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TCE Investigation Report for SWMU 7/8 - Tow Way Fuel Farm

Naval Station Roosevelt Roads
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Ceiba, Puerto Rico

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TABLE OF CONTENTS

Page

1.0 INTRODUCTION 1-1
1.1 Objectives 1-1
1.2 Report Organization 1-2

2.0 BACKGROUND 2-1
2.1 Facility Background 2-1
2.2 Tow Way Fuel Farm Background 2-1

3.0 TCE INVESTIGATION 3-1
3.1 Temporary Well Installation Procedures 3-1
3.2 Groundwater Sampling Procedures 3-3
3.3 Quality Assurance/Quality Control Procedures 3-4

4.0 PHYSICAL CHARACTERISTICS OF THE STUDY AREA 4-1
4.1 Climatology 4-1
4.2 Topography 4-2
4.3 Geology 4-2
4.4 Hydrogeology 4-4

5.0 NATURE AND EXTENT OF CONTAMINATION 5-1
5.1 Shallow Temporary and Permanent Wells 5-2
5.2 Deep Temporary Wells 5-3
5.3 Dense, Non-Aqueous Phase Liquid (DNAPL) 5-4
5.4 QA/QC Sampling 5-5

6.0 BASELINE HUMAN HEALTH RISK 6-1
6.1 Hazard Identification 6-2
6.1.1 Data Collection 6-2
6.1.2 Identification of COPCs 6-2
6.2 Dose-Response Assessment 6-3
6.2.1 Non-carcinogenic Dose Response Assessment 6-3
6.2.2 Carcinogenic Dose Response Assessment 6-4
6.2.3 Dermal Absorption Efficiency 6-5
6.3 Exposure Assessment 6-5
6.3.1 Conceptual Site Model 6-6
6.3.2 Quantification of Exposure 6-7
6.3.3 Exposure Parameters 6-8
6.4 Risk Characterization 6-8
6.4.1 Quantification and Characterization of Carcinogenic Risks 6-8
6.4.2 Quantification and Characterization of Noncarcinogenic Risks 6-9
6.4.3 Potential Human Health Effects 6-9
6.4.4 Uncertainty Analysis 6-10
6.5 Summary of the Baseline HHRA 6-11

7.0 CONCLUSIONS AND RECOMMENDATIONS 7-1

7.1 Conclusions 7-1
7.2 Recommendations 7-1

8.0 REFERENCES 8-1

LIST OF TABLES

3-1 Temporary Well Installation Screening Decision Criteria
3-2 Temporary Well Construction Summary
3-3 Sample Summary Matrix

5-1 On-Site Laboratory Analytical Data Summary
5-2 Stateside Laboratory Analytical Data Summary
5-3 QA/QC Sample Analytical Data Summary

6-1 Comparing Chemicals in Groundwater to Region III Risk Based Tap Water Concentrations and USEPA Maximum Level Concentrations
6-2 Chemicals of Concern Respective RFD and CSF
6-3 Critical Effects and Target Organs
6-4 Exposure Parameters for Human health Risk Assessment
6-5 Summary of Potential Human Health Risks

LIST OF FIGURES

2-1 Regional Location Map
2-2 TCE Investigation Location Map

3-1 TCE Investigation Temporary Well Locations

4-1 Fence Diagram and Cross Section Location Map
4-2 Fence Diagram
4-3 Cross Section A-A’
4-4 Cross Section B-B’
4-5 Surface of Hard Bedrock

5-1 Shallow Temporary Well Analytical Data, On-Site and Stateside Laboratories
5-2 Deep Temporary Well Analytical Data, On-Site and Stateside Laboratories

6-1 TCE Plume Represented by Shallow Temporary Wells
6-2 TCE Plume Represented by Deep Temporary Wells

APPENDICIES

A Test Boring and Well Construction Records
B Chain of Custody Forms
C Risk Assessment Calculation

LIST OF ACRONYMS AND ABBREVIATION

AOC	Area of Concern
Baker	Baker Environmental, Inc.
bgs	below ground surface
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CMS	Corrective Measures Study
DNAPL	Dense, Non-Aqueous Phase Liquid
DoN	Department of the Navy
DRMO	Defense Reutilization and Marketing Office
°C	Degrees Centigrade
°F	Degrees Fahrenheit
HSWA	Hazardous and Solid Waste Amendments
IAS	Initial Assessment Study
IR	Installation Restoration (Program)
LANTDIV	Atlantic Division, Naval Facilities Engineering Command
MCL	Maximum Concentration Limit
MW	Monitoring Well
NEESA	Naval Energy and Environmental Support Activity
NSRR	Naval Station Roosevelt Roads
NTR	Navy Technical Representative
PVC	Poly-Vinyl Chloride
QA/QC	Quality Assurance/Quality Control
QC	Quality Control
RBC	Risk-Based Concentration
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SWMU	Solid Waste Management Unit
TCE	Trichloroethene
TW	Temporary Well
TWFF	Tow Way Fuel Farm
µg/L	micrograms per liter
UGW	Monitoring Well
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VOCs	Volatile Organic Compounds

1.0 INTRODUCTION

This document presents the results from the trichloroethene (TCE) investigation at Solid Waste Management Unit (SWMU) 7, Tow Way Fuel Farm (TWFF), Naval Station Roosevelt Roads, Ceiba, Puerto Rico. This TCE investigation was conducted June 1999. This 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.

On October 20, 1994 the United States Environmental Protection Agency (USEPA) Region II issued a Final Resource Conservation and Recovery Act (RCRA) Part B Permit (RCRA/HSWA Permit No. PR2170027203) to Naval Station Roosevelt Roads (NSRR). This permit contains requirements for RCRA Facility Investigation (RFI) activities at 24 solid waste management units (SWMUs) and 3 areas of concern (AOCs). 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.

1.1 Objectives

The objective of this investigation was to:

- Confirm the presence of TCE in groundwater
- Identify the presence or absence of DNAPL
- Determine the extent of contamination
- Provide an assessment of human health risk
- Determine what further actions are warranted

The objective of this report is to present and evaluate the data collected during the investigation. The evaluation consists of development of a stratigraphic conceptual model and a discussion of presence of the TCE within that model context. This report will assist in assessing if any further action is warranted at the site investigated.

1.2 Report Organization

Section 1.0 of this document includes this introduction and the objectives of this report. Section 2.0 provides a description of the facility and historical background. Section 3.0 describes the field activities undertaken during the investigation. Section 3.0 also describes sampling procedures, sampling locations, and quality control (QC) conducted during the sampling activities. Section 4.0 provides a description of the physical characteristics (i.e., geology and hydrology of the investigation area). Section 5.0 describes the nature and extent of contaminants detected. A human health risk assessment is provided in Section 6.0. Section 7.0 presents conclusions and recommendations. Section 8.0 provides references used in this report.

2.0 BACKGROUND

This section contains a description Naval Station Roosevelt Roads physical setting, facility background, and a summary of the history of the site investigated.

2.1 Facility Background

NSRR occupies part 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 of San Juan, along Route 3. The closest large town is Fajardo (population approximately 37,000), which is about 4 miles north of NSRR off Route 3. Ceiba (population approximately 17,000) adjoins the west boundary of NSRR (see Figure 2-1).

NSRR occupies over 33,500 acres and has administrative and command responsibilities for some operations separated from the main base on Vieques Island.

NSRR was commissioned in 1943 as a Naval Operations Base, and finally re-designated a Naval Station in 1957. The primary mission of NSRR today is provision of full support for Atlantic Fleet weapons training and development activities.

2.2 Tow Way Fuel Farm Background

The TWFF is located along Forrestal Drive (Figure 2-2) in NSRR. The TWFF has been the subject of numerous investigations extending back beyond the advent of RCRA corrective action requirements. A full RFI was performed at the site and a report issued. It was recommended in the report that a Corrective Measures Study (CMS) be performed at the site to select the appropriate corrective measure. The first step in the CMS was to perform certain additional investigations designed to fill data gaps remaining from the RFI. Groundwater samples were obtained during the additional investigations.

Groundwater samples were collected from wells at the TWFF during the CMS Investigation conducted in April 1998. TCE was detected at well 7-MW07 at 2,000 µg/L. TCE was also detected in well 7-MW08 at 3 µg/L. A focused investigation of the TCE occurrence was deemed warranted based on the maximum detection, its possible ramification in terms of a potential Dense Non-Aqueous Phase Liquid (DNAPL), and the historic use of the area.

Based on the CMS Investigation findings, a history of the buildings in proximity to 7-MW07 was compiled, based on interviews with station personnel. The building immediately northeast of 7-MW07 (Building 46 between Forrestal Drive and the well) was comprised of a half-cylindrical structure constructed of cloth over a frame, which was anchored to a concrete slab. The building was destroyed during Hurricane Georges (September 1998). A previous, more substantial structure located on the same pad was destroyed during Hurricane Hugo (September 1989). This building was reportedly to have been used for the storage and maintenance of small watercraft used in various harbor operations. While the repair activities have apparently been somewhat limited, the fact that maintenance was performed indicates the potential for cleaning and degreasing operations, which could have resulted in a release of solvents. Also, it is unclear to what extent the buildings were used for storage and what was stored. The potential of stored material release cannot be discounted.

3.0 TCE INVESTIGATION

The following subsections present a description of the activities conducted at the site. These activities included temporary well installation and groundwater sampling of the temporary wells and select existing permanent wells. Also included is a description of the Quality Assurance/Quality Control procedures employed during sampling.

3.1 Temporary Well Installation Procedures

In this report, temporary well locations are designated by "TW" (TW-A). Additionally, the shallow wells are designated by a lower case "s" in the suffix (TW-As), and deep wells are designated by a lower case "d" in the suffix (TW-Ad).

A total of 15 temporary well locations were placed at the site (Figure 3-1). Three temporary wells (designated TW-A, TW-B and TW-C) were installed in the vicinity of 7-MW07. An additional well (designated TW-E) was installed in the vicinity of 7-MW08. TW-D was attempted but not installed due to conditions described later. The temporary wells were generally placed in a series of arced rows around 7-MW07. The first row of temporary wells (A, B, and C) was radially located 50 feet from 7-MW07, while TW-D and TW-E were located 50 feet from 7-MW08. The second row of temporary wells (TW-1, TW-2, TW-3, and TW-4) was radially located 150 feet from 7-MW07. The third row of temporary wells (TW-101 through TW-105) was located from approximately 210 feet to 350 feet from well 7-MW07. Temporary well 7-TCE-MW07 was located approximately five feet south of 7-MW07. Two temporary wells were installed at most locations (TW-A through TW-C, TW-E, and TW-1 through TW-4). The shallow well was set within, or near the bottom of the water bearing zone, and the deeper well was set approximately 5 feet deeper. This was done to assist in determining if a DNAPL existed at the bottom of the water bearing zone. One temporary well was installed in the location, TW-101 through TW-105, and 7-TCE-MW07. It should be noted that the temporary wells were set deeper than prescribed in the work plan to determine the presence of DNAPL at the bottom of the water-bearing zone. Temporary well 7-TCE-MW07 was installed adjacent to 7-MW07 and to the bottom of the water-bearing zone to determine the presence of DNAPL at this location.

To delineate the extent of TCE contamination, the temporary wells were installed and sampled in a progressive fashion. A chronology of well installation and sampling at the site is provided in Table 3-1.

The temporary well borings were advanced using hollow-stem augers, air rotary, percussive air hammer, or a combination of the three methods. Hollow-stem augers were generally used in fill areas, marine sediment deposits and relatively soft bedrock. Auger refusal was encountered in bedrock and areas of hard cobbles and boulders. Air rotary drilling was used in relatively hard bedrock. Percussive air hammer was used where auger and air rotary methods could not advance the boring. The Test Boring and Well Construction Records (Appendix A) detail where each drilling method was employed. Table 3-2 provides temporary well construction details.

The bedrock encountered at TW-D and TW-E was very hard. Air rotary drilling could not advance those borings to the required depth. Similar conditions were also encountered when installing the deeper wells at TW-A, TW-B, and TW-C. A percussive air hammer was mobilized to complete TW-E and the deeper wells at TW-A, TW-B, and TW-C. In the interim, wells TW-1 through TW-4 were installed. The location of TW-4 was close to the attempted TW-D location, therefore it was then decided not to install TW-D.

Borings TW-A through TW-E and TW-1 through TW-4 were drilled, and wells installed in a similar fashion. Initially, the boreholes for TW-A through TW-C, TW-E, and TW-1 through TW-4 were set within, or near the bottom of the water-bearing zone. Where possible, split-spoon samples were collected at five-foot intervals. The purpose of this was to verify stratigraphy and identify areas of contamination. Samples were not collected for laboratory analysis. The weathered bedrock was extremely hard in many locations such that split spoon samples could not be collected. Thus, five-foot sampling intervals were not necessarily maintained. A boring log was maintained for each location and included information such as lithology, water occurrence, well installation details, and evidence of contamination.

Once each bore hole for TW-A through TW-C, TW-E, and TW-1 through TW-4 were at an appropriate depth, a temporary well was installed. This installation consisted of two-inch diameter, schedule 40 poly-vinyl chloride (PVC) riser, with five feet of 0.01 inch slotted screen at the bottom. The temporary well was covered at the surface to prevent inflow of surface water or accidental introduction of foreign material into the hole. After groundwater samples were

collected as described in Section 3.2, well materials were removed and the boreholes TW-A through TW-C, TW-E, and TW-1 through TW-4 were advanced an additional 5 feet and another well installed as described above. New well materials were used for each new well.

Borings for TW-101 through TW-105 and 7-TCE-MW07 were drilled, and wells installed in a similar fashion. The bore holes for these wells were advanced using auger or air hammer methods. Split spoon samples were not collected. Each of these well borings was advanced to the bottom of the water-bearing zone, similar to the other deep wells. When each boring was completed to the appropriate depth, temporary wells were installed. This installation consisted of two-inch diameter, schedule 40 PVC, riser with five feet of 0.01 inch slotted screen at the bottom. Only one well was installed at each location.

Upon completion of the sampling, all temporary wells were removed and the hole was backfilled with drill cuttings. The cuttings were placed in the hole at approximately the same depth from which they were derived.

3.2 Groundwater Sampling Procedures

Groundwater samples were collected from each temporary well. Wells were sampled at least eight hours after installation. Due to time constrains, TW-103 through TW-106 were sampled at least four hours after installation. Groundwater samples were obtained without purging, using a bottom filling bailer. It should be noted that purging is generally employed to ensure that fresh, formation water is sampled. In this case, the intent was to maximize the ability of the sampling to detect a DNAPL layer. A new bailer constructed of polyethylene was used for each sample. The bailer was emptied from the bottom directly into pre-labeled sample containers. The sample containers were placed on ice until delivery to the laboratory. Samples were kept under strict chain-of-custody, copies of the chain-of-custody forms are presented in Appendix B. Samples were collected for both mobile laboratory analysis and stateside laboratory analysis. Select samples were submitted to the stateside laboratory for confirmation analysis of the mobile laboratory. Table 3-3 provides a summary of which samples were submitted to the mobile and stateside laboratories.

To guide temporary well installation, the on-site mobile laboratory was used to analyze each sample. Analysis included BTEX parameters and select volatile organic compounds (VOCs), including TCE. The results were provided to the field personal within 24 hours to assist in determining placement of additional wells. Duplicate samples were collected at each temporary well for possible submission to a stateside laboratory. Based on the on-site laboratory results, select samples were submitted for stateside laboratory analysis for confirmation purposes. Section 3.3 discusses the frequency of stateside submission.

3.3 Quality Assurance/Quality Control Procedures

The investigations described are designed to verify the presence of TCE in the subsurface. The following steps were taken to ensure the data obtained meets the required standards:

- Approximately 75% of all samples with on-site laboratory detections of TCE were submitted to the stateside laboratory for confirmation.
- Approximately one sample of every four samples in which the on-site laboratory did not detect TCE was submitted to stateside laboratory for confirmation.
- Field equipment rinsate blank samples were collected to assess potential contamination related to field sampling equipment.
- Trip blank samples were employed to assess cross contamination during sample storage and shipping.
- Field blank samples were collected to assess the presence of contaminants in ambient field conditions.

Analysis in the stateside laboratory was performed in accordance with SW-846 methodologies. The stateside laboratory provided CLP equivalent data packages which were subjected to independent, third party, validation in accordance with EPA Region II protocol.

4.0 PHYSICAL CHARACTERISTICS OF THE STUDY AREA

The physical setting of NSRR was documented in the 1984 IAS (NEESA, 1984). This information is summarized below. Sections 4.1 and 4.2 were obtained from Baker's Draft Final RCRA Facility Investigation Report for Operable Units 3 and 5.

4.1 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 temperature ranges from 82.0° in January to 88.2°F in August. The mean annual minimum temperature varies from 64.0° in January to 73.2° in June. The highest maximum temperature recorded was 95°F, while the lowest minimum was 59°F. Rain usually occurs at least nine days in every month, with an average of 60 inches per year although a dry winter season occurs from December through April. About 22 thunderstorm-days occur per year, with maximum frequencies of three 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. Over the open sea, a maximum of clouds (usually broken stratocumulus) occurs during early morning, with the skies clearing or becoming scattered with cumulus by afternoon. Completely clear or overcast skies are rare during daylight hours, while clear skies frequently occur at night.

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

4.2 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 two 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 which reaches the Unaccompanied Enlisted Personnel Housing areas to an acceptable level. Relief is low along the shoreline. Lagoons and mangrove swamps are common.

4.3 Geology

Subsurface conditions at SWMU 7 have been illustrated by fence diagrams and cross sections (the locations of which are presented on Figure 4-1). The fence diagram is presented on Figure 4-2, and the geologic cross sections on Figures 4-3 and 4-4. The Test Boring and Well Construction records are contained in Appendix A. In general, the subsurface consists of

unconsolidated material, and bedrock. Each is discussed in the paragraphs that follow. It should be noted that all stratigraphic contacts are estimated because samples were collected at a minimum frequency of every 5 feet.

Two unconsolidated stratigraphic units were observed at SWMU 7, namely fill material and marine deposits. The fill material consists predominantly of rock fragments, with lesser amounts of sand, silt, and clay. The fill material was observed to consist mainly of cobbles and boulders in the vicinity of TW-2 and TW-3. Fill material generally extends from the ground surface to 5 to 10 feet below ground surface (bgs). The exception is at TW-E where the fill consists of asphalt roadway and sub-base, and extends to a depth of only about 1.5 feet bgs. As shown on Figures 4-2 and 4-3, the fill (the red unit) is thinnest near the hill along Forrestal Drive (UGW-19). The fill thickens southward toward TW-102 and Ensenada Honda. Marine deposits were found near Ensenada Honda, in TW-101 through TW-104 (Figure 4-2, the blue unit). These sediments pinch out northward, toward the TW-1 through TW-4 line. Marine sediments generally consist of sand and shell fragments. It is estimated that the marine deposits are thickest near TW-101 (4 feet bgs to 20 bgs).

Bedrock at SWMU 7 has previously been reported as Gabbro (Baker, 1997). Gabbro is an intrusive, mafic-mineral, igneous rock, which is generally fine-grained and dark green to black in color (Strahler 1981). This description is consistent with observations of unweathered rock at the site.

The bedrock at the site can be classified in two broad categories, relatively soft bedrock and relatively hard bedrock. The relatively soft bedrock was generally observed as decomposed (unconsolidated), with varying amounts of silt, clay and rock fragments (e.g., TW-C, 5-6 feet bgs). The relatively hard bedrock was observed as lithofied as well as weathered and unweathered. The fracturing of the weathered bedrock varies from many to few fractures, but is fairly consistent in color (brown). Unweathered bedrock appears very hard, with no to little fracturing, dark gray to black in color, and with an intact crystalline structure (e.g., TW-E, 1 to 8 feet bgs). For mapping and hydrogeologic purposes, “hard” bedrock is characterized by split-spoon drives of 50 blows or more per one six-inch interval or less. “Soft” bedrock is characterized by split-spoon drives of 50 blows or less per one six-inch interval, driven at least two six-inch intervals.

The depth and thickness of the "soft" and "hard" bedrock varies considerably. The soft bedrock is thickest in the vicinity of 7-MW07 (Figures 4-2 and 4-4). The "soft" bedrock thins to the south (TW-2 and TW-3 on Figure 4-2) and northeastward (UGW-21 on Figure 4-2 and TW-E on Figure 4-3). In fact, the "soft" bedrock was not observed in borings for UGW-21 and TW-E. The top of the "soft" bedrock dips downward, toward Ensenada Honda (between TW-2 and TW-102 on Figure 4-4). The top of the "hard" bedrock appears lowest in the vicinity of 7-MW07, which corresponds to the thickest observation of the "soft" bedrock (Figures 4-2 and 4-3). This situation results in a prominent bowl in the top surface of the "hard" bedrock, and is best illustrated on Figure 4-5. While there is an overall downward slope toward Ensenada Honda, the bowl interrupts this trend. The top of the "hard" bedrock is shallowest at TW-E, near the hillside along Forrestal Drive.

4.4 Hydrogeology

The water-bearing zone at the site is relatively thin and was encountered at varied depths. For this discussion and presentation, the water-bearing zone was determined by soil saturation observations during drilling. The water-bearing zone is indicated on Figures 4-2 through 4-4 by the black lines. Groundwater was shallowest in the TW-101 through TW-104 wells, approximately 8 bgs, and was deepest in TW-4, encountered at 25 feet bgs. The water-bearing zone ranges from approximately 3 feet thick at TW-C to 20 feet thick at TW-104.

The location and vertical extent of the water-bearing zone appears to be influenced by several factors, including:

- *Fractures and highly weathered zones* - Unweathered bedrock predominates at TW-E. The presence of groundwater was observed to be coincident with weathered drill cuttings. Prior drilling experience suggests that bedrock in fracture zones tends to exhibit weathering characteristics. Additionally, relatively hard, but weathered bedrock predominates at TW-C. A thin, relatively soft zone was encountered during drilling at TW-C between 17 and 20 feet bgs (Figure 4-2). This interval corresponded with the observance of groundwater.

- *The presence of unconsolidated sediments* - The water-bearing zone appeared most shallow and relatively thick where unconsolidated fill and marine sediment

were present (TW-101 through TW-104). These unconsolidated sediments are also thickest in this area.

- *The bowl feature in the top of the "hard" bedrock* - The water-bearing zone appears thickest where the "soft" bedrock is thickest (in the vicinity of 7-MW07). Groundwater appears to lie in the "soft" bedrock, or just within the "hard" bedrock in the vicinity of the bowl feature and the area south (particularly between 7-MW07 and TW-2 on Figure 4-2).

The groundwater flow direction at the site is to the south, toward Ensenada Honda. This interpretation is based on historical data. Groundwater levels were not included in the scope of this investigation. However, both the SWMU 7 RFI and the SWMU 7 CMS Investigation show groundwater flow to the south in the vicinity of the investigation area (Baker 1997 and 1999). The groundwater flow gradient is shallow, 0.003 feet/foot to the south (as determined from a groundwater surface contour map [Baker 1999]).

5.0 NATURE AND EXTENT OF CONTAMINATION

This section presents an overview of the chemical analytical results obtained as part of the TCE investigation at SWMU 7. This section details the occurrence of VOC contamination in groundwater, particularly TCE. This section also provides a discussion of DNAPL. Table 5-1 presents the on-site laboratory data. Table 5-2 presents the stateside laboratory data. Table 5-3 presents the QA/QC sampling data.

A comprehensive well sampling event was conducted during the CMS Investigation in 1998. TCE was undetected in wells west of this investigation site (Baker, 1999). It is assumed that TCE has remained undetected in these wells in 1999. With that assumption, the TCE plume is effectively surrounded by undetectable concentrations of TCE.

The on-site laboratory analyzed all groundwater samples. Additionally, a stateside laboratory analyzed a select number of samples for quality control purposes. A comparison of the two data sets (Figures 5-1 and 5-2) suggests two things:

- The on-site laboratory is a generally reliable qualitative tool. The fixed-base laboratory confirmed the mobile laboratory non-detects, and generally confirmed the detections. The exception is 7-TCE-As. The stateside laboratory detected TCE at 55 µg/L and the on-site laboratory did not detect TCE.

- The on-site laboratory is a generally not reliable quantitative tool. The differences in the detected levels of TCE vary, with no consistent trends. For example, the stateside and on-site laboratories compare favorably sample 7-TCE-Cs (25 µg/L and 30 µg/L, respectively). However, for 7-TCE-Cd, the comparison is poor (1,500 µg/L for stateside and 220 for on-site).

It can be concluded that the on-site laboratory data is sufficient for providing a general indication of where TCE is present, but is not for remedial design or risk assessment.

