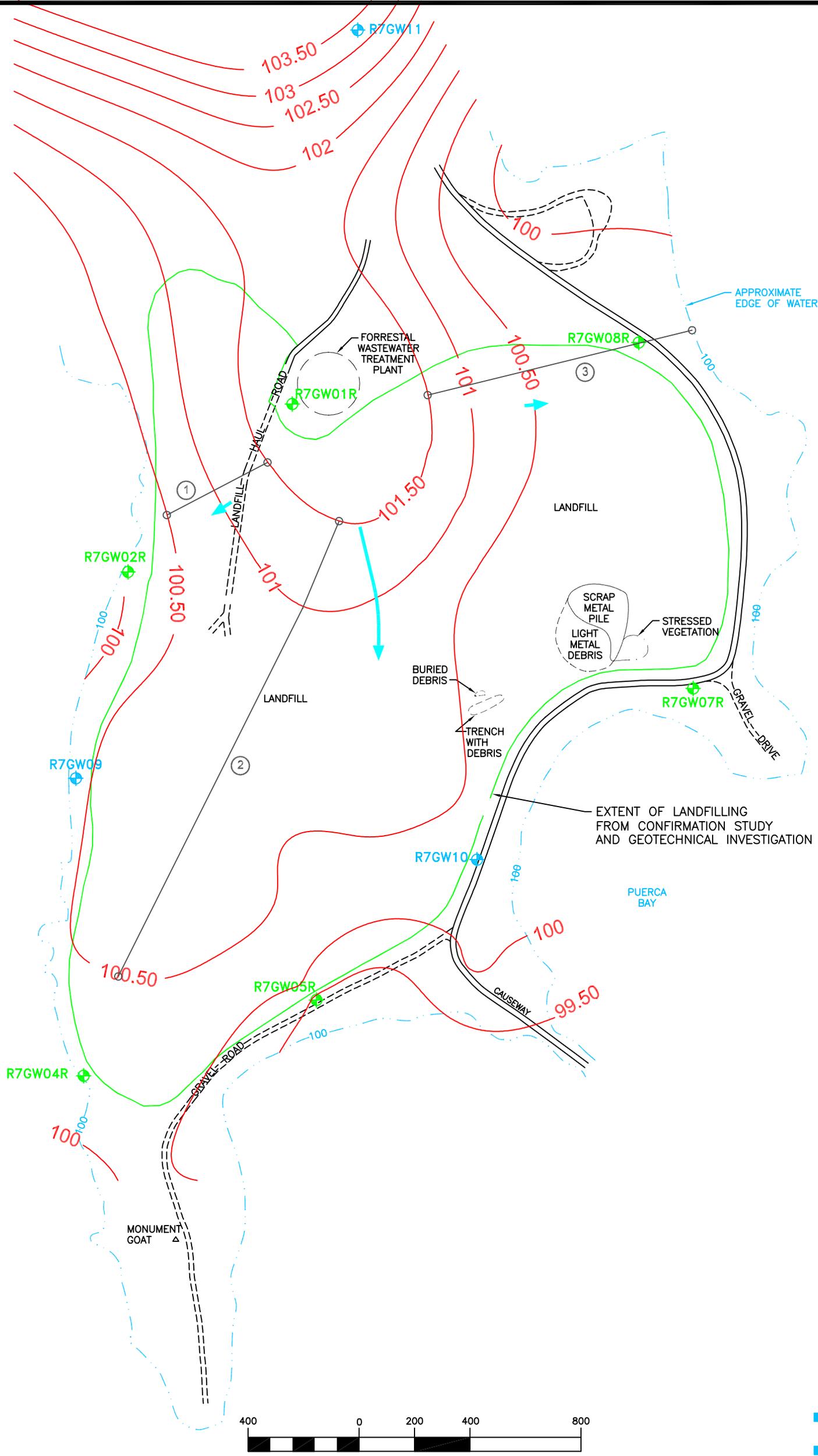
**GROUNDWATER HYDRAULIC GRADIENT CALCULATIONS  
SWMU 3 - BASE LANDFILL  
MARCH 2002 RCRA FACILITY INVESTIGATION  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

<b>Event</b>	<b>Line Location</b>	<b>Line Length (ft)</b>	<b>Head Difference (ft)</b>	<b>Gradient-I (ft/ft)</b>
2/28/2002	1	408.84	1.00	0.00245
2/28/2002	2	1812.00	1.00	0.00055
2/28/2002	3	981.27	1.50	0.00153
3/12/2002	1	553.37	1.50	0.00271
3/12/2002	2	1839.72	1.00	0.00054
3/12/2002	3	986.74	1.50	0.00152
average gradient =				0.00155

**SECTION 3.0**  
**FIGURES**

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2099810W

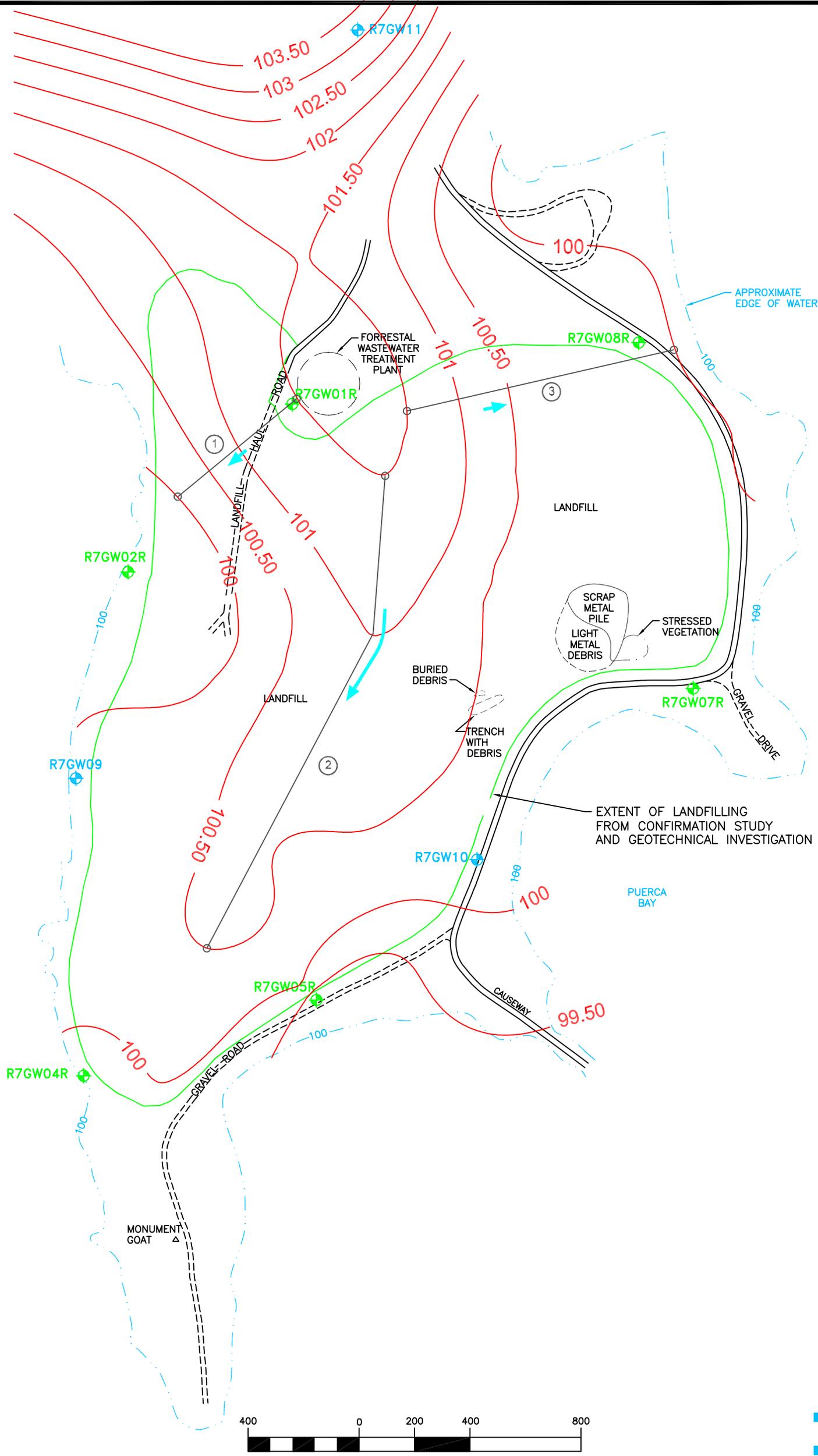
1 inch = 400 ft.

**LEGEND**

- MONITOR WELL LOCATION (INSTALLED JUNE 1998, BURNS AND McDONNELL)
  - MONITOR WELL LOCATION (INSTALLED DECEMBER 2000, BAKER)
  - GROUNDWATER CONTOUR LINE AND ELEVATION, DATUM = MEAN SEA LEVEL + 100 FEET
  - GROUNDWATER FLOW DIRECTION
  - LINE USED TO CALCULATE HYDRAULIC GRADIENT
- NOTE: CONTOURS WERE GENERATED WITH GROUNDWATER MODELING SOFTWARE<sup>®</sup> USING AN INVERSE-DISTANCE WEIGHTED WITH QUADRATIC NODAL FUNCTION INTERPOLATION ROUTINE. ALL CONTOURS ARE APPROXIMATE AND SUBJECT TO THE INTERPOLATION METHOD USED.

SOURCE: LANTDIV, FEB. 1992

**FIGURE 3-1**  
**GROUNDWATER CONTOUR MAP, FEBRUARY 2002**  
**DRAFT RFI REPORT**  
**SWMU 3 - BASE LANDFILL**  
**NAVAL STATION ROOSEVELT ROADS**  
**PUERTO RICO**



2099811W

1 inch = 400 ft.

**LEGEND**

- MONITOR WELL LOCATION (INSTALLED JUNE 1998, BURNS AND McDONNELL)
  - MONITOR WELL LOCATION (INSTALLED DECEMBER 2000, BAKER)
  - GROUNDWATER CONTOUR LINE AND ELEVATION, DATUM = MEAN SEA LEVEL + 100 FEET
  - GROUNDWATER FLOW DIRECTION
  - LINE USED TO CALCULATE HYDRAULIC GRADIENT
- NOTE: CONTOURS WERE GENERATED WITH GROUNDWATER MODELING SOFTWARE® USING AN INVERSE-DISTANCE WEIGHTED WITH QUADRATIC NODAL FUNCTION INTERPOLATION ROUTINE. ALL CONTOURS ARE APPROXIMATE AND SUBJECT TO THE INTERPOLATION METHOD USED.

SOURCE: LANTDIV, FEB. 1992

**FIGURE 3-2**  
**GROUNDWATER CONTOUR MAP, MARCH 2002**  
**DRAFT RFI REPORT**  
**SWMU 3 - BASE LANDFILL**  
**NAVAL STATION ROOSEVELT ROADS**  
**PUERTO RICO**

## **4.0 FACILITY INVESTIGATION**

The following sections present a description of the procedures utilized as well as the environmental field investigation activities conducted at SWMU 3. All investigations performed and the methodologies used were in accordance with the approved Final RFI Work Plan (Baker, 2002). Sampling locations utilized during the RFI at SWMU 3 are provided in Figures 4-1 and Figure 4-2.

### **4.1 Groundwater Investigation Procedures**

The groundwater investigation for SWMU 3 included the purging, and sampling of 9 existing monitor wells.

Prior to groundwater sampling, a complete round of water levels was collected from all nine monitor wells at SWMU 3. The monitor wells were also purged prior to sampling in accordance with EPA Region Low Flow Groundwater Sampling Procedures. During purging field measurements of pH, temperature, specific conductance, turbidity, dissolved oxygen (DO), and oxidation-reduction potential were taken at approximately five-minute intervals until these parameters were stabilized. Table 4-1 provides a summary of the groundwater field parameters at SWMU 3, while Figure 4-1 presents the locations of each monitor well at the Base Landfill.

Groundwater samples were obtained using a low flow sampling method presented in the EPA approved Final RFI Work Plan (Baker, 2002). The groundwater samples were analyzed for the Appendix IX parameters including volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides/polychlorinated biphenyls (PCBs), organophosphorus (OP) - pesticides, dioxins/furans, chlorinated herbicides, cyanide, sulfide, asbestos, explosives, total metals, and dissolved metals as presented in Table 4-2. The Appendix IX compound list and contract required quantitation limits (CRQL) for this RFI are presented in Table 4-3, while Table 4-4 provides a summary of the nine monitor well construction details. The soil boring and well construction records are available for review in Appendix A.

Groundwater samples were introduced into laboratory-prepared containers directly from the sampling device. Sample bottles for the VOC analysis were filled first, followed by bottles for the rest of the Appendix IX list. Groundwater samples were kept in coolers on ice and under strict chain-of-custody until delivered to the laboratory. Chain-of-custody records for these and

all environmental media are provided as Appendix B, while the analytical results can be found in Appendix C. Analytical results from the mainland laboratory were validated by an independent, third party, data validator.

#### **4.2 Sediment Sampling Procedures**

A total of 17 sediment samples were collected at SWMU 3 during the initial and additional RCRA Facility Investigations as presented in Table 4-5 and on Figure 4-2. Each sediment sample was collected utilizing the methods and procedures listed in the EPA approved RFI work plan (Baker, 1995).

Each sediment sample was analyzed for VOCs, SVOCs, pesticides/PCBs, dioxins/furans, chlorinated herbicides, total organic carbon (TOC), explosives, and the Appendix IX total metals list as presented in Table 4-5. The sediment samples collected during the 1995 RCRA Facility Investigation were also analyzed for sulfide and % solids. The sediment samples collected during the 1997 RCRA Facility Investigation were also analyzed for asbestos.

Samples were packed in ice, maintained with the proper chain-of-custody record, and shipped next day air to the “fixed base” laboratory. Chain-of-custody records for these and all environmental media are provided as Appendix B. Analytical results from the mainland laboratory were validated by an independent, third party, data validator. The analytical results for sediment can be found in Appendix C.

#### **4.3 Geophysical Investigation Procedures**

In June 1999, Forrest Environmental Services, Inc. performed a preliminary electromagnetic survey for Baker at the Base Landfill as part of the RCRA Facility Investigation. The purpose of this survey was to coarsely define the boundary at the landfill (Forrest, 1999). The Preliminary Geophysical Survey SWMU 3 Base Landfill is presented in Appendix D.

#### **4.4 Quality Assurance/Quality Control Sampling Procedures**

Extensive field Quality Assurance/Quality Control (QA/QC) samples were collected during the investigation as shown in Table 4-6 as presented in Appendix E. These samples were obtained to:

- (1) Ensure that the new low flow tubing utilized during the sampling procedure was free of contaminants (i.e., equipment rinsate blanks);
- (2) Evaluate field methodology (i.e., duplicate samples);
- (3) Establish field background conditions (i.e., field blanks); and
- (4) Evaluate whether cross-contamination occurred during sampling and/or shipping (i.e., trip blanks);

Several types of field QA/QC samples were collected and analyzed including duplicate samples, equipment rinsate samples, field blanks, matrix spike/matrix spike duplicate (MS/MSD), and trip blanks samples. These QA/QC samples are defined below:

- Duplicate Sample (D): Two samples collected simultaneously into separate containers from the same source under identical conditions. One duplicate sample was collected for every 10 environmental samples collected for each media type.
- Equipment Rinsate Sample (ER): Sample obtained by running laboratory supplied deionized water over/through sample collection equipment. This sample was used to determine if the new low flow tubing utilized during the sampling procedure was free of contaminants.
- Field Blank (FB): Sample obtained from each water source utilized during the field program. The only water source collected during the field program was laboratory supplied deionized water utilized to collect the equipment rinsate blank.
- Matrix Spike/Matrix Spike Duplicate (MS/MSD): MS/MSDs are not field samples but are laboratory derived, and are collected to evaluate the matrix effect of the sample upon the analytical methodology. An MS and MSD must be performed for each group of samples of a similar matrix. MS/MSD samples were collected at a frequency of one sample for every 20 environmental samples collected.
- Trip Blank (TB): Trip blanks were prepared at the laboratory and shipped with the sample containers. Trip blanks were packaged for shipment with the other VOC samples and sent for analysis. At no time after preparation were the trip blank sample containers

opened before they reached the laboratory. At least one trip blank per shipping cooler containing samples requiring VOC analysis was sent to the laboratory for VOC analysis.