5.1 Shallow Temporary and Permanent Wells

Figure 5-1 summarizes VOCs detected in shallow well groundwater samples by the on-site and stateside laboratories. TCE was positively identified in the three wells comprising the 50 foot radius away from 7MW07. TCE was detected at 2,000 µg/L (on-site) at 7MW07 and two orders of magnitude less at the three wells (TW-A, TW-B, and TW-C) spaced 50 feet away from 7MW07. It should be noted that the concentration of TCE of 2,000 µg/L in 7MW07 from the on-site laboratory corresponded to the previous result obtained during the CMS Investigation of 2,000 µg/L. TCE was also positively detected in 7MW08 as it was in the CMS Investigation. TCE was not positively identified in any of the other shallow temporary wells at this site.

The stateside laboratory detected 1,1-dichloroethene below method detection limits (estimated at 3.8 µg/L). This compound was not analyzed by the on-site laboratory. 1,1-Dichloroethene is a degradation product of TCE. Thus, its presence in groundwater is expected in association with TCE.

Chloroform was detected in 7-MW07 (29 µg/L) by the on-site laboratory. Because the on-site laboratory provides a qualitative assessment of contamination, and chloroform was not detected by the stateside laboratory, this compound is not considered a chemical of concern. Additionally, chloroform was detected in field blank FB02 at 84 µg/L. A more detailed discussion of QA/QC samples is provided in Section 5.4. Chloromethane was detected by the on-site laboratory and is likely related to water chlorination.

Detections of VOCs were compared to screening criteria, including the Federal Maximum Concentration Limit (MCL) and the USEPA, Region III Tap Water Risk Based Concentration (RBC). Results of the comparisons are present on both Tables 5-1 and 5-2, as well as Figure 5-1. All positive detections of TCE were above both the MCL and RBC. The single detection of 1,1-dichloroethene was above the RBC.

It should be noted that well UGW-24 was re-sampled as part of this investigation. This well is not located in the study area, but in the extreme northern portion of the TWWF. TCE was detected in UGW-24 at 2 µg/L during the CMS Investigation. TCE was not detected during this investigation.

5.2 Deep Temporary Wells

Figure 5-2 summarizes VOCs detected in deep well groundwater samples by the on-site and stateside laboratories. TCE was positively identified in the three wells comprising the 50 foot radius away from 7MW07, two of the four wells comprising the 150 foot radius, and one of the five wells from the furthest ring of sampling locations from 7MW07. Each ring of samples was approximately one order of magnitude less then the preceding ring. TCE was not positively identified in any of the other deep temporary wells at this site. The majority of the TCE concentrations detected in the deep samples increased when compared to the samples collected from the shallow wells.

Several other VOCs were detected by the on-site laboratory, including benzene (TW-2), methylene chloride (TW-2 and TW-4), chloroform (TW-4 and 7-TCE-MW07), and bromodichloromethane (TW-2 and TW-4). The stateside laboratory does not confirm the presence of any of these compounds and, therefore, are not considered to be chemicals of concern. Chlorodibromomethane was detected by the on-site laboratory at two locations (TW-2 and W-4). Chloromethane was detected at one location and is most likely related to water chlorination. 1,1-Dichloroethene was detected in two of the wells (TW-3 and TW-C). 1,1-Dichlorethene is a daughter product of TCE. Thus, its presence in groundwater is expected in association with TCE. Additionally, chloroform was detected in field blank FB02 at 84 µg/L and bromodichloromethane was detected at 14 µg/L. Methylene chloride is common laboratory contaminant. Chlorodibromomethane and bromodichloromethane are byproducts of water chlorination. These compounds may be related to the on-site laboratory analytical contamination and/or ambient field conditions, as the stateside laboratory did not detect these compounds and, therefore, are not considered chemicals of concern.

Benzene may be related to the site given the location of the well to fuel handling facilities. However, two lines of evidence suggest that benzene is not a concern at the site. First, benzene was detected at only one location. Second, the stateside laboratory did not verify the detection.

Detections of VOCs were compared to screening criteria, including the Federal MCL and the USEPA RBC. Results of the comparisons are present on both Tables 5-1 and 5-2, as wells as Figure 5-2. All positive detections of TCE were above both the MCL and RBC.

5.3 Dense, Non-Aqueous Phase Liquid (DNAPL)

There are two lines of evidence for assessing the potential for DNAPL according to USEPA's "Estimating Potential for Occurrence of DNAPL at Superfund Sites" (USEPA, 1992a). These lines are historical site use information and site characterization data. Regarding historical use, information obtained by Baker (see Section 2.2) suggests that there was a potential for the use of limited quantities of degreasing solvents. Regarding site characterization data, some of the evidence gathered during the site investigation includes:

- Lack of soil discoloration
- Lack of solvent odor in the soil
- Lack of significant VOC vapors in soil cuttings or groundwater
- Lack of immiscble liquids in the wells, and in groundwater generated during drilling
- Maximum detection of TCE is below 1% of the solubility limit of TCE (USEPA, 1992a). The solubility of TCE is approximately 1,100,000 μg/L at 20°C. One percent of that is 11,000 μg/L. The maximum detection at the site is 2,000 μg/L.
- There are no anomalous upgradient or side gradient detections of TCE (USEPA, 1992a)
- TCE concentrations at the site decrease significantly (one to two orders of magnitude) in a distance of 50 feet.

The deep temporary wells were placed below the bottom of the water-bearing zone to capture DNAPL if present (Table 3-1 shows the elevation interval of well screens relative to the elevation of the water-bearing zone. Additionally, one temporary well was placed in the vicinity of 7-MW07, an identified water-bearing zone low spot. No DNAPL was detected in any of the temporary wells.

The investigations completed did not show any evidence that a DNAPL was present. In this scenario, the quantity of solvent spilled was likely insufficient to penetrate the water table. Groundwater became contaminated through infiltration of water and release of mobile gases.

5.4 QA/QC Samples

As discussed in Section 3.3 QA/QC samples were collected, including trip blanks, field blanks, and equipment rinsate blanks. Laboratory-grade water was used to collect the field blanks. All QA/QC samples were analyzed by the stateside laboratory. Table 5-3 provides a summary of analytical data associated with QA/QC samples collected for this investigation. VOCs were not detected in trip blanks or equipment rinsate blanks. Bromoform and chloroform were detected in the sample 99FB02 at 14 µg/L and 84 µg/L, respectively.

6.0 BASELINE HUMAN HEALTH RISK

This Baseline Human Health Risk Assessment (HHRA) was prepared for SWMU 7 at the Naval Station Roosevelt Roads, Puerto Rico as part of the RFI. The objectives of the HHRA were to identify Chemicals of Potential Concern (COPCs) in groundwater and to evaluate potential risks associated with direct contact exposures to these COPCs. No soil samples were collected. This HHRA was designed to evaluate the potential for the occurrence of both carcinogenic and non-carcinogenic health effects under Reasonable Maximum Exposure (RME) scenarios.

This HHRA was conducted in accordance with United States Environmental Protection Agency (EPA) regulations and is consistent with the following risk assessment guidance documents:

- Risk Assessment Guidance for Superfund (RAGS) Volume I Human Health Evaluation Manual Part A. USEPA 1989.
- Supplemental Guidance to RAGS: Calculating the Concentration Term. USEPA 1992b.
- Exposure Factors Handbook Volume 1 and II. USEPA 1997.
- Region III Risk Based Concentrations (RBCs). USEPA 1999a.
- Integrated Risk Information System. USEPA 1999b.

This HHRA is organized in the following manner (National Academy of Sciences National Research Council, 1983):

6.1 Hazard Identification - This section will provide a summary of the analytical data for groundwater and identify chemicals and media of concern.

6.2 Dose-Response Assessment - In this section reference doses and slope factors for each COPC are presented, and methods for assessing carcinogenic and non-carcinogenic dose-response relationships are discussed.

6.3 Exposure Assessment - This section identifies potentially exposed populations, exposure pathways, and exposure parameters used for estimating site-specific risk.

6.4 Risk Characterization - This section presents the estimated risks for each scenario and provides a qualitative uncertainty analysis.

6.5 Summary of the Baseline HHRA – This section will summarize the risk associated with potential exposures to COPCs in groundwater.

6.1 Hazard Identification

6.1.1 Data Collection

With the exception of samples collected from well 7MW7, results are presented for samples obtained from temporary wells. In general, samples collected from temporary wells are more turbid than those collected from permanent monitoring wells. Therefore, using temporary well data in an evaluation of human health risk can bias the end result because contaminants associated with soil particles are assumed to be dissolved in groundwater. This may not be the case and the results of such a risk assessment must be evaluated with this in mind.

Seventeen groundwater samples were collected at SWMU 7 and evaluated for organic chemicals. A more detailed description of sampling techniques and analysis can be found in Section 3.0 of this remedial investigation. Chloromethane was detected in two samples at concentrations ranging from 9.0 to 13.0 µg/L with an arithmetic mean of 11.0 µg/L. 1,1 Dichloroethene was detected in three samples with concentrations ranging from 3.0 to 5.0 µg/L and an arithmetic mean of 3.8 µg/L. Trichloroethene was detected in nine samples with concentrations ranging from 5.4 to 1,500 µg/L and an arithmetic mean of 173.4 µg/L.

6.1.2 Identification of COPCs

COPCs are those constituents having the greatest potential to affect human health and the environment. They are selected by comparing the maximum constituent concentrations detected in the environmental samples to regulatory criteria. Chemicals exceeding regulatory criteria are retained as COPCs for further evaluation; chemicals detected at concentrations below these criteria are not evaluated unless other circumstances (frequency of exposure or documented usage) warrant the reinclusion and further evaluation of chemicals selected as COPCs.

For this HHRA, Baker compared the chemicals in environmental samples to Region III Risk Based Concentrations (RBCs) (EPA 1999a). RBCs were derived using conservative EPA promulgated default values and the most recent toxicological criteria available. RBCs for potentially carcinogenic and non-carcinogenic chemicals were individually derived based on a target incremental lifetime cancer risk (ICR) of 1×10^{-6} and a target hazard quotient (HQ) of 1.0, respectively. For potential carcinogens, the toxicity criteria applicable to the derivation of the RBCs are chronic oral and inhalation cancer slope factors; for non-carcinogens they are oral and inhalation reference doses. Non-carcinogenic RBCs were adjusted downward to correspond to a target HQ of 0.1 rather than 1 to ensure that chemicals with additive effects are not prematurely eliminated during screening (EPA 1999a).

The maximum detected concentrations for chloromethane, 1,1 dichloroethene, and trichloroethene were compared to their respective Region III Tap Water Concentrations. The results of this screening process identified all three chemicals as COPCs. These results are presented in Table 6-1.

6.2 Dose Response Assessment

In this section the relationship between a dose of a chemical agent and frequency of an adverse effect in an exposed population will be characterized. Dose-response information or toxicity criteria have been obtained from the Integrated Risk Information System (IRIS) (EPA, 1999b).

6.2.1 Non-carcinogenic Dose Response Assessment

The potential non-carcinogenic health effects associated with exposures to non-carcinogenic COPCs were evaluated using acceptable daily intake levels established by EPA (1999b; 1999c). Acceptable daily intake levels for human populations that are not expected to cause adverse health effects over a lifetime of exposure are referred to as Reference Doses (RfD) and are expressed as mg/kg-day (EPA, 1989). Based on EPA toxicity criteria, the COPCs at the site evaluated for non-carcinogenic effects are aluminum, arsenic, barium, cadmium, chromium, copper, manganese, and vanadium. The RfDs developed by EPA for these chemicals are presented in Table 6-2. Table 6-3 presents the critical effect and target organ that serves as the basis for the toxicity criteria developed by the EPA.

6.2.2 Carcinogenic Dose Response Assessment

The potential carcinogenic health effects associated with exposures to carcinogenic COPCs were evaluated using cancer slope factors (CSF) established by EPA (1999b; 1999c). The CSF is an estimate of an upper-bound probability of an individual developing cancer as a result of a lifetime of exposure to a particular level or dose of a potential carcinogen. The cancer slope factor is expressed as $(mg/kg\text{-}day)^{-1}$. CSFs for oral and inhalation pathways have been developed. The CSFs developed by EPA for these chemicals are presented in Table 6-2. The following EPA Weight of Evidence (WOE) Classification was used to determine which COPCs will be evaluated for potential carcinogenic effects:

Group A	Human Carcinogen (sufficient evidence of carcinogenicity in humans)
Group B1	Probable Human Carcinogen (limited evidence of carcinogenicity in humans)
Group B2	Probable Human Carcinogen (sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans)
Group C	Possible Human Carcinogen (limited evidence of carcinogenicity in animal or lack of human data)
Group D	Not Classifiable as to Human Carcinogenicity (inadequate or no evidence)
Group E	Evidence of Noncarcinogenicity for Humans (no evidence of carcinogenicity in adequate studies)

COPCs are presented with their respective WOEs in Table 6-2. According to EPA guidance (1989), only those chemicals with Group A, B (B1 or B2), or C rankings were addressed for possible carcinogenic effects. Any chemical that is not listed by EPA with a WOE, but is considered likely to cause cancer was retained for further analysis. Specifically, trichloroethene, and chloromethane do not have assigned WOE classification and are listed on the IRIS database. However, they are considered likely to cause cancer by the EPA National Center for Exposure Assessment (NCEA) (EPA 1999c). Thus, they were retained for quantitative risk analysis based on provisional cancer slope factors provided by the NCEA (EPA, 1999c).

6.2.3 Dermal Absorption Efficiency

Many of the RfDs and CSFs are derived from oral toxicological studies based on administered doses, and they do not account for the amount of a substance that can penetrate exchange boundaries after contact (e.g., absorbed dose). As a result, there is very little information available regarding dermal toxicity criteria. Therefore, in order to account for a difference in toxicity between an administered dose and an absorbed dose, the RfDs and CSFs (that were based on an administered dose) were adjusted, as described by the EPA (EPA, 1989), using experimentally-derived oral absorption efficiencies. The noncarcinogenic dermal absorbed dose is derived by multiplying the RfD by an oral absorption efficiency. The carcinogenic dermal absorbed dose is derived by dividing the CSF by an oral absorption efficiency. The oral absorption efficiency (OAF) for TCE was identified as 1.0 (EPA 1999d). An OAF for 1,1 dichloroethene was not identified. An OAF for chloromethane was not required as non-carcinogenic effects associated with this chemical are not being evaluated in this HHRA because of the to lack of available toxicological information (EPA, 1999c).

6.3 Exposure Assessment

The exposures assessment estimates the magnitude of actual and/or potential human exposures, the frequency and duration of exposures, and the pathways (i.e., inhalation, ingestion, and dermal contact) by which people are potentially exposed (National Academy of Sciences National Research Council, 1983). In order for an exposure to occur, a complete pathway must exist with the following conditions:

-a source and mechanism of chemical release into the environment
-an environmental transport medium
-a point of potential human contact with the medium; and
-a human exposure route at the contact point.

This HHRA has already established a potential source (e.g. groundwater containing organic COPCs) and an environmental transport medium (e.g., groundwater). This section will present the exposure pathways and scenarios, and discuss the variables that will be used to estimate risk associated with these pathways.

6.3.1 Conceptual Site Model

Current exposure to groundwater at Roosevelt Roads is limited. Access to SWMU 7 is restricted to military personnel and on-site workers. Depth to groundwater at SWMU 7 is variable depending on topographic elevation but is encountered, on average, at approximately 10 feet bgs. Groundwater is not used as a potable source at Naval Station Roosevelt Roads. A potable water treatment plant that receives raw water from the Rio Blanco has serviced the Station for over 30 years and will do so for the indefinite future.

Groundwater throughout the Station exists in lenticular beds of clay, sand, rock and gravel. It is generally high in iron, manganese and other inorganics. Upgradient water supply wells developed in Ceiba (approximately three miles from Station headquarters) have since been abandoned because of high levels of salinity. Groundwater pump tests were conducted at Roosevelt Roads in early May, 1999. Pump tests were conducted for 2.5 days in duration (60 hours) using two well locations. The aggregate yield from these wells was 98.7 gallons per day (McLaren/Hart, Inc., 1999). Potable groundwater aquifers are considered those aquifers which can sustain a residential household requiring 150 gallons of water per day (USEPA, 1988).

Pump tests indicate that groundwater at Roosevelt Roads could not be used for potable purposes based on yield results in addition to the generally poor water quality. It is unlikely that groundwater will be used as a potable source in the future.

Future potential human receptors to contaminants in groundwater are limited to construction workers engaged in excavation activities. If workers dig to depths of 10 feet bgs or greater, they could contact contaminants in groundwater by accidental ingestion and dermal exposure. Inhalation exposures to volatilized organics from groundwater were also considered for the construction worker.

Receptor	**Environmental Media**	**Pathway**
Adult Construction Worker	Groundwater	Ingestion
		Dermal Contact
		Inhalation

6.3.2 Quantification of Exposure

The chemical concentrations used to estimate chronic daily intakes (CDIs) and dermal absorbed doses (DADs) for each medium are representative of the types of potential exposures encountered by each receptor. Exposure can occur discretely or at a number of sampling locations depending on the type of scenario considered for a given receptor. Furthermore, certain environmental media such as groundwater and surface water are migratory, and chemical concentrations detected in these media change frequently over time. Soil and sediment are, by nature, less transitory. The manner in which environmental data are represented also depends on the number of samples and sampling locations available for a given area and a given medium.

USEPA risk assessment guidance (USEPA, 1989) recommends that an upper bound estimate of the arithmetic mean concentration be used to calculate CDI. This estimate, which should be in the high end of the concentration frequency distribution, is called the RME concentration. The RME concentration is defined as the highest concentration that is reasonably expected to be contacted via a given pathway over a long-term exposure period.

To quantify exposure, analytical data must be evaluated to determine its distribution. In general, two types of distribution are applied to environmental data: the normal and lognormal distributions. Because of the relatively small size of the data set and the limited number of parameters, no evaluation of the distribution was conducted. For conservatism, a normal distribution was assumed and a normal 95th % upper-confidence limit (UCL) was derived according to the *Supplemental Guidance to RAGS: Calculating the Concentration Term (USEPA, 1992b).* The 95 percent UCL provides reasonable confidence that the true site average will not be underestimated (EPA 1992b)". In some cases where there is limited data, the 95% UCL may be greater than the maximum detected concentration. In this case the maximum detected concentration is used to calculate risk.

For results reported as "nondetect" (i.e., results flagged with the following validation qualifiers: U, UN), a value of one half of the sample-specific detection limit was used to calculate the 95% UCL.

6.3.3 Exposure Parameters

The parameters used to quantify potential chemical uptake from each complete exposure pathway can be found in Table 6-4. Each parameter was conservatively chosen from the standard default values provided by EPA in guidance documents (1989, 1991b, 1992c, 1997a,).

6.4 Risk Characterization

This section provides numerical estimates of human health and environmental risks posed by the presence of COPCs at the site.

6.4.1 Quantification and Characterization of Carcinogenic Risks

Quantitative risk calculations for potentially carcinogenic COPCs estimate inferentially (versus probabilistically) the potential ICR for an individual in a specified population. This unit of risk refers to a potential cancer risk that is above the background cancer risk in unexposed individuals. For example, an ICR of 1×10^{-6} indicates that an exposed individual has an increased probability of one in one million of developing cancer subsequent to exposure, over the course of his lifetime. The following equation was used in estimating the ICR:

ICR = Cancer Slope Factor (CSF) X Chronic Daily Intake (CDI)

The CSF is expressed as $(mg/kg\text{-}day)^{-1}$ and the chronic daily intake (CDI) is expressed as mg/kg-day. The aforementioned equation was derived assuming that cancer is a nonthreshold process and that the potential excess risk level is proportional to the cumulative intake over a lifetime.

For quantitative estimation of risk, it is assumed that cancer risks from various exposure routes are additive. Estimated ICR values will be compared to 1×10^{-6} to 1×10^{-4} which represents the target risk range of ICR values considered by the EPA to represent an acceptable (i.e., de minimus) risk (USEPA, 1990).

6.4.2 Quantification and Characterization of Noncarcinogenic Risks

Noncarcinogenic compounds assume that a threshold toxicological effect exists. Therefore, the potential for noncarcinogenic effects is calculated by comparing (i.e., dividing) CDI levels with RfDs for each COPC. Noncarcinogenic effects are estimated by calculating the HQ for individual chemicals and the hazard index (HI) for overall chemicals and pathways by the following equation:

Hazard Quotient = CDI/RfD

An HQ is the ratio of the daily intake or absorbed dose to the reference dose (or reference concentration for inhalation exposure). CDI is the chronic daily intake (mg/kg/day) of each COPC and RfD is the reference dose (mg/kg/day) of the COPC over a prolonged period of exposure. RfDi is the reference dose used when determining exposure due to inhalation. To account for the additivity of noncarcinogenic risk following exposure to numerous chemicals, the HI, which is the sum of all the HQs, will be calculated. A ratio of 1.0 is used for examination of the HQ and HI. Ratios less than 1.0 indicate that adverse noncarcinogenic health effects are unlikely. Ratios greater than 1.0 indicate the potential for adverse noncarcinogenic health effects to occur at that exposure level, and caution should be exercised. However, this does not mean that adverse effects will definitely be observed since the RfD incorporates safety and modifying factors to ensure that it is well below that dose for which adverse effects have been observed. This procedure assumes that the risks from exposure to multiple chemicals are additive, an assumption that is invalid for compounds that have different target organs or cause different, non-synergistic effects.

6.4.3 Potential Human Health Effects

Table 6-5 presents a summary of potential human health risks across all pathways of exposure. The total cancer risk across all media and exposure pathways is 5×10^{-6}. This value is within the generally acceptable risk range of 1×10^{-4} to 1×10^{-6}. The total noncancer HI was 1.8, which exceeds unity (1.0). This exceedance suggests that adverse systemic health effects could occur subsequent to exposure. The majority of the unacceptable HI value is associated with maximum groundwater concentrations of TCE detected in sample 7TCE-Cd.

6.4.4 Uncertainty Analysis

Uncertainties are encountered throughout the risk assessment process. This section discusses the sources of uncertainty inherent in the following elements of the human health evaluation performed SWMU 7

Uncertainties associated with sample collection groundwater samples were collected using temporary wells which, generally, for higher turbidity in samples submitted for laboratory analysis. At SWMU 7, the maximum detected TCE was 1,500 µg/L obtained from sample 7TCE-Cd. This elevated result, in combination with a limited data set skewed the calculation of the 95% UCL value so a maximum detected TCE value was used in risk characterization. The associated uncertainty is that risk estimates are biased high because of the nature of the groundwater investigation. Additional monitoring well installation around 7TCE-Cd and the collection of more representative samples could reduce the HI value of 1.8 to acceptable levels (i.e., below 1.0).

Uncertainties Associates with Additivity

Uncertainties associated with risk characterization include the assumption of chemical additivity and the inability to predict synergistic or antagonistic interactions between COPCs. These uncertainties are inherent in any inferential risk assessment. EPA promulgated inputs to the quantitative risk assessment and toxicological indices are calculated to be protective of the human receptor and to err conservatively, so that potential human health risks will not be underestimated.

Uncertainties with the Cancer Slope Factors

The oral carcinogenic slope factor for chloromethane was derived from an inhalation study (USEPA, 1997b, 1999c). There is no approved CsFo or CSFi for chloromethane, rather provisional values derived by NCEA and presented in the 1997 Health Effects Summary Tables were utilized. NCEA states that there are a significant number of uncertainties associated with a route to route extrapolation, and may not be appropriate. Chloromethane contributed 0.7% of the total cancer risk.

TCE was withdrawn from the IRIS database in 1989. The oral cancer slope factor used in this HHRA was derived by NCEA based on a 1985 Health Assessment Document. This value is provisional (EPA 1999c). EPA is currently updating its position on TCE health risk for both carcinogenic and non-carcinogenic health effects.

6.5 Risk Assessment Summary

The human health risk assessment indicates that construction workers who may dig to the water table and contact COPCs in groundwater as a result of excavation activities could experience adverse systemic health effects subsequent to exposure. No other human or ecological receptors were evaluated because of the nature of contamination at SWMU 7.

It was assumed that construction workers could be exposed to the volatile organic COPCs chloromethane, 1,1-dichloroethene and trichloroethene by accidental ingestion, dermal contact and inhalation pathways. A hazard index (HI) value of 1.8 was derived, which exceeds 1.0, suggesting the potential for adverse non-carcinogenic health effects. TCE was responsible for approximately 85% of this unacceptable HI value.

The potential carcinogenic risks associated with construction worker exposure to volatile organics in SWMU 7 groundwater fall within USEPAs generally acceptable risk range of 1×10^{-4} to 1×10^{-6}

7.0 CONCLUSIONS AND RECOMMENDATIONS

This section of the report provides conclusions based on analysis of the investigation findings. Recommendations are provided in response to the conclusions.

7.1 Conclusions

The presence of TCE in the study area was confirmed; however, DNAPL TCE was not detected in the investigation area and information collected to date suggests that free-phase DNAPL is not present in the aquifer.

Dissolved-phase TCE was observed in the water-bearing zone in the investigation area. The maximum concentration of TCE was detected in 7-MW07 at 2,000 µg/L. This confirms the initial detection during the CMS. All other detections were one to two orders-of-magnitude less. The plume as defined by the shallow temporary wells is limited in extent, primarily in the vicinity of 7-MW07, but also in the vicinity of 7-MW08. The plume extent is approximated on Figure 6-1. The plume as defined by the deep temporary wells extends approximately 200 feet from 7-MW07 in a comma shape toward Ensenada Honda. The plume extent is approximated on Figure 6-2.

In most cases the deep well was screened at or below the bottom of the water-bearing zone (Table 3-1) to detect any DNAPL or dissolved-phase TCE that possibly migrated to the bottom. Table 3-1 also shows that half of the shallow wells were installed at or below the bottom of the water-bearing zone. These instances where both wells were installed below the bottom of the water-bearing zone include TW-B, TW-C, TW-2, and TW-4. Because the deep wells were screened either at or below the water bearing zone, the wells provide an indication of whether or not a DNAPL exists. In addition, the groundwater quality data did not detect concentrations that were indicative of a DNAPL. As a result, a DNAPL is not likely present at the site.

7.2 Recommendations

A more detailed evaluation will be performed in the CMS which is currently under development for the Tow Way Fuel Farm. This evaluation will include remedial alternative evaluations as well as the development of risk based clean-up goals.

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TABLES

TABLE 3-1

TEMPORARY WELL INSTALLATION SCREENING DECISION CRITERIA
SWMU 7 - TCE INVESTIGATION
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO

Decision Criteria	Well Installed	Depth (ft bgs)	TCE Detected	Action
If TCE detected in TW-A install TW-1 and TW-2	TW-As	25	No	Install TW-1 and TW-2
	TW-Ad	30	Yes	
If TCE detected in TW-B install TW-1, TW-2, and TW-3	TW-Bs	25	Yes	Install TW-1, TW-2, and TW-3
	TW-Bd	30	Yes	
If TCE detected in TW-C install TW-3 and TW-4	TW-Cs	22.6	Yes	Install TW-3 and TW-4
	TW-Cd	27	Yes	
If TCE detected in any two wells TW-A, TW-B, and TW-C install TW-1 through TW-4	TW-As	25	No	Install TW-1 through TW-4
	TW-Ad	30	Yes	
	TW-Bs	25	Yes	
	TW-Bd	30	Yes	
	TW-Cs	22.6	Yes	
	TW-Cd	27	Yes	
If TCE detected in TW-D install TW-4 and TW-5	Refusal	11	Yes	No Additional Wells Installed
If TCE detected in TW-E install TW-5 and TW-6	TW-Es	25	No	No Additional Wells Installed
	TW-Ed	30	No	
If TCE detected in TW-1 install TW-101	TW-1s	25	No	No Additional Wells Installed
	TW-1d	30	No	
If TCE detected in TW-2 install TW-101 and TW-102	TW-2s	20	No	No Additional Wells Installed
	TW-2d	25	No	
If TCE detected in TW-3 install TW-102 and TW-103	TW-3s	16.5	No	Install TW-102 and TW-103
	TW-3d	20.5	Yes	
If TCE detected in TW-4 install TW-103, TW-104, and TW-105	TW-4s	29.3	No	Install TW-103, TW-104, and TW-105
	TW-4d	35	Yes	
If TCE detected in TW-101 evaluate delineation within site constraints	TW-101	22	No	Plume delineated
If TCE detected in TW-102 evaluate delineation within site constraints	TW-102	22	Yes	Plume delineated, headwall within 150 feet
If TCE detected in TW-103 evaluate delineation within site constraints	TW-103	22	No	Plume delineated
If TCE detected in TW-104 evaluate delineation within site constraints	TW-104	28	No	Plume delineated
If TCE detected in TW-105 evaluate delineation within site constraints	TW-105	28	No	Plume delineated

Notes:
ft bgs - feet below ground surface

TABLE 3-2

TEMPORARY WELL CONSTRUCTION SUMMARY
SWMU 7 - TCE INVESTIGATION
NAVAL STATION, ROOSEVELT ROADS, CEIBA, PUERTO RICO

Well ID	Top of Well Screen (ft. Datum)[3]	Bottom of Well Screen (ft. Datum)[3]	Screen Length (feet)	Top of Water [1] (ft. Datum)[3]	Bottom of WBZ [2] (ft. Datum)[3]	Thickness of WBZ (feet)
TW-As	92.54	87.54	5	97.54	82.54	15
TW-Ad	87.54	82.54	5			
TW-Bs	90.15	85.15	5	95.15	90.15	5
TW-Bd	85.15	80.15	5			
TW-Cs	95.78	90.78	5	96.38	93.38	3
TW-Cd	91.38	86.38	5			
TW-Es	90.70	85.70	5	90.70	>80.70	<10
TW-Ed	85.70	80.70	5			
TW-1s	88.93	83.93	5	93.93	83.93	10
TW-1d	83.93	78.93	5			
TW-2s	98.59	88.59	10	98.59	93.59	5
TW-2d	88.59	83.59	5			
TW-3s	97.94	92.94	5	99.44	97.09	2.35
TW-3d	93.94	88.94	5			
TW-4s	86.79	81.79	5	86.09	>74.09	<12
TW-4d	81.09	76.09	5			
TW-101	90.08	85.08	5	99.08	87.08	12
TW-102	89.55	84.55	5	98.55	86.55	12
TW-103	89.63	84.63	5	98.63	87.63	11
TW-104	86.51	81.51	5	101.51	82.51	19
TW-105 [4]	86.0	81.0	5	101.0	82.0	19
7-TCE-MW07	78.32	73.32	5	99.32	76.32	23

Notes:

[1] As interpreted by moisture content of soil samples
[2] WBZ = Water-Bearing Zone
[3] Datum plan used is mean low water = 100.00 ft. as established by U.S. Navy Survey Section as of November 1941.
[4] Well location not surveyed, elevations are estimated

TABLE 3-3

SAMPLE SUMMARY MATRIX
SWMU 7 - TCE INVESTIGATION
NAVAL STATION, ROOSEVELT ROADS, CEIBA, PUERTO RICO

Sample ID	Sample Date	Analysis Requested		Comments
		On-Site Laboratory VOCs	Stateside Laboratory VOCs	
7MW07	6/27/99	X		Groundwater
7MW07D	6/27/99	X		Duplicate
7MW08	6/27/99	X		Groundwater
UGW24	6/27/99	X		Groundwater
7TCE-As	6/24/99	X	X	Groundwater
7TCE-Ad	6/30/99	X	X	Groundwater
7TCE-Bs	6/24/99	X	X	Groundwater
7TCE-Bd	6/30/99	X	X	Groundwater
7TCE-Cs	6/26/99	X	X	Groundwater
7TCE-Cd	6/30/99	X	X	Groundwater
7TCE-Es	6/30/99	X	X	Groundwater
7TCE-EsD	6/30/99		X	Duplicate
7TCE-Ed	6/30/99	X		Groundwater
7TCE-1s	6/27/99	X	X	Groundwater
7TCE-1d	6/29/99	X	X	Groundwater
7TCE-2s	6/28/99	X		Groundwater
7TCE-2d	6/29/99	X	X	Groundwater
7TCE-3s	6/28/99	X		Groundwater
7TCE-3d	6/29/99	X	X	Groundwater
7TCE-4s	6/28/99	X	X	Groundwater
7TCE-4d	6/29/99	X	X	Groundwater
7TCE-101	6/30/99	X		Groundwater
7TCE-102	7/1/99	X	X	Groundwater
7TCE-103	6/30/99	X		Groundwater
7TCE-104	7/1/99	X	X	Groundwater
7TCE-105	7/1/99	X	X	Groundwater
7TCE-7MW07	7/2/99	X	X	Groundwater

TABLE 5-1

ON-SITE LABORATORY ANALYTICAL DATA SUMMARY
SWMU 7 - TCE INVESTIGATION
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO

		EPA Region III	"First Row" Temporary Wells							
	Federal	**Tap Water**	Shallow Wells				Deep Wells			
Sample ID	MCL	**RBC**	7TCE-As	7TCE-Bs	7TCE-Cs	7TCE-Es	7TCE-Ad	7TCE-Bd	7TCE-Cd	7TCE-Ed
Sample Date	(ug/l)	(ug/l)	06/25/99	06/24/99	06/26/99	06/30/99	06/30/99	06/30/99	06/30/99	07/01/99
Sample Type			Primary	Primary	Primary	Primary	Primary	Primary	Primary	Primary
Volatile Organic Compounds (ug/l)										
Benzene	5	0.36	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Bromodichloromethane	100	0.17	NA	NA	NA	5 U	5 U	5 U	5 U	5 U
Bromoform	100	8.50	NA	NA	NA	5 U	5 U	5 U	5 U	5 U
Chlorodibromomethane	100	0.13	NA	NA	NA	5 U	5 U	5 U	5 U	5 U
Chloroform	100	0.15	NA	NA	NA	5 U	5 U	5 U	5 U	5 U
Ethylbenzene	700	1300	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Methylene chloride	5	4.10	NA	NA	NA	5 U	5 U	5 U	5 U	5 U
Toluene	1000	750.0	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Trichloroethene	5	1.60	5 U	**42**	**30**	5 U	**98**	**92**	**220**	5 U
Xylene (total)	10000	12,000	15 U	15 U	15 U	15 U	15 U	15 U	15 U	15 U

Notes:
Shading indicates value exceeds Federal Maximum Contaminant Level for drinking water.
Bold face type indicates value exceeds USEPA Region III Tap water Risk Based Criteria.
U = Not detected; value presented is analytical reporting limit for compound.
NA = Not analyzed
(1) Field sample was actually 7TCE-102x (replaces data for 7TCE-102).

TABLE 5-1

ON-SITE LABORATORY ANALYTICAL DATA SUMMARY
SWMU 7 - TCE INVESTIGATION
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO

		EPA Region III	"Second Row" Temporary Wells							
	Federal	**Tap Water**	Shallow Wells				Deep Wells			
Sample ID	MCL	**RBC**	7TCE-1s	7TCE-2s	7TCE-3s	7TCE-4s	7TCE-1d	7TCE-2d	7TCE-3d	7TCE-4d
Sample Date	(ug/l)	(ug/l)	06/27/99	06/28/99	06/28/99	06/28/99	06/29/99	06/29/99	06/29/99	06/29/99
Sample Type			Primary	Primary	Primary	Primary	Primary	Primary	Primary	Primary
Volatile Organic Compounds (ug/l)										
Benzene	5	0.36	5 U	5 U	5 U	5 U	5 U	**28**	5 U	5 U
Bromodichloromethane	100	0.17	5 U	5 U	5 U	5 U	5 U	**8**	5 U	**7**
Bromoform	100	8.50	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Chlorodibromomethane	100	0.13	5 U	5 U	5 U	5 U	5 U	**5**	5 U	**6**
Chloroform	100	0.15	5 U	5 U	5 U	5 U	5 U	5 U	5 U	**18**
Ethylbenzene	700	1300	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Methylene chloride	5	4.10	5 U	5 U	5 U	5 U	5 U	**23**	5 U	**9**
Toluene	1,000	750.0	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Trichloroethene	5	1.60	5 U	5 U	5 U	5 U	5 U	5 U	**87**	**6**
Xylene (total)	10,000	12,000	15 U	15 U	15 U	15 U	15 U	15 U	15 U	15 U

Notes:
Shading indicates value exceeds Federal Maximum Contaminant Level for drinking water.
Bold face type indicates value exceeds USEPA Region III Tap water Risk Based Criteria.
U = Not detected; value presented is analytical reporting limit for compound.
NA = Not analyzed
(1) Field sample was actually 7TCE-102x (replaces data for 7TCE-102).

TABLE 5-1

ON-SITE LABORATORY ANALYTICAL DATA SUMMARY
SWMU 7 - TCE INVESTIGATION
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO

Sample ID Sample Date Sample Type	Federal MCL (ug/l)	**EPA Region III Tap Water RBC** (ug/l)	"Third Row" Temporary Wells					Adjacent to 7MW07
			7TCE-101 07/01/99 Primary	7TCE-102 [1] 07/02/99 Primary	7TCE-103 07/01/99 Primary	7TCE-104 07/02/99 Primary	7TCE-105 07/02/99 Primary	7TCE-MW07 07/02/99 Primary
Volatile Organic Compounds (ug/l)								
Benzene	5	0.36	5 U	5 U	5 U	5 U	5 U	5 U
Bromodichloromethane	100	0.17	5 U	5 U	5 U	5 U	5 U	5 U
Bromoform	100	8.50	5 U	5 U	5 U	5 U	5 U	5 U
Chlorodibromomethane	100	0.13	5 U	5 U	5 U	5 U	5 U	5 U
Chloroform	100	0.15	5 U	5 U	5 U	5 U	5 U	**6**
Ethylbenzene	700	1300	5 U	5 U	5 U	5 U	5 U	5 U
Methylene chloride	5	4.10	5 U	5 U	5 U	5 U	5 U	5 U
Toluene	1000	750.0	5 U	5 U	5 U	5 U	5 U	5 U
Trichloroethene	5	1.60	5 U	**19**	5 U	5 U	5 U	**210**
Xylene (total)	10000	12,000	15 U	15 U	15 U	15 U	15 U	15 U

Notes:
Shading indicates value exceeds Federal Maximum Contaminant Level for drinking water.
Bold face type indicates value exceeds USEPA Region III Tap water Risk Based Criteria.
U = Not detected; value presented is analytical reporting limit for compound.
NA = Not analyzed
[1] Field sample was actually 7TCE-102x (replaces data for 7TCE-102).

TABLE 5-1

ON-SITE LABORATORY ANALYTICAL DATA SUMMARY
SWMU 7 - TCE INVESTIGATION
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO

Sample ID Sample Date Sample Type	Federal MCL (ug/l)	**EPA Region III Tap Water RBC** (ug/l)	Permanent Wells 7MW07 06/27/99 Primary	7MW07D 06/27/99 Duplicate	7MW08 06/27/99 Primary	UGW24 06/27/99 Primary	Number Exceeding Federal MCL	Range Exceeding Federal MCL	**Number Exceeding Region III Tap Water RBC**	**Range Exceeding Region III Tap Water RBC**	Location Maximum Detect
Volatile Organic Compounds (ug/l)											
Benzene	5	0.36	5 U	5 U	5 U	5 U	1/26	28	1/26	28	7TCE-2D
Bromodichloromethane	100	0.17	5 U	5 U	5 U	5 U	0/23		2/23	7-8	7TCE-2D
Bromoform	100	8.50	5 U	5 U	5 U	5 U	0/23		0/23		
Chlorodibromomethane	100	0.13	5 U	5 U	5 U	5 U	0/23		2/23	5-6	7TCE-4D
Chloroform	100	0.15	**29**	**13**	5 U	5 U	0/23		4/23	6-29	7MW07
Ethylbenzene	700	1300	5 U	5 U	5 U	5 U	0/26		0/26		
Methylene chloride	5	4.10	5 U	5 U	5 U	5 U	2/23	9-23	2/23	9-23	7TCE-2D
Toluene	1,000	750.0	5 U	5 U	5 U	5 U	0/26		0/26		
Trichloroethene	5	1.60	**2,000**	**1,800**	**17**	5 U	12/26	6-2,000	12/26	6-2,000	7MW07
Xylene (total)	10,000	12,000	15 U	15 U	15 U	15 U	0/26		0/26		

Notes:
Shading indicates value exceeds Federal Maximum Contaminant Level for drinking water.
Bold face type indicates value exceeds USEPA Region III Tap water Risk Based Criteria.
U = Not detected; value presented is analytical reporting limit for compound.
NA = Not analyzed

TABLE 5-2

STATESIDE LABORATORY ANALYTICAL DATA SUMMARY
SWMU 7 - TCE INVESTIGATION
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO

Location	Federal MCL	**EPA Region III Tap Water RBC**	"First Row" Temporary Wells							
			Shallow Wells					Deep Wells		
Sample ID			7TCE-As	7TCE-Bs	7TCE-Cs	7TCE-Es	7TCE-EsD	7TCE-Ad	7TCE-Bd	7TCE-Cd
Sample Date	(ug/l)	(ug/l)	06/25/99	06/25/99	06/27/99	06/30/99	06/30/99	06/30/99	06/30/99	06/30/99
Sample Type			Primary	Primary	Primary	Primary	Duplicate	Primary	Primary	Primary
Volatile Organic Compounds (ug/l)										
Acetone	NE	610	50 U	50 U	50 U	50 U	50 U	50 U	50 U	500 U
Benzene	5	0.36	5 U	5 U	5 U	5 U	5 U	5 U	5 U	50 U
Bromodichloromethane	100	0.17	5 U	5 U	5 U	5 U	5 U	5 U	5 U	50 U
Bromoform	100	8.5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	50 U
2-Butanone (MEK)	NE	1,900	25 U	25 U	25 U	25 U	25 U	25 U	25 U	250 U
Carbon disulfide	NE	1,000	5 U	5 U	5 U	5 U	5 U	5 U	5 U	50 U
Carbon tetrachloride	5	0.16	5 U	5 U	5 U	5 U	5 U	5 U	5 U	50 U
Chlorobenzene	NE	110	5 U	5 U	5 U	5 U	5 U	5 U	5 U	50 U
Chloroethane	NE	3.6	10 U	10 U	10 U	10 U	10 U	10 U	10 U	100 U
Chloroform	100	0.15	5 U	5 U	5 U	5 U	5 U	5 U	5 U	50 U
Chloromethane	NE	2.1	10 U	10 U	10 U	10 U	10 U	10 U	10 U	100 U
1,1-Dichloroethane	NE	800	5 U	5 U	5 U	5 U	5 U	5 U	5 U	50 U
1,2-Dichloroethane	5	0.12	5 U	5 U	5 U	5 U	5 U	5 U	5 U	50 U
1,1-Dichloroethene	7	0.044	5 U	**3.8** J	5 U	5 U	5 U	**5**	5 U	50 U
cis-1,2-Dichloroethene	70	61	5 U	5 U	5 U	5 U	5 U	5 U	5 U	50 U
trans-1,2-Dichloroethene	100	120	5 U	5 U	5 U	5 U	5 U	5 U	5 U	50 U
1,2-Dichloropropane	5	0.16	5 U	5 U	5 U	5 U	5 U	5 U	5 U	50 U

Notes:
Shading indicates exceedance of Federal MCL for drinking water.
Bold indicates exceedance of USEPA Region III Tap water RBC.
U - Not detected.
NE - Criteria Not Established.

TABLE 5-2 (Continued)

STATESIDE LABORATORY ANALYTICAL DATA SUMMARY
SWMU 7 - TCE INVESTIGATION
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO

Location	Federal MCL	**EPA Region III Tap Water RBC**	"First Row" Temporary Wells							
			Shallow Wells					Deep Wells		
Sample ID			7TCE-As	7TCE-Bs	7TCE-Cs	7TCE-Es	7TCE-EsD	7TCE-Ad	7TCE-Bd	7TCE-Cd
Sample Date	(ug/l)	(ug/l)	06/25/99	06/25/99	06/27/99	06/30/99	06/30/99	06/30/99	06/30/99	06/30/99
Sample Type			Primary	Primary	Primary	Primary	Duplicate	Primary	Primary	Primary
Volatile Organic Compounds (ug/l)										
cis-1,3-Dichloropropene	NE	NE	5 U	5 U	5 U	5 U	5 U	5 U	5 U	50 U
trans-1,3-Dichloropropene	NE	NE	5 U	5 U	5 U	5 U	5 U	5 U	5 U	50 U
Dibromochloromethane	100	0.13	5 U	5 U	5 U	5 U	5 U	5 U	5 U	50 U
Ethylbenzene	700	1300	5 U	5 U	5 U	5 U	5 U	5 U	5 U	50 U
2-Hexanone	NE	1500	25 U	25 U	25 U	25 U	25 U	25 U	25 U	250 U
Methyl bromide	NE	8.5	10 U	10 U	10 U	10 U	10 U	10 U	10 U	100 U
Methyl isobutyl ketone (MIBK)	NE	140	25 U	25 U	25 U	25 U	25 U	25 U	25 U	250 U
Methylene chloride	5	4.10	5 U	5 U	5 U	5 U	5 U	5 U	5 U	50 U
Styrene	100	1600	5 U	5 U	5 U	5 U	5 U	5 U	5 U	50 U
1,1,2,2-Tetrachloroethane	NE	0.053	5 U	5 U	5 U	5 U	5 U	5 U	5 U	50 U
Tetrachloroethene	5	1.1	5 U	5 U	5 U	5 U	5 U	5 U	5 U	50 U
Toluene	1,000	750	5 U	5 U	5 U	5 U	5 U	5 U	5 U	50 U
1,1,1-Trichloroethane	200	540	5 U	5 U	5 U	5 U	5 U	5 U	5 U	50 U
1,1,2-Trichloroethane	5	0.19	5 U	5 U	5 U	5 U	5 U	5 U	5 U	50 U
Trichloroethene	5	1.6	**55**	**92**	**25**	5 U	5 U	**140**	**66**	**1,500**
Vinyl chloride	2	0.019	10 U	10 U	10 U	10 U	10 U	10 U	10 U	100 U
Xylene (total)	10,000	12,000	10 U	10 U	10 U	10 U	10 U	10 U	10 U	100 U

Notes:
Shading indicates exceedance of Federal MCL for drinking water.
Bold indicates exceedance of USEPA Region III Tap water RBC.
U - Not detected.
NE - Criteria Not Established.

TABLE 5-2 (Continued)

STATESIDE LABORATORY ANALYTICAL DATA SUMMARY
SWMU 7 - TCE INVESTIGATION
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO

Location	Federal MCL (ug/l)	**EPA Region III Tap Water RBC** (ug/l)	"Second Row" Temporary Wells					
			Shallow Wells		Deep Wells			
Sample ID			7TCE-1s	7TCE-4s	7TCE-1d	7TCE-2d	7TCE-3d	7TCE-4d
Sample Date			06/26/99	06/28/99	06/29/99	06/29/99	06/29/99	06/29/99
Sample Type			Primary	Primary	Primary	Primary	Primary	Primary
Volatile Organic Compounds (ug/l)								
Acetone	NE	610	50 U	50 U	50 U	50 U	50 U	50 U
Benzene	5	0.36	5 U	5 U	5 U	5 U	5 U	5 U
Bromodichloromethane	100	0.17	5 U	5 U	5 U	5 U	5 U	5 U
Bromoform	100	8.5	5 U	5 U	5 U	5 U	5 U	5 U
2-Butanone (MEK)	NE	1,900	25 U	25 U	25 U	25 U	25 U	25 U
Carbon disulfide	NE	1,000	5 U	5 U	5 U	5 U	5 U	5 U
Carbon tetrachloride	5	0.16	5 U	5 U	5 U	5 U	5 U	5 U
Chlorobenzene	NE	110	5 U	5 U	5 U	5 U	5 U	5 U
Chloroethane	NE	3.6	10 U	10 U	10 U	10 U	10 U	10 U
Chloroform	100	0.15	5 U	5 U	5 U	5 U	5 U	5 U
Chloromethane	NE	2.1	**13**	10 U	10 U	10 U	**9** J	10 U
1,1-Dichloroethane	NE	800	5 U	5 U	5 U	5 U	5 U	5 U
1,2-Dichloroethane	5	0.12	5 U	5 U	5 U	5 U	5 U	5 U
1,1-Dichloroethene	7	0.044	5 U	5 U	5 U	5 U	**3** J	5 U
cis-1,2-Dichloroethene	70	61	5 U	5 U	5 U	5 U	5 U	5 U
trans-1,2-Dichloroethene	100	120	5 U	5 U	5 U	5 U	5 U	5 U
1,2-Dichloropropane	5	0.16	5 U	5 U	5 U	5 U	5 U	5 U

Notes:
Shading indicates exceedance of Federal MCL for drinking water.
Bold indicates exceedance of USEPA Region III Tap water RBC.
U - Not detected.
NE - Criteria Not Established.