**SECTION 4.0**  
**TABLES**

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**TABLE 4-1**

**SUMMARY OF GROUNDWATER FIELD PARAMETERS  
SWMU 3 - BASE LANDFILL  
MARCH 2002 RCRA FACILITY INVESTIGATION  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Well ID/ Sample Date	Time Interval	Static Water Level (ft from top of PVC)	Temperature (°C)	pH (S.U.)	Specific Conductance (umhos/cm)	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	Turbidity (N.T.U.)
R7GW11 02/28/02	1053	6.92						
	1058	7.04	30.0	6.68	915		39.1	56.1
	1120	7.04	29.7	6.80	916		36.8	16.9
	1126	7.06	29.9	6.77	909		41.6	11.2
	1132	7.06	29.6	6.77	911		49.9	10.2
	1139	7.06	29.5	6.80	907		55.1	8.26
	1146	7.05	29.7	6.88	908		58.6	14.0
	1156	7.05	29.3	6.97	909		62.3	10.3
	1204	7.03	29.4	6.95	916	0.6	64.3	6.56
R7GW08R 02/28/02	1457	11.12						
	1504	11.25	29.8	6.79	44,300		-140.5	472
	1510	11.24	29.4	6.95	42,700		-139.6	306
	1517	11.25	29.1	6.95	40,900		-145.2	142
	1524	11.23	29.4	7.04	40,200		-146.2	53.9
	1530	11.24	29.7	7.05	38,800		-154.5	21.5
	1537	11.25	29.3	7.06	38,900		-161.6	16.3
	1544	11.23	28.7	7.13	37,900	0.6	-160.7	10.7
R7GW07R 02/28/02	1707	14.79						
	1713	NA	29.0	6.64	1,898		-174.3	601
	1720	NA	29.1	6.66	1,848		-153.2	358
	1729	NA	28.6	6.73	1,826		-131.4	269
	1736	NA	28.7	6.77	1,827		-128.2	233
	1744	NA	28.6	6.86	1,808		-117.1	70.6
	1751	NA	28.7	6.87	1,824	1.0	-127.5	123
R7GW05R 03/02/02	0818	14.36						
	0831	14.51	28.3	6.95	36,600		-244.4	307
	0841	14.52	28.0	6.88	31,200		-229.1	121
	0847	14.55	28.0	6.86	30,100		-229.9	91.2
	0854	14.55	28.1	6.91	29,200		-233.0	44.4
	0900	14.54	28.4	6.89	28,700		-237.1	29.6
	0909	14.54	28.5	6.91	28,500		-250.1	20.3
	0915	14.55	28.7	6.92	28,200		-259.4	14.8
0921	14.56	28.8	6.90	28,100	0.6	-268.4	12.2	

**TABLE 4-1**

**SUMMARY OF GROUNDWATER FIELD PARAMETERS  
SWMU 3 - BASE LANDFILL  
MARCH 2002 RCRA FACILITY INVESTIGATION  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Well ID/ Sample Date	Time Interval	Static Water Level (ft from top of PVC)	Temperature (°C)	pH (S.U.)	Specific Conductance (umhos/cm)	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	Turbidity (N.T.U.)
R7GW04R 03/02/02	1315	12.30						
	1323	14.10	31.1	6.70	54,200		-91.0	684
	1330	15.52	32.3	6.76	53,700		-92.5	727
	1337	16.40	32.2	6.71	53,600		-85.4	553
	1344	17.56	31.7	6.72	54,100		-80.4	241
	1350	18.02	31.5	6.73	55,100		-73.7	227
	1357	18.49	32.3	6.72	56,500	2.0	-70.1	312
R7GW01R 03/02/02	1530	7.22						
	1536	7.27	29.2	6.96	2,463		-131.7	91.9
	1542	7.28	29.3	6.97	2,406		-122.1	62.6
	1549	7.27	28.8	6.97	2,296		-137.1	17.6
	1558	7.29	28.6	7.03	2,235		-142.7	5.13
	1607	7.27	28.6	7.01	2,227		-179.6	2.29
	1614	7.28	28.4	7.02	2,208		-181.8	2.06
1621	7.28	28.6	7.03	2,221	0.2	-187.2	2.08	
R7GW09 03/03/02	1233	9.74						
	1242	9.78	30.2	7.09	47,300		-302.0	23.3
	1250	9.78	30.4	7.01	46,100		-285.9	33.4
	1258	9.77	30.0	6.99	49,500		-288.7	17.6
	1305	9.78	30.2	7.02	48,900		-281.2	4.58
	1311	9.78	30.3	6.99	49,600		-288.5	3.14
	1320	9.79	29.6	7.02	54,000		-313.5	2.33
	1335	9.79	30.5	7.03	48,700		-294.0	0.83
	1341	9.80	30.2	7.01	47,600		-292.6	0.85
1348	9.80	29.9	6.99	50,900	0.3	-279.0	0.47	
R7GW10 03/03/02	1512	13.60						
	1518	13.68	29.8	7.04	4,357		-105.8	13.0
	1524	13.68	29.6	7.03	4,093		-105.4	9.41
	1530	13.68	29.8	7.01	4,001		-104.8	9.14
	1536	13.68	29.6	7.03	3,788		-102.0	7.52
	1542	13.68	29.5	7.01	3,629		-98.9	5.80
	1348	13.68	29.5	7.01	3,532		-100.4	3.66
	1355	13.67	29.8	7.02	3,455		-97.8	3.08
1602	13.67	29.6	7.01	3,435	0.6	-98.5	2.64	

**TABLE 4-1**

**SUMMARY OF GROUNDWATER FIELD PARAMETERS  
SWMU 3 - BASE LANDFILL  
MARCH 2002 RCRA FACILITY INVESTIGATION  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Well ID/ Sample Date	Time Interval	Static Water Level (ft from top of PVC)	Temperature (°C)	pH (S.U.)	Specific Conductance (umhos/cm)	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	Turbidity (N.T.U.)
R7GW02R 03/05/02	0929	5.41						
	0935	5.75	28.3	6.91	46,000		-336.6	Over-Range
	0944	5.73	28.2	6.90	55,100		-307.7	368
	0950	5.69	28.2	6.93	48,100		-294.5	217
	0956	5.72	28.1	7.02	25,600		-277.3	38.0
	1003	5.72	28.1	7.07	22,500		-257.2	9.80
	1057	5.72	29.1	7.05	22,500		-236.9	37.8
	1115	5.70	28.7	7.05	18,870		-231.4	9.43
	1122	5.72	28.3	7.01	17,830		-230.6	7.45
	1128	5.64	28.2	7.01	17,860		-229.9	18.8
1134	5.74	28.0	6.99	17,510	0.4	-227.4	17.2	

Notes:

PVC - Polyvinyl chloride.

°C - Degrees Celsius.

S.U. - Standard Unit.

umhos/cm - micro ohms per centimeter.

mg/L - milligrams per liter.

mV - millivolts.

N.T.U. - Nephelometric Turbidity Units.

NA - Not Available.

**TABLE 4-2**

**SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM  
SWMU 3 - BASE LANDFILL  
MARCH 2002 RCRA FACILITY INVESTIGATION  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Sample Media	Sample Designation	Sample Date	Analysis Requested											Comments
			App IX VOCs	App IX SVOCs	App IX Pest/PCBs	App IX OP-Pest	App IX Chlor Herbs	App IX Dioxins/Furans	Cyanide/Sulfide	Asbestos	Explosives	App IX Total Metals	App. IX Diss Metals	
Groundwater	R7GW01R	03/02/02	X	X	X	X	X	X	X	X	X	X	X	
	R7GW02R	03/05/02	X	X	X	X	X	X	X	X	X	X	X	
	R7GW02RD	03/05/02	X	X	X	X	X	X	X	X	X	X	X	Duplicate
	R7GW02RMS	03/05/02	X	X	X	X	X	X	X		X	X	X	Matrix Spike
	R7GW02RMSD	03/05/02	X	X	X	X	X	X	X		X	X	X	Matrix Spike Duplicate
	R7GW04R	03/02/02	X	X	X	X	X	X	X	X	X	X	X	
	R7GW05R	03/02/02	X	X	X	X	X	X	X	X	X	X	X	
	R7GW07R	02/28/02	X	X	X	X	X	X	X	X	X	X	X	
	R7GW08R	02/28/02	X	X	X	X	X	X	X	X	X	X	X	
	R7GW09	03/03/02	X	X	X	X	X	X	X	X	X	X	X	
	R7GW10	03/03/02	X	X	X	X	X	X	X	X	X	X	X	
	R7GW11	02/28/02	X	X	X	X	X	X	X	X	X	X	X	

TABLE 4-3

**METHOD PERFORMANCE LIMITS  
APPENDIX IX COMPOUND LIST AND CONTRACT  
REQUIRED QUANTITATION LIMITS (CRQL)**

Volatiles	Quantitation Limits*		Method Number
	Water (mg/L)	Low Soil (mg/kg)	
Acetone	50	50	8260
Acetonitrile	200	200	8260
Acrolein	100	100	8260
Acrylonitrile	100	100	8260
Benzene	5.0	5.0	8260
Bromodichloromethane	5.0	5.0	8260
Bromoform	5.0	5.0	8260
Bromomethane	10	10	8260
Carbon Disulfide	5.0	5.0	8260
Carbon Tetrachloride	5.0	5.0	8260
Chlorobenzene	5.0	5.0	8260
Chloroethane	10	10	8260
Chloroform	5.0	5.0	8260
Chloromethane	10	10	8260
Chloroprene	5.0	3.0	8260
3-Chloro-1-propene	5.0	5.0	8260
1,2-Dibromo-3-chloropropane	5.0	10	8260
Dibromochloromethane	5.0	5.0	8260
1,2-Dibromoethane	5.0	5.0	8260
Dibromomethane	5.0	5.0	8260
trans-1,4-Dichloro-2-butene	10	10	8260
Dichlorodifluoromethane	10	5.0	8260
Dibromomethane	5.0	5.0	8260
1,1-Dichloroethane	5.0	5.0	8260
1,2-Dichloroethane	5.0	5.0	8260
trans-1,2-dichloroethene	5.0	5.0	8260
1,1-Dichloroethene	5.0	5.0	8260
Methylene Chloride	5.0	5.0	8260
1,2-Dichloropropane	5.0	5.0	8260
cis-1,3-Dichloropropene	5.0	5.0	8260
trans-1,3-Dichloropropene	5.0	5.0	8260
Ethyl benzene	5.0	5.0	8260
Ethyl methacrylate	5.0	5.0	8260
2-Hexanone	25	25	8260
Iodomethane	5.0	5.0	8260
Isobutanol	200	200	8260
Methacrylonitrile	100	100	8260
2-Butanone	25	25	8260
Methyl methacrylate	5.0	5.0	8260
4-Methyl-2-pentanone	25	25	8260

**TABLE 4-3**

**METHOD PERFORMANCE LIMITS  
APPENDIX IX COMPOUND LIST AND CONTRACT  
REQUIRED QUANTITATION LIMITS (CRQL)**

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

\* 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.

TABLE 4-3

**METHOD PERFORMANCE LIMITS  
APPENDIX IX COMPOUND LIST AND CONTRACT  
REQUIRED QUANTITATION LIMITS (CRQL)**

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

TABLE 4-3

**METHOD PERFORMANCE LIMITS  
APPENDIX IX COMPOUND LIST AND CONTRACT  
REQUIRED QUANTITATION LIMITS (CRQL)**

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

TABLE 4-3

**METHOD PERFORMANCE LIMITS  
APPENDIX IX COMPOUND LIST AND CONTRACT  
REQUIRED QUANTITATION LIMITS (CRQL)**

Semivolatiles (Cont.)	Quantitation Limits*		Method Number
	Water (mg/L)	Low Soil (mg/kg)	
n-Nitrosodiethylamine	10	330	8270
n-Nitrosodimethylamine	10	330	8270
n-Nitrosodiphenylamine	NA	330	8270
n-Nitrosodi-n-propylamine	10	330	8270
n-Nitrosomethylethylamine	10	330	8270
n-Nitrosomorpholine	10	330	8270
n-Nitrosopiperidine	10	330	8270
n-Nitrosopyrrolidine	10	330	8270
5-Nitro-o-toluidine	10	330	8270
bis-(2-chloroisopropyl)ether	10	330	8270
Pentachlorobenzene	10	330	8270
Pentachloronitrobenzene	10	330	8270
Pentachlorophenol	50	1,700	8270
Phenacetin	10	330	8270
Phenanthrene	10	330	8270
Phenol	10	330	8270
1,4-Phenylenediamine	2,000	1,700	8270
2-Picolin	10	330	8270
Pronamide	10	330	8270
Pyrene	10	330	8270
Pyridine	50	330	8270
Safrole	10	330	8270
1,2,4,5-Tetrachlorobenzene	10	330	8270
2,3,4,6-Tetrachlorophenol	10	330	8270
o-Toluidine	10	330	8270
1,2,4-Trichlorobenzene	10	330	8270
2,4,5-Trichlorophenol	10	330	8270
2,4,6-Trichlorophenol	10	330	8270
1,3,5-Trinitrobenzene	10	330	8270

\* 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.

NA - Not Available

TABLE 4-3

**METHOD PERFORMANCE LIMITS  
APPENDIX IX COMPOUND LIST AND CONTRACT  
REQUIRED QUANTITATION LIMITS (CRQL)**

Pesticides/PCBs	Quantitation Limits*		Method Number
	Water (mg/L)	Low Soil (mg/kg)	
Aldrin	0.05	1.7	8081
Alpha-BHC	0.05	1.7	8081
beta-BHC	0.05	1.7	8081
delta-BHC	0.05	1.7	8081
gamma-BHC	0.05	1.7	8081
Chlordane	0.5	17	8081
Chlorobenzilate	0.5	17	8081
4,4'-DDT	0.1	3.3	8081
4,4'-DDE	0.1	3.3	8081
4,4'-DDD	0.1	3.3	8081
Dieldrin	0.1	3.3	8081
Endosulfan I	0.05	1.7	8081
Endosulfan II	0.1	3.3	8081
Endosulfan sulfate	0.1	3.3	8081
Endrin	0.1	3.3	8081
Isodrin	0.05	3.3	8081
Kepone	1.0	170	8081
Toxaphene	5.0	170	8081
Endrin Aldehyde	0.1	3.3	8081
Heptachlor	0.05	1.7	8081
Heptachlor epoxide	0.05	1.7	8081
Methoxychlor	0.5	17	8081
Aroclor-1016	1.0	33	8082
Aroclor-1221	2.0	67	8082
Aroclor-1232	1.0	33	8082
Aroclor-1242	1.0	33	8082
Aroclor-1248	1.0	33	8082
Aroclor-1254	1.0	33	8082
Aroclor-1260	1.0	33	8082

\* 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.

**TABLE 4-3**

**METHOD PERFORMANCE LIMITS  
APPENDIX IX COMPOUND LIST AND CONTRACT  
REQUIRED QUANTITATION LIMITS (CRQL)**

OP-Pesticides	Quantitation Limits*		Method Number
	Water (mg/L)	Low Soil (mg/kg)	
Dimethoate	10	330	8270
Disulfoton	NA	330	8270
Famphur	10	330	8270
Methyl parathion	10	330	8270
o,o,o-Triethylphosphorothioate	10	330	8270
Parathion	10	330	8270
Phorate	10	330	8270
Sulfotepp	10	330	8270
Thionazin	10	330	8270

\* 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.

NA - Not Available

**TABLE 4-3**

**METHOD PERFORMANCE LIMITS  
APPENDIX IX COMPOUND LIST AND CONTRACT  
REQUIRED QUANTITATION LIMITS (CRQL)**

<b>Dioxins/Furans (SW-846 Method 8280)</b>	<b>Quantitation Limits*</b>		<b>Method Number</b>
	<b>Water (mg/L)</b>	<b>Low Soil (mg/kg)</b>	
2,3,7,8-TCDD	0.005	0.50	8280
2,3,7,8-PCDF	0.005	0.50	8280
2,3,7,8-PCDD	0.005	0.50	8280
2,3,7,8-HCDF	0.005	0.50	8280
2,3,7,8-HCDD	0.005	0.50	8280
2,3,7,8-TCDF	0.005	0.50	8280

\* 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.

**TABLE 4-3**

**METHOD PERFORMANCE LIMITS  
APPENDIX IX COMPOUND LIST AND CONTRACT  
REQUIRED QUANTITATION LIMITS (CRQL)**

<b>Chlorinated Herbicides</b>	<b>Quantitation Limits*</b>		<b>Method Number</b>
	<b>Water (mg/L)</b>	<b>Low Soil (mg/kg)</b>	
2,4-D	0.50	8.3	8151
2,4,5-T	0.50	8.3	8151
2,4,5-TP	0.50	8.3	8151

\* 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.

TABLE 4-3

**METHOD PERFORMANCE LIMITS  
APPENDIX IX COMPOUND LIST AND CONTRACT  
REQUIRED QUANTITATION LIMITS (CRQL)**

Inorganics	Method Number	Quantitation Limits*		Method Description
		Water (mg/L)	Low Soil (mg/kg)	
Antimony	6010	20	2.0	Inductively Coupled Plasma
Arsenic	6010	10	1.0	Inductively Coupled Plasma
Barium	6010	10	1.0	Inductively Coupled Plasma
Beryllium	6010	4.0	0.4	Inductively Coupled Plasma
Cadmium	6010	5.0	0.5	Inductively Coupled Plasma
Chromium	6010	10	1.0	Inductively Coupled Plasma
Cobalt	6010	10	1.0	Inductively Coupled Plasma
Copper	6010	20	2.0	Inductively Coupled Plasma
Lead	6010	5.0	0.5	Inductively Coupled Plasma
Mercury	7470/7471	0.2	0.02	Cold Vapor AA
Nickel	6010	40	4.0	Inductively Coupled Plasma
Selenium	6010	10	1.0	Inductively Coupled Plasma
Silver	6010	10	1.0	Inductively Coupled Plasma
Thallium	6010	10	1.0	Inductively Coupled Plasma
Tin	6010	10	5.0	Inductively Coupled Plasma
Vanadium	6010	10	1.0	Inductively Coupled Plasma
Cyanide	9012	0.010	1.0	Colorimetric
Sulfide	9030	1.0	25	Titrimetric, Iodine
Zinc	6010	20	2.0	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.

**TABLE 4-4**

**SUMMARY OF SOIL BORING AND WELL CONSTRUCTION DETAILS  
 SWMU 3 - BASE LANDFILL  
 RCRA FACILITY INVESTIGATION  
 NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Location Type	Monitor Well No.	Date Installed	Top of PVC Casing Elevation (ft msl)	Ground Surface Elevation (feet above msl)	Boring Depth (ft bgs)	Well Depth (ft bgs)	Screen Interval Depth (ft bgs)	Sand Pack Interval (ft bgs)	Bentonite Interval (ft bgs)	Stick-Up (ft bgs)
Monitor Well	R7GW01R	12/18/00	108.90	107.05	14.0	14.0	4.0-14.0	2.0-14.0	0.0-2.0	1.85
	R7GW02R	12/18/00	105.11	102.45	14.0	14.0	4.0-14.0	2.0-14.0	0.0-2.0	2.66
	R7GW04R	12/19/00	112.39	110.55	35.0	30.0	20.0-30.0	18.0-30.0	16.0-18.0	1.84
	R7GW05R	12/16/00	113.73	111.60	25.0	22.0	12.0-22.0	10.0-22.0	4.0-10.0	2.13
	R7GW07R	12/14/00	114.94	112.63	18.0	18.0	8.0-18.0	6.0-18.0	4.0-6.0	2.31
	R7GW08R	01/18/01	111.33	108.90	18.0	18.0	8.0-18.0	6.0-18.0	4.0-6.0	2.43
	R7GW09	06/09/98	109.69	108.09	20.0	20.3	9.7-20.3	4.7-20.0	3.0-4.7	1.60
	R7GW10	06/09/98	113.96	111.97	21.0	21.0	10.2-21.0	5.2-21.0	3.0-5.2	1.99
	R7GW11	06/10/98	110.20	110.41	20.0	15.4	4.8-15.4	4.0-20.0	2.0-4.0	-0.21

**Notes:**

ft - feet.

bgs - below ground surface.

msl - mean sea level + 100 ft.