TABLE 5-2 (Continued)

STATESIDE LABORATORY ANALYTICAL DATA SUMMARY
SWMU 7 - TCE INVESTIGATION
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO

Location	Federal MCL	**EPA Region III Tap Water RBC**	"Second Row" Temporary Wells					
			Shallow Wells		Deep Wells			
Sample ID			7TCE-1s	7TCE-4s	7TCE-1d	7TCE-2d	7TCE-3d	7TCE-4d
Sample Date	(ug/l)	(ug/l)	06/26/99	06/28/99	06/29/99	06/29/99	06/29/99	06/29/99
Sample Type			Primary	Primary	Primary	Primary	Primary	Primary
Volatile Organic Compounds (ug/l)								
cis-1,3-Dichloropropene	NE	NE	5 U	5 U	5 U	5 U	5 U	5 U
trans-1,3-Dichloropropene	NE	NE	5 U	5 U	5 U	5 U	5 U	5 U
Dibromochloromethane	100	0.13	5 U	5 U	5 U	5 U	5 U	5 U
Ethylbenzene	700	1300	5 U	5 U	5 U	5 U	5 U	5 U
2-Hexanone	NE	1500	25 U	25 U	25 U	25 U	25 U	25 U
Methyl bromide	NE	8.5	10 U	10 U	10 U	10 U	10 U	10 U
Methyl isobutyl ketone (MIBK)	NE	140	25 U	25 U	25 U	25 U	25 U	25 U
Methylene chloride	5	4.10	5 U	5 U	5 U	5 U	5 U	5 U
Styrene	100	1600	5 U	5 U	5 U	5 U	5 U	5 U
1,1,2,2-Tetrachloroethane	NE	0.053	5 U	5 U	5 U	5 U	5 U	5 U
Tetrachloroethene	5	1.1	5 U	5 U	5 U	5 U	5 U	5 U
Toluene	1,000	750	5 U	5 U	5 U	5 U	5 U	5 U
1,1,1-Trichloroethane	200	540	5 U	5 U	5 U	5 U	5 U	5 U
1,1,2-Trichloroethane	5	0.19	5 U	5 U	5 U	5 U	5 U	5 U
Trichloroethene	5	1.6	5 U	5 U	5 U	5 U	**44**	5 U
Vinyl chloride	2	0.019	10 U	10 U	10 U	10 U	10 U	10 U
Xylene (total)	10,000	12,000	10 U	10 U	10 U	10 U	10 U	10 U

Notes:
Shading indicates exceedance of Federal MCL for drinking water.
Bold indicates exceedance of USEPA Region III Tap water RBC.
U - Not detected.
NE - Criteria Not Established.

TABLE 5-2 (Continued)

STATESIDE LABORATORY ANALYTICAL DATA SUMMARY
SWMU 7 - TCE INVESTIGATION
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO

Location Sample ID Sample Date Sample Type	Federal MCL (ug/l)	**EPA Region III Tap Water RBC** (ug/l)	"Third Row" Temporary Wells			Adjacent to 7MW07
			7TCE-102 07/01/99 Primary	7TCE-104 07/01/99 Primary	7TCE-105 07/01/99 Primary	7TCEMW7 07/01/99 Primary
Volatile Organic Compounds (ug/l)						
Acetone	NE	610	50 U	50 U	50 U	500 U
Benzene	5	0.36	5 U	5 U	5 U	50 U
Bromodichloromethane	100	0.17	5 U	5 U	5 U	50 U
Bromoform	100	8.5	5 U	5 U	5 U	50 U
2-Butanone (MEK)	NE	1,900	25 U	25 U	25 U	250 U
Carbon disulfide	NE	1,000	5 U	5 U	5 U	50 U
Carbon tetrachloride	5	0.16	5 U	5 U	5 U	50 U
Chlorobenzene	NE	110	5 U	5 U	5 U	50 U
Chloroethane	NE	3.6	10 U	10 U	10 U	100 U
Chloroform	100	0.15	5 U	5 U	5 U	50 U
Chloromethane	NE	2.1	10 U	10 U	10 U	100 U
1,1-Dichloroethane	NE	800	5 U	5 U	5 U	50 U
1,2-Dichloroethane	5	0.12	5 U	5 U	5 U	50 U
1,1-Dichloroethene	7	0.044	5 U	5 U	5 U	50 U
cis-1,2-Dichloroethene	70	61	5 U	5 U	5 U	50 U
trans-1,2-Dichloroethene	100	120	5 U	5 U	5 U	50 U
1,2-Dichloropropane	5	0.16	5 U	5 U	5 U	50 U

Notes:
Shading indicates exceedance of Federal MCL for drinking water.
Bold indicates exceedance of USEPA Region III Tap water RBC.
U - Not detected.
NE - Criteria Not Established.

TABLE 5-2 (Continued)

STATESIDE LABORATORY ANALYTICAL DATA SUMMARY
SWMU 7 - TCE INVESTIGATION
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO

Location Sample ID Sample Date Sample Type	Federal MCL (ug/l)	**EPA Region III Tap Water RBC** (ug/l)	"Third Row" Temporary Wells			Adjacent to 7MW07
			7TCE-102 07/01/99 Primary	7TCE-104 07/01/99 Primary	7TCE-105 07/01/99 Primary	7TCEMW7 07/01/99 Primary
Volatile Organic Compounds (ug/l)						
cis-1,3-Dichloropropene	NE	NE	5 U	5 U	5 U	50 U
trans-1,3-Dichloropropene	NE	NE	5 U	5 U	5 U	50 U
Dibromochloromethane	100	0.13	5 U	5 U	5 U	50 U
Ethylbenzene	700	1300	5 U	5 U	5 U	50 U
2-Hexanone	NE	1500	25 U	25 U	25 U	250 U
Methyl bromide	NE	8.5	10 U	10 U	10 U	100 U
Methyl isobutyl ketone (MIBK)	NE	140	25 U	25 U	25 U	250 U
Methylene chloride	5	4.10	5 U	5 U	5 U	50 U
Styrene	100	1600	5 U	5 U	5 U	50 U
1,1,2,2-Tetrachloroethane	NE	0.053	5 U	5 U	5 U	50 U
Tetrachloroethene	5	1.1	5 U	5 U	5 U	50 U
Toluene	1,000	750	5 U	5 U	5 U	50 U
1,1,1-Trichloroethane	200	540	5 U	5 U	5 U	50 U
1,1,2-Trichloroethane	5	0.19	5 U	5 U	5 U	50 U
Trichloroethene	5	1.6	**5.4**	5 U	5 U	**1,000**
Vinyl chloride	2	0.019	10 U	10 U	10 U	100 U
Xylene (total)	10,000	12,000	10 U	10 U	10 U	100 U

Notes:
Shading indicates exceedance of Federal MCL for drinking water.
Bold indicates exceedance of USEPA Region III Tap water RBC.
U - Not detected.
NE - Criteria Not Established.

TABLE 5-2 (Continued)

STATESIDE LABORATORY ANALYTICAL DATA SUMMARY
SWMU 7 - TCE INVESTIGATION
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO

Location Sample ID Sample Date Sample Type	Federal MCL (ug/l)	**EPA Region III Tap Water RBC** (ug/l)	Criteria Exceedance Summary				
			Number Exceeding Federal MCL	Range Exceeding Federal MCL	Number Exceeding Tap Water RBCs	Range Exceeding Tap Water RBCs	Location Maximum Detect
Volatile Organic Compounds (ug/l)							
Acetone	NE	610	NE		0/12		
Benzene	5	0.36	0/18		0/18		
Bromodichloromethane	100	0.17	0/18		0/18		
Bromoform	100	8.5	0/18		0/18		
2-Butanone (MEK)	NE	1,900	NE		0/18		
Carbon disulfide	NE	1,000	NE		0/18		
Carbon tetrachloride	5	0.16	0/18		0/18		
Chlorobenzene	NE	110	NE		0/18		
Chloroethane	NE	3.6	NE		0/18		
Chloroform	100	0.15	0/18		0/18		
Chloromethane	NE	2.1	NE		2/18	9 J - 13	7TCE-1S
1,1-Dichloroethane	NE	800	NE		0/18		
1,2-Dichloroethane	5	0.12	0/18		0/18		
1,1-Dichloroethene	7	0.044	0/18		3/18	3 J - 5	7TCE-AD
cis-1,2-Dichloroethene	70	61	0/18		0/18		
trans-1,2-Dichloroethene	100	120	0/18		0/18		
1,2-Dichloropropane	5	0.16	0/18		0/18		

Notes:
Shading indicates exceedance of Federal MCL for drinking water.
Bold indicates exceedance of USEPA Region III Tap water RBC.
U - Not detected.
NE - Criteria Not Established.

TABLE 5-2 (Continued)

STATESIDE LABORATORY ANALYTICAL DATA SUMMARY
SWMU 7 - TCE INVESTIGATION
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO

Location Sample ID Sample Date Sample Type	Federal MCL (ug/l)	**EPA Region III Tap Water RBC** (ug/l)	Criteria Exceedance Summary				
			Number Exceeding Federal MCL	Range Exceeding Federal MCL	Number Exceeding Tap Water RBCs	Range Exceeding Tap Water RBCs	Location Maximum Detect
Volatile Organic Compounds (ug/l)							
cis-1,3-Dichloropropene	NE	NE	NE		NE		
trans-1,3-Dichloropropene	NE	NE	NE		NE		
Dibromochloromethane	100	0.13	0/18		0/18		
Ethylbenzene	700	1300	0/18		0/18		
2-Hexanone	NE	1500	NE		0/18		
Methyl bromide	NE	8.5	NE		0/18		
Methyl isobutyl ketone (MIBK)	NE	140	NE		0/18		
Methylene chloride	5	4.10	0/18		0/18		
Styrene	100	1600	0/18		0/18		
1,1,2,2-Tetrachloroethane	NE	0.053	NE		0/18		
Tetrachloroethene	5	1.1	0/18		0/18		
Toluene	1,000	750	0/18		0/18		
1,1,1-Trichloroethane	200	540	0/18		0/18		
1,1,2-Trichloroethane	5	0.19	0/18		0/18		
Trichloroethene	5	1.6	9/18	5.4 - 1,500	9/18	5.4 - 1,500	7TCE-CD
Vinyl chloride	2	0.019	0/18		0/18		
Xylene (total)	10,000	12,000	0/18		0/18		

Notes:
Shading indicates exceedance of Federal MCL for drinking water.
Bold indicates exceedance of USEPA Region III Tap water RBC.
U - Not detected.
NE - Criteria Not Established.

TABLE 5-3

TRIP BLANKS, FIELD BLANKS, AND EQUIPMENT RINSATE BLANKS
SWMU 7 - TCE INVESTIGATION
NAVAL STATION ROOSEVELT ROADS, CIEBA, PUERTO RICO

Location	Trip Blanks					Field Blanks		Equipment Blanks		
Sample ID	7TCE-TB01	7TB02	9TB03	9TB04	9TB07	99FB01	99FB02	99-ER02	99-ER03	99-ER04
Sample Date	06/25/99	07/01/99	06/28/99	06/29/99	06/30/99	06/30/99	06/30/99	06/30/99	06/30/99	06/30/99
Sample Type	Trip Blank	Trip Blank	Trip Blank	Trip Blank	Trip Blank	Field Blank	Field Blank	Equip Rinse	Equip Rinse	Equip Rinse
Volatile Organic Compounds (ug/l)										
Acetone	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Benzene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Bromodichloromethane	5 U	5 U	5 U	5 U	5 U	5 U	14	5 U	5 U	5 U
Bromoform	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2-Butanone (MEK)	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
Carbon disulfide	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Carbon tetrachloride	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Chlorobenzene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Chloroethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Chloroform	5 U	5 U	5 U	5 U	5 U	5 U	84	5 U	5 U	5 U
Chloromethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
cis-1,2-Dichloroethene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
cis-1,3-Dichloropropene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Dibromochloromethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1-Dichloroethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1-Dichloroethene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,2-Dichloroethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,2-Dichloropropane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Ethylbenzene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2-Hexanone	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
Methyl bromide	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Methyl isobutyl ketone (MIBK)	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
Methylene chloride	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Styrene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1,2,2-Tetrachloroethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Tetrachloroethene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Toluene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
trans-1,2-Dichloroethene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
trans-1,3-Dichloropropene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1,1-Trichloroethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U

TABLE 5-3 (continued)

TRIP BLANKS, FIELD BLANKS, AND EQUIPMENT RINSATE BLANKS
SWMU 7 - TCE INVESTIGATION
NAVAL STATION ROOSEVELT ROADS, CIEBA, PUERTO RICO

Location	Trip Blanks					Field Blanks		Equipment Blanks		
Sample ID	7TCE-TB01	7TB02	9TB03	9TB04	9TB07	99FB01	99FB02	99-ER02	99-ER03	99-ER04
Sample Date	06/25/99	07/01/99	06/28/99	06/29/99	06/30/99	06/30/99	06/30/99	06/30/99	06/30/99	06/30/99
Sample Type	Trip Blank	Trip Blank	Trip Blank	Trip Blank	Trip Blank	Field Blank	Field Blank	Equip Rinse	Equip Rinse	Equip Rinse
1,1,2-Trichloroethane	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Trichloroethene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Vinyl chloride	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Xylene (total)	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Miscellaneous (ug/l)										
Gasoline Range Organics	0.25 U	NA	NA	NA	NA	50 U	50 U	50 U	50 U	NA
Diesel Range Organics	NA	NA	NA	NA	NA	100 U	100 U	100 U	100 U	NA

Notes:
U = Not detected; value presented is analytical reporting limit for compound.
NA = Not analyzed

TABLE 6-1

COMPARING CHEMICALS IN GROUNDWATER TO REGION III RISK BASED TAP WATER CONCENTRATIONS AND USEPA MAXIMUM LEVEL CONCENTRATIONS
SWMU 7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

	Maximum Concentration	Tap Water RBC(1)	Does it Exceed?	Location of Maximum Concentration	Range of Concentrations	Frequency of Detection
Volatile Organic Chemicals (ug/l)						
Chloromethane	13	2.11 C	YES	7TCE-1s	9.0-13	2/17
1,1 Dichloroethene	3.8 J	0.04 C	YES	7TCE-Bs	3.0-3.8	2/17
Trichloroethene	1500	1.55 C	YES	8TCE-Cd	5.4-1,500	6/17

(1) Region III Risk Based Concentrations (RBC) USEPA 1999a.
J Estimated Value
C Carcinogen

TABLE 6-2

CHEMICALS OF CONCERN RESPECTIVE RFD AND CSF
SWMU 7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

Chemical Of Concern	Source	RfDo mg/kg/d	CSFo 1/mg/kg/d	RfDo mg/kg/d	CSFi 1/mg/kg/d	EPA WOE
Chloromethane	EPA-NCEA	NA(1)	1.3×10^{-2}	8.6×10^{-2}	3.5×10^{-3}	NA(2)
1,1 Dichloroethene	IRIS	9.0×10^{-3}	6.0 x 10-1	NA	1.75×10^{-1}	C
Trichloroethene	EPA-NCEA	6.0×10^{-3}	1.1 x 10-2	NA	6×10^{-3}	NA(3)

Notes:
(1) Not Available (EPA, 1999c)
(2) Not listed as a carcinogen by EPA on the IRIS database, thus no WOE information is available. However, the National Center for Environmental Assessment does list this chemical as likely to be a carcinogen and provides a provisional cancer slope factor (EPA, 1999c)
(3) Withdrawn from the IRIS data base in 1989, but was previously listed as a B2 carcinogen (EPA, 1999c)

WOE EPA Weight of Evidence Classification
IRIS Integrated Risk Information System EPA 1999b.
EPA NCEA United States Environmental Protection Agency National Center for Environmental Assessment

TABLE 6-3

CRITICAL EFFECTS AND TARGET ORGANS
SWMU 7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

Chemicals Of Concern	Target Organ	Critical Effect
Chloromethane	Not Specified	Not Specified
1,1 Dichloroethene[(1)]	Liver	Lesions
Trichloroethene[(2)]	Liver	Not specified

Notes:

(1) Integrated Risk Information System EPA 1999b.
(2) Current Drinking Water Criteria EPA 1999

TABLE 6-4

EXPOSURE PARAMETERS FOR HUMAN HEALTH RISK ASSESSMENT
SWMU 7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

			Excavator Worker	
			Adult	Reference
Exposure Duration	ED	year	1	Professional
Exposure Frequency	EF	days/year	120	Professional
Exposure Time-Water	ET_w	hours/day	8	Professional
Averaging Time	AT	days		
carcinogenic			25,550	USEPA 1989
non-carcinogenic			365	USEPA 1989
Body Weight	BW	kg	70	USEPA 1989
Ingestion Rate-water	IR_w	L/day	0.05	USEPA 1992b(1)
Surface Area-water	SA_w	cm^2	5,000	USEPA 1997
Inhalation Rate	IR	m^3/day	12	USEPA 1997(2)
Volatilzation Factor	K	L/m^3	0.5	USEPA 1989
Dermal Permeability Factor	Kp	cm/hr		
Chloromethane			0.0042	USEPA 1992b
1,1 Dichloroethene			0.016	USEPA 1992b
Trichloroethene			0.016	USEPA 1992b

Notes:
(1) Surface water ingestion rate for swimmers was conservatively used USEPA 1992b
(2) This inhalation rate was derived from USEPA 1997 and represents a 8 hour work day with a 1.5 m^3/day inhalation rate.

TABLE 6-5

SUMMARY OF POTENTIAL HUMAN HEALTH RISKS
CONSTRUCTION WORKERS EXPOSED TO COPCs IN GROUNDWATER -SWMU 7
NAVAL BASE ROOSEVELT ROADS, PUERTO RICO

	Cancer Risks					Noncancer Risks					
Medium	Chemical	Ingestion	Dermal	Inhalation	Exposure Routes Total	Chemical	Primary Target Organ	Ingestion	Dermal	Inhalation	Exposure Route Total
Groundwater	Chloromethane	6.E-09	2.E-09	2.E-08	3.E-08	Chloromethane	NA	NA	NA	5.E-03	5.E-03
	1,1-Dichloroethene	1.E-07	2.E-07	5.E-07	8.E-07	1,1-Dichloroethene	Liver	2.E-03	3.E-03	_--	4.E-03
	Trichloroethene	7.E-07	1.E-06	5.E-06	7.E-06	Trichloroethene	Liver	7.E-01	1.E+00	_--	1.8
Subtotal		8.E-07	1.E-06	6.E-06	8.E-06	Subtotal		7.E-01	1.E+00	5.E-03	1.8
Total Cancer Risk across all media and all exposure routes					8.E-06	Total Hazard Index across all media and all exposure routes					1.8

FIGURES

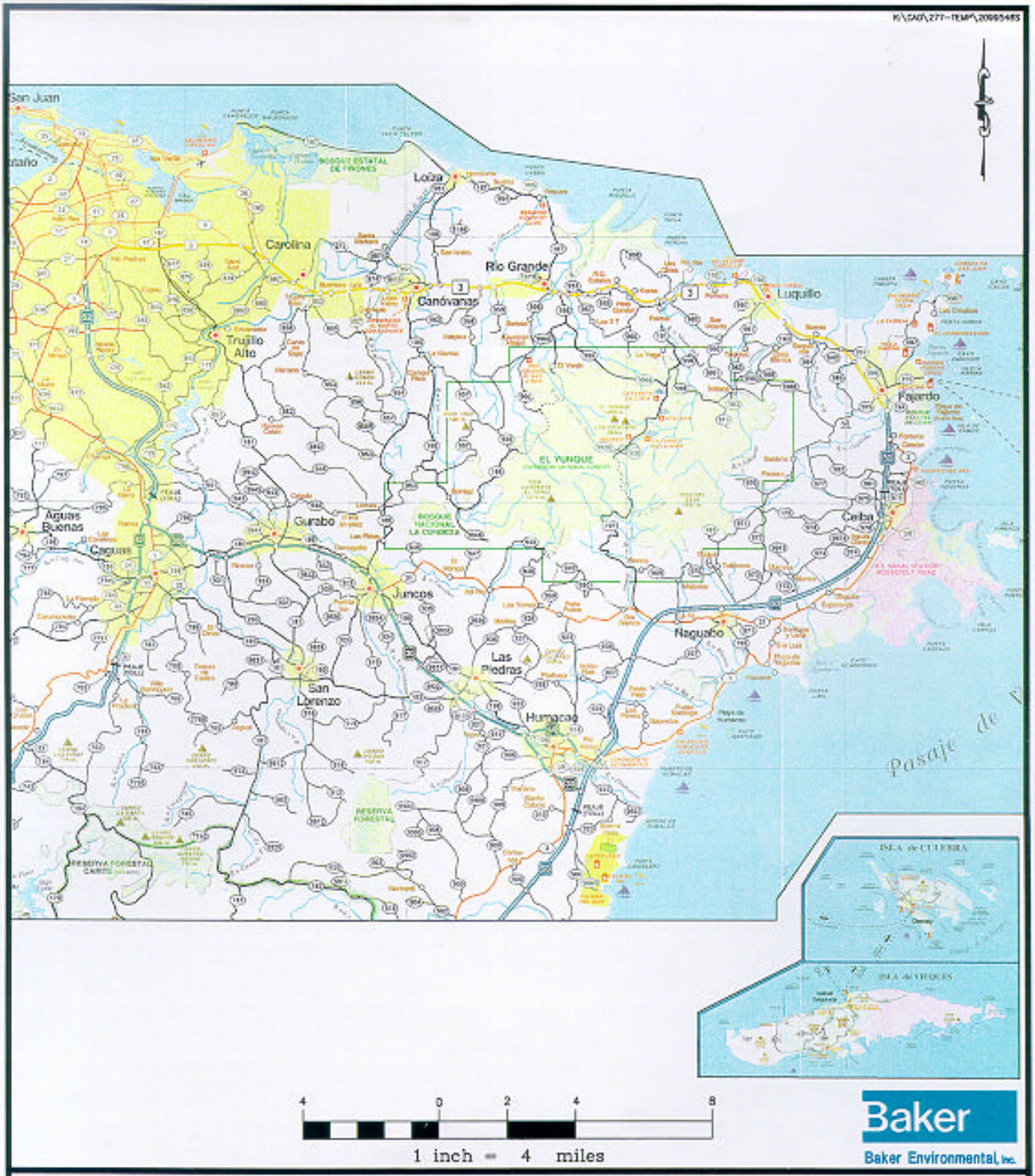
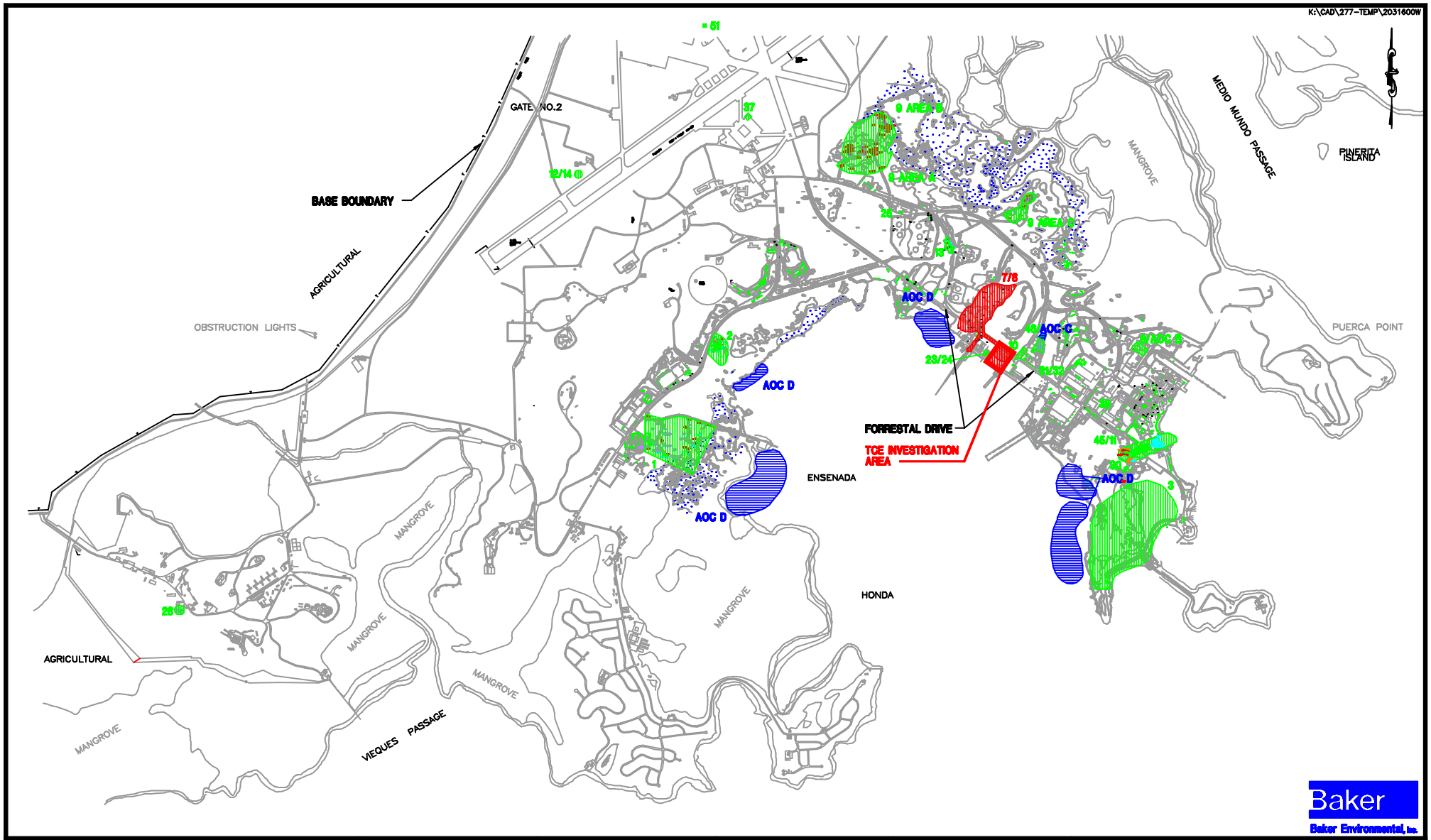


FIGURE 2-1
REGIONAL LOCATION MAP

NAVAL STATION ROOSEVELT ROADS
PUERTO RICO

SOURCE: METRODATA, INC., 1999.



LEGEND

1 – SWMUs

7/8 – SWMU AREA UNDER INVESTIGATION

AOC D – AOCs

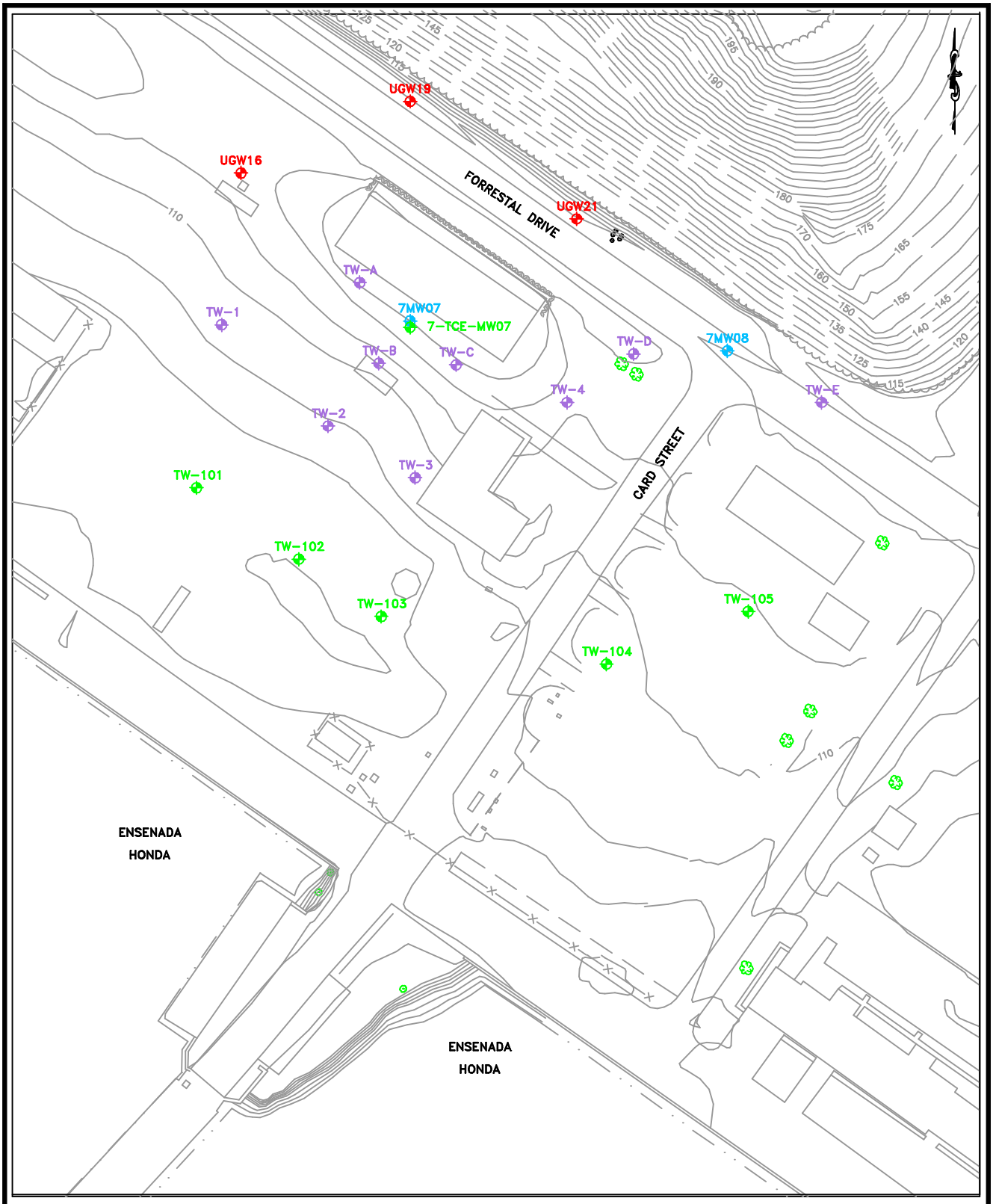
SOURCE: LANTDIV, FEB. 1992/1997

2500 0 1250 2500

1 inch = 2500 ft.

FIGURE 2-2
TCE INVESTIGATION LOCATION MAP

NAVAL STATION ROOSEVELT ROADS
PUERTO RICO



80 0 40 80
1 inch = 80 ft.

NOTE:
DATUM PLAN USED IS MEAN LOW WATER = 100.00 FT. AS ESTABLISHED BY U.S. NAVY SURVEY SECTION AS OF NOVEMBER 1941.
LOCATION OF TW-105 APPROXIMATED.

K:\CAD\277-TEMP\2031500W

Baker

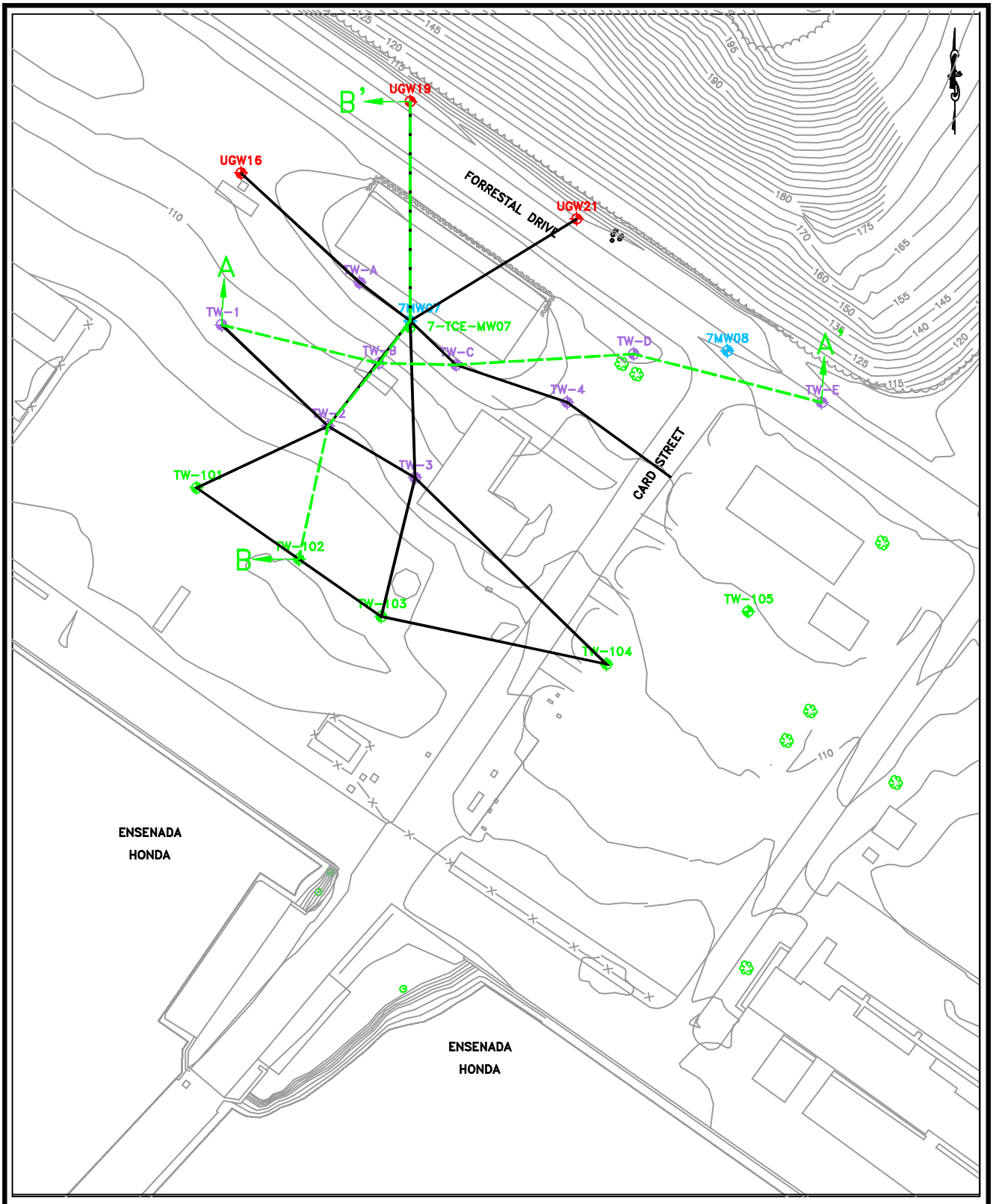
LEGEND

- EXISTING MONITORING WELL LOCATION
- EXISTING MONITORING WELL LOCATION SAMPLED DURING THIS INVESTIGATION
- TEMPORARY MONITORING WELL LOCATION (SHALLOW AND DEEP)
- TEMPORARY MONITORING WELL LOCATION (DEEP ONLY)

SOURCE: LANTDIV, FEB. 1992/1997

FIGURE 3-1
TCE INVESTIGATION TEMPORARY WELL LOCATIONS
SWMU 7 - TOW WAY FUEL FARM

NAVAL STATION ROOSEVELT ROADS
PUERTO RICO



80 0 40 80
1 inch = 80 ft.

NOTE:
DATUM PLAN USED IS MEAN LOW WATER = 100.00 FT. AS ESTABLISHED BY U.S. NAVY SURVEY SECTION AS OF NOVEMBER 1941.
LOCATION OF TW-105 APPROXIMATED.

K:\CAD\277-TEMP\2031501W

Baker

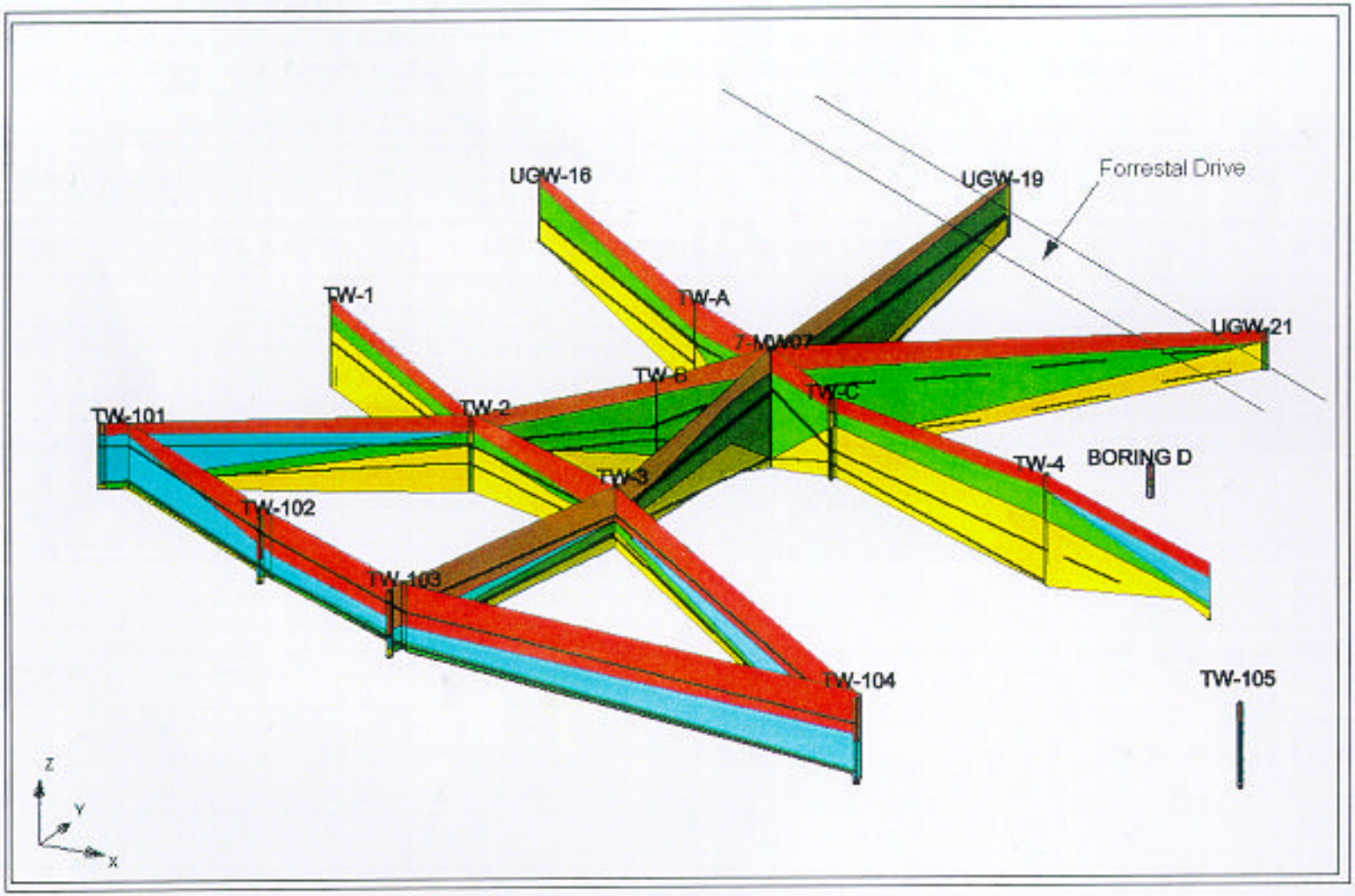
LEGEND

- EXISTING MONITORING WELL LOCATION
- EXISTING MONITORING WELL LOCATION SAMPLED DURING THIS INVESTIGATION
- TEMPORARY MONITORING WELL LOCATION (SHALLOW AND DEEP)
- TEMPORARY MONITORING WELL LOCATION (DEEP ONLY)
- FENCE DIAGRAM LOCATION
- CROSS SECTION LOCATION

SOURCE: LANTDIV, FEB. 1992/1997

FIGURE 4-1
FENCE DIAGRAM AND CROSS SECTION LOCATION MAP
SWMU 7 - TOW WAY FUEL FARM

NAVAL STATION ROOSEVELT ROADS
PUERTO RICO



HORIZONTAL SCALE 1" ≃ 27'
VERTICAL EXAGGERATION = 1x

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LEGEND

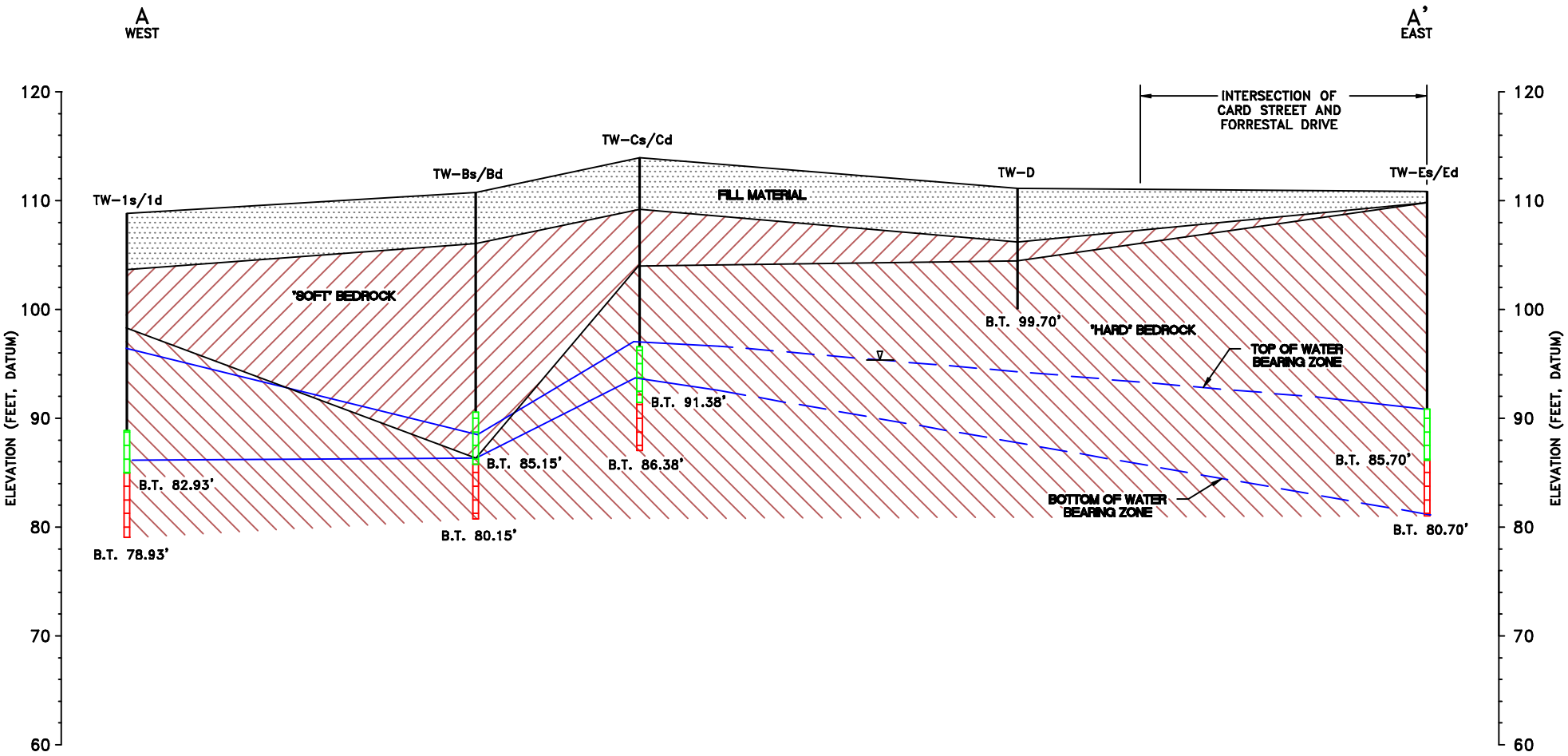
- FILL MATERIAL
- "SOFT" BEDROCK
- "HARD" BEDROCK
- MARINE SEDIMENTS
- WATER-BEARING ZONE

FIGURE 4-2
FENCE DIAGRAM
SWMU 7 – TCE INVESTIGATION

NAVAL STATION ROOSEVELT ROADS
PUERTO RICO

2031506W

2031810W



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LEGEND

- ESTIMATED CONTACT
- PROJECTED CONTACT
- ESTIMATED WATER-BEARING ZONE
- PROJECTED WATER-BEARING ZONE
- B.T. 78.93' BORING TERMINATED, DATUM ELEVATION
- SHALLOW WELL SCREEN INTERVAL
- DEEP WELL SCREEN INTERVAL
- WELL SCREEN INTERVAL

40 0 20 40 80
Horizontal Scale: 1 inch = 40 ft.

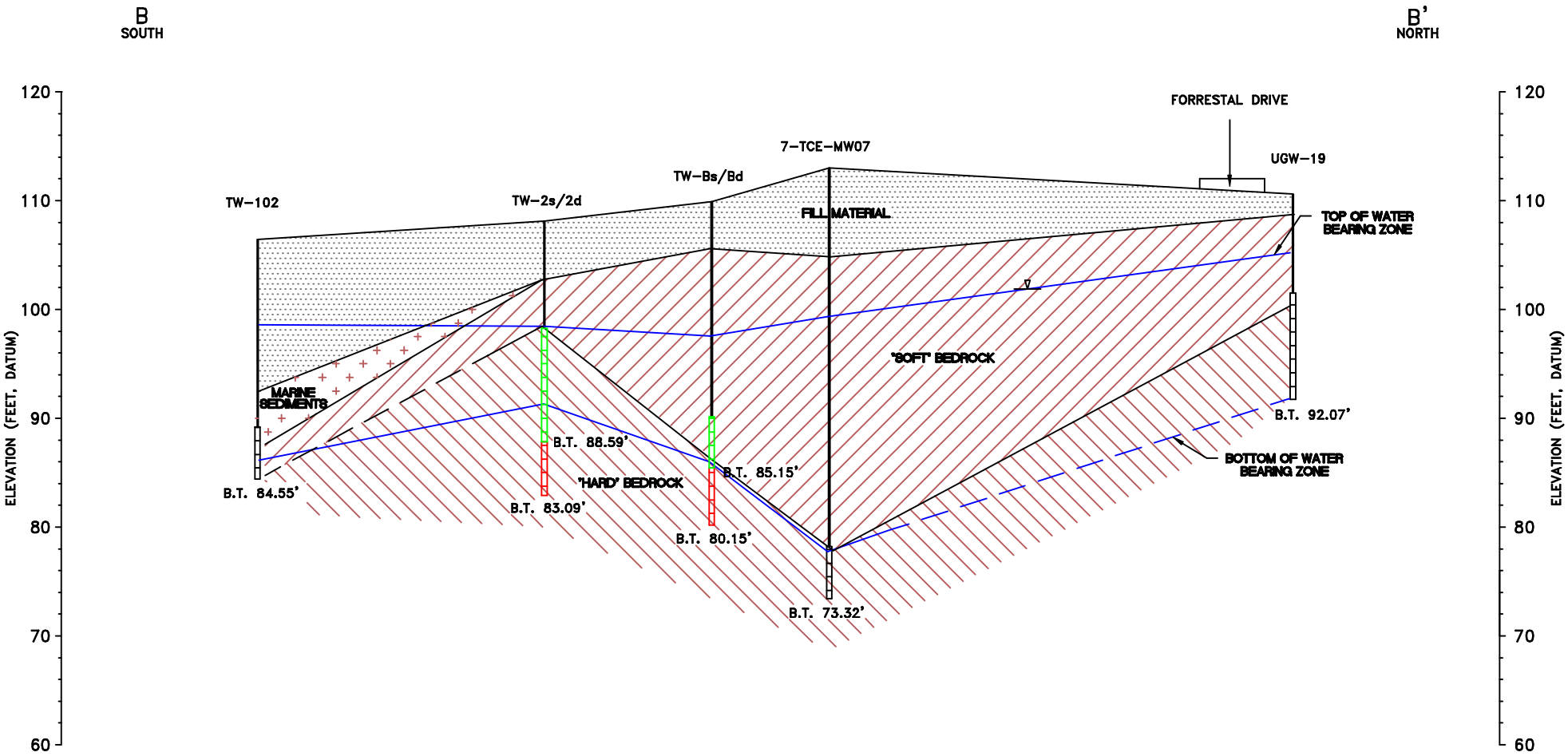
10 0 5 10 20
Vertical Scale: 1 inch = 10 ft.

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

FIGURE 4-3
CROSS SECTION A-A'
SWMU 7 - TCE INVESTIGATION

NAVAL STATION ROOSEVELT ROADS
PUERTO RICO

2031811W



Baker
Baker Environmental, Inc.