**TABLE 4-5**

**SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM  
SWMU 3 - BASE LANDFILL  
1995 AND 1997 RCRA FACILITY INVESTIGATION  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Sample Media	Sample Designation	Sample Date	Sample Depth (ft bgs)	Analysis Requested											Comments	
				App IX VOCs	App IX SVOCs	App IX Pest/PCBs	App IX Chlor. Herbs	App IX Dioxins/Furans	TOC	Explosives	App IX Total Metals	Sulfide	% Solids	Asbestos		
Sediment	3SD01	10/29/95	0.0 - 1.0	X	X	X	X	X	X	X	X	X	X	X		
	3SD02	10/29/95	0.0 - 1.0	X	X	X	X	X	X	X	X	X	X	X		
	3SD03	10/29/95	0.0 - 1.0	X	X	X	X	X	X	X	X	X	X	X		
	3SD04	10/27/95	0.0 - 1.0	X	X	X	X	X	X	X	X	X	X	X		
	3SD05	10/27/95	0.0 - 1.0	X	X	X	X	X	X	X	X	X	X	X		
	3SD06	10/27/95	0.0 - 1.0	X	X	X	X	X	X	X	X	X	X	X		
	3SD07	10/27/95	0.0 - 1.0	X	X	X	X	X	X	X	X	X	X	X		
	3SD08	10/28/95	0.0 - 1.0	X	X	X	X	X	X	X	X	X	X	X		
	3SD09	10/28/95	0.0 - 1.0	X	X	X	X	X	X	X	X	X	X	X		
	3SD10	10/27/95	0.0 - 1.0	X	X	X	X	X	X	X	X	X	X	X		
	3SD11	10/28/95	0.0 - 1.0	X	X	X	X	X	X	X	X	X	X	X		
	3SD12	10/28/95	0.0 - 1.0	X	X	X	X	X	X	X	X	X	X	X		
	3SD13	10/28/95	0.0 - 1.0	X	X	X	X	X	X	X	X	X	X	X		
	3SD14	10/28/95	0.0 - 1.0	X	X	X	X	X	X	X	X	X	X	X		
	3SD15	10/28/95	0.0 - 1.0	X	X	X	X	X	X	X	X	X	X	X		
	3SD16	09/19/97	0.0 - 3.0	X	X	X	X	X	X	X	X	X			X	
	3SD17	09/19/97	0.0 - 3.0	X	X	X	X	X	X	X	X	X			X	

**Note:**

ft bgs - feet below ground surface.

**TABLE 4-6**

**SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM  
QA/QC SAMPLE MATRIX - SWMU 3  
MARCH 2002 RCRA FACILITY INVESTIGATION  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Sample ID	Sample Date	Analysis Requested											Comments	
		App IX VOCS	App IX SVOCs	App IX Pest/PCBs	App IX OP-Pest	App IX Chlor Herbs	App IX Dioxins/Furans	Cyanide/Sulfide	Asbestos	Explosives	App IX Total Metals	App. IX Diss Metals		
<b>TRIP BLANKS</b>														
3TB01	03/01/02	X												Trip Blank
3TB02	03/04/02	X												Trip Blank
3TB03	03/05/02	X												Trip Blank
3TB04	03/06/02	X												Trip Blank
<b>EQUIPMENT RINSATES</b>														
3ER01	03/06/02	X	X	X	X	X	X	X	X	X	X	X	X	(1)
<b>FIELD BLANKS</b>														
3FB01	03/06/02	X	X	X	X	X	X	X	X	X	X	X	X	(2)

**Notes:**

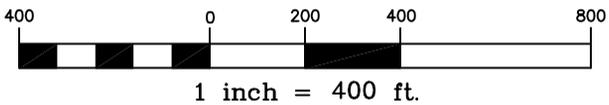
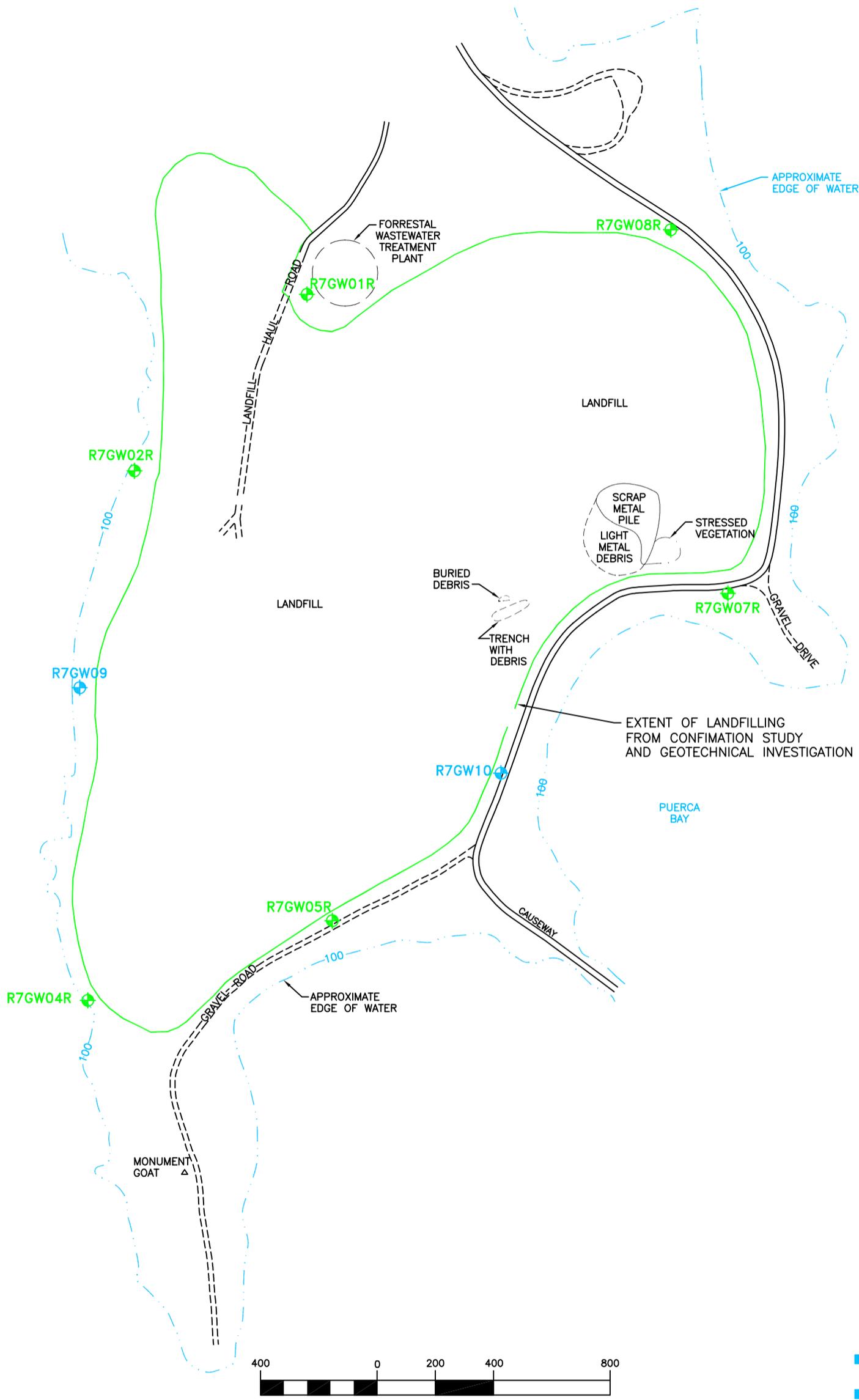
(1) - Silicon Tubing.

(2) - Lab grade deionized water.

**SECTION 4.0**  
**FIGURES**

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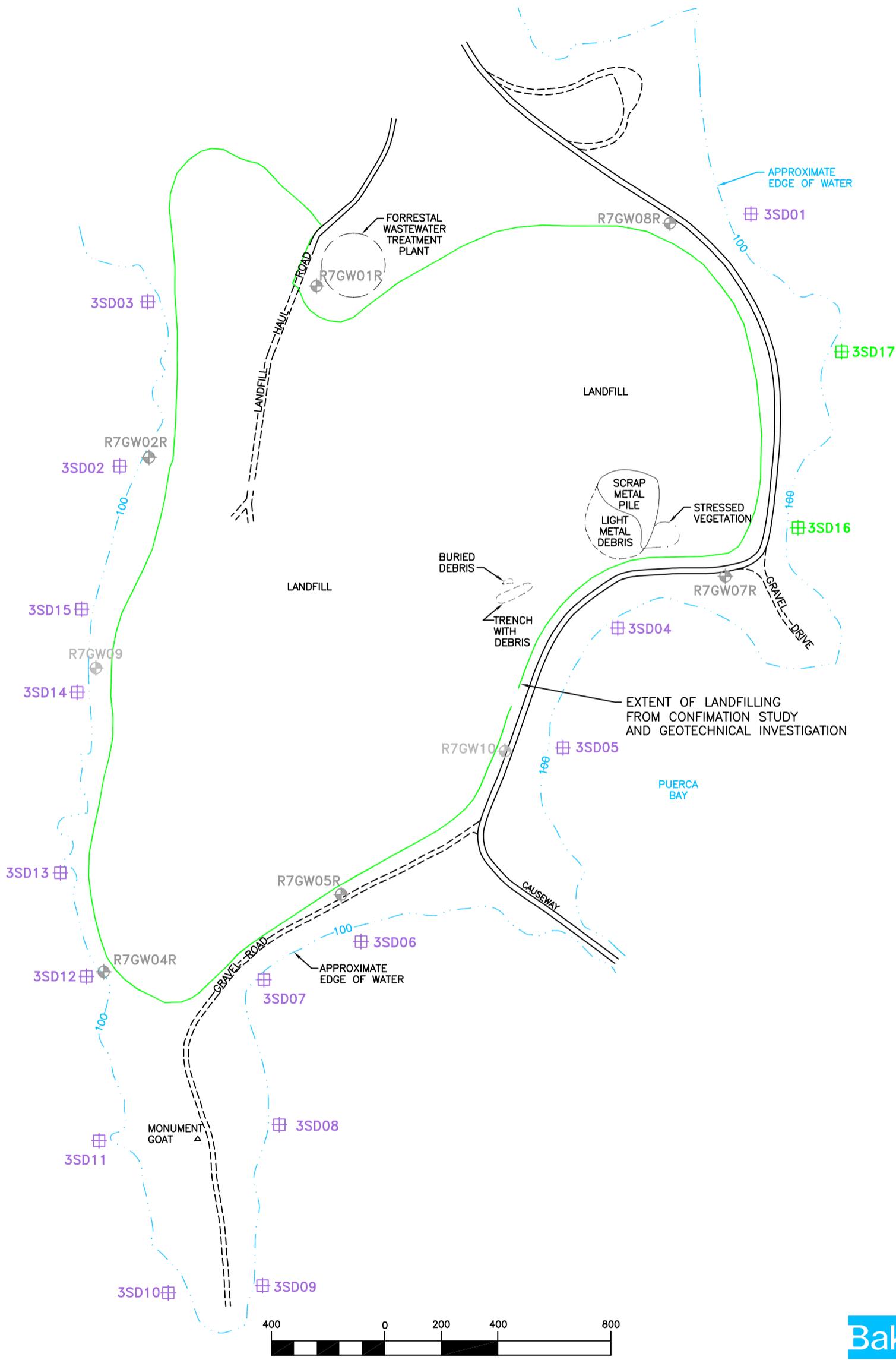
1 inch = 400 ft.



**LEGEND**

-  MONITOR WELL LOCATION (INSTALLED JUNE 1998, BURNS AND McDONNELL)
-  MONITOR WELL LOCATION (INSTALLED DECEMBER 2000, BAKER)

**FIGURE 4-1**  
**GROUNDWATER SAMPLE LOCATIONS**  
 DRAFT RFI REPORT  
 SWMU 3 - BASE LANDFILL  
 MARCH 2002 RCRA FACILITY INVESTIGATION  
 NAVAL STATION ROOSEVELT ROADS  
 PUERTO RICO



**LEGEND**

- SEDIMENT SAMPLE LOCATION (1995 RCRA FACILITY INVESTIGATION)
- SEDIMENT SAMPLE LOCATION (1997 RCRA FACILITY INVESTIGATION)
- MONITOR WELL LOCATION (INSTALLED JUNE 1998, BURNS AND McDONNELL)
- MONITOR WELL LOCATION (INSTALLED DECEMBER 2000, BAKER)

**FIGURE 4-2**  
**SEDIMENT SAMPLE LOCATIONS**  
**DRAFT RFI REPORT**  
**SWMU 3 – BASE LANDFILL**  
**1995 AND 1997 RCRA FACILITY INVESTIGATIONS**  
**NAVAL STATION ROOSEVELT ROADS**  
**PUERTO RICO**

## **5.0 NATURE AND EXTENT OF CONTAMINATION**

This section presents an overview of chemical analytical results obtained from samples collected during the RFI, as well as the four rounds of groundwater samples collected under the RCRA Subtitle D monitoring program. The objective of this section is to characterize the nature and delineate the extent of potential contamination at SWMU 3. The data obtained for the Base Landfill was through the sample collection and analysis of groundwater and sediment. The analytical results for environmental and QA/QC samples are also presented in this section.

Organic and inorganic compounds detected in the groundwater samples were compared with their respective tap water risk based concentrations (RBCs), Federal Maximum Contaminant Levels (MCLs), and surface water screening values for NSRR. The sediment analytical results were compared to sediment screening values established for NSRR. The surface water and sediment screening values are those that have been developed by Baker to be utilized for Ecological Risk Assessments at NSRR. These values have been reviewed and approved by the EPA.

Appendix B provides the chain-of-custody records for samples collected at SWMU 3. Appendix C provides analytical results for all the media collected during the RCRA Facility Investigations, as well as during the RCRA Subtitle D groundwater monitoring. Appendix D presents the geophysical survey performed by Forrest Environmental Services, Inc. Appendix E provides the analytical results for the QA/QC samples collected during this RFI investigation. Appendix F provides data validation report narratives and Appendix G provides field notes taken during the investigation.

### **5.1 Groundwater**

Sampling activities for groundwater were conducted at SWMU 3 during five separate field investigations including March 2002, August 2000, May 2000, February 2000, and June 1998. Results for each of the investigations mentioned above will be discussed in the following sections.

### 5.1.1 March 2002

Groundwater samples collected during the most recent field investigation were analyzed for Appendix IX VOCs, SVOCs, pesticides/PCBs, OP-pesticides, dioxins/furans, chlorinated herbicides, cyanide, sulfide, asbestos, explosives, total metals, and dissolved metals. A total of ten samples, including one duplicate, were collected during this investigation. Analytical results (see Appendix C) of the samples concluded the following:

- Three VOCs were detected in the groundwater samples, which were isolated to five of the nine-groundwater monitor wells (R7GW01R, R7GW04R, R7GW07R, R7GW08R, and R7GW11). Chloroform was the only constituent detected at a concentration exceeding the tap water RBC in sample R7GW11 as presented in Table 5-1. It should be noted that a Federal MCL has not been established for acetone and chloroform.
- Seven SVOCs were detected in the groundwater samples and were isolated to two of the monitor wells at the Base Landfill (R7GW01R and R7GW02R). Three SVOCs were detected at concentrations exceeding the tap water RBCs in sample R7GW01R and one SVOC in R7GW02R. Of those detections, benzo(a)pyrene also exceeded the Federal MCLs in sample R7GW01R. It should be noted that a Federal MCL has not been established for 1,4-dioxane, benzo(b)fluoranthene, benzo(g,h,i)perylene, diethylphthalate, indeno(1,2,3-cd)pyrene, and isophorone.
- Beta-BHC was the only pesticides that was detected in the groundwater samples and was only detected in one of the nine samples (R7GW05R). There were no exceedances of any listed criteria. It should be noted that a Federal MCL and a marine surface water screening value have not been established for beta-BHC.
- There were no positive detections of PCBs, OP-pesticides, dioxins/furans, or explosives.
- 2,4,5-TP (Silvex) was the only chlorinated herbicide that was detected in the groundwater samples collected and only from one of the samples (R7GW09). There were no exceedances of any listed criteria. It should be noted that a marine surface water screening value has not been established for 2,4,5-TP (Silvex).

- Sulfide was the only miscellaneous parameter detected in four of the nine the groundwater samples. It should be noted that a Federal MCL, tap water RBC, and a marine surface water screening value have not been established for sulfide.
- Fourteen total inorganic compounds were detected in the groundwater samples as presented in Table 5-2. Arsenic and thallium were both detected at concentrations exceeding the Federal MCL, while arsenic, barium, thallium, and vanadium exceeded the tap water RBC. It should be noted that there are no Federal MCLs for total inorganic constituents cobalt, nickel, tin, vanadium, and zinc, as well as there is no tap water RBC values for lead and mercury. Copper, nickel, thallium, and zinc were detected at concentrations exceeding the marine surface water screening values used to determine if an ecological risk is present.