LEGEND

- ESTIMATED CONTACT
- PROJECTED CONTACT
- ESTIMATED WATER-BEARING ZONE
- PROJECTED WATER-BEARING ZONE
- B.T. 84.55' BORING TERMINATED, DATUM ELEVATION
- SHALLOW WELL SCREEN INTERVAL
- DEEP WELL SCREEN INTERVAL
- WELL SCREEN INTERVAL

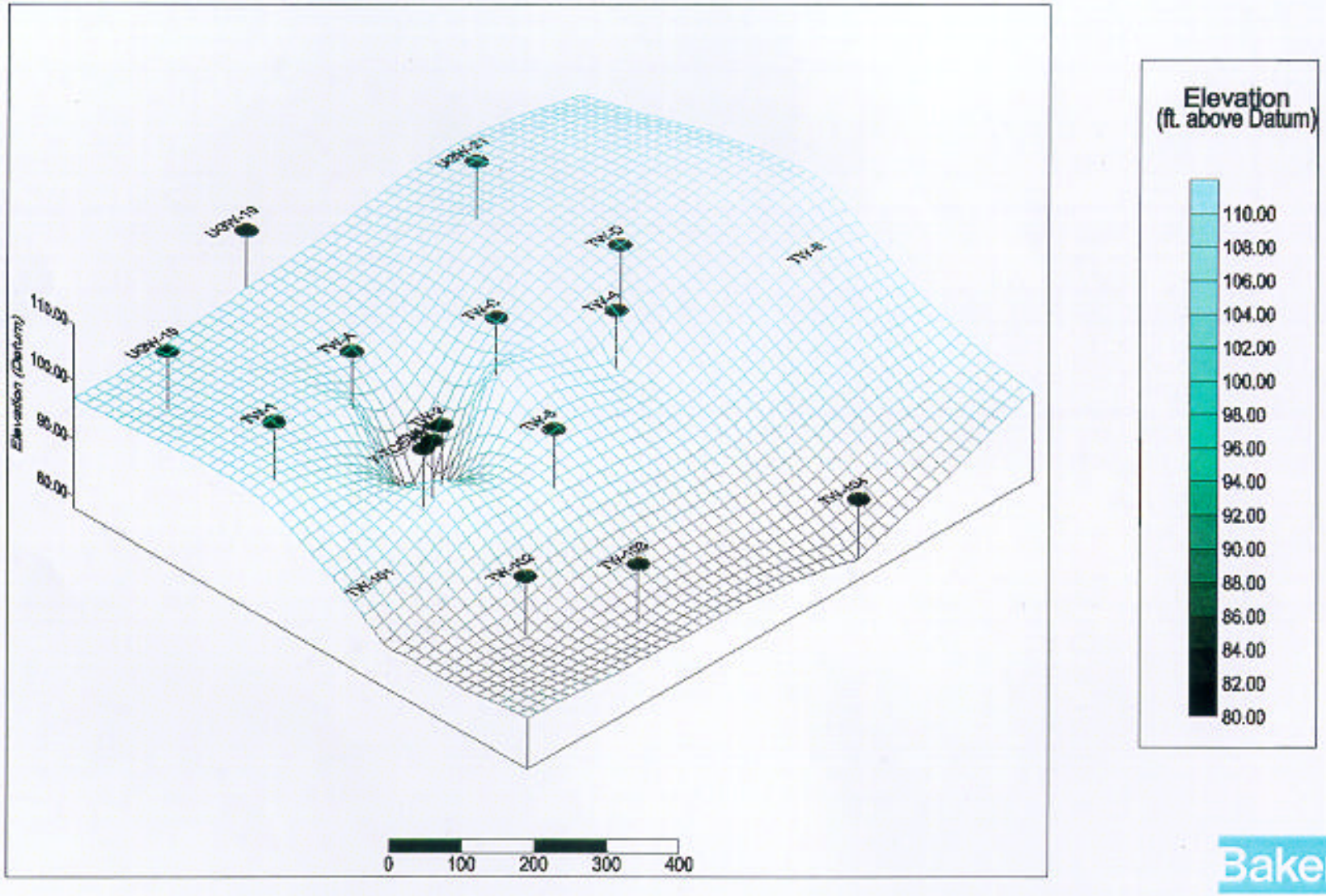
40 0 20 40 80
Horizontal Scale: 1 inch = 40 ft.

10 0 5 10 20
Vertical Scale: 1 inch = 10 ft.

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

FIGURE 4-4
CROSS SECTION B-B'
SWMU 7 - TCE INVESTIGATION

NAVAL STATION ROOSEVELT ROADS
PUERTO RICO



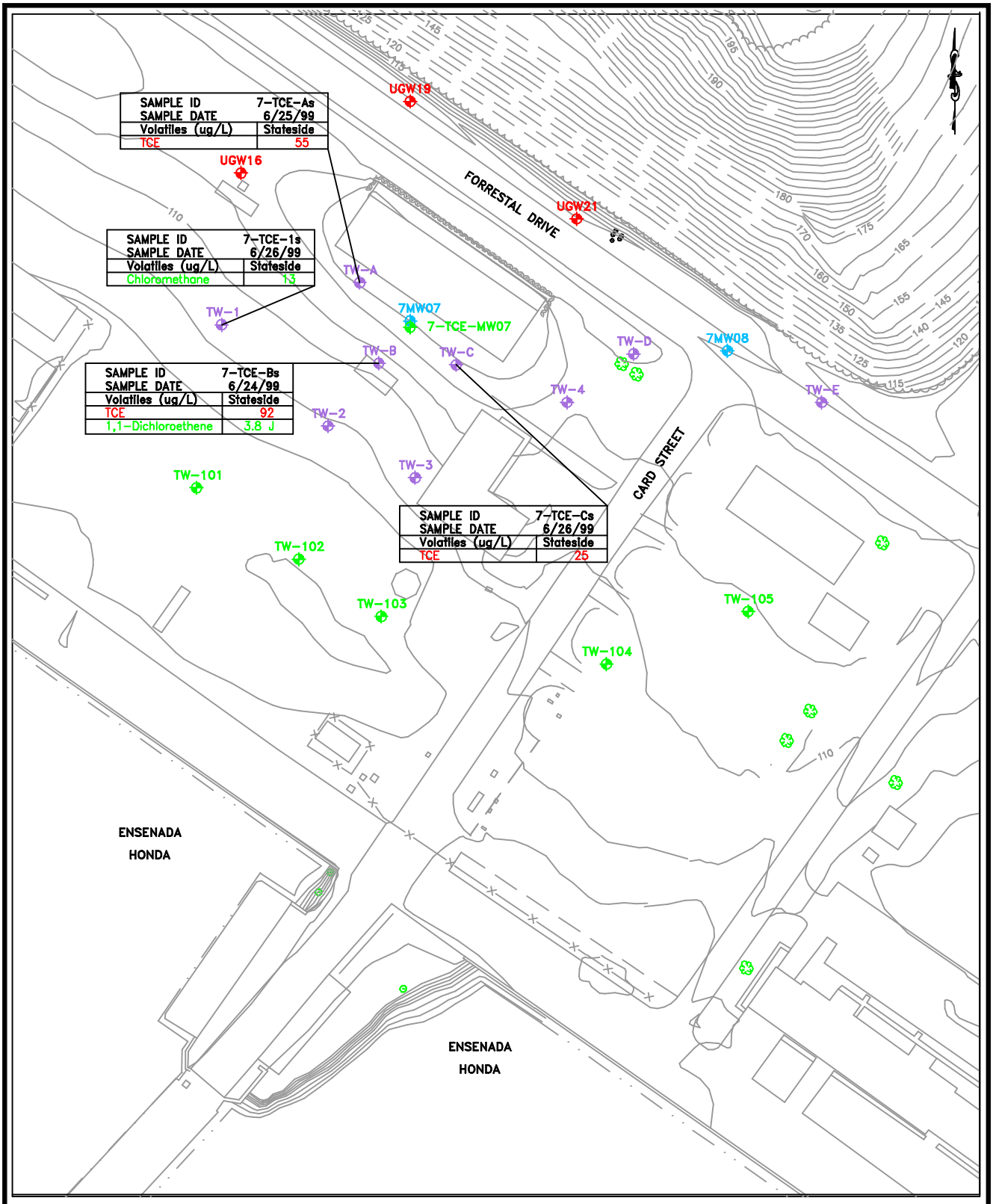
Baker

Baker Environmental, Inc.

FIGURE 4-5
SURFACE OF HARD BEDROCK
SWMU 7 – TCE INVESTIGATION

NAVAL STATION ROOSEVELT ROADS
PUERTO RICO

2031505W



80 0 40 80
1 inch = 80 ft.

NOTE:
DATUM PLAN USED IS MEAN LOW WATER = 100.00 FT. AS ESTABLISHED BY U.S. NAVY SURVEY SECTION AS OF NOVEMBER 1941.
LOCATION OF TW-105 APPROXIMATED.

K:\CAD\277-TEMP\2031509W

Baker

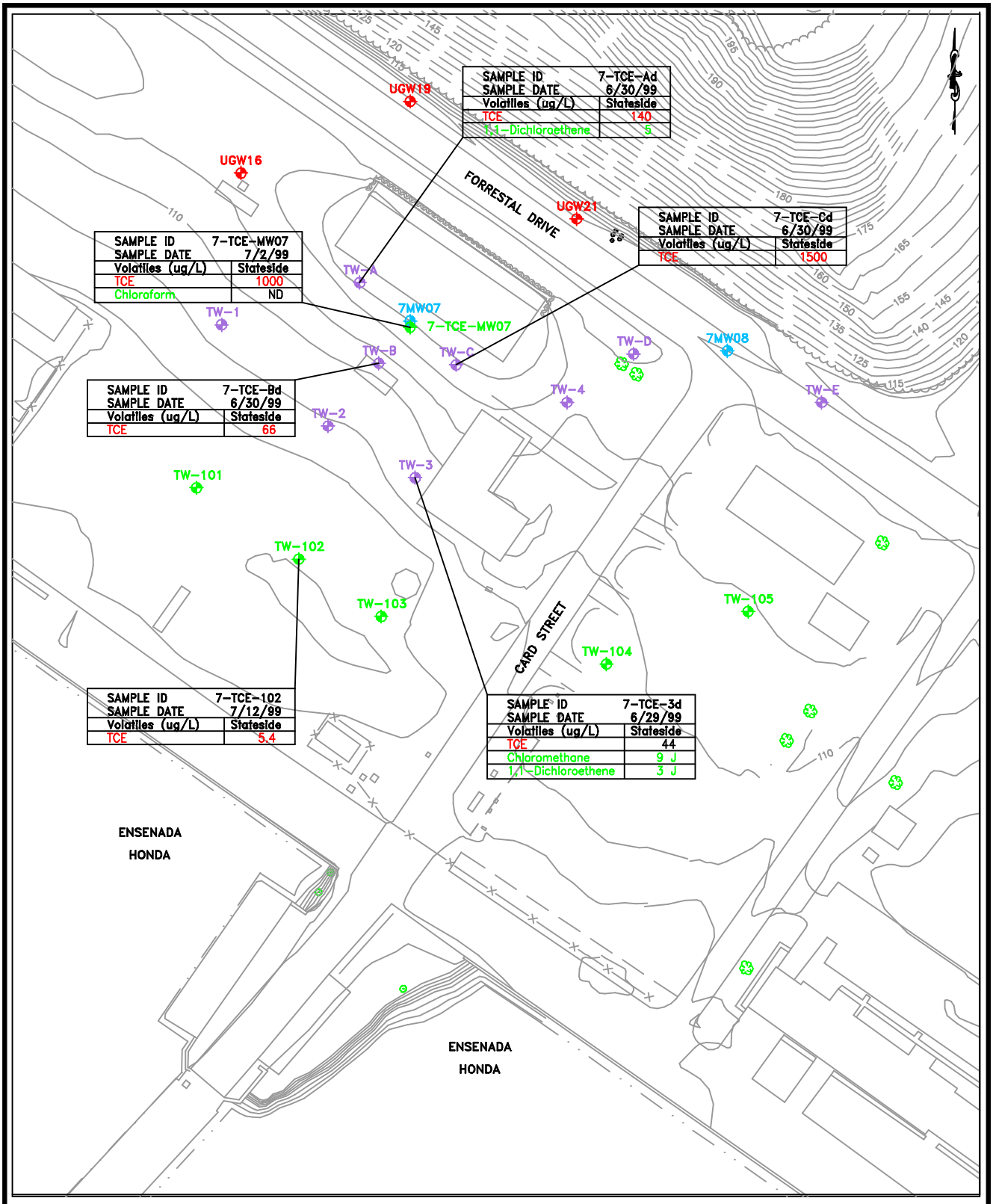
LEGEND

- – EXISTING MONITORING WELL LOCATION
- – EXISTING MONITORING WELL LOCATION SAMPLED DURING THIS INVESTIGATION
- – TEMPORARY MONITORING WELL LOCATION (SHALLOW AND DEEP)
- – TEMPORARY MONITORING WELL LOCATION (DEEP ONLY)
- 17 – EXCEEDS FEDERAL MCL AND USEPA REGION III RBC
- 3.8 J – EXCEEDS USEPA REGION III RBC
- ND – NOT DETECTED
- NA – NOT ANALYZED

SOURCE: LANTDIV, FEB. 1992/1997

FIGURE 5-1
SHALLOW TEMPORARY WELL ANALYTICAL DATA
ON-SITE AND STATESIDE LABORATORIES
SWMU 7 – TOW WAY FUEL FARM

NAVAL STATION ROOSEVELT ROADS
PUERTO RICO



NOTE:
DATUM PLAN USED IS MEAN LOW WATER = 100.00 FT. AS ESTABLISHED BY U.S. NAVY SURVEY SECTION AS OF NOVEMBER 1941.
LOCATION OF TW-105 APPROXIMATED.

K:\CAD\277-TEMP\2031508W

Baker

LEGEND

- EXISTING MONITORING WELL LOCATION
- EXISTING MONITORING WELL LOCATION SAMPLED DURING THIS INVESTIGATION
- TEMPORARY MONITORING WELL LOCATION (SHALLOW AND DEEP)
- TEMPORARY MONITORING WELL LOCATION (DEEP ONLY)

210 – EXCEEDS FEDERAL MCL AND USEPA REGION III RBC
3 J – EXCEEDS USEPA REGION III RBC
ND – NOT DETECTED
NA – NOT ANALYZED

SOURCE: LANTDIV, FEB. 1992/1997

FIGURE 5-2
DEEP TEMPORARY WELL ANALYTICAL DATA
ON-SITE AND STATESIDE LABORATORIES
SWMU 7 – TOW WAY FUEL FARM

NAVAL STATION ROOSEVELT ROADS
PUERTO RICO

UGW19

UGW16

FORRESTAL DRIVE

UGW21

TW-A

TW-1

7MW07

7-TCE-MW07

TW-B

TW-C

TW-D

7MW08

TW-4

TW-E

TW-2

TW-3

CARD STREET

TW-101

TW-102

TW-103

TW-105

TW-104

ENSENADA HONDA

ENSENADA HONDA

80 0 40 80

1 inch = 80 ft.

NOTE:
DATUM PLAN USED IS MEAN LOW WATER = 100.00 FT. AS ESTABLISHED BY U.S. NAVY SURVEY SECTION AS OF NOVEMBER 1941.
LOCATION OF TW-105 APPROXIMATED.

Baker

K:\CAD\277-TEMP\2031506W

LEGEND

- EXISTING MONITORING WELL LOCATION
- EXISTING MONITORING WELL LOCATION SAMPLED DURING THIS INVESTIGATION
- TEMPORARY MONITORING WELL LOCATION (SHALLOW AND DEEP)
- TEMPORARY MONITORING WELL LOCATION (DEEP ONLY)

SOURCE: LANTDIV, FEB. 1992/1997

FIGURE 6-1
TCE PLUME REPRESENTED BY
SHALLOW TEMPORARY WELLS
SWMU 7 - TOW WAY FUEL FARM

NAVAL STATION ROOSEVELT ROADS
PUERTO RICO

UGW19

UGW16

FORRESTAL DRIVE

UGW21

TW-A

7MW07

7-TCE-MW07

TW-1

TW-B

TW-C

TW-D

7MW08

TW-4

TW-E

TW-2

TW-3

CARD STREET

TW-101

TW-102

TW-103

TW-105

TW-104

ENSENADA HONDA

ENSENADA HONDA

80 0 40 80

1 inch = 80 ft.

NOTE:
DATUM PLAN USED IS MEAN LOW WATER = 100.00 FT. AS ESTABLISHED BY U.S. NAVY SURVEY SECTION AS OF NOVEMBER 1941.
LOCATION OF TW-105 APPROXIMATED.

K:\CAD\277-TEMP\2031507W

Baker

LEGEND

- EXISTING MONITORING WELL LOCATION
- EXISTING MONITORING WELL LOCATION SAMPLED DURING THIS INVESTIGATION
- TEMPORARY MONITORING WELL LOCATION (SHALLOW AND DEEP)
- TEMPORARY MONITORING WELL LOCATION (DEEP ONLY)

SOURCE: LANTDIV, FEB. 1992/1997

FIGURE 6-2
TCE PLUME REPRESENTED BY DEEP TEMPORARY WELLS
SWMU 7 - TOW WAY FUEL FARM

NAVAL STATION ROOSEVELT ROADS
PUERTO RICO

APPENDIX A
TEST BORING AND WELL CONSTRUCTION RECORDS

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	SWMU 7 - Tow Way Fuel Farm TCE Investigation		
CTO NO.:	26007-031	BORING NO.:	TW-A
COORDINATES:	EAST: 782561.7299	NORTH:	145532.6540
ELEVATION:	SURFACE: 112.54	TOP OF PVC CASING:	

Rig: Simco and Mobile B-61

	Split Spoon	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	1-7/8 in	--	3-1/4 in	--	6/22/99	0.0 - 21.0	P. Sunny, High 80s	15.0
Length	2 ft	--	5 ft	--	6/24/99	21.0 - 25.0	M. Sunny, Low 90s	
Type	Stainless	--	H.S.A.	--	6/29/99	25.0 - 30.0	M. Cloudy, Mid 80s	
Hammer Wt.	140 lbs	--	--	--				
Fall	30 in	--	--	--				

Remarks: The Mobile Rig was used to advance the well boring via air hammer on 6/29
Geoworks was subcontracted by IPSI to perform air hammer work

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison H = Hammer
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Shallow Screen (Black)	2-in.		
Deep Screen (Gray)	2-in.		

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
1 2 3 4 5 (5.0)	A-N	--	--	--	--	Fill Material		
6 (6.5)	S-1	1.3 65%	21 37 41	--	0.4 0.4	SILT, little rock frag, trace clay; brown & red-brown; v hard; dry		
7 8 9 10 (10.0)	A-N	--	--	--	--			
			10			Match to Sheet 2		102.54

DRILLING CO.:	Inland Pollution Services	BAKER REP.:	Mark DeJohn
DRILLER:	Abraham Nunez	BORING NO.:	TW-A SHEET 1 OF 2

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SWMU 7 - Tow Way Fuel Farm TCE Investigation

CTO NO.: 26007-031 BORING NO.: TW-A

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison H = Hammer N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail				Elevation (Ft. MSL)
11		S-2	1.3	26	--	0.4	Continued from Sheet 1					
			65%	31		0.4	ROCK, weathered; red-brown &					
12	12.0			50			gray; v hard; damp					
13												
14												
15	15.0											
	15.3	S-3	0.33	100/4"	--	.4/.4	ROCK as frag, angular; dark red-					
16							brown; v hard; wet					
17		A-N	--	--	--	--						
18												
19												
20	20.0									20.0		92.54
	20.4	S-4	0.4	100/5"	--	.4/.4	As above w/ some silt & clay					
21							Auger refusal @ 21'					
22		R-N	--	--	--	--	Weathered Rock					
23												
24												
25	25.0									25.0		87.54
26												
27		A-N	--	--	--	--						
28												
29												
30	30.0									30.0		82.54
							BOH@ 30 ft.					

DRILLING CO.: Inland Pollution Services BAKER REP.: Mark DeJohn

DRILLER: Abraham Nunez BORING NO.: TW-A SHEET 2 OF 2

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	SWMU 7 - Tow Way Fuel Farm TCE Investigation		
CTO NO.:	26007-031	BORING NO.:	TW-B
COORDINATES:	EAST: 782576.6644	NORTH:	145469.3355
ELEVATION:	SURFACE: 110.15	TOP OF PVC CASING:	

Rig: Simco and Mobile B-61

	Split Spoon	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	1-7/8 in	--	3-1/4 in	--	6/22/99	0.0 - 17.0	P. Sunny, High 80s	15.0
Length	2 ft	--	5 ft	--	6/23/99	17.0 - 25.0	M. Sunny, Low 90s	
Type	Stainless	--	H.S.A.	--	6/26/99	25.0 - 27.0	P. Sunny, Mid 70s	
Hammer Wt.	140 lbs	--	--	--	6/29/99	27.0 - 30.0	M. Cloudy, Mid 80s	
Fall	30 in	--	--	--				

Remarks: The Mobile Rig was used to advance the well boring via air hammer on 6/29

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison H = Hammer
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Shallow screen (Black)	2-in.		
Deep screen (Gray)	2-in.		

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
1 2 3 4 5	5.0	A-N	--	--	--	--	Fill Material 5.0		105.15
6 7	7.0	S-1	1.3 65%	17 23 28 37	--	0.4 0.4	SILT, trace fine rock frag & clay; orange-brown & brown; v hard; damp - weathered rock		
8 9 10	10.0	A-N	--	--	--	--			
		S-2	1.0	44	--	5/5	Match to Sheet 2		

DRILLING CO.:	Inland Pollution Services	BAKER REP.:	Mark DeJohn
DRILLER:	Abraham Nunez	BORING NO.:	TW-B

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SWMU 7 - Tow Way Fuel Farm TCE Investigation

CTO NO.: 26007-031 BORING NO.: TW-B

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison H = Hammer N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail				Elevation (Ft. MSL)
11	11.0		100%	70			Continued from Sheet 1					
							As above - weathered rock					
12												
13												
14												
15	15.0											
16		S-3	1.5	16 18	--	5.0	SILT, little rock frag (angular) &					
			75%	22		5.0	clay; red-brown; hard; wet					
17	17.0			55			weathered rock					
18		A-N	--	--	--	--						
19												
20	20.0									20.0	90.15	
21		S-4	1.3	12 17	--	5.0	As above, but damp					
			65%	20		5.0						
22	22.0			26								
23		A-N	--	--	--	--						
24												
25	25.0									25.0	85.15	
	25.1	S-5	0.1	100/1"	--	--	ROCK, weathered; v hard; brown;					
26							damp					
27		H-N	--	--	--	--	ROCK, weathered; v hard; brown;					
28							dry					
29												
30	30.0									30.0	80.15	
							BOH @ 30 ft.					

DRILLING CO.: Inland Pollution Services BAKER REP.: Mark DeJohn

DRILLER: Abraham Nunez BORING NO.: TW-B SHEET 2 OF 2

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	SWMU 7 - Tow Way Fuel Farm TCE Investigation		
CTO NO.:	26007-031	BORING NO.:	TW-C
COORDINATES:	EAST: 782637.3886	NORTH:	145568.0618
ELEVATION:	SURFACE: 113.38	TOP OF PVC CASING:	

Rig: Simco and Mobile B-61

	Split Spoon	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	1-7/8 in	--	3-1/4 in	--	6/23/99	0.0 - 10.0	P. Sunny, High 70s	17.0
Length	2 ft	--	5 ft	--	6/24/99	10.0 - 15.0	M. Sunny, Low 90s	
Type	Stainless	--	H.S.A.	--	6/25/99	15.0 - 22.6	M. Sunny, High 70s	
Hammer Wt.	140 lbs	--	--	--	6/29/99	20.0 - 27.0	M. Cloudy, Mid 80s	
Fall	30 in	--	--	--				

Remarks: The Mobile Rig was used to advance the well boring via air hammer on 6/29
Geoworks was subcontracted by IPSI to perform air hammer work

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison H = Hammer
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Shallow screen (Black)	2-in.		
Deep screen (Gray)	2-in.		