Maximum detected concentrations for four metals (copper, nickel, thallium, and zinc) exceeded surface water screening values (see Table 5-2). Consistent with the Chief of Naval Operations (CNO) policy for conducting ecological risk assessments (CNO 1999), the significance of these exceedances were evaluated by taking into consideration the following factors:

- Comparison of average groundwater concentrations (one-half non-detects) to surface water screening values
- Background groundwater concentrations
- Dilution effects

Average concentrations are appropriate for evaluating impacts to populations of lower trophic level receptors (i.e., fish, aquatic plants, and aquatic invertebrates). Because some of these receptors are relatively immobile, individuals are likely to be impacted by locations of maximum concentrations. However, evaluation of the average exposure case is more indicative of the level of impact that might be expected at the population level. The comparison of maximum groundwater concentrations to surface water screening values did not take into consideration dilution effects that would occur upon discharge of groundwater to surface water. Dilution was considered by assuming a dilution factor of 10 (Buchman 1999),

a factor that is likely to be very conservative given the nature of the marine environment surrounding SWMU 3 (large size, wave/tidal action).

In the case of nickel, the mean groundwater concentration exceeded the maximum concentration. This is due to high detection limits reported for this metal by the analytical laboratory for non-detected results. For conservatism, the mean concentration was used to evaluate this metal.

### Copper

The mean copper concentration in site groundwater [0.0164 milligrams per liter (mg/L)] is greater than the surface water screening value (0.0037 mg/L). However, background data indicate that copper is not likely to present a risk to aquatic receptors above background levels. The maximum and mean background concentrations for copper (0.352 mg/L and 0.149.5 mg/L) exceed the maximum and average site concentrations for this metal (0.056 mg/L and 0.0164 mg/L, respectively). Furthermore, when a dilution factor of 10 (Buchman 1999) is applied to the average copper concentration, the average groundwater concentration becomes 0.00164 mg/L. This value is less than the surface water screening value (0.0037 mg/L). Based on a comparison of maximum and mean site concentrations to background values and application of a dilution factor of 10 to the mean copper concentration, no further evaluation is recommended for copper in groundwater.

### Nickel

The mean nickel concentration in site groundwater (0.0189 mg/L [Note: the mean nickel concentration exceeds the maximum nickel concentration due to high detection limits reported for non-detected results]) is greater than the surface water screening value (0.0083 mg/L). However, background data indicate that nickel is not likely to present a risk to aquatic receptors above background levels. The maximum and mean background concentrations for nickel (0.0737 mg/L and 0.0449 mg/L, respectively) exceed the maximum and mean site concentrations for this metal (0.009 J mg/L and 0.0189 mg/L, respectively). Furthermore, when a dilution factor of 10 (Buchman 1999) is applied to the average nickel concentration, the average groundwater concentration becomes 0.00189 mg/L. This value is less than the surface water screening value (0.0083 mg/L). Based on a comparison of

maximum and mean site concentrations to background values and application of a dilution factor of 10 to the mean site concentration, no further evaluation is recommended for nickel in groundwater.

### Thallium

The mean concentration for thallium (0.0087 mg/L) is less than the surface water screening value (0.0213 mg/L). Furthermore, when a dilution factor of 10 (Buchman 1999) is applied to the mean thallium concentration, the average concentration becomes 0.00087 mg/L. This value is less than the surface water screening value (0.0213 mg/L). Based on the comparison of the mean thallium site concentration to the surface water screening value and application of a dilution factor of ten to the mean site concentration, no further evaluation is recommended for thallium in groundwater.

### Zinc

The mean concentration for zinc (0.044 mg/L) is less than the surface water screening value (0.0856 mg/L). Background data also indicate that zinc is not likely to present a risk to aquatic receptors above background levels. The maximum and mean background concentration for zinc (0.32 mg/L and 0.1804 mg/L, respectively) exceed the maximum and mean site concentrations for this metal (0.29 mg/L and 0.044 mg/L, respectively). Furthermore, when a dilution factor of 10 (Buchman 1999) is applied to the average zinc concentration, the average concentration becomes 0.0044 mg/L. This value is less than the surface water screening value (0.0037 mg/L). Based on a comparison of the mean zinc concentration to the surface water screening value, the comparison of maximum and mean site concentrations to maximum and mean background concentrations, and application of a dilution factor of 10 to the mean site concentration, no further action is recommended for zinc in groundwater.

- Eleven dissolved inorganic compounds were detected in the groundwater samples as presented in Table 5-3. Thallium was the only compound to exceed any of the listed criteria. The concentrations of thallium ranged from 0.0099J mg/L to 0.027 mg/L, which exceeded the Federal MCL and the Tap Water RBC and was only detected in two of the samples (R7GW04R and R7GW05R).

It should be noted that there are no Federal MCLs for inorganic constituents cobalt, nickel, tin, vanadium, and zinc, as well as there is no tap water RBC values for lead and mercury. There are no marine surface water screening values available for the dissolved inorganic constituent's barium, beryllium, cobalt, thallium, tin, and vanadium.

### **5.1.2 August 2000**

Groundwater samples collected during the August 2000 field investigation were analyzed for Appendix I VOCs and total metals. A total of nine samples were collected during this investigation. Analytical results (see Appendix C) of the samples concluded the following:

- There were no positive detections of VOCs in the groundwater samples collected.
- Seven total inorganic compounds were detected in the groundwater samples as presented in Table 5-4. Chromium was detected at concentrations exceeding the tap water RBC in six samples (R7GW01, R7GW02, R7GW05, R7GW08, R7GW09, and R7GW11). Vanadium was detected at concentrations exceeding the tap water RBC in five samples (R7GW01, R7GW07, R7GW08, R7GW10, and R7GW11).

It should be noted that there are no Federal MCLs for inorganic constituent's cobalt, silver, vanadium, and zinc.

### **5.1.3 May 2000**

Groundwater samples collected during the May 2000 field investigation were analyzed for Appendix I VOCs and total metals. A total of nine samples were collected during this investigation. Analytical results (see Appendix C) of the samples concluded the following:

- There were no positive detections of VOCs in the groundwater samples collected.
- Seven total inorganic compounds were detected in the groundwater samples as presented in Table 5-5. Chromium was the only constituent detected which exceeded its Federal MCL.

Five constituents detected exceeded their tap water RBCs, including barium, chromium, cobalt, copper, and vanadium.

It should be noted that there are no Federal MCLs for inorganic constituent's cobalt, nickel, and vanadium, as well as there is no tap water RBC value for lead.

#### **5.1.4 February 2000**

Groundwater samples collected during the February 2000 field investigation were analyzed for Appendix I VOCs and total metals. A total of nine samples were collected during this investigation. Analytical results (see Appendix C) of the samples concluded the following:

- There were no positive detections of VOCs in the groundwater samples collected.
- Four total inorganic compounds were detected in the groundwater samples as presented in Table 5-6. Three of the four detected constituents exceeded their tap water RBCs including chromium, vanadium, and zinc.

It should be noted that there are no Federal MCLs for inorganic constituent's vanadium and zinc.

#### **5.1.5 June 1998**

Groundwater samples collected during the 1998 field investigation were analyzed for Appendix IX VOCs, SVOCs, pesticides/PCBs, OP-pesticides, dioxins/furans, chlorinated herbicides, sulfide, asbestos, explosives, and total metals. A total of ten samples including one duplicate were collected during this investigation. Analytical results (see Appendix C) of the samples concluded the following:

- Six VOCs were detected in the groundwater samples, which were isolated to three of the nine-groundwater monitor wells (R7GW04, R7GW05, and R7GW11). Vinyl chloride was the only constituent detected which exceeded its tap water RBC as presented in Table 5-7. It should be noted that a Federal MCL has not been established for 1,1-dichloroethane, acetone, and chloromethane.

- Two SVOCs were detected in the groundwater samples and were isolated to two of the monitor wells at the Base Landfill (R7GW02 and R7GW08). 1,4-dioxane was the only constituent of the two detected, which exceeded its tap water RBC value in one of the samples. It should be noted that a Federal MCL has not been established for 1,4-dioxane.
- There were no positive detections of pesticides/PCBs, OP-pesticides, chlorinated herbicides, dioxins/furans, or explosives.
- Sulfide was the only miscellaneous parameter detected in one of the groundwater samples. It should be noted that a Federal MCL and tap water RBC screening value has not been established for sulfide.
- Thirteen total inorganic compounds were detected in the groundwater samples as presented in Table 5-8. Arsenic was the only constituent detected which exceeded the Federal MCL in two samples, while arsenic, barium, chromium, and vanadium exceeded the tap water RBC.

It should be noted that there are no Federal MCLs for inorganic constituents cobalt, nickel, silver, tin, vanadium, and zinc, as well as there is no tap water RBC values for lead.

## 5.2 Sediment

A total of 17 sediment samples were collected around the Base Landfill during two RCRA facility investigations as presented on Figure 4-2. Two sediment samples located on the eastern side of the Base Landfill were collected during the 1997 RCRA Facility Investigation because the shoreline was being extended at these locations in the area related to construction activities at the CPO Hut during the sampling event in October 1995. This filling covered these sediments such that a representative sample could not be obtained (Baker, 1998a). The sediment samples collected during the 1995 RCRA Facility Investigation were analyzed for the Appendix IX VOCs, SVOCs, pesticide/PCBs, chlorinated herbicides, dioxins/furans, explosives, TOC, sulfide, % solids, and metals. The sediment samples collected during the 1997 RCRA Facility Investigation were analyzed for the Appendix IX VOCs, SVOCs, pesticide/PCBs, chlorinated herbicides, dioxins/furans, explosives, TOC, asbestos, and metals as presented in Table 4-5. The sediment analytical results for the two field investigations will be discussed in the following sections.

Analytical results (see Appendix C) of the samples concluded the following:

- Acetone was the only VOC detected in any of the sediment samples collected with a concentration ranging from 26 micrograms per kilogram ( $\mu\text{g}/\text{kg}$ ) in sample 3SD13 to 93  $\mu\text{g}/\text{kg}$  in sample 3SD12 as presented in Table 5-9.
- Three SVOCs were detected in the sediment samples collected, including benzoic acid, bis(2-ethylhexyl) phthalate, and phenol.
- There were no positive detections of pesticides/PCBs, chlorinated herbicides, or explosives.
- Total HxCDD was the only dioxin/furan detected in one of the sediment samples, with a concentration of 1J  $\mu\text{g}/\text{kg}$  in sample 3SD15.
- Three miscellaneous parameters were detected in the sediment samples collected including total organic carbon, sulfide, and % solids.
- Fourteen inorganic compounds were detected in the sediment samples as presented in Table 5-10.

The sediments from SWMU 3, along with other sediments from NSRR, were grouped together in a single database that represents AOC D (SWMUs 1, 2, 3, and 7). These sediments were grouped this way in accordance to the Final RCRA/HSWA Permit No. PR2170027203 dated October 20, 1994 (USEPA, 1994). According to this permit, AOC D consists of the marine sediments impacted by the base's outfalls, the base's 3 large littoral landfills, recurring major oil spills, probable submarine discharge of contaminated groundwater from the Tow Way Fuel Farm area, and past waste disposal practices, which included routine disposal of hazardous wastes and/or constituents into storm-water drains (USEPA, 1994).

During the Phase I Health and Environmental Assessment (HEA), potentially unacceptable risks were estimated for recreational users and future residents who may be dermally exposed to sediments in AOC D. In addition, the ecological risk assessment conducted in the HEA indicated that a slight potential for risk to the aquatic environment exists in the SWMUs that were evaluated in AOC D. However, as per the Navy's November 24, 1998 response to EPA comment

letter dated September 15, 1998, the primary risks indicated in the above mentioned HEA included the sediments from the end of the cooling water tunnel at Puerca Bay (SMWU 11/45), as well as the sediments associated with SWMU 2. After further review, the samples from SWMU 11/45 should not have been included in the HEA since they are not apart of the Ensenada Honda sediments. The sediment samples collected at SWMU 2 are near shore sediments, likely to have been impacted by erosion of the SWMU 2 soil. Therefore, it was Navy's technical opinion, mentioned in the September 15, 1998 response to comment letter, that these near shore sediment samples be addressed along with SWMU 2 during the CMS stage for this site. Therefore, the Navy removed the sediment samples collected at SWMU 11/45 and SWMU 2 from the sediment database for AOC D. The Navy then performed a risk assessment on this new sediment database from AOC D (Baker, 1998b). This new risk assessment indicated that there were no unacceptable risks posed by the AOC D sediments, which includes SWMU 3 sediments. The EPA then submitted a comment letter on February 12, 1999 stating that they will approve the Navy's determination of no unacceptable human health risks from AOC D. This approval is based on the recommendation from the Navy that the sediment data for samples adjacent to SWMU 2 and samples adjoining the old power plant cooling water tunnel be excluded from the data set used in the risk assessment. During the Phase II HEA, the COPC selection process was not applied to the Phase II data. Instead, risks that could be estimated for the Phase II data were qualitatively derived from a comparison between Phase I and Phase II data (Baker, 1998a).

Table 5-11 presents the general magnitude of the detected concentrations from the Phase II investigation were lower than those detected during the Phase I investigation. Therefore, it was concluded that the overall risks derived from the Phase II data were less than those that were estimated in the previous HEA for the Phase I data (Baker, 1998a). Since no additional risks were

shown to exist from the Phase II sampling, a comparison of Phase I and Phase II data was presented instead of an additional risk assessment.

### **5.3 Geophysical Investigation**

The geophysical investigation was successfully implemented. The complete June 1999 preliminary electromagnetic survey of the Base Landfill can be viewed in its entirety in Appendix D.

### **5.4 Quality Assurance/Quality Control Sample Results (March 2002)**

A portion of the QA/QC sampling efforts consisted of equipment rinsate samples, trip blanks, and field blanks. The analytical results from the QA/QC sampling is presented as Appendix E.

#### **5.4.1 Equipment Rinsate Sample**

One equipment rinsate sample (3ER01) was collected during the field activities. Sample 3ER01 was collected while pumping lab grade deionized water through the disposable sample tubing used with the peristaltic pump. This sample was analyzed for Appendix IX VOCs, SVOCs, pesticides/PCBs, OP-pesticides, dioxins/furans, cyanide, sulfide, asbestos, explosives, chlorinated herbicides, total metals, and dissolved metals.

- Two VOCs were detected in the equipment rinsate sample including methyl ethyl ketone and methylene chloride.
- There were no detections of SVOCs, pesticides/PCBs, OP-pesticides, chlorinated herbicides, dioxins/furans, explosives, miscellaneous parameters, and dissolved metals.
- Tin was the only total inorganic compound detected in the equipment rinsate sample.

#### **5.4.2 Trip Blank Samples**

Four trip blanks were collected during the field activities and analyzed for Appendix IX VOCs as presented in Table 5-12.

- Three VOCs were detected in the trip blank samples, including carbon disulfide, methylene chloride, and toluene. There were no exceedances of any of the listed criteria.

### **5.4.3 Field Blank Sample**

One field blank (3FB01) was collected during the investigation and analyzed for Appendix IX VOCs, SVOCs, pesticides/PCBs, OP-pesticides, dioxins/furans, cyanide, sulfide, asbestos, explosives, chlorinated herbicides, total metals, and dissolved metals. The water analyzed included lab grade deionized water.

- Methylene chloride was the only VOC detected in the field blank sample.
- There were no detections of SVOCs, pesticides/PCBs, OP-pesticides, chlorinated herbicides, dioxins/furans, explosives, miscellaneous parameters, total metals, and dissolved metals.

## **5.5 Data Validation**

A detailed and independent data validation was performed by Heartland Environmental Services, Inc. to verify the qualitative and quantitative reliability of the data presented and adherence to stated analytical protocols. This review included a detailed review and interpretation of all the data generated by the laboratory for data quality Level D deliverables. The primary tools that were utilized by the experienced data validation personnel included analytical method operating procedures, Statement of Work for CLP guidance documents, EPA Region II guidelines for data validation, established criteria, and professional judgement.

The data validation reports stated that the overall laboratory performance was acceptable. The overall quality of the data package is acceptable. The reported results are accepted as reported by the laboratory with the noted qualifications. Data validation reports were prepared by the data validator that provided the back-up information accompanying the qualifying statements presented in the QA review. The report narratives can be found in Appendix F.

**SECTION 5.0**  
**TABLES**

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TABLE 5-1

**SUMMARY OF ORGANIC DETECTIONS IN GROUNDWATER  
SWMU 3 - BASE LANDFILL  
MARCH 2002 RCRA FACILITY INVESTIGATION  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Site ID	<b>EPA Region III</b>		<u>Marine</u>	R7GW01R	R7GW02R	R7GW02R	R7GW04R	R7GW05R
Sample ID	<b>Federal</b>	<b>Tap Water</b>	<u>Surface Water</u>	R7GW01R	R7GW02R	R7GW02RD	R7GW04R	R7GW05R
Sample Date	<b>MCL</b>	<b>RBC</b>	<u>Screening Values</u>	03/02/02	03/05/02	03/05/02	03/02/02	03/02/02
	(ug/L)	(ug/L)	(ug/L)					
<b>Volatiles (ug/L)</b>								
Acetone	NE	60.8	1,000	50 UJ	50 U	50 U	12 J	50 UJ
Chloroform	NE	0.15	815	5 U	5 U	5 U	5 U	5 U
Toluene	1,000	74.7	37	1.4 J	5 U	5 U	1.4 J	5 U
<b>Semivolatiles (ug/L)</b>								
1,4-Dioxane	NE	6.1	67,000	10 U	<b>22</b>	<b>38</b>	10 U	10 UJ
Benzo(a)pyrene	0.2	0.092	10	<b>0.5 J</b>	10 U	10 U	10 U	10 UJ
Benzo(b)fluoranthene	NE	0.092	30	<b>0.36 J</b>	10 U	10 U	10 U	10 UJ
Benzo(g,h,i)perylene	NE	NE	30	0.84 J	10 U	10 UJ	10 U	10 UJ
Diethylphthalate	NE	2,900	76	10 U	0.65 J	10 U	10 U	10 UJ
Indeno(1,2,3-cd)pyrene	NE	0.092	30	<b>0.79 J</b>	10 U	10 UJ	10 U	10 UJ
Isophorone	NE	70	129	0.97 J	10 U	10 U	10 U	10 UJ
<b>Pesticides/PCBs (ug/L)</b>								
beta-BHC	NE	3,721	NE	0.05 U	0.05 U	0.05 U	0.05 U	0.015 J
<b>OP-Pesticides (ug/L)</b>								
Not Detected								
<b>Chlorinated Herbicides (ug/L)</b>								
2,4,5-TP (Silvex)	50	29.2	NE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
<b>Dioxins/Furans (ug/L)</b>								
Not Detected								
<b>Explosives (ug/L)</b>								
Not Detected								
<b>Misc. Parameters</b>								
Sulfide (ug/L)	NE	NE	NE	860 J	830 J	1,000 U	1,000 U	4,800
<b>Notes:</b>								
J - Estimated value.	NE - Not Established.			UJ - Reported quantitation limit is				
U - Not detected.	ug/L - micrograms per liter.			qualified as estimate.				