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
1, 2, 3, 4, 5	5.0	A-N	--	--	--	--	Fill Material		108.38
6	6.0	S-1	0.7 70%	16 48	--	3/3	ROCK FRAG (subangular) & SILT, trace fine sand; brown & gray; v hard; dry (weathered rock)		
7, 8, 9, 10	10.0	A-N	--	--	--	--	No Recovery		
	10.1	S-2	0.0	50/1"	--	--	Match to Sheet 2		

DRILLING CO.:	Inland Pollution Services	BAKER REP.:	Mark DeJohn
DRILLER:	Abraham Nunez	BORING NO.:	TW-C

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SWMU 7 - Tow Way Fuel Farm TCE Investigation

CTO NO.: 26007-031 BORING NO.: TW-C

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison H = Hammer N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail				Elevation (Ft. MSL)
11							Continued from Sheet 1					
12		R-N	--	--	--	--	ROCK, cuttings contain clay & subangular frag w/ weathered surfaces; dry					
13												
14												
15	15.0											
16												
17		R-N	--	--	--	--	ROCK, soft zone @ 17 - 20 ft.; wet				17.6	95.78
18												
19												
20	20.0											
21		(R-N)					ROCK, weathered; brown; damp cuttings beginning @ ~22 ft					
22	(22)										22.0	91.38
											22.6	90.78
23		H-N	--	--	--	--						
24							ROCK, gray & less weathered; damp cuttings					
25												
26												
27	27.0										27.0	86.38
28							BOH @ 27 ft.					
29												
30												

DRILLING CO.: Inland Pollution Services BAKER REP.: Mark DeJohn

DRILLER: Abraham Nunez BORING NO.: TW-C SHEET 2 OF 2

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	SWMU 7 - Tow Way Fuel Farm TCE Investigation		
CTO NO.:	26007-031	BORING NO.:	TW-D
COORDINATES:	EAST: 782923.7742	NORTH:	145487.1838
ELEVATION:	SURFACE: 110.70	TOP OF PVC CASING:	

Rig: Simco and Mobile B-61

	Split Spoon	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	1-7/8 in	--	3-1/4 in	--	6/23/99	0.0 - 7.0	P. Sunny, High 70s	--
Length	2 ft	--	5 ft	--	6/25/99	7.0 - 10.0	M. Sunny, Low 90s	
Type	Stainless	--	H.S.A.	--				
Hammer Wt.	140 lbs	--	--	--				
Fall	30 in	--	--	--				

Remarks:

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison H = Hammer
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
1, 2, 3, 4, 5	5.0	A-N	--	--	--	--	Fill Material		105.70
6, 7	7.0	S-1	1.3 65%	16 22 37 50	--	3.0 3.0	ROCK FRAG (subangular) & SILT, trace fine sand; red-brown; v hard; damp (weathered rock)		
8, 9, 10		R-N	--	--	--	--	Bedrock, fine crystalline; black; generally fresh surfaces; dry		

Match to Sheet 2

DRILLING CO.:	Inland Pollution Services	BAKER REP.:	Mark DeJohn
DRILLER:	Abraham Nunez	BORING NO.:	TW-D

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SWMU 7 - Tow Way Fuel Farm TCE Investigation

CTO NO.: 26007-031 BORING NO.: TW-D

SAMPLE TYPE	DEFINITIONS
S = Split Spoon A = Auger	SPT = Standard Penetration Test (ASTM D1586)
T = Shelby Tube W = Wash	PID = Photo Ionization Detector Measurement
R = Air Rotary C = Core	MSL = Mean Sea Level
D = Denison H = Hammer N = No Sample	ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail				Elevation (Ft. MSL)
11	11.0						Continued from Sheet 1				11.0	99.70
							BOH @ 11 ft.					
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												

DRILLING CO.: Inland Pollution Services BAKER REP.: Mark DeJohn

DRILLER: Abraham Nunez BORING NO.: TW-D SHEET 2 OF 2

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	SWMU 7 - Tow Way Fuel Farm TCE Investigation		
CTO NO.:	26007-031	BORING NO.:	TW-E
COORDINATES:	EAST: 782924.4147	NORTH:	145438.6178
ELEVATION:	SURFACE: 110.70	TOP OF PVC CASING:	

Rig: Simco and Mobile B-61

	Split Spoon	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	1-7/8 in	--	3-1/4 in	--	6/29/99	0.0 25.0	M. Cloudy, High 80s	20.0
Length	2 ft	--	5 ft	--	6/30/99	25.0 - 30.0	M. Sunny, Near 80	
Type	Stainless	--	H.S.A.	--				
Hammer Wt.	140 lbs	--	--	--				
Fall	30 in	--	--	--				

Remarks: Geoworks performed the drilling and well installation

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison H = Hammer
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
1						Asphalt road and subbase		
2						ROCK, dark gray to black; crystalline; dry; little weathering		
3								
4	H-N							
5								
6								
7								
8								
9						ROCK, becoming brown; more weathering		
10								
						Match to Sheet 2		

DRILLING CO.:	Inland Pollution Services	BAKER REP.:	Mark DeJohn
DRILLER:	Abraham Nunez	BORING NO.:	TW-E SHEET 1 OF 2

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SWMU 7 - Tow Way Fuel Farm TCE Investigation

CTO NO.: 26007-031 BORING NO.: TW-E

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison H = Hammer N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail				Elevation (Ft. MSL)
11							Continued from Sheet 1					
12												
13												
14												
15												
16												
17												
18												
19												
20		H-N	--	--	--	--	water at 20 ft.				20.0	90.70
21												
22												
23												
							less weathering; black; harder					
24												
25											25.0	85.70
26												
27												
28												
29												
30	30.0										30.0	80.70
							BOH @ 30 ft.					

DRILLING CO.: Inland Pollution Services BAKER REP.: Mark DeJohn

DRILLER: Abraham Nunez BORING NO.: TW-E SHEET 2 OF 2

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	SWMU 7 - Tow Way Fuel Farm TCE Investigation		
CTO NO.:	26007-031	BORING NO.:	TW-1
COORDINATES:	EAST: 782453.2313	NORTH:	145499.4730
ELEVATION:	SURFACE: 108.93	TOP OF PVC CASING:	--

Rig: Simco and Mobile B-61

	Split Spoon	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	1-7/8 in	--	3-1/4 in	--	6/26/99	0.0 - 25.0	P. Sunny, High 70s	18.0
Length	2 ft	--	5 ft	--	6/28/99	25.0 - 30.0	P. Sunny, Low 80s	
Type	Stainless	--	H.S.A.	--				
Hammer Wt.	140 lbs	--	--	--				
Fall	30 in	--	--	--				

Remarks:

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison H = Hammer
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Shallow screen (Black)	2-in.		
Deep screen (Gray)	2-in.		

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
1 2 3 4 5 (5.0)	A-N	--	--	--	--	Fill Material (5.0)		103.93
6 7 (7.0)	S-1	1.4 70%	6 15 26 50	--	0.6 / 0.6	SILT, little rock frag, trace to little clay, trace f sand; brown w/ orangish iron staining; v dense damp (weathered rock)		
8 9 10 (10.0)	A-N	--	--	--	--			
	S-2	0.6	42	--	.4/.4	Match to Sheet 2		

DRILLING CO.:	Inland Pollution Services	BAKER REP.:	Mark DeJohn
DRILLER:	Abraham Nunez	BORING NO.:	TW-1

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SWMU 7 - Tow Way Fuel Farm TCE Investigation

CTO NO.: 26007-031 BORING NO.: TW-1

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison H = Hammer N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
11	10.8		75%	50/3"			Continued from Sheet 1		
12, 13, 14, 15	15.0	A-N	--	--	--	--	SILT, some f/c gravel, little f/c sand, trace clay; green-gray; v dense; damp (weathered rock)		
	15.5	S-3	0.4	113/6"	--	.4/.4	SILT, little rock frag (angular) & clay; red-brown; hard; wet (weathered rock)		
16, 17, 18, 19, 20	20.0	A-N	--	--	--	--			
	20.5	S-4	0.5	120/6"			ROCK FRAG (f/c), trace silt & clay w/ silt & f sand layer; green-gray; v dense; wet	20.0	88.93
21, 22, 23, 24, 25	25.0	A-N	--	--	--	--			
	25.2	S-5	0.2	100/3"	--	--	ROCK, weathered; rust-brown; v dense; damp w/ moist clay-filled fractures	25.0	83.93
26, 27, 28, 29, 30	30.0	A-N	--	--	--	--			
	30.8	S-6	0.8	39-100/3"	--	.3/.3	ROCK, weathered; mottled; brown, lt green, white & tan: v hard; damp	30.0	78.93

DRILLING CO.: Inland Pollution Services BAKER REP.: Mark DeJohn

DRILLER: Abraham Nunez BORING NO.: TW-1 SHEET 2 OF 2

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	SWMU 7 - Tow Way Fuel Farm TCE Investigation		
CTO NO.:	26007-031	BORING NO.:	TW-2
COORDINATES:	EAST: 782536.8299	NORTH:	145420.0759
ELEVATION:	SURFACE: 108.59	TOP OF PVC CASING:	

Rig: Simco and Mobile B-61

	Split Spoon	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	1-7/8 in	--	3-1/4 in	--	6/26/99	0.0 - 7.0	P. Sunny, High 80s	10.0
Length	2 ft	--	5 ft	--	6/27/99	7.0 - 20.2	M. Cloudy, High 70s	
Type	Stainless	--	H.S.A.	--	6/28/99	20.2 - 25.5	P. Sunny, Low 80s	
Hammer Wt.	140 lbs	--	--	--				
Fall	30 in	--	--	--				

Remarks:

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison H = Hammer
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Shallow screen (Black)	2-in.		
Deep screen (Gray)	2-in.		

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
1 2 3 4 5 (5.0)	A-N	--	--	--	--	Fill Material; cobbles and boulders hard to drill thru (3 attempts) 5.0		103.59
6 7 (7.0)	S-1	0.8 40%	2 2 3 5	--	1.0 1.0	CLAY, trace f sand & silt; brown & tan; m stiff; damp (weathered rock)		
8 9 10 (10.0)	A-N	--	--	--	--	F/C ROCK FRAG, little f/c sand, trace clay; olive drab; v dense; wet (weathered rock) 10.0		98.59
10.5	S-2	0.5	50/6"	--	1/1	Match to Sheet 2		

DRILLING CO.:	Inland Pollution Services	BAKER REP.:	Mark DeJohn
DRILLER:	Abraham Nunez	BORING NO.:	TW-2 SHEET 1 OF 2

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SWMU 7 - Tow Way Fuel Farm TCE Investigation

CTO NO.: 26007-031 BORING NO.: TW-2

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison H = Hammer N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
11						Continued from Sheet 1		
12								
13	A-N	--	--	--	--			
14								
15								
15.0								
15.5	S-3	0.5	75/6"	--	5/5	FINE SAND, some f rock frag, trace c sand; brown; v dense; damp (weathered rock)		
16								
17								
18	A-N	--	--	--	--			
19								
20								
20.0							20.0	88.59
20.2	S-4	0	75/2"	--	--	No recovery		
21								
22								
23	A-N	--	--	--	--			
24								
25								
25.0							25.0	83.59
25.5	S-5	0.4	67/6"	--	3/3	ROCK FRAG, some f/c sand, trace silt & clay; green-brown; v hard; damp	25.5	83.09
26								
27						BOH @ 25.5 ft.		
28								
29								
30								

DRILLING CO.: Inland Pollution Services BAKER REP.: Mark DeJohn

DRILLER: Abraham Nunez BORING NO.: TW-2 SHEET 2 OF 2

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	SWMU 7 - Tow Way Fuel Farm TCE Investigation		
CTO NO.:	26007-031	BORING NO.:	TW-3
COORDINATES:	EAST: 782605.2168	NORTH:	145379.5127
ELEVATION:	SURFACE: 109.44	TOP OF PVC CASING:	

Rig: Simco and Mobile B-61

	Split Spoon	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	1-7/8 in	--	3-1/4 in	--	6/26/99	0.0 - 0.0	P. Sunny, High 80s	10.0
Length	2 ft	--	5 ft	--	6/27/99	0.0 - 16.5	M. Cloudy, High 70s	
Type	Stainless	--	H.S.A.	--	6/28/99	20.2 - 20.5	P. Sunny, Low 80s	
Hammer Wt.	140 lbs	--	--	--				
Fall	30 in	--	--	--				

Remarks:

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison H = Hammer
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Shallow screen (Black)	2-in.		
Deep screen (Gray)	2-in.		

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
1, 2, 3, 4, 5 (5.0)	A-N	--	--	--	--	Fill Material - cobbles; hard to to drill thru (3 attempts)		
6, 7 (7.0)	S-1	0.8 40%	2 3 2 3	--	0.4 / 0.4	CLAY, some silt, trace rock frag & c sand; brown m stiff; damp (fill)		
8, 9, 10 (10.0)	A-N	--	--	--	--	F SAND, some clay; dark gray; m dense; moist to wet (Fill)		
			8	--		Match to Sheet 2		

DRILLING CO.:	Inland Pollution Services	BAKER REP.:	Mark DeJohn
DRILLER:	Abraham Nunez	BORING NO.:	TW-3 SHEET 1 OF 2

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SWMU 7 - Tow Way Fuel Farm TCE Investigation

CTO NO.: 26007-031 BORING NO.: TW-3

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison H = Hammer N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail				Elevation (Ft. MSL)
11		S-2	2.0	9			Continued from Sheet 1					
			100%	15	--	0.4	11.5					97.94
12	12.0			18		0.4	ROCK FRAG, some f sand; dk green to brown; dense; damp (weathered rock)					
13		A-N	--	--	--	--						
14												
15	15.0											
				16			ROCK, weathered, a few clay-filled fractures; black & brown w/ rust color; v dense; damp				15.5	93.94
16		S-3	1.3	25	--	1.0						
	16.5		87%	62		1.0					16.5	92.94
17												
18		A-N	--	--	--	--						
19												
20	20.0						ROCK FRAG, some c sand;					
	20.5	S-4	0.3	67/6"	--	4/4	black; v hard; damp (weath. rock)				20.5	88.94
21							BOH @ 20.5 ft.					
22												
23												
24												
25												
26												
27												
28												
29												
30												

DRILLING CO.: Inland Pollution Services BAKER REP.: Mark DeJohn

DRILLER: Abraham Nunez BORING NO.: TW-3 SHEET 2 OF 2

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	SWMU 7 - Tow Way Fuel Farm TCE Investigation		
CTO NO.:	26007-031	BORING NO.:	TW-4
COORDINATES:	EAST: 782724.5350	NORTH:	145438.6431
ELEVATION:	SURFACE: 111.09	TOP OF PVC CASING:	

Rig:	Split Spoon	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	1-7/8 in	--	3-1/4 in	--	6/27/99	0.0 - 30.5	M. Cloudy, High 70s	25.0
Length	2 ft	--	5 ft	--	6/28/99	30.5 - 37.0	P. Sunny, Near 90	
Type	Stainless	--	H.S.A.	--				
Hammer Wt.	140 lbs	--	--	--				
Fall	30 in	--	--	--				

Remarks:

SAMPLE TYPE

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

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Shallow Screen (Black)	2-in.		
Deep Screen (Gray)	2-in.		

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
1 2 3 4 5	5.0	A-N	--	--	--	--	Fill Material (mainly rock frag) 5.0		106.09
6 7	5.0	S-1	1.4 70%	12 19 23 12	--	0.4 0.4	CLAY, some silt, trace f rock frag; dk brown; dense; damp (weathered rock)		
8 9 10	10.0								
				6			Match to Sheet 2		

DRILLING CO.:	Inland Pollution Services	BAKER REP.:	Mark DeJohn
DRILLER:	Abraham Nunez	BORING NO.:	TW-4 SHEET 1 OF 3

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SWMU 7 - Tow Way Fuel Farm TCE Investigation

CTO NO.: 26007-031 BORING NO.: TW-4

SAMPLE TYPE

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

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
11	S-2	1.4	28	--	0.4	Continued from Sheet 1		
11.5		93%	50/6"		0.4	CLAY, trace rock frag & silt; brown; v hard; damp		
12, 13, 14, 15	A-N	--	--	--	--			
15.0								
15.5	S-3	0.5	72/6"	--	--	F/C SAND, some rock frag, trace silt & clay; brown; v dense; damp		
16, 17, 18, 19, 20	A-N	--	--	--	--			
20.0								
20.5	S-4	0.5	100/5"	--	--	As above		
21, 22, 23, 24	A-N	--	--	--	--			
							24.3	86.79
25.0								
26	S-5	1.3	22 26	--	--	ROCK FRAG, trace f/c sand, silt & clay; brown; v dense; wet		
26.5		87%	56/6"					
27, 28, 29	A-N	--	--	--	--			
							29.3	81.79
30.0						As above	30.0	81.09
30.5	S-6	0.5	72/6"	--	--	Match to Sheet 3		

DRILLING CO.: Inland Pollution Services BAKER REP.: Mark DeJohn

DRILLER: Abraham Nunez BORING NO.: TW-4 SHEET 2 OF 3

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SWMU 7 - Tow Way Fuel Farm TCE Investigation

CTO NO.: 26007-031 BORING NO.: TW-4

SAMPLE TYPE

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

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
BG/PS = Background/Point Source

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail			Elevation (Ft. MSL)
31							Continued from Sheet 2				
32											
33		A-N	--	--	--	--					
34											
35	35.0									35.0	76.09
36		S-7	1.0 50%	3 12 26 32	--	2.0 2.0	F/C ROCK FRAG, some f/c sand, little clay; brown; dense; wet				
37	37.0									37.0	74.09
38							BOH @ 37 ft.				
39											
40											
41											
42											
43											
44											
45											
46											
47											
48											
49											
50											

DRILLING CO.: Inland Pollution Services BAKER REP.: Mark DeJohn

DRILLER: Abraham Nunez BORING NO.: TW-4 SHEET 3 OF 3

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	SWMU 7 - Tow Way Fuel Farm TCE Investigation		
CTO NO.:	26007-031	BORING NO.:	TW-101
COORDINATES:	EAST: 782433.602	NORTH:	145371.6088
ELEVATION:	SURFACE: 107.08	TOP OF PVC CASING:	--

Rig: Mobile B-61	**Split Spoon**	**Casing**	**Hammer**	**Core Barrel**	**Date**	**Progress (Ft.)**	**Weather**	**Depth to Water (Ft.)**
Size (ID)	--	--	6-in	--	6/30/99	0.0 - 22.0	Sunny	8.0
Length	--	--	5 ft	--				
Type	--	--	Percusive	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: Geoworks, subcontracted to IPSI, performed the work

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison H = Hammer
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Sch 40 PVC Riser	2-in.	0.0	17.0
Sch 40 PVC Screen (10-Slot)	2-in.	17.0	22.0

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
1								
2								
3	H-N	--	--	--	--	SILT, some f sand and cobbles; light brown; dry		
4						4.0		103.08
5								
6								
7	H-N	--	--	--	--	SILT; grayish-brown; damp		
8								
9						wet - water @ 8-ft		
10								

Match to Sheet 2

DRILLING CO.:	Inland Pollution Services	BAKER REP.:	David D. Schilling
DRILLER:	Abraham Nunez	BORING NO.:	TW-101

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SWMU 7 - Tow Way Fuel Farm TCE Investigation

CTO NO.: 26007-031 BORING NO.: TW-101

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison H = Hammer N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
11						Continued from Sheet 1		
12								
13								
14	H-N	--	--	--	--	F SAND w/ shell frag; brown; wet		
15								
16								
17							17.0	90.08
18								
19								
20	H-N	--	--	--	--	CLAY; redish brown; hard; dry		
21								
22	22.0						22.0	85.08
23						BOH @ 22-ft		
24								
25								
26								
27								
28								
29								
30								

DRILLING CO.: Inland Pollution Services BAKER REP.: David D. Schilling

DRILLER: Abraham Nunez BORING NO.: TW-101 SHEET 2 OF 2

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORI

PROJECT: SWMU 7 - Tow Way Fuel Farm TCE Investigation

CTO NO.: 26007-031 BORING NO.: TW-102

COORDINATES: EAST: 782513.8234 NORTH: 145315.5807

ELEVATION: SURFACE: 106.55 TOP OF PVC CASING: --

Rig: Mobile B-61

	Split Spoon	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	--	--	3-1/4 in	--	6/30/99	0.0 - 22.0	Sunny	8.0
Length	--	--	5 ft	--				
Type	--	--	H.S.A.	--				
Hammer Wt	--	--	--	--				
Fall	--	--	--	--				

Remarks: Geoworks, subcontracted to IPSI, performed the work

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison H = Hammer
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Sch 40 PVC Riser	2-in.	0.0	17.0
Sch 40 PVC Screen (10-Slot)	2-in.	17.0	22.0

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
1								
2	A-N	--	--	--	--	SAND & GRAVEL; lt brown; dry		.
3								
4								
5								
6								
7								
8						wet - water @ 8-ft		
9								
10						Match to Sheet 2		

DRILLING CO.: Inland Pollution Services BAKER REP.: David D. Schilling

DRILLER: Abraham Nunez BORING NO.: TW-102 SHEET 1 OI 2

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SWMU 7 - Tow Way Fuel Farm TCE Investigation

CTO NO.: 26007-031 BORING NO.: TW-102

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison H = Hammer N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
11						Continued from Sheet 1		
12								
13								
14	A-N	--	--	--	--	SAND & SHELL FRAG; lt gray; wet		
15								
16								
17							17.0	89.55
18								
19								
20	A-N	--	--	--	--	CLAY; red-brown; dry @ 20-ft		
21								
22	22.0						22.0	84.55
23						BOH @ 22-ft		
24								
25								
26								
27								
28								
29								
30								

DRILLING CO.: Inland Pollution Services BAKER REP.: David D. Schilling

DRILLER: Abraham Nunez BORING NO.: TW-102 SHEET 2 OF 2

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	SWMU 7 - Tow Way Fuel Farm TCE Investigation		
CTO NO.:	26007-031	BORING NO.:	TW-103
COORDINATES:	EAST: 782513.8234	NORTH:	145315.5807
ELEVATION:	SURFACE: 106.63	TOP OF PVC CASING:	

Rig: Mobile B-61								
	Split Spoon	**Casing**	**Augers**	**Core Barrel**	**Date**	**Progress (Ft.)**	**Weather**	**Depth to Water (Ft.)**
Size (ID)	--	--	3-1/4 in	--	6/30/99	0.0 - 22.0	Sunny	8.0
Length	--	--	5 ft	--				
Type	--	--	H.S.A.	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: Geoworks, subcontracted to IPSI, performed the work

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison H = Hammer
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Sch 40 PVC Riser	2-in.	0.0	17.0
Sch 40 PVC Screen (10-Slot)	2-in.	17.0	22.0

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
1	A-N	--	--	--	--	SAND & GRAVEL; lt brown; dry		
2								
3								
4								
5								
6								
7								
8						wet - water @ 8-ft		
9								
10						Match to Sheet 2		

DRILLING CO.:	Inland Pollution Services	BAKER REP.:	David D. Schilling
DRILLER:	Abraham Nunez	BORING NO.:	TW-103 SHEET 1 OF 2

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SWMU 7 - Tow Way Fuel Farm TCE Investigation

CTO NO.: 26007-031 BORING NO.: TW-103

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison H = Hammer N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail				Elevation (Ft. MSL)
11							Continued from Sheet 1					
12												
13												
14		A-N	--	--	--	--	SAND & SHELL FRAG; lt gray; wet					
15												
16												
17											17.0	89.63
18												
19		A-N	--	--	--	--	CLAY; red-brown; dry @ 19-ft					
20												
21												
22	22.0										22.0	84.63
23							BOH @ 22-ft					
24												
25												
26												
27												
28												
29												
30												

DRILLING CO.: Inland Pollution Services BAKER REP.: David D. Schilling

DRILLER: Abraham Nunez BORING NO.: TW-103 SHEET 2 OF 2

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	SWMU 7 - Tow Way Fuel Farm TCE Investigation		
CTO NO.:	26007-031	BORING NO.:	TW-104
COORDINATES:	EAST: 782755.4508	NORTH:	145233.3080
ELEVATION:	SURFACE: 109.51	TOP OF PVC CASING:	

Rig: Mobile B-61								
	Split Spoon	**Casing**	**Hammer**	**Core Barrel**	**Date**	**Progress (Ft.)**	**Weather**	**Depth to Water (Ft.)**
Size (ID)	--	--	6-in	--	7/1/99	0.0 - 28.0	Rainy	8.0
Length	--	--	5 ft	--				
Type	--	--	Percusive	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: Geoworks, subcontracted to IPSI, performed the work

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison H = Hammer
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Sch 40 PVC Riser	2-in.	0.0	23.0
Sch 40 PVC Screen (10-Slot)	2-in.	23.0	28.0

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
1	H-N	--	--	--	--	SAND & GRAVEL; dry		
2								
						Boulder from 2 to 4 feet		
3								
4								
5	H-N	--	--	--	--	SAND; lt brown; damp		
6								
7								
8								
						wet - water @ 8-ft		
9								
10								
						Match to Sheet 2		

DRILLING CO.:	Inland Pollution Services	BAKER REP.:	David D. Schilling
DRILLER:	Abraham Nunez	BORING NO.:	TW-104 SHEET 1 OF 2