TABLE 5-1

**SUMMARY OF ORGANIC DETECTIONS IN GROUNDWATER  
SWMU 3 - BASE LANDFILL  
MARCH 2002 RCRA FACILITY INVESTIGATION  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Site ID	<b>EPA Region III</b>	<u>Marine</u>	R7GW07R	R7GW08R	R7GW09	R7GW10	R7GW11	
Sample ID	<b>Federal</b>	<b>Tap Water</b>	<u>Surface Water</u>	R7GW07R	R7GW08R	R7GW09	R7GW10	R7GW11
Sample Date	<b>MCL</b>	<b>RBC</b>	<u>Screening Values</u>	02/28/02	02/28/02	03/03/02	03/03/02	02/28/02
	(ug/L)	(ug/L)	(ug/L)					
<b>Volatiles (ug/L)</b>								
Acetone	NE	60.8	1,000	50 U	50 U	50 UJ	50 UJ	50 U
Chloroform	NE	0.15	815	5 U	5 U	5 U	5 U	3 J
Toluene	1,000	74.7	37	0.78 J	1.1 J	5 U	5 U	5 U
<b>Semivolatiles (ug/L)</b>								
1,4-Dioxane	NE	6.1	67,000	10 U	10 U	10 U	10 U	10 U
Benzo(a)pyrene	0.2	0.092	10	10 U	10 U	10 U	10 U	10 U
Benzo(b)fluoranthene	NE	0.092	30	10 U	10 U	10 U	10 U	10 U
Benzo(g,h,i)perylene	NE	NE	30	10 U	10 U	10 U	10 U	10 U
Diethylphthalate	NE	2,900	76	10 U	10 U	10 U	10 U	10 U
Indeno(1,2,3-cd)pyrene	NE	0.092	30	10 U	10 U	10 U	10 U	10 U
Isophorone	NE	70	129	10 U	10 U	10 U	10 U	10 U
<b>Pesticides/PCBs (ug/L)</b>								
beta-BHC	NE	3,721	NE	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
<b>OP-Pesticides (ug/L)</b>								
Not Detected								
<b>Chlorinated Herbicides (ug/L)</b>								
2,4,5-TP (Silvex)	50	29.2	NE	0.5 U	0.5 U	0.1 J	0.5 U	0.5 U
<b>Dioxins/Furans (ug/L)</b>								
Not Detected								
<b>Explosives (ug/L)</b>								
Not Detected								
<b>Misc. Parameters</b>								
Sulfide (ug/L)	NE	NE	NE	1,000 UJ	1,000 UJ	8,800	990 J	1,000 UJ
<b>Notes:</b>								
J - Estimated value.	NE - Not Established.			UJ - Reported quantitation limit is				
U - Not detected.	ug/L - micrograms per liter.			qualified as estimate.				

TABLE 5-1

SUMMARY OF ORGANIC DETECTIONS IN GROUNDWATER  
 SWMU 3 - BASE LANDFILL  
 MARCH 2002 RCRA FACILITY INVESTIGATION  
 NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO

Site ID	EPA Region III		<u>Marine</u>	Number		Range	<u>Number</u>	Range	<u>Number</u>	Range	Location
Sample ID	Federal	Tap Water	<u>Surface Water</u>	Exceeding	Exceeding	Exceeding	Exceeding	Exceeding	Exceeding	Exceeding	Maximum
Sample Date	MCL	RBC	<u>Screening Values</u>	Federal	Federal	EPA Region III	EPA Region III	Marine	Marine	Marine	Detect
	(ug/L)	(ug/L)	(ug/L)	MCL	MCL	Tap Water	Tap Water	Surface Water	Surface Water	Surface Water	
						RBC	RBC	Screening Values	Screening Values	Screening Values	
<b>Volatiles (ug/L)</b>											
Acetone	NE	60.8	1,000	NE		0/10		0/10			R7GW04R
Chloroform	NE	0.15	815	NE		1/10	3J	0/10			R7GW11
Toluene	1,000	74.7	37	0/10		0/10		0/10			R7GW01R\ R7GW04R
<b>Semivolatiles (ug/L)</b>											
1,4-Dioxane	NE	6.1	67,000	NE		2/10	22-38	0/10			R7GW02RD
Benzo(a)pyrene	0.2	0.092	10	1/10	0.5J	1/10	0.5J	0/10			R7GW01R
Benzo(b)fluoranthene	NE	0.092	30	NE		1/10	0.36J	0/10			R7GW01R
Benzo(g,h,i)perylene	NE	NE	30	NE		NE		0/10			R7GW01R
Diethylphthalate	NE	2,900	76	NE		0/10		0/10			R7GW02R
Indeno(1,2,3-cd)pyrene	NE	0.092	30	NE		1/10	0.79J	0/10			R7GW01R
Isophorone	NE	70	129	NE		0/10		0/10			R7GW01R
<b>Pesticides/PCBs (ug/L)</b>											
beta-BHC	NE	3,721	NE	NE		0/10		NE			R7GW05R
<b>OP-Pesticides (ug/L)</b>											
Not Detected											
<b>Chlorinated Herbicides (ug/L)</b>											
2,4,5-TP (Silvex)	50	29.2	NE	0/10		0/10		NE			R7GW09
<b>Dioxins/Furans (ug/L)</b>											
Not Detected											
<b>Explosives (ug/L)</b>											
Not Detected											
<b>Misc. Parameters</b>											
Sulfide (ug/L)	NE	NE	NE	NE		NE		NE			R7GW09
<b>Notes:</b>											
J - Estimated value.	NE - Not Established.			UJ - Reported quantitation limit is							
U - Not detected.	ug/L - micrograms per liter.			qualified as estimate.							

TABLE 5-2

**SUMMARY OF (TOTAL) INORGANIC DETECTIONS IN GROUNDWATER  
SWMU 3 - BASE LANDFILL  
MARCH 2002 RCRA FACILITY INVESTIGATION  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Site ID	EPA Region III	Marine	R7GW01R	R7GW02R	R7GW02R	R7GW04R	R7GW05R	
Sample ID	Federal	Tap Water	Surface Water	R7GW01R	R7GW02R	R7GW02RD	R7GW04R	R7GW05R
Sample Date	MCL	RBC	Screening Values	03/02/02	03/05/02	03/05/02	03/02/02	03/02/02
	(mg/L)	(mg/L)	(mg/L)					
<b>Inorganics - Total (mg/L)</b>								
Arsenic	0.01	0.000045	0.036	<b>0.0037 J</b>	0.01 U	0.01 U	<b>0.012 J</b>	0.01 UJ
Barium	2	0.26	50	0.06	0.063	0.062	<b>0.37</b>	0.02
Beryllium	0.004	0.0073	NA	0.004 U	0.00079 J	0.00069 J	0.004 U	0.004 U
Cadmium	0.005	0.00183	0.0094	0.005 U	0.005 U	0.005 U	0.0011 J	0.005 U
Chromium	0.1	0.011	0.0504	0.01 U	0.01 U	0.01 U	0.0071 J	0.01 U
Cobalt	NE	0.073	NA	0.01 U	0.01 U	0.01 U	0.047	0.01 U
Copper	1.3 <sup>(1)</sup>	0.15	0.0037	0.02 U	0.02 U	0.02 U	<u>0.056</u>	0.02 U
Mercury	0.002	NE	0.0011	0.000084 J	0.0002 UJ	0.0002 UJ	0.00011 J	0.0002 U
Nickel	NE	0.073	0.0083	0.04 U	0.04 U	0.04 U	<u>0.009 J</u>	0.04 U
Selenium	0.05	0.018	0.0711	0.01 UJ	0.0084 J	0.01 UJ	0.011 J	0.0069 J
Thallium	0.002	0.00026	0.0213	0.01 U	0.01 U	<b>0.008 J</b>	<b>0.034</b>	0.01 U
Tin	NE	2.2	NA	0.05 U	0.05 U	0.011 J	0.1 U	0.05 U
Vanadium	NE	0.026	NA	0.01 U	0.0023 J	0.01 U	<b>0.045</b>	0.0035 J
Zinc	NE	1.1	0.0856	0.02 U	0.02 U	0.02 U	<u>0.29</u>	0.023

**Notes:**

J - Estimated value.

U - Not detected.

NE - Not Established.

NA - Not Available.

mg/L - milligrams per liter.

UJ - Reported quantitation limit is  
qualified as estimate.<sup>(1)</sup> - This value represents the action level for this compound.

TABLE 5-2

**SUMMARY OF (TOTAL) INORGANIC DETECTIONS IN GROUNDWATER  
SWMU 3 - BASE LANDFILL  
MARCH 2002 RCRA FACILITY INVESTIGATION  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Site ID	EPA Region III			R7GW07R	R7GW08R	R7GW09	R7GW10	R7GW11
Sample ID	Federal	Tap Water	Marine Surface Water	R7GW07R	R7GW08R	R7GW09	R7GW10	R7GW11
Sample Date	MCL	RBC	Screening Values	02/28/02	02/28/02	03/03/02	03/03/02	02/28/02
	(mg/L)	(mg/L)	(mg/L)					
<b>Inorganics - Total (mg/L)</b>								
Arsenic	0.01	0.000045	0.036	0.01 U	0.01 U	0.01 UJ	0.01 UJ	0.01 U
Barium	2	0.26	50	0.082	0.11	0.1	0.052	0.0033 J
Beryllium	0.004	0.0073	NA	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
Cadmium	0.005	0.00183	0.0094	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Chromium	0.1	0.011	0.0504	0.0023 J	0.01 U	0.01 U	0.01 U	0.01 U
Cobalt	NE	0.073	NA	0.0053 J	0.01 U	0.01 U	0.01 U	0.01 U
Copper	1.3 <sup>(1)</sup>	0.15	0.0037	<u>0.028</u>	0.02 U	0.02 U	0.02 U	0.02 U
Mercury	0.002	NE	0.0011	0.000082 J	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Nickel	NE	0.073	0.0083	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
Selenium	0.05	0.018	0.0711	0.01 UJ	0.01 UJ	0.0085 J	0.01 UJ	0.01 UJ
Thallium	0.002	0.00026	0.0213	0.01 UJ	0.01 UJ	0.02 U	0.01 U	0.01 UJ
Tin	NE	2.2	NA	0.0068 J	0.05 U	0.05 U	0.05 U	0.05 U
Vanadium	NE	0.026	NA	0.023	0.02 U	0.0025 J	0.0032 J	0.01 U
Zinc	NE	1.1	0.0856	0.06 J	0.02 U	0.007 J	0.02 U	0.02 U

**Notes:**

J - Estimated value.

U - Not detected.

NE - Not Established.

NA - Not Available.

mg/L - milligrams per liter.

UJ - Reported quantitation limit is qualified as estimate.

<sup>(1)</sup> - This value represents the action level for this compound.

TABLE 5-2

**SUMMARY OF (TOTAL) INORGANIC DETECTIONS IN GROUNDWATER  
SWMU 3 - BASE LANDFILL  
MARCH 2002 RCRA FACILITY INVESTIGATION  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Site ID	EPA Region III			Marine		Number	Range	Number	Range
Sample ID	Federal	Tap Water	Surface Water	Number	Range	Exceeding	Exceeding	Exceeding	Exceeding
Sample Date	MCL	RBC	Screening Values	Exceeding	Exceeding	EPA Region III	EPA Region III	Marine	Marine
	(mg/L)	(mg/L)	(mg/L)	Federal	Federal	Tap Water	Tap Water	Surface Water	Surface Water
				MCL	MCL	RBC	RBC	Screening Values	Screening Values
<b>Inorganics - Total (mg/L)</b>									
Arsenic	0.01	0.000045	0.036	1/10	0.012J	2/10	0.0037J - 0.012J	0/10	
Barium	2	0.26	50	0/10		1/10	0.37	0/10	
Beryllium	0.004	0.0073	NA	0/10		0/10		NA	
Cadmium	0.005	0.00183	0.0094	0/10		0/10		0/10	
Chromium	0.1	0.011	0.0504	0/10		0/10		0/10	
Cobalt	NE	0.073	NA	NE		0/10		NA	
Copper	1.3 <sup>(1)</sup>	0.15	0.0037	0/10		0/10		2/10	0.028 - 0.056
Mercury	0.002	NE	0.0011	0/10		NE		0/10	
Nickel	NE	0.073	0.0083	NE		0/10		1/10	0.009J
Selenium	0.05	0.018	0.0711	0/10		0/10		0/10	
Thallium	0.002	0.00026	0.0213	2/10	0.008J-0.034	2/10	0.008J-0.034	1/10	0.034
Tin	NE	2.2	NA	NE		0/10		NA	
Vanadium	NE	0.026	NA	NE		1/10	0.045	NA	
Zinc	NE	1.1	0.0856	NE		0/10		1/10	0.29

**Notes:**

J - Estimated value.

U - Not detected.

NE - Not Established.

NA - Not Available.

mg/L - milligrams per liter.

UJ - Reported quantitation limit is qualified as estimate.

<sup>(1)</sup> - This value represents the action level for this compound.

TABLE 5-2

**SUMMARY OF (TOTAL) INORGANIC DETECTIONS IN GROUNDWATER  
SWMU 3 - BASE LANDFILL  
MARCH 2002 RCRA FACILITY INVESTIGATION  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Site ID Sample ID Sample Date	EPA Region III		Marine	Location Maximum Detect
	Federal MCL (mg/L)	Tap Water RBC (mg/L)	Surface Water Screening Values (mg/L)	
<b>Inorganics - Total (mg/L)</b>				
Arsenic	0.01	0.000045	0.036	R7GW04R
Barium	2	0.26	50	R7GW04R
Beryllium	0.004	0.0073	NA	R7GW02R
Cadmium	0.005	0.00183	0.0094	R7GW04R
Chromium	0.1	0.011	0.0504	R7GW04R
Cobalt	NE	0.073	NA	R7GW04R
Copper	1.3 <sup>(1)</sup>	0.15	0.0037	R7GW04R
Mercury	0.002	NE	0.0011	R7GW04R
Nickel	NE	0.073	0.0083	R7GW04R
Selenium	0.05	0.018	0.0711	R7GW04R
Thallium	0.002	0.00026	0.0213	R7GW04R
Tin	NE	2.2	NA	R7GW02RD
Vanadium	NE	0.026	NA	R7GW04R
Zinc	NE	1.1	0.0856	R7GW04R

**Notes:**

J - Estimated value.

U - Not detected.

NE - Not Established.

NA - Not Available.

mg/L - milligrams per liter.

UJ - Reported quantitation limit is  
qualified as estimate.

<sup>(1)</sup> - This value represents the action level for this compound.

TABLE 5-3

**SUMMARY OF (DISSOLVED) INORGANIC DETECTIONS IN GROUNDWATER  
SWMU 3 - BASE LANDFILL  
MARCH 2002 RCRA FACILITY INVESTIGATION  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Site ID	EPA Region III	Marine	R7GW01R	R7GW02R	R7GW02R	R7GW04R	R7GW05R	
Sample ID	Federal	Tap Water	Surface Water	R7GW01R	R7GW02R	R7GW02RD	R7GW04R	R7GW05R
Sample Date	MCL	RBC	Screening Values	03/02/02	03/05/02	03/05/02	03/02/02	03/02/02
	(mg/L)	(mg/L)	(mg/L)					
<b>Inorganics - Dissolved (mg/L)</b>								
Barium	2	0.26	50	0.059	0.061	0.061	0.25	0.019
Beryllium	0.004	0.0073	NA	0.004 U	0.0008 J	0.00072 J	0.004 U	0.004 U
Cobalt	NE	0.073	NA	0.01 U	0.01 U	0.01 U	0.041	0.01 U
Lead	0.015 <sup>(1)</sup>	NE	0.0085	0.005 U	0.005 U	0.005 U	0.01 U	0.01 U
Mercury	0.002	NE	0.0011	0.00009 J	0.0002 UJ	0.0002 UJ	0.0002 U	0.000079 J
Nickel	NE	0.073	0.0083	0.04 U	0.04 U	0.04 U	0.0057 J	0.04 U
Selenium	0.05	0.018	0.0711	0.01 UJ	0.01 UJ	0.01 UJ	0.0098 J	0.011 J
Thallium	0.002	0.00026	0.0213	0.01 U	0.01 U	0.01 U	<b>0.027</b>	<b>0.0099</b> J
Tin	NE	2.2	NA	0.05 U	0.05 U	0.0082 J	0.1 U	0.05 U
Vanadium	NE	0.026	NA	0.0022 J	0.01 U	0.01 U	0.01 U	0.01 U
Zinc	NE	1.1	0.0856	0.006 J	0.014 J	0.02 U	0.064	0.02 U

**Notes:**

J - Estimated value.

U - Not detected.

NA - Not Available.

NE - Not Established.

mg/L - milligrams per liter.

UJ - Reported quantitation limit is qualified as estimate.

<sup>(1)</sup> - This value represents the action level for this compound.

TABLE 5-3

**SUMMARY OF (DISSOLVED) INORGANIC DETECTIONS IN GROUNDWATER  
SWMU 3 - BASE LANDFILL  
MARCH 2002 RCRA FACILITY INVESTIGATION  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Site ID	EPA Region III	Marine	R7GW07R	R7GW08R	R7GW09	R7GW10	R7GW11	
Sample ID	Federal	Tap Water	Surface Water	R7GW07R	R7GW08R	R7GW09	R7GW10	R7GW11
Sample Date	MCL	RBC	Screening Values	02/28/02	02/28/02	03/03/02	03/03/02	02/28/02
	(mg/L)	(mg/L)	(mg/L)					
<b>Inorganics - Dissolved (mg/L)</b>								
Barium	2	0.26	50	0.06	0.1	0.11	0.058	0.0032 J
Beryllium	0.004	0.0073	NA	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U
Cobalt	NE	0.073	NA	0.0018 J	0.01 U	0.01 U	0.01 U	0.01 U
Lead	0.015 <sup>(1)</sup>	NE	0.0085	0.0019 J	0.005 U	0.01 U	0.005 U	0.005 U
Mercury	0.002	NE	0.0011	0.00014 J	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Nickel	NE	0.073	0.0083	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
Selenium	0.05	0.018	0.0711	0.01 UJ	0.01 UJ	0.02 UJ	0.01 UJ	0.01 UJ
Thallium	0.002	0.00026	0.0213	0.01 UJ	0.01 UJ	0.02 U	0.01 U	0.01 UJ
Tin	NE	2.2	NA	0.05 U	0.0066 J	0.05 U	0.05 U	0.05 U
Vanadium	NE	0.026	NA	0.013	0.02 U	0.0045 J	0.0039 J	0.01 U
Zinc	NE	1.1	0.0856	0.0066 J	0.02 U	0.02 U	0.02 U	0.0062 J

**Notes:**

J - Estimated value.

U - Not detected.

NA - Not Available.

NE - Not Established.

mg/L - milligrams per liter.

UJ - Reported quantitation limit is qualified as estimate.

<sup>(1)</sup> - This value represents the action level for this compound.

TABLE 5-3

**SUMMARY OF (DISSOLVED) INORGANIC DETECTIONS IN GROUNDWATER  
SWMU 3 - BASE LANDFILL  
MARCH 2002 RCRA FACILITY INVESTIGATION  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Site ID	EPA Region III		Marine	Number		Range	Number	Range	
Sample ID	Federal	Tap Water	Surface Water	Exceeding	Exceeding	Exceeding	Exceeding	Exceeding	
Sample Date	MCL	RBC	Screening Values	Federal	Federal	EPA Region III	EPA Region III	Marine	
	(mg/L)	(mg/L)	(mg/L)	MCL	MCL	Tap Water	Tap Water	Surface Water	
						RBC	RBC	Screening Values	
								Screening Values	
<b>Inorganics - Dissolved (mg/L)</b>									
Barium	2	0.26	50	0/10		0/10		0/10	
Beryllium	0.004	0.0073	NA	0/10		0/10		NA	
Cobalt	NE	0.073	NA	NE		0/10		NA	
Lead	0.015 <sup>(1)</sup>	NE	0.0085	0/10		NE		0/10	
Mercury	0.002	NE	0.0011	0/10		NE		0/10	
Nickel	NE	0.073	0.0083	NE		0/10		0/10	
Selenium	0.05	0.018	0.0711	0/10		0/10		0/10	
Thallium	0.002	0.00026	0.0213	2/10	0.0099J-0.027	2/10	0.0099J - 0.027	1/10	0.027
Tin	NE	2.2	NA	NE		0/10		NA	
Vanadium	NE	0.026	NA	NE		0/10		NA	
Zinc	NE	1.1	0.0856	NE		0/10		0/10	

**Notes:**

J - Estimated value.

U - Not detected.

NA - Not Available.

NE - Not Established.

mg/L - milligrams per liter.

UJ - Reported quantitation limit is qualified as estimate.

<sup>(1)</sup> - This value represents the action level for this compound.

TABLE 5-3

**SUMMARY OF (DISSOLVED) INORGANIC DETECTIONS IN GROUNDWATER  
SWMU 3 - BASE LANDFILL  
MARCH 2002 RCRA FACILITY INVESTIGATION  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Site ID	EPA Region III		Marine	Location
Sample ID	Federal	Tap Water	Surface Water	
Sample Date	MCL	RBC	Screening Values	Maximum
	(mg/L)	(mg/L)	(mg/L)	Detect
<b>Inorganics - Dissolved (mg/L)</b>				
Barium	2	0.26	50	R7GW04R
Beryllium	0.004	0.0073	NA	R7GW02R
Cobalt	NE	0.073	NA	R7GW04R
Lead	0.015 <sup>(1)</sup>	NE	0.0085	R7GW07R
Mercury	0.002	NE	0.0011	R7GW07R
Nickel	NE	0.073	0.0083	R7GW04R
Selenium	0.05	0.018	0.0711	R7GW05R
Thallium	0.002	0.00026	0.0213	R7GW04R
Tin	NE	2.2	NA	R7GW02RD
Vanadium	NE	0.026	NA	R7GW07R
Zinc	NE	1.1	0.0856	R7GW04R

**Notes:**

J - Estimated value.

U - Not detected.

NA - Not Available.

NE - Not Established.

mg/L - milligrams per liter.

UJ - Reported quantitation limit is qualified as estimate.

<sup>(1)</sup> - This value represents the action level for this compound.

TABLE 5-4

SUMMARY OF (TOTAL) INORGANIC DETECTIONS IN GROUNDWATER  
 SWMU 3 - BASE LANDFILL  
 AUGUST 2000 GROUNDWATER MONITORING  
 NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO

Site ID	EPA Region III		R7GW01	R7GW02	R7GW04	R7GW05	R7GW07	R7GW08	R7GW09	R7GW10	R7GW11
Sample ID	Federal	Tap Water	R7GW01	R7GW02	R7GW04	R7GW05	R7GW07	R7GW08	R7GW09	R7GW10	R7GW11
Sample Date	MCL	RBC	08/15/00	08/15/00	08/15/00	08/15/00	08/15/00	08/15/00	08/15/00	08/15/00	08/15/00
	(mg/L)	(mg/L)									
<b>Inorganics - Total (mg/L)</b>											
Barium	2	0.26	0.098	0.001 U	0.158	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Chromium	0.1	0.011	<b>0.044</b>	<b>0.04</b>	0.01 U	<b>0.03</b>	0.01 U	<b>0.052</b>	<b>0.038</b>	0.01 U	<b>0.02</b>
Cobalt	NE	0.073	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.048	0.001 U	0.001 U
Copper	1.3 <sup>(1)</sup>	0.15	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.032
Silver	NE	0.018	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.01	0.001 U
Vanadium	NE	0.026	<b>0.102</b>	0.001 U	0.001 U	0.001 U	<b>0.034</b>	<b>0.032</b>	0.001 U	<b>0.06</b>	<b>0.028</b>
Zinc	NE	1.1	0.286	0.324	0.252	0.248	0.246	0.322	0.258	0.308	0.342

**Notes:**

U - Not detected.

NE - Not Established.

mg/L - milligrams per liter.

<sup>(1)</sup> - This value represents the action level for this compound.

**TABLE 5-4**

**SUMMARY OF (TOTAL) INORGANIC DETECTIONS IN GROUNDWATER  
SWMU 3 - BASE LANDFILL  
AUGUST 2000 GROUNDWATER MONITORING  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Site ID Sample ID Sample Date	EPA Region III		Number		Range		Location Maximum Detect
	Federal MCL (mg/L)	Tap Water RBC (mg/L)	Exceeding Federal MCL	Exceeding Federal MCL	Exceeding EPA Region III Tap Water RBC	Exceeding EPA Region III Tap Water RBC	
<b>Inorganics - Total (mg/L)</b>							
Barium	2	0.26	0/9		0/9		R7GW04
Chromium	0.1	0.011	0/9		6/9	0.02-0.052	R7GW08
Cobalt	NE	0.073	NE		0/9		R7GW09
Copper	1.3 <sup>(1)</sup>	0.15	0/9		0/9		R7GW11
Silver	NE	0.018	NE		0/9		R7GW10
Vanadium	NE	0.026	NE		5/9	0.028-0.102	R7GW01
Zinc	NE	1.1	NE		0/9		R7GW11

**Notes:**

U - Not detected.

NE - Not Established.

mg/L - milligrams per liter.

<sup>(1)</sup> - This value represents the action level  
for this compound.

TABLE 5-5

**SUMMARY OF (TOTAL) INORGANIC DETECTIONS IN GROUNDWATER  
SWMU 3 - BASE LANDFILL  
MAY 2000 GROUNDWATER MONITORING  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Site ID	EPA Region III		R7GW01	R7GW02	R7GW04	R7GW05	R7GW07	R7GW08	R7GW09	R7GW10	R7GW11
Sample ID	Federal	Tap Water	R7GW01	R7GW02	R7GW04	R7GW05	R7GW07	R7GW08	R7GW09	R7GW10	R7GW11
Sample Date	MCL	RBC	05/09/00	05/09/00	05/09/00	05/09/00	05/09/00	05/09/00	05/09/00	05/09/00	05/09/00
	(mg/L)	(mg/L)									
<b>Inorganics - Total (mg/L)</b>											
Barium	2	0.26	0.248	0.001 U	<b>0.766</b>	0.001 U	0.001 U	0.024	0.096	0.001 U	0.062
Chromium	0.1	0.011	<b>0.038</b>	0.001 U	<b>0.064</b>	<b>0.06</b>	<b>0.022</b>	<b>0.08</b>	<b>0.104</b>	0.001 U	<b>0.064</b>
Cobalt	NE	0.073	0.04	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	<b>0.092</b>	0.001 U	0.026
Copper	1.3 <sup>(1)</sup>	0.15	0.076	0.034	0.076	0.03	0.054	0.044	<b>0.272</b>	0.032	<b>0.216</b>
Lead	0.015 <sup>(1)</sup>	NE	0.008 UJ	0.008 UJ	0.008 UJ	0.008 UJ	0.008 UJ	0.008 J	0.008 UJ	0.008 UJ	0.008 UJ
Nickel	NE	0.073	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.01 UJ	0.026 J	0.01 UJ	0.03 J
Vanadium	NE	0.026	<b>0.048</b>	0.02	<b>0.04</b>	<b>0.03</b>	<b>0.116</b>	<b>0.06</b>	<b>0.038</b>	<b>0.044</b>	<b>0.088</b>

**Notes:**

J - Estimated value.

U - Not detected.

NE - Not Established.

mg/L - milligrams per liter.

UJ - Reported quantitation limit is qualified as estimate.

<sup>(1)</sup> - This value represents the action level for this compound.

**TABLE 5-5**

**SUMMARY OF (TOTAL) INORGANIC DETECTIONS IN GROUNDWATER  
SWMU 3 - BASE LANDFILL  
MAY 2000 GROUNDWATER MONITORING  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Site ID Sample ID Sample Date	EPA Region III				Number Exceeding EPA Region III Tap Water RBC	Range Exceeding EPA Region III Tap Water RBC	Location Maximum Detect
	Federal MCL (mg/L)	Tap Water RBC (mg/L)	Number Exceeding Federal MCL	Range Exceeding Federal MCL			
<b>Inorganics - Total (mg/L)</b>							
Barium	2	0.26	0/9		1/9	0.766	R7GW04
Chromium	0.1	0.011	1/9	0.104	7/9	0.022 - 0.104	R7GW09
Cobalt	NE	0.073	NE		1/9	0.092	R7GW09
Copper	1.3 <sup>(1)</sup>	0.15	0/9		2/9	0.216 - 0.272	R7GW09
Lead	0.015 <sup>(1)</sup>	NE	0/9		NE		R7GW08
Nickel	NE	0.073	NE		0/9		R7GW11
Vanadium	NE	0.026	NE		8/9	0.03 - 0.116	R7GW07

**Notes:**

J - Estimated value.

U - Not detected.

NE - Not Established.

mg/L - milligrams per liter.

UJ - Reported quantitation limit is  
qualified as estimate.

<sup>(1)</sup> - This value represents the action level  
for this compound.

TABLE 5-6

SUMMARY OF (TOTAL) INORGANIC DETECTIONS IN GROUNDWATER  
 SWMU 3 - BASE LANDFILL  
 FEBRUARY 2000 GROUNDWATER MONITORING  
 NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO

Site ID	EPA Region III		R7GW01	R7GW02	R7GW04	R7GW05	R7GW07	R7GW08	R7GW09	R7GW10	R7GW11
Sample ID	Federal	Tap Water	R7GW01	R7GW02	R7GW04	R7GW05	R7GW07	R7GW08	R7GW09	R7GW10	R7GW11
Sample Date	MCL	RBC	02/02/00	02/02/00	02/02/00	02/02/00	02/02/00	02/02/00	02/02/00	02/02/00	02/02/00
	(mg/L)	(mg/L)									
<b>Inorganics - Total (mg/L)</b>											
Barium	2	0.26	0.022 J	0.001 UJ	0.001 UJ	0.001 UJ	0.001 UJ	0.001 UJ	0.001 UJ	0.001 UJ	0.001 UJ
Chromium	0.1	0.011	<b>0.026 J</b>	<b>0.078 J</b>	<b>0.014 J</b>	<b>0.07 J</b>	<b>0.012 J</b>	<b>0.06 J</b>	0.001 J	<b>0.014 J</b>	0.01 J
Vanadium	NE	0.026	<b>0.034 J</b>	0.001 UJ	0.012 J	0.001 UJ	<b>0.04 J</b>	0.001 UJ	<b>0.078 J</b>	0.016 J	0.001 UJ
Zinc	NE	1.1	<b>11.9</b>	0.262	0.174	0.26	0.334	0.24	0.226	0.214	0.628

**Notes:**

J - Estimated value.

NE - Not Established.

mg/L - milligrams per liter.

UJ - Reported quantitation limit is qualified as estimate.

**TABLE 5-6**

**SUMMARY OF (TOTAL) INORGANIC DETECTIONS IN GROUNDWATER  
SWMU 3 - BASE LANDFILL  
FEBRUARY 2000 GROUNDWATER MONITORING  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Site ID Sample ID Sample Date	EPA Region III		Number Exceeding Federal MCL	Range Exceeding Federal MCL	Number Exceeding EPA Region III Tap Water RBC	Range Exceeding EPA Region III Tap Water RBC	Location Maximum Detect
	Federal MCL (mg/L)	Tap Water RBC (mg/L)					
<b>Inorganics - Total (mg/L)</b>							
Barium	2	0.26	0/9		0/9		R7GW01
Chromium	0.1	0.011	0/9		7/9	0.012J - 0.078J	R7GW02
Vanadium	NE	0.026	NE		3/9	0.034J - 0.078J	R7GW09
Zinc	NE	1.1	NE		1/9	11.9	R7GW01

**Notes:**

J - Estimated value.

NE - Not Established.

mg/L - milligrams per liter.

UJ - Reported quantitation limit is  
qualified as estimate.

TABLE 5-7

**SUMMARY OF ORGANIC DETECTIONS IN GROUNDWATER  
SWMU 3 - BASE LANDFILL  
JUNE 1998 GROUNDWATER MONITORING  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Site ID	EPA Region III		R7GW01	R7GW02	R7GW04	R7GW05	R7GW07	R7GW08	R7GW09	R7GW09	R7GW10	R7GW11
Sample ID	Federal	Tap Water	R7GW01	R7GW02	R7GW04	R7GW05	R7GW07	R7GW08	R7GW09	R7GW109	R7GW10	R7GW11
Sample Date	MCL	RBC	06/19/98	06/18/98	06/19/98	06/18/98	06/17/98	06/18/98	06/17/98	06/17/98	06/17/98	06/18/98
	(ug/L)	(ug/L)										
<b>Volatiles (ug/L)</b>												
1,1-Dichloroethane	NE	79.8	0.5 U	0.5 U	0.5 U	1	0.5 U					
Acetone	NE	60.8	2 R	2 R	5 J	2 R	2 R	2 R	2 R	2 R	2 R	2 J
Chlorobenzene	100	11	0.5 U	0.5 U	0.5 U	0.8	0.5 U					
Chloromethane	NE	2.1	0.5 U	0.5 U	0.7	0.5 U						
cis-1,2-Dichloroethene	70	6.1	0.5 U	0.5 U	0.5 U	2	0.5 U					
Vinyl chloride	2	0.015	0.5 U	0.5 U	0.5 U	1	0.5 U					
<b>Semivolatiles (ug/L)</b>												
1,4-Dioxane	NE	6.1	20 UJ	34 J	20 U	20 U	20 UJ					
Bis(2-ethylhexyl)phthalate	6	4.8	10 U	2 J	10 U	10 U	10 U	10 U				
<b>Pesticides/PCBs (ug/L)</b>												
Not Detected												
<b>OP-Pesticides (ug/L)</b>												
Not Detected												
<b>Chlorinated Herbicides (ug/L)</b>												
Not Detected												
<b>Dioxins/Furans (ug/L)</b>												
Not Detected												
<b>Explosives (ug/L)</b>												
Not Detected												
<b>Misc. Parameters</b>												
Sulfide (ug/L)	NE	NE	1,000 U	1,000 U	1,000 U	1,300	1,000 U					

**Notes:**

- J - Estimated value.
- U - Not detected.
- NE - Not Established.
- ug/L - micrograms per liter.
- UJ - Reported quantitation limit is qualified as estimate.
- R - Result is rejected and unusable.

TABLE 5-7

**SUMMARY OF ORGANIC DETECTIONS IN GROUNDWATER  
SWMU 3 - BASE LANDFILL  
JUNE 1998 GROUNDWATER MONITORING  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Site ID Sample ID Sample Date	EPA Region III				Number	Range	Location Maximum Detect
	Federal MCL (ug/L)	Tap Water RBC (ug/L)	Number Exceeding Federal MCL	Range Exceeding Federal MCL	Exceeding EPA Region III Tap Water RBC	Exceeding EPA Region III Tap Water RBC	
<b>Volatiles (ug/L)</b>							
1,1-Dichloroethane	NE	79.8	NE		0/10		R7GW05
Acetone	NE	60.8	NE		0/2		R7GW04
Chlorobenzene	100	11	0/10		0/10		R7GW05
Chloromethane	NE	2.1	NE		0/10		R7GW04
cis-1,2-Dichloroethene	70	6.1	0/10		0/10		R7GW05
Vinyl chloride	2	0.015	0/10		1/10	1	R7GW05
<b>Semivolatiles (ug/L)</b>							
1,4-Dioxane	NE	6.1	NE		1/10	34J	R7GW02
Bis(2-ethylhexyl)phthalate	6	4.8	0/10		0/10		R7GW08
<b>Pesticides/PCBs (ug/L)</b>							
Not Detected							
<b>OP-Pesticides (ug/L)</b>							
Not Detected							
<b>Chlorinated Herbicides (ug/L)</b>							
Not Detected							
<b>Dioxins/Furans (ug/L)</b>							
Not Detected							
<b>Explosives (ug/L)</b>							
Not Detected							
<b>Misc. Parameters</b>							
Sulfide (ug/L)	NE	NE	NE		NE		R7GW05

**Notes:**

J - Estimated value.

U - Not detected.

NE - Not Established.

ug/L - micrograms per liter.

UJ - Reported quantitation limit is  
qualified as estimate.

R - Result is rejected and unusable.

TABLE 5-8

**SUMMARY OF (TOTAL) INORGANIC DETECTIONS IN GROUNDWATER  
SWMU 3 - BASE LANDFILL  
JUNE 1998 GROUNDWATER MONITORING  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Site ID	EPA Region III		R7GW01	R7GW02	R7GW04	R7GW05	R7GW07
Sample ID	Federal	Tap Water	R7GW01	R7GW02	R7GW04	R7GW05	R7GW07
Sample Date	MCL	RBC	06/19/98	06/18/98	06/19/98	06/18/98	06/17/98
	(mg/L)	(mg/L)					
<b>Inorganics, Total (mg/L)</b>							
Antimony	0.006	0.15	0.0018 U	0.0018 U	0.0018 U	0.0018 U	0.0018 U
Arsenic	0.01	0.000045	0.0021 U	<b>0.0169</b>	0.0021 U	<b>0.0062</b>	0.0021 U
Barium	2	0.26	<b>0.324</b>	0.0141	0.106	0.0105	0.0096
Cadmium	0.005	0.00183	0.0003 U	0.0003 U	0.0003 U	0.0003 U	0.0003 U
Chromium	0.1	0.011	0.0034	0.0008 U	0.0008 U	0.0014	0.0013
Cobalt	NE	0.073	0.0089	0.0016	0.0042	0.0016	0.0005
Copper	1.3 <sup>(1)</sup>	0.15	0.0134	0.0094	0.0228	0.0088	0.0046
Lead	0.015 <sup>(1)</sup>	NE	0.0017 U	0.0085 U	0.0085 U	0.0017 UJ	0.0026
Nickel	NE	0.073	0.0022	0.00064	0.0011	0.0006 UJ	0.0006 U
Silver	NE	0.018	0.0007 U	0.00176	0.0007 U	0.0007 U	0.0007 U
Tin	NE	2.2	0.0022 U	0.0024	0.0022 U	0.0022 U	0.0022 U
Vanadium	NE	0.026	0.0152	0.0098	0.0198	0.013	0.0084
Zinc	NE	1.1	0.0128	0.0227	0.0296	0.0386	0.0084

**Notes:**

U - Not detected.

NE - Not Established.

mg/L - milligrams per liter.

UJ - Reported quantitation limit is qualified as estimate.

<sup>(1)</sup> - This value represents the action level for this compound.

TABLE 5-8

**SUMMARY OF (TOTAL) INORGANIC DETECTIONS IN GROUNDWATER  
SWMU 3 - BASE LANDFILL  
JUNE 1998 GROUNDWATER MONITORING  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Site ID	EPA Region III	R7GW08	R7GW09	R7GW09	R7GW10	R7GW11	
Sample ID	Federal	R7GW08	R7GW09	R7GW109	R7GW10	R7GW11	
Sample Date	MCL	06/18/98	06/17/98	06/17/98	06/17/98	06/18/98	
	(mg/L)	(mg/L)					
<b>Inorganics, Total (mg/L)</b>							
Antimony	0.006	0.15	0.0018 U	0.0018 U	0.0018 U	0.002	0.0018 U
Arsenic	0.01	0.000045	<b>0.0066</b>	0.0021 U	0.0021 U	<b>0.0101</b>	0.0021 U
Barium	2	0.26	0.0451	0.195	0.192	0.174	0.025
Cadmium	0.005	0.00183	0.0003 U	0.00057	0.00062	0.00054	0.0003 U
Chromium	0.1	0.011	0.0017	0.0032	0.0061	<b>0.016</b>	0.0021
Cobalt	NE	0.073	0.001	0.0155	0.0167	0.0081	0.0004 U
Copper	1.3 <sup>(1)</sup>	0.15	0.0086	0.0358	0.0531	0.0195	0.0046
Lead	0.015 <sup>(1)</sup>	NE	0.0085 U	0.0085 U	0.0085 U	0.0069	0.0018
Nickel	NE	0.073	0.0012	0.0067	0.0083	0.0068	0.0006 U
Silver	NE	0.018	0.0007 U	0.0007 U	0.0007 U	0.0007 U	0.0007 U
Tin	NE	2.2	0.0022 U	0.0022 U	0.0022 U	0.0022 U	0.0022 U
Vanadium	NE	0.026	0.0092	0.0182	<b>0.0285</b>	<b>0.0899</b>	0.0059
Zinc	NE	1.1	0.0225	0.0296	0.0293	0.0207	0.0254

**Notes:**

U - Not detected.

NE - Not Established.

mg/L - milligrams per liter.

UJ - Reported quantitation limit is qualified as estimate.

<sup>(1)</sup> - This value represents the action level for this compound.

TABLE 5-8

**SUMMARY OF (TOTAL) INORGANIC DETECTIONS IN GROUNDWATER  
SWMU 3 - BASE LANDFILL  
JUNE 1998 GROUNDWATER MONITORING  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Site ID	EPA Region III				Number	Range	Location
Sample ID	Federal	Tap Water	Number	Range	Exceeding	Exceeding	Maximum
Sample Date	MCL	RBC	Exceeding	Exceeding	EPA Region III	EPA Region III	Detect
	(mg/L)	(mg/L)	Federal	Federal	Tap Water	Tap Water	
			MCL	MCL	RBC	RBC	
<b>Inorganics, Total (mg/L)</b>							
Antimony	0.006	0.15	0/10		0/10		R7GW10
Arsenic	0.01	0.000045	2/10	0.0101 - 0.0169	4/10	0.0062 - 0.0169	R7GW02
Barium	2	0.26	0/10		1/10	0.324	R7GW01
Cadmium	0.005	0.00183	0/10		0/10		R7GW109
Chromium	0.1	0.011	0/10		1/10	0.016	R7GW10
Cobalt	NE	0.073	NE		0/10		R7GW109
Copper	1.3 <sup>(1)</sup>	0.15	0/10		0/10		R7GW109
Lead	0.015 <sup>(1)</sup>	NE	0/10		NE		R7GW10
Nickel	NE	0.073	NE		0/10		R7GW109
Silver	NE	0.018	NE		0/10		R7GW02
Tin	NE	2.2	NE		0/10		R7GW02
Vanadium	NE	0.026	NE		2/10	0.0285 - 0.0899	R7GW10
Zinc	NE	1.1	NE		0/10		R7GW05

**Notes:**

U - Not detected.

NE - Not Established.

mg/L - milligrams per liter.

UJ - Reported quantitation limit is qualified as estimate.

<sup>(1)</sup> - This value represents the action level for this compound.

**TABLE 5-9**

**SUMMARY OF ORGANIC DETECTIONS IN SEDIMENT  
SWMU 3 - BASE LANDFILL  
1995 AND 1997 RCRA FACILITY INVESTIGATIONS  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Site ID	3SD01	3SD02	3SD03	3SD04	3SD05	3SD06	3SD07	3SD08	3SD09
Sample ID	3SD01	3SD02	3SD03	3SD04	3SD05	3SD06	3SD07	3SD08	3SD09
Sample Date	10/29/95	10/29/95	10/29/95	10/27/95	10/27/95	10/27/95	10/27/95	10/28/95	10/28/95
Depth Range (ft bgs)	0.00-1.00	0.00-1.00	0.00-1.00	0.00-1.00	0.00-1.00	0.00-1.00	0.00-1.00	0.00-1.00	0.00-1.00
<b>Volatiles (ug/kg)</b>									
Acetone	14 U	19 U	20 U	17 U	26 U	15 U	18 U	26 U	18 U
<b>Semivolatiles (ug/kg)</b>									
Benzoic acid	2,300 U	2,500 U	2,600 U	3,600	770 J	770 J	570 J	3,300 U	3,000 U
Bis(2-ethylhexyl)phthalate	450 U	500 U	520 U	560 U	510 U	480 U	520 U	660 U	590 U
Phenol	450 U	500 U	520 U	560 U	510 U	480 U	520 U	660 U	590 U
<b>Pesticides/PCBs (ug/kg)</b>									
Not Detected									
<b>Chlorinated Herbicides (ug/kg)</b>									
Not Detected									
<b>Dioxins/Furans (ug/kg)</b>									
Total HxCDD	0.19 U	0.18 U	0.12 U	0.21 U	0.27 U	0.17 U	0.12 U	0.28 U	0.31 U
<b>Explosives (ug/kg)</b>									
Not Detected									
<b>Misc. Parameters</b>									
Total Organic Carbon (ug/kg)	60,000,000	14,500,000	73,500,000	90,100,000	24,900,000	38,600,000	96,700,000	66,400,000	18,600,000
Sulfide (ug/kg)	33,900 U	90,800	139,000	42,200 U	37,100 U	35,500 U	37,700 U	69,400	44,900 U
% Solids	63.9	65.3	62	58.6	64.8	70.7	67.6	49.4	55.7

**Notes:**

ug/kg - micrograms per kilogram.  
ft bgs - feet below ground surface.  
NA - Not analyzed.

U - Not detected. The associate number indicates the approximate sample concentration necessary to be detected.

J - Analyte present. Reported value may not be accurate or precise.  
UJ - Not detected, quantitation limit may be inaccurate or imprecise.

**TABLE 5-9**

**SUMMARY OF ORGANIC DETECTIONS IN SEDIMENT  
SWMU 3 - BASE LANDFILL  
1995 AND 1997 RCRA FACILITY INVESTIGATIONS  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Site ID	3SD10	3SD11	3SD12	3SD13	3SD14	3SD15	3SD16	3SD17
Sample ID	3SD10	3SD11	3SD12	3SD13	3SD14	3SD15	3SD16	3SD17
Sample Date	10/27/95	10/28/95	10/28/95	10/28/95	10/28/95	10/28/95	09/19/97	09/19/97
Depth Range (ft bgs)	0.00-1.00	0.00-1.00	0.00-1.00	0.00-1.00	0.00-1.00	0.00-1.00	0.00-3.00	0.00-3.00
<b>Volatiles (ug/kg)</b>								
Acetone	22 U	16 U	93	26	18 U	19 U	13 UJ	16 UJ
<b>Semivolatiles (ug/kg)</b>								
Benzoic acid	2,400 J	2,600 U	3,100 U	4,100 U	2,600 U	2,700 U	2,100 U	2,700 U
Bis(2-ethylhexyl)phthalate	630 U	130 J	64 J	200 J	520 U	59 J	420 U	530 U
Phenol	420 J	160 J	800	810 U	100 J	530 U	420 U	530 U
<b>Pesticides/PCBs (ug/kg)</b>								
Not Detected								
<b>Chlorinated Herbicides (ug/kg)</b>								
Not Detected								
<b>Dioxins/Furans (ug/kg)</b>								
Total HxCDD	0.2 U	0.12 U	0.17 U	0.38 U	0.23 U	1 J	0.06 U	0.06 U
<b>Explosives (ug/kg)</b>								
Not Detected								
<b>Misc. Parameters</b>								
Total Organic Carbon (ug/kg)	72,800,000	51,000,000	18,700,000	31,800,000	95,400,000	11,200,000	NA	NA
Sulfide (ug/kg)	69,100 J	69,900 J	242,000 J	58,400 UJ	102,000 J	59,300 J	NA	NA
% Solids	51.5	78.1	52.3	40.4	63.5	62.4	NA	NA

**Notes:**

ug/kg - micrograms per kilogram.  
ft bgs - feet below ground surface.  
NA - Not analyzed.

U - Not detected. The associate number indicates the approximate sample concentration necessary to be detected.

J - Analyte present. Reported value may not be accurate or precise.  
UJ - Not detected, quantitation limit may be inaccurate or imprecise.

**TABLE 5-9**

**SUMMARY OF ORGANIC DETECTIONS IN SEDIMENT  
SWMU 3 - BASE LANDFILL  
1995 AND 1997 RCRA FACILITY INVESTIGATIONS  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Site ID Sample ID Sample Date Depth Range (ft bgs)	Number of Positive Detections	Range of Positive Detections	Location Maximum Detect
<b>Volatiles (ug/kg)</b>			
Acetone	2/17	26 - 93	3SD12
<b>Semivolatiles (ug/kg)</b>			
Benzoic acid	5/17	570J - 3,600	3SD04
Bis(2-ethylhexyl)phthalate	4/17	59J - 200J	3SD13
Phenol	4/17	100J - 800	3SD12
<b>Pesticides/PCBs (ug/kg)</b>			
Not Detected			
<b>Chlorinated Herbicides (ug/kg)</b>			
Not Detected			
<b>Dioxins/Furans (ug/kg)</b>			
Total HxCDD	1/17	1J	3SD15
<b>Explosives (ug/kg)</b>			
Not Detected			
<b>Misc. Parameters</b>			
Total Organic Carbon (ug/kg)	15/15	11,200,000 - 96,700,000	3SD07
Sulfide (ug/kg)	8/15	59,300J - 242,000J	3SD12
% Solids	15/15	40.4 - 78.1	3SD11

**Notes:**

ug/kg - micrograms per kilogram.  
ft bgs - feet below ground surface.  
NA - Not analyzed.

U - Not detected. The associate number indicates the approximate sample concentration necessary to be detected.

J - Analyte present. Reported value may not be accurate or precise.  
UJ - Not detected, quantitation limit may be inaccurate or imprecise.

**TABLE 5-10**

**SUMMARY OF INORGANIC DETECTIONS IN SEDIMENT  
SWMU 3 - BASE LANDFILL  
1995 AND 1997 RCRA FACILITY INVESTIGATIONS  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Site ID	3SD01	3SD02	3SD03	3SD04	3SD05	3SD06	3SD07	3SD08
Sample ID	3SD01	3SD02	3SD03	3SD04	3SD05	3SD06	3SD07	3SD08
Sample Date	10/29/95	10/29/95	10/29/95	10/27/95	10/27/95	10/27/95	10/27/95	10/28/95
Depth Range (ft bgs)	0.00-1.00	0.00-1.00	0.00-1.00	0.00-1.00	0.00-1.00	0.00-1.00	0.00-1.00	0.00-1.00
<b>Inorganics - Total (mg/kg)</b>								
Antimony	7.4 U	7.7 U	8.2 U	8.5 U	8.8 U	6.6 U	7.1 U	7.8 U
Arsenic	1.8	4.3 J	1.4	1.4	0.89 U	0.94 U	1.1	2.1
Barium	9.3	9.1	7.5	7.5	8.2	6.3	8.4	8.3
Beryllium	0.18 U	0.20 U	0.2 U	0.2 U	0.21 U	0.16 U	0.2	0.19 U
Cadmium	2.5 U	2.6 U	2.8 U	2.9 U	3 U	2.3 U	2.4 U	2.6 U
Chromium	5.1	15.3	5.0	5.0	5.8	3.7	8.2	3.9
Cobalt	1.3	4.6	1.5	1.5 U	1.6	1.2 U	1.7	1.4 U
Copper	13.8	29.1	19.3	19.3	14.8	11.4	20.9	16.6
Lead	1.2 J	1.7 J	1.8 J	1.8 J	0.36 J	0.7 J	1.0 J	1.2 J
Nickel	2.2 U	4.3	2.6	2.6 U	2.6 U	2.0 U	2.1 U	2.3 U
Selenium	0.61 UJ	1.6 UJ	1.6 UJ	1.6 UJ	1.8 J	1.4 UJ	1.4 UJ	2.2 UJ
Tin	6.8 U	7.5 U	7.8 U	7.8 U	8.1 U	6.1 U	6.5 U	7.1 U
Vanadium	6.2	27.7	7.2	7.2	5.0	7.1	19.7	12.7
Zinc	2.9	20.2	7.9	7.9	3.0	3.6	8.3	6.4

**Notes:**

J - Analyte present. Reported value may not be accurate or precise.  
 UJ - Not detected, quantitation limit may be inaccurate or imprecise.  
 mg/kg - milligrams per kilogram.  
 ft bgs - feet below ground surface.

U - Not detected. The associate number indicates the approximate sample concentration necessary to be detected.

**TABLE 5-10**

**SUMMARY OF INORGANIC DETECTIONS IN SEDIMENT  
SWMU 3 - BASE LANDFILL  
1995 AND 1997 RCRA FACILITY INVESTIGATIONS  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Site ID	3SD09	3SD10	3SD11	3SD12	3SD13	3SD14	3SD15	3SD16	3SD17
Sample ID	3SD09	3SD10	3SD11	3SD12	3SD13	3SD14	3SD15	3SD16	3SD17
Sample Date	10/28/95	10/27/95	10/28/95	10/28/95	10/28/95	10/28/95	10/28/95	09/19/97	09/19/97
Depth Range (ft bgs)	0.00-1.00	0.00-1.00	0.00-1.00	0.00-1.00	0.00-1.00	0.00-1.00	0.00-1.00	0.00-3.00	0.00-3.00
<b>Inorganics - Total (mg/kg)</b>									
Antimony	8.4 U	3.6 UJ	3.7 UJ	4.3 UJ	5.3 UJ	2.7 UJ	3.4 UJ	0.31 J	0.4 J
Arsenic	3.2	0.9	0.82	1.4	0.57	0.97 J	3.8 J	2 J	2.4 J
Barium	8.6	7.0	9.0	13.2	6.6	15.0	16.9	7.8 J	7.1 J
Beryllium	0.2 U	0.15 U	0.16 U	0.26	0.23 U	0.12 U	0.14 U	0.05 U	0.05 U
Cadmium	2.9 U	0.33 U	0.33 U	0.38 U	0.48 U	0.24 U	0.3 U	0.11 J	0.07 U
Chromium	3.1 U	7.6	5.0	13.0	6.8	19.8	18.8	5.8	3.3
Cobalt	1.5 U	1.5	1.6	5.3	0.93	6.8	7.3	1.6	0.11 U
Copper	15.2	7.9	9.4	18.7	11.4	38.4	25.7	7.8 J	0.71 J
Lead	0.76 J	2.0	0.73	0.96	1.1	2.1	1.6	0.73	1
Nickel	2.5 U	2.7	1.8	7.1	3.2	7.6	10.6	1.2 J	0.13 U
Selenium	1.7 UJ	0.89	0.62 U	1.0 U	1.1 U	0.74 U	0.68 U	0.45 UJ	0.9 UJ
Tin	7.7 U	2.8 U	2.8 U	3.4	4.2	2.1 U	2.6 U	1 J	1.9 J
Vanadium	13.4	20.2	19.6	29.0	12.2	66.9	40.2	19.3	3.6 J
Zinc	6.8	9.6	6.8	15.2	10.3	29.8	16.7	6	1.7 J

**Notes:**

J - Analyte present. Reported value may not be accurate or precise.  
 UJ - Not detected, quantitation limit may be inaccurate or imprecise.  
 mg/kg - milligrams per kilogram.  
 ft bgs - feet below ground surface.

U - Not detected. The associate number indicates the approximate sample concentration necessary to be detected.

**TABLE 5-10**

**SUMMARY OF INORGANIC DETECTIONS IN SEDIMENT  
SWMU 3 - BASE LANDFILL  
1995 AND 1997 RCRA FACILITY INVESTIGATIONS  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Site ID Sample ID Sample Date Depth Range (ft bgs)	Number of Positive Detections	Range of Positive Detections	Location Maximum Detect
<b>Inorganics - Total (mg/kg)</b>			
Antimony	2/17	0.31J - 0.4J	3SD17
Arsenic	15/17	0.57 - 4.3J	3SD02
Barium	17/17	6.3 - 16.9	3SD15
Beryllium	2/17	0.2 - 0.26	3SD12
Cadmium	1/17	0.11J	3SD16
Chromium	16/17	3.3 - 19.8	3SD14
Cobalt	12/17	0.93 - 7.3	3SD15
Copper	17/17	7.8J - 38.4	3SD14
Lead	17/17	0.36J - 2.1	3SD14
Nickel	9/17	1.2J - 10.6	3SD15
Selenium	2/17	0.89 - 1.8J	3SD05
Tin	4/17	1J - 4.2	3SD13
Vanadium	17/17	3.6J - 66.9	3SD14
Zinc	17/17	1.7J - 29.8	3SD14

**Notes:**

J - Analyte present. Reported value may not be accurate or precise.  
 UJ - Not detected, quantitation limit may be inaccurate or imprecise.  
 mg/kg - milligrams per kilogram.  
 ft bgs - feet below ground surface.

U - Not detected. The associate number indicates the approximate sample concentration necessary to be detected.

TABLE 5-11

Revised 12/23/02

**DATA COMPARISONS FOR AOC D (STATION LANDFILL) SEDIMENT  
1995 AND 1997 RCRA FACILITY INVESTIGATIONS  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Analysis	Range of Positive Detections - Phase I Data <sup>(1)</sup>	Range of Positive Detections - Phase II Data <sup>(2)</sup>
<b>Volatiles (ug/kg)</b>		
Acetone	26-93	ND
Xylene (total)	2J	ND
<b>Semivolatiles (ug/kg)</b>		
Benzo(a)anthracene	120J	ND
Benzo(a)pyrene	64J-160J	ND
Benzo(b)fluoranthene	63J-310J	ND
Benzo(g,h,i)perylene	140J	ND
Benzo(k)fluoranthene	72J-130J	ND
Benzoic Acid	570J-3,600	ND
Bis(2-ethylhexyl)phthalate	59J-200J	ND
Chrysene	140J-180J	ND
Fluoranthene	120J-130J	ND
Indeno(1,2,3-cd)pyrene	51J-140J	ND
Phenanthrene	86J	ND
Phenol	100J-800	ND
Pyrene	62J-180J	ND
<b>Pesticides/PCBs (ug/kg)</b>		
4,4'-DDD	42-97	ND
4,4'-DDE	370-930	ND
4,4'-DDT	63-130	ND
Aroclor-1260	440	ND
<b>Herbicides (ug/kg)</b>		
2,4,5-TP (Silvex)	40J	ND
<b>Dioxins/Furans (ug/kg)</b>		
Total HxCDD	0.64J-2.4J	NA
Total HxCDF	0.31J-2.2J	NA
Total PeCDF	0.34J	NA
Total TCDF	0.13J	NA
<b>Inorganics (mg/kg)</b>		
Antimony	0.31J-23.6J	0.31J-0.40J
Arsenic	0.19J-9.8	2J-2.4J
Barium	6.3-486J	7.1J-7.8J
Beryllium	0.07-0.56	ND
Cadmium	0.11J-4.7	0.11J
Chromium	3.3-49.2	3.3-5.8
Cobalt	0.93-34.7	1.6
Copper	0.71J-1,020	0.71-7.8
Lead	0.36J-966J	0.73-1
Mercury	0.04-0.85	ND
Nickel	1.2J-63.3	1.2
Selenium	0.23J-1.8J	ND
Silver	0.38J-0.63	ND
Tin	1J-181	1J-1.9J
Vanadium	3.6J-154J	3.6J-19.3
Zinc	1.7J-1,780	1.7J-6

**Notes:**<sup>(1)</sup> - Data from 1995-1996 investigation (Baker, 1998).<sup>(2)</sup> - Data from 1997 investigation (Baker, 1998).

ND - Not Detected.

NA - Not Analyzed.

J - Analyte was positively identified. Reported value may not be accurate or precise.

TABLE 5-12

Revised 12/23/02

**SUMMARY OF ORGANIC DETECTION IN TRIP BLANK SAMPLES  
SWMU 3 -BASE LANDFILL  
MARCH 2002 RCRA FACILITY INVESTIGATION  
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO**

Sample ID Sample Date	EPA Region III		3TB01 03/01/02	3TB02 03/04/02	3TB03 03/05/02	3TB04 03/06/02	Number Exceeding Federal MCL	Range Exceeding Federal MCL	Number Exceeding EPA Region III Tap Water RBC	Range Exceeding EPA Region III Tap Water RBC	Location Maximum Detect
	Federal MCL (ug/L)	Tap Water RBC (ug/L)									
<b>Volatiles (ug/L)</b>											
Carbon disulfide	NE	100	5 U	5 U	1.9 J	5 U	NE		0/4		3TB03
Methylene chloride	5	4.1	5 U	5 U	0.64 J	0.7 J	0/4		0/4		3TB04
Toluene	1,000	74.7	5 U	5 U	5 U	0.68 J	0/4		0/4		3TB04

**Notes:**

J - Estimated value.

U - Not detected.

NE - Not Established.

ug/L - micrograms per liter.

## **6.0 CONCLUSIONS AND RECOMMENDATIONS**

The following section provides the conclusions and recommendations for the base landfill as determined from the findings of the investigations discussed previously.

### **6.1 Conclusions**

This section of the report provides overall conclusions regarding groundwater and sediment from the Base Landfill based on results of this and past field investigations.

Based on the groundwater results from the March 2002 field investigation, benzo (a) pyrene, arsenic, and thallium were the only constituents found to exceed the Federal MCLs as shown on Figure 6-1. Benzo (a) pyrene was found in monitor well R7GW01R, which is just southwest of the wastewater treatment plant and north of the landfill. It should be noted that the groundwater flow direction from this well is radially to the southwest, south, and southeast, towards the landfill, as shown on Figures 3-1 and 3-2. Therefore it is unlikely that this constituent is associated with SWMU 3. None of the VOCs, pesticides, or chlorinated herbicides detected was in excess of the Federal MCLs. No PCBs, OP-pesticides, dioxins/furans, or explosives were detected in any of the samples.

Total arsenic and total thallium was detected in monitor well R7GW04R in excess of the Federal MCL. Arsenic was not detected in the dissolved sample but thallium was detected in the dissolved sample from this location. This monitor well is located in the extreme southwestern portion of the site. Total thallium was also detected in monitor well R7GW02R along the western side of the site. The dissolved fraction of thallium was not detected from this well.

Four inorganic constituents (copper, nickel, thallium, and zinc) were detected in the total groundwater samples in excess of the surface water screening values. Further evaluation of these constituents consistent with the CNO policy for conducting ecological risk assessments determined that no further evaluation is recommended as presented in Section 5.1.1.

Figure 6-1 provides the constituents that were detected in the groundwater samples in excess of the screening criteria.

No further action was proposed for sediment at SWMU 3 in the Draft RFI Report for Additional Investigations at OU 1, 6, and 7 (Baker, 1998a). The EPA responded to this recommendation by requesting the Navy address their comments, as well as to revise the risk assessment for this site. The Navy responded to the EPA's comments on November 24, 1998 with a response to comment letter including the revised risk assessment for this site. The Navy indicated in their response to comment letter that the primary risks identified in the Phase I HEA included the sediments from the end of the cooling water tunnel at Puerca Bay (SMWU 11/45), as well as the sediments associated with SWMU 2. After further review, the samples from SWMU 11/45 should not have been included in the HEA since they are not apart of the Ensenada Honda sediments. The sediment samples collected at SWMU 2 are near shore sediments, likely to have been impacted by erosion of the SWMU 2 soil. Therefore, it was Navy's technical opinion that these near shore sediment samples be addressed along with SWMU 2 during the CMS stage for this site. The Navy removed the sediment samples collected at SWMU 11/45 and SWMU 2 from the sediment database for AOC D. The Navy then performed a risk assessment on this new sediment database from AOC D (Baker, 1998b). This new risk assessment indicated that there were no unacceptable risks posed by the AOC D sediments, which includes SWMU 3 sediments. The EPA commented on the Navy's response to EPA comment letter by approving the Navy's no further action recommended for this site. This approval is based on the recommendation from the Navy that the sediment data for samples adjacent to SWMU 2 and samples adjoining the old power plant cooling water tunnel be excluded from the data set used in the risk assessment.

## **6.2 Recommendations**

The current round of groundwater sampling at the landfill facility does not indicate that the operation of the facility is negatively impacting the groundwater with respect to human health or the environment. This coupled with the fact that the landfill facility at NSRR is currently under operation in accordance with RCRA Subtitle D and groundwater is being monitored on a semi-annual basis. Therefore, pending approval of this RFI the Navy recommends that groundwater at SWMU 3 be continued to be monitored under the RCRA Subtitle D program to ensure that groundwater is not being impacted by landfill operations. The Navy also recommends that additional analysis of the following PAHs (benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene), SVOC (1,4-dioxane), along with the following pesticide (beta-BHC) be performed at this site during the next round of groundwater sampling to monitor the results of these constituents detected during the RFI investigation. This analysis will continue until these

constituents are not detected for two consecutive Subtitle D investigations. The results of each RCRA Subtitle D investigation will be provided to both the EQB and EPA as required by 40 CFR Part 258.

No further action is required with respect to the sediment as discussed in the previous section.

With the completion of the groundwater investigation requirements, the RFI stage at SWMU 3 is now considered complete. Any further action following this RFI for this facility will be deferred until SWMU 3 is closed.

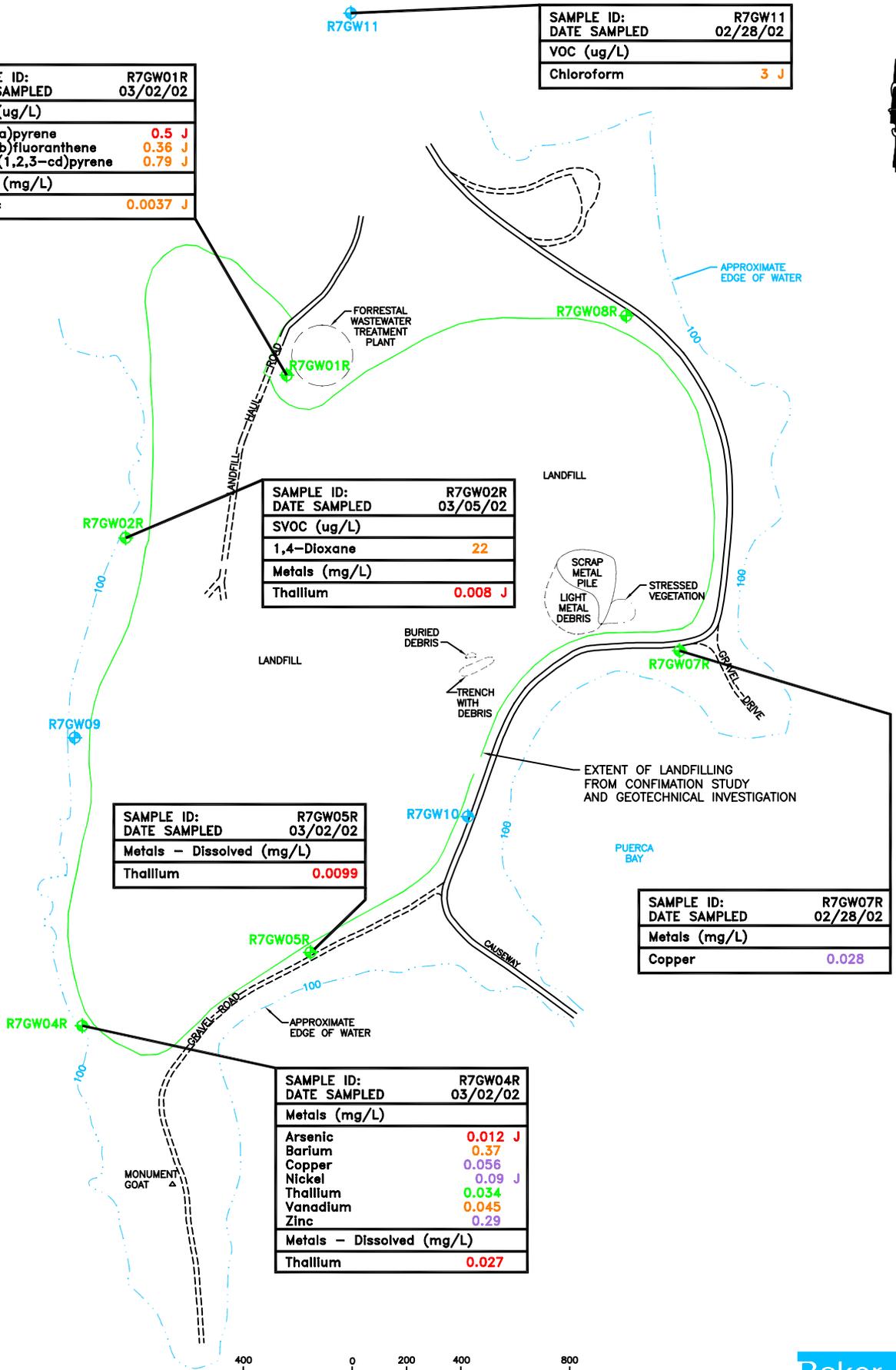
**SECTION 6.0**  
**FIGURES**

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SAMPLE ID:	R7GW01R
DATE SAMPLED	03/02/02
SVOC (ug/L)	
Benzo(a)pyrene	0.5 J
Benzo(b)fluoranthene	0.36 J
Indeno(1,2,3-cd)pyrene	0.79 J
Metals (mg/L)	
Arsenic	0.0037 J

SAMPLE ID:	R7GW11
DATE SAMPLED	02/28/02
VOC (ug/L)	
Chloroform	3 J

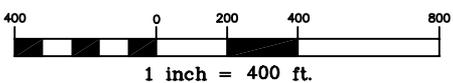


SAMPLE ID:	R7GW02R
DATE SAMPLED	03/05/02
SVOC (ug/L)	
1,4-Dioxane	22
Metals (mg/L)	
Thallium	0.008 J

SAMPLE ID:	R7GW05R
DATE SAMPLED	03/02/02
Metals - Dissolved (mg/L)	
Thallium	0.0099

SAMPLE ID:	R7GW07R
DATE SAMPLED	02/28/02
Metals (mg/L)	
Copper	0.028

SAMPLE ID:	R7GW04R
DATE SAMPLED	03/02/02
Metals (mg/L)	
Arsenic	0.012 J
Barium	0.37
Copper	0.056
Nickel	0.09 J
Thallium	0.034
Vanadium	0.045
Zinc	0.29
Metals - Dissolved (mg/L)	
Thallium	0.027



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**LEGEND**

- ◆ MONITOR WELL LOCATION (INSTALLED JUNE 1998, BURNS AND McDONNELL)
- ◆ MONITOR WELL LOCATION (INSTALLED DECEMBER 2000, BAKER)
- EXCEEDS EPA REGION III TAP WATER RBC.
- EXCEEDS EPA REGION III TAP WATER RBC AND FEDERAL MCL.
- EXCEEDS NSRR MARINE SURFACE WATER SCREENING VALUES.
- EXCEEDS EPA REGION III TAP WATER RBC, FEDERAL MCL, AND NSRR MARINE SURFACE WATER SCREENING VALUES.

**FIGURE 6-1**  
**GROUNDWATER DETECTIONS IN EXCESS OF SCREENING CRITERIA**  
**DRAFT RFI REPORT**  
**SWMU 3 - BASE LANDFILL**  
**MARCH 2002 RCRA FACILITY INVESTIGATION**  
**NAVAL STATION ROOSEVELT ROADS**  
**PUERTO RICO**

SOURCE: LANTDIV, FEB. 1992

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