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SWMU 7 - Tow Way Fuel Farm TCE Investigation

CTO NO.: 26007-031 BORING NO.: TW-104

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison H = Hammer N = No Sample

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail				Elevation (Ft. MSL)
11							Continued from Sheet 1					
12												
13												
14		H-N	--	--	--	--	SAND; brown; wet					
15												
16												
17											17.0	92.51
18												
19												
20												
21												
22												
23											23.0	86.51
24												
25												
26												
27												
28	28.0	H-N	--	--	--	--	CLAY; some angular rock frag; brown; dry				28.0	81.51
29							BOH @ 28-ft					
30												

DRILLING CO.: Inland Pollution Services BAKER REP.: David D. Schilling

DRILLER: Abraham Nunez BORING NO.: TW-104 SHEET 2 OF 2

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SWMU 7 - Tow Way Fuel Farm TCE Investigation

CTO NO.: 26007-031 BORING NO.: TW-105

COORDINATES: EAST: NORTH:

ELEVATION: SURFACE: TOP OF PVC CASING:

Rig: Mobile B-61								
	Split Spoon	**Casing**	**Hammer**	**Core Barrel**	**Date**	**Progress (Ft.)**	**Weather**	**Depth to Water (Ft.)**
Size (ID)	--	--	6-in	--	7/1/99	0.0 - 28.0	Rainy	8.0
Length	--	--	5 ft	--				
Type	--	--	Percusive	--				
Hammer Wt.	--	--	--	--				
Fall	--	--	--	--				

Remarks: Geoworks, subcontracted to IPSI, performed the work

SAMPLE TYPE

S = Split Spoon A = Auger
T = Shelby Tube W = Wash
R = Air Rotary C = Core
D = Denison H = Hammer
N = No Sample

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Sch 40 PVC Riser	2-in.	0.0	23.0
Sch 40 PVC Screen (10-Slot)	2-in.	23.0	28.0

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
1	H-N	--	--	--	--	SAND & GRAVEL; dry		
2								
						Boulder from 2 to 6 feet		
3								
4								
5	H-N	--	--	--	--	SAND; lt brown; damp		
6								
7								
8	H-N	--	--	--	--	SAND; brown; wet water @ 8 feet		
9								
10								
						Match to Sheet 2		

DRILLING CO.: Inland Pollution Services BAKER REP.: David D. Schilling

DRILLER: Abraham Nunez BORING NO.: TW-105 SHEET 1 OF 2

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SWMU 7 - Tow Way Fuel Farm TCE Investigation

CTO NO.: 26007-031 BORING NO.: TW-105

SAMPLE TYPE	DEFINITIONS
S = Split Spoon A = Auger	SPT = Standard Penetration Test (ASTM D1586)
T = Shelby Tube W = Wash	PID = Photo Ionization Detector Measurement
R = Air Rotary C = Core	MSL = Mean Sea Level
D = Denison H = Hammer N = No Sample	ps/bg = point source/background

Depth (Ft.)		Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
11							Continued from Sheet 1		
12									
13									
14									
15									
16									
17								17.0	
18									
19									
20									
21									
22									
23								23.0	
24									
25									
26									
27									
28	28.0	H-N	--	--	--	--	CLAY; some angular rock frag; brown; dry	28.0	
29							BOH @ 28-ft		
30									

DRILLING CO.: Inland Pollution Services BAKER REP.: David D. Schilling

DRILLER: Abraham Nunez BORING NO.: TW-105 SHEET 2 OF 2

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT:	SWMU 7 - Tow Way Fuel Farm TCE Investigation		
CTO NO.:	26007-031	BORING NO.:	TW-106
COORDINATES:	EAST: 782601.2748	NORTH:	145502.5336
ELEVATION:	SURFACE: 113.32	TOP OF PVC CASING:	

Rig:	Split Spoon	Casing	Augers	Core Barrel	Date	Progress (Ft.)	Weather	Depth to Water (Ft.)
Size (ID)	1-7/8 in	--	3-1/4 in	--	7/1/99	0.0 - 40.0	P. Cloudy	
Length	2 ft	--	5 ft	--				
Type	Stainless	--	H.S.A.	--				
Hammer Wt.	140 lbs	--	--	--				
Fall	30 in	--	--	--				

Remarks: Located beside 7-MW07. Coordinates given above are for 7-MW07.
Geoworks, subcontracted to IPSI, performed the work

SAMPLE TYPE

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

WELL INFORMATION

Type	Diam.	Top Depth (Ft.)	Bottom Depth (Ft.)
Sch 40 PVC Riser	2-in.	0.0	35.0
Sch 40 PVC Screen (10-Slot)	2-in.	35.0	40.0

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
1								
2	H-N	--	--	--	--	SILT, some sand and cobbles; brown; dry		
3								
4								
5								
6								
7								
8								
9								
10						Match to Sheet 2		

DRILLING CO.:	Inland Pollution Services	BAKER REP.:	David D. Schilling
DRILLER:	Abraham Nunez	BORING NO.:	TW-106 SHEET 1 OF 3

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SWMU 7 - Tow Way Fuel Farm TCE Investigation

CTO NO.: 26007-031 BORING NO.: TW-106

SAMPLE TYPE	DEFINITIONS
S = Split Spoon A = Auger	SPT = Standard Penetration Test (ASTM D1586)
T = Shelby Tube W = Wash	PID = Photo Ionization Detector Measurement
R = Air Rotary C = Core	MSL = Mean Sea Level
D = Denison P = Piston N = No Sample	ps/bg = point source/background

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
11						Continued from Sheet 1		
	H-N	--	--	--	--	CLAY & ROCK FRAG; brown		
12						damp		
13								
14								
	H-N	--	--	--	--	SAND & SHELL FRAG; gray;		
15						wet - water @ 14 ft		
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
						Match to Sheet 3		

DRILLING CO.: Inland Pollution Services BAKER REP.: David D. Schilling

DRILLER: Abraham Nunez BORING NO.: TW-106 SHEET 2 OF 3

Baker

Baker Environmental

TEST BORING AND WELL CONSTRUCTION RECORD

PROJECT: SWMU 7 - Tow Way Fuel Farm TCE Investigation

CTO NO.: 26007-031 BORING NO.: TW-106

SAMPLE TYPE

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

DEFINITIONS

SPT = Standard Penetration Test (ASTM D1586)
PID = Photo Ionization Detector Measurement
MSL = Mean Sea Level
BG/PS = Background/Point Source

Depth (Ft.)	Sample Type & No.	Sample Rec. (Ft.,%)	SPT	Lab ID	PID (ppm) ps/bg	Visual Description	Well Installation Detail	Elevation (Ft. MSL)
31						Continued from Sheet 2		
32								
33								
34								
35							35.0	78.32
36								
37		H-N	--	--	--	--	ROCK FRAG, subangular; dark gray; dry	
38								
39								
40	40.0						40.0	73.32
41						BOH @ 40-ft		
42								
43								
44								
45								
46								
47								
48								
49								
50								

DRILLING CO.: Inland Pollution Services BAKER REP.: David D. Schilling

DRILLER: Abraham Nunez BORING NO.: TW-106 SHEET 3 OF 3

APPENDIX B
CHAIN OF CUSTODY RECORD

Serial Number 146741

SL SAVANNAH LABORATORIES & ENVIRONMENTAL SERVICES, INC.

5102 LaRoche Avenue, Savannah, GA 31404 — Phone: (912) 354-7858 — Fax: (912) 352-0165
2846 Industrial Plaza Drive, Tallahassee, FL 32301 — Phone: (904) 878-3994 — Fax: (904) 878-9504
1900 Lakeshore Drive, Mobile, AL 36693 — Phone: (334) 666-6633 — Fax: (334) 666-6696
6712 Benjamin Road, Suite 100, Tampa, FL 33634 — Phone: (813) 885-7427 — Fax: (813) 885-7049
1100 Alpha Drive, Suite 110, Destrehan, LA 70047 — Phone: (504) 764-1100 — Fax: (504) 726-1163

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

SW4149-11

PROJECT REFERENCE | PROJECT NO. | PO NUMBER

PROJECT LOC. (State): PR | SAMPLER(s) NAME | PHONE | FAX

CLIENT NAME | CLIENT PROJECT MANAGER

CLIENT ADDRESS (CITY, STATE, ZIP)

MATRIX TYPE | REQUIRED ANALYSES | PAGE 2 OF 2

STANDARD REPORT DELIVERY [X]

EXPEDITED REPORT DELIVERY (surcharge) [ ]

Date Due: ____

SAMPLE DATE	SAMPLE TIME	SL NO.	SAMPLE IDENTIFICATION	AQUEOUS WATER	SOLID OR SEMISOLID	AIR	NONAQUEOUS LIQUID (oil, solvent, etc)	VOCs										REMARKS
6/30			FTCE- ~~[illegible]~~ Ad					X										

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME
D. Campbell	6/30		[illegible]	6/30	1400			
RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY (SIGNATURE)	DATE	TIME
[illegible]	6/31							

LABORATORY USE ONLY

RECEIVED FOR LABORATORY BY: (SIGNATURE)	DATE	TIME	CUSTODY INTACT	CUSTODY SEAL NO.	SL LOG NO.	LABORATORY REMARKS:
			[ ] YES [ ] NO			RB

CLIENTS FIELD COPY

teg Puerto Rico

Chain of Custody Record

PO # _____

Client: P. I. T. [illegible]
Address: _____
Phone: _____ FAX: _____
Client Project #: _____ Project Manager: [illegible]

Date: 6-29-99 Page 1 of 1
TEG Project #: 99T0629 BAK Contract #: _____
Location: [illegible] / [illegible] / [illegible] Rio [illegible]
Collector: M. D. [illegible] Date of Collection: 6-29-99

Sample Name	Depth	Time	Sample Matrix	Container Type	"Grab Composite"	8021	8020 A (TPH)	VOL 8260	SEMI VOL 8270	TPH 418.1	TPH 8015 B (gasoline)	TPH 8015 B (diesel)	TPH 8015 B (gas & diesel)	TPH 8015 B (motor oil)	TPH 8015 B (full range)	TOTAL LEAD	TCLP PEST	METALS	RC	8082-PCBS	8082-Pesticide	PNA 610/8100	TCLP METALS	TCE		FIELD NOTES / PRESERVATION	Total # of Containers
TTCE-10		0130	H_2O	VOA vials	G																			X			2
TTCE-2D		0745																						X			2
TTCE-3D		0800																						X			2
TTCE-4D		1015																						X			2

RELINQUISHED BY (signature)	Date/Time	RECEIVED BY (signature)	Date/Time
Matt Maloney	6-29-99 / 1511	[illegible]	[illegible]
RELINQUISHED BY (signature)	Date/Time	RECEIVED BY (signature)	Date/Time

			TEMPERATURE
Total # of containers	6	8	
Chain of Custody seals Y / N / NA			
Seals Intact? Y / N / NA			
Received good conditions / cold			[illegible]

G–Grab C–Composite S–Soil W–Aqueous

teg Transglobal Environmental Geochemistry

Chain of Custody Record

PO # _____

Client: [illegible]

Address _____

Phone _____ FAX _____

Client Project # [illegible] Project Manager _____

Date 6/04/99 Page 2 of _____

TEG Project # [illegible] Outside Lab.# _____

Location [illegible]

Collector [illegible] Date of Collection 6/04/99

Sample #	Depth	Time	Sample Type	Container Type	VOA 8010	VOA 8020 (BTEX)	VOA 8260	SEMI VOL 8270	TRPH 418.1	TPH 8015 (gasoline)	TPH 8015 (diesel)	TPH 8015 (gas & diesel)	TPH 8015 (oil)	PNA 610/8100	TOTAL LEAD	pH	METALS	RCI							FIELD NOTES / PRESERVATION	Total # of Containers
7 7CE DSV		945																								2
9-B06-1120SV		1105				✓																				2
9-B02-1L-GW01		1155				✓																				2
9-B02-1L-GW02		1600				✓																				2
9-B02-1L-GW03		1605				✓																				2
9-B02-1L-GW05		1605				✓																				2

RELINQUISHED BY (signature)	Date/Time	RECEIVED BY (signature)	Date/Time
[illegible]		[illegible]	
RELINQUISHED BY (signature)	Date/Time	RECEIVED BY (signature)	Date/Time

		TEMPERATURE
Total # of containers	[illegible]	[illegible]
Chain of Custody seals Y / N / NA		
Seals intact? Y / N / NA		
Received good conditions / cold		

Sample disposal instructions: _____ TEG Disposal @ $2.00 each _____ Return to client _____ Pick up

teg Transglobal Environmental Geochemistry

Chain of Custody Record

PO # _____

Client: [illegible]

Address _____

Phone _____ FAX _____

Client Project # CJ-099 Project Manager _____

Date [illegible] Page 3 of _____

TEG Project # [illegible] Outside Lab.# _____

Location [illegible]

Collector [illegible] Date of Collection [illegible]

Sample #	Depth	Time	Sample Type	Container Type	VOA 8010	VOA 8020 (BTEX)	VOA 8260	SEMI VOL. 8270	TRPH 418.1	TPH 8015 (gasoline)	TPH 8015 (diesel)	TPH 8015 (gas & diesel)	TPH 8015 (oil)	PNA 610/8100	TOTAL LEAD	pH	METALS	HCl							FIELD NOTES / PRESERVATION	Total # of Containers
9-B05-HP01	✓	0705	[illegible]	[illegible]		✓																				2
9B06-HP03	✓	0750																	✓							2
9B05-HP04	✓	[illegible]				✓																				2
9B06-HP01	✓	[illegible]																	✓							2
7CF-A1	✓	1100																	✓							2
9-02R-GW04	✓	1115				✓																				2
9-02-GW07	?	1149				✓																				2
9-B06-HP04	✓	[illegible]				✓																				2
9B05-HP02	✓	1715				✓																				2

RELINQUISHED BY (signature)	Date/Time	RECEIVED BY (signature)	Date/Time
[illegible]			
RELINQUISHED BY (signature)	Date/Time	RECEIVED BY (signature)	Date/Time

Total # of containers [illegible]

Chain of Custody seals Y / N / NA

Seals Intact? Y / N / NA

Received good conditions / cold

TEMPERATURE [illegible]

Sample disposal instructions: TEG Disposal @ $2.00 each ___ Return to client ___ Pickup

teg Transglobal Environmental Geochemistry

Chain of Custody Record

PO # _____

Client: [illegible]

Address _____

Phone _____ FAX _____

Client Project # CTU-099 Project Manager _____

Date _____ Page 6 of _____

TEG Project # [illegible] Outside Lab # _____

Location [illegible] V9

Collector [illegible] Date of Collection [illegible]

Sample #	Depth	Time	Sample Type	Container Type	VOA 8010	VOA 8020 (BTEX)	VOA 8260	SEMI VOL 8270	TRPH 418.1	TPH 8015 (gasoline)	TPH 8015 (diesel)	TPH 8015 (gas & diesel)	TPH 8015 (oil)	PNA 610/8100	TOTAL LEAD	pH	METALS	RCI	[illegible]						FIELD NOTES / PRESERVATION	Total # of Containers
7-TCE 35		735	water	[illegible]															✓							2
7TCE 35		740																	✓							2
7 TCE 45		745																	✓							2
13 6W02		910				✓																				2
9 MW 6W01		920				✓																				2
13 6W05		925				✓																				2
13 6W06		935				✓																				2
13 6W06D		935				✓																				2

RELINQUISHED BY (signature)	Date/Time	RECEIVED BY (signature)	Date/Time
[illegible]		[illegible]	
RELINQUISHED BY (signature)	Date/Time	RECEIVED BY (signature)	Date/Time

Total # of containers

Chain of Custody seals Y / N / NA

Seals Intact? Y / N / NA

Received good conditions / cold

TEMPERATURE

Outside 70s

Sample disposal instructions: ___ TEG Disposal @ $2.00 each ___ Return to client ___ Pickup

teg Transglobal Environmental Geochemistry

Chain of Custody Record

PO # _____

Client: [illegible] Date: [illegible]/99 Page 4 of _____

Address _____ TEG Project # 9910604BDA Outside Lab.# _____

Phone _____ FAX _____ Location [illegible]

Client Project # CTD-055 Project Manager [illegible] Collector [illegible] Date of Collection [illegible]

Sample #	Depth	Time	Sample Type	Container Type	VOA 8010	VOA 8020 (BTEX)	VOA 8260	SEMI VOL 8270	TRPH 418.1	TPH 8015 (gasoline)	TPH 8015 (diesel)	TPH 8015 B (gas & diesel)	TPH 8015 (oil)	PNA 610/8100	TOTAL LEAD	pH	METALS	RCI	Cl(aq)						FIELD NOTES / PRESERVATION	Total # of Containers
9A02R-HP05		610	water	VOA		✓						✓														2
TICE CST		730																	✓							2
9B05-HP05		815				✓						✓														2
9B05 HP03		830				✓						✓														2
9B02R-HP06		1015				✓						✓														2
9A02-HP03		1115				✓						✓														2
9A02-HP03 DUP		1115				✓						✓														2
9A02-HP04		1300				✓						✓														2
9A02-HP05		1400				✓						✓														2
9A02-HP01		1400				✓						✓														2
9B06-HP05		1400				✓						✓							✓							2
9B02R-HP10		1455				✓						✓														2
9B02R-HP01		1455				✓						✓														2
9-02R-HP11		1445				✓						✓														2
9-02R-HP12		1505				✓						✓														2

RELINQUISHED BY (signature)	Date/Time	RECEIVED BY (signature)	Date/Time
[illegible]		[illegible]	
RELINQUISHED BY (signature)	Date/Time	RECEIVED BY (signature)	Date/Time

Total # of containers	30
Chain of Custody seals Y / N / NA	
Seals Intact? Y / N / NA	
Received good conditions / cold	

TEMPERATURE: [illegible]

Sample disposal instructions: _____ TEG Disposal @ $2.00 each _____ Return to client ✓ Pickup

teg Transglobal Environmental Geochemistry

Chain of Custody Record

PO # _____

Client: _____ Date 6/07/99 Page 5 of ____

Address _____ TEG Project # [illegible] Outside Lab.# _____

Phone _____ FAX _____ Location _____

Client Project # _____ Project Manager _____ Collector [illegible] Date of Collection 6/2/99

Sample #	Depth	Time	Sample Type	Container Type	VOA 8010	VOA 8020 (BTEX)	VOA 8260	SEMI VOL 8270	TRPH 418.1	TPH 8015 (gasoline)	TPH 8015 (diesel)	TPH 8015 (gas & diesel)	TPH 8015 (oil)	PNA 610/8100	TOTAL LEAD	pH	METALS	RCI	[illegible]						FIELD NOTES / PRESERVATION	Total # of Containers
7MW08 ✓		750	water	[illegible]															✓							2
7MW07 ✓		[illegible]																	✓							2
7MW07D ✓		[illegible]																	✓							2
7TCE-15 ✓		[illegible]																	✓							2
UG-W-04 ✓		[illegible]																	✓							2

RELINQUISHED BY (signature) Date/Time RECEIVED BY (signature) Date/Time

RELINQUISHED BY (signature) Date/Time RECEIVED BY (signature) Date/Time

Total # of containers 10

Chain of Custody seals Y / N / NA

Seals intact? Y / N / NA

Received good conditions / cold

TEMPERATURE Only 10 Jars

Sample disposal instructions: TEG Disposal @ $2.00 each Return to client ____ Pickup

teg Transglobal Environmental Geochemistry

Chain of Custody Record

PO # _____

Client: BAKER ENVIRONMENTAL, INC.
Address: 420 ROUSER ROAD
Phone: 412 269-2609 FAX: 412 769-2002
Client Project #: CTC-099 Project Manager: TOM FULLER

Date: 7/1/99 Page 1 of 1
TEG Project #: 99I 0701 BAK Outside Lab.#: _____
Location: NAV. STA. ROS. ROADS.
Collector: MARK KLEIS Date of Collection: 7/1/99

Sample #	Depth	Time	Sample Type	Container Type	VOA 8010	VOA 8020 (BTEX)	VOA 8260	SEMI VOL 8270	TRPH 418.1	TPH 8015 (gasoline)	TPH 8015 (diesel)	TPH 8015 (gas & diesel)	TPH 8015 (oil)	PNA 610/8100	TOTAL LEAD	pH	METALS	RCI	TCE	FINGERPRINT					FIELD NOTES / PRESERVATION	Total # of Containers
7TCEMW7		1500	W	40ml															X							2
7TCE104 ✓		1500	W																X							2
7TCE105 ✓		1500	W																X							2
7TCE102X ✓		1500	W																X							2
TWFF-OLD																				X					STAINED	
TWFF-NEW																				X					STAINED	
TWFF-SAMPLE																				X					SAMPLE	

RELINQUISHED BY (signature) Date/Time: 7/1/99 1730
RECEIVED BY (signature) Date/Time: 7/01/99 5:30
RELINQUISHED BY (signature) Date/Time:
RECEIVED BY (signature) Date/Time:

Total # of containers: 8
Chain of Custody seals Y / N / NA: /
Seals intact? Y / N / NA: /
Received good conditions (cold): Y / N

TEMPERATURE: 10 both

Sample disposal instructions: ____ TEG Disposal @ $2.00 each ____ Return to client ____ Pickup

teg Puerto Rico

Chain of Custody Record

PO # _____

Client: BARGO ENVIRONMENTAL

Address: 420 PONCE RD

Phone: 412 269-[illegible] FAX: 412 269-2002

Client Project #: [illegible]99 Project Manager: TOM FULLER

Date: 6/30/99 Page 1 of 1

TEG Project #: [illegible] BAK Control#: _____

Location: NAV. SIM. RES. ROAD

Collector: MARK KLINES Date of Collection: 6/30/99

Sample Name	Depth	Time	Sample Matrix	Container Type	*Grab Composite*	8021	8020 A (BTEX)	VOL 8260	SFM VOL 8270	TRPH 418.1	TPH 8015 B (gasoline)	TPH 8015 B (diesel)	TPH 8015 B (gas & diesel)	TPH 8015 B (motor oil)	TPH 8015 B (full range)	TOTAL LEAD	TCLP LEAD	METALS	RCI	8082-PCBS	8082-Pesticide	HNA & IGYR.DD	TCLP METALS	W/ ICE		FIELD NOTES / PRESERVATION	Total # of Containers
7-MC-[illegible] ✓			W	[illegible]																				X		[illegible]	2
7-MC-101 ✓			W																					X			2
7-MC-102 ✓			W																					X			2
7-MC-103 ✓			W																					X			2

RELINQUISHED BY (signature)	Date/Time	RECEIVED BY (signature)	Date/Time
[illegible]	6/30/99 1755	[illegible]	6/30/99 1755
RELINQUISHED BY (signature)	Date/Time	RECEIVED BY (signature)	Date/Time

Total # of containers	8	TEMPERATURE
Chain of Custody seals Y / N / NA		
Seals Intact? Y / N / NA		
Received good conditions / cold	Y	[illegible]

G=Grab C=Composite S=Soil W=Aqueous

teg Transglobal Environmental Geochemistry

Chain of Custody Record

PO # _____

Client: BAKER ENVIRONMENTAL

Address 420 TRUSSER ROAD

Phone (412) 269-6000 FAX (412) 269-2000

Client Project # CTC-099 Project Manager TOM FULLER

Date 6/30/99 Page 1 of 1

TEG Project # 99I0630 BAK Outside Lab.# _____

Location NAV. STA. RED. READS

Collector MARK KIMES Date of Collection 6/30/99

Sample #	Depth	Time	Sample Type	Container Type	VOA 8010	VOA 8020 (BTEX)	VOA 8260	SEMI VOL 8270	TRPH 418.1	TPH 8015 (gasoline)	TPH 8015 (diesel)	TPH 8015 (gas & diesel)	TPH 8015 (oil)	PNA 610/8100	TOTAL LEAD	pH	METALS	RCI	TCE						FIELD NOTES / PRESERVATION	Total # of Containers
7-TCE-E5 ✓		0700	W	Acid															X							
7-TCE-A1 ✓																			X							
7-TCE-B1 ✓																			X							
7-TCE-C1 ✓																			X							
ANALYZE	7-TCE-E5			(ADAP) FIRST	AND	PROVIDE					VERBAL			RESULT		TO		717-0669								

RELINQUISHED BY (signature)	Date/Time	RECEIVED BY (signature)	Date/Time
[signature]	6/30/99 0830	[signature]	8:30 6/30/99
RELINQUISHED BY (signature)	Date/Time	RECEIVED BY (signature)	Date/Time

Total # of containers	8	TEMPERATURE
Chain of Custody seals Y / N / NA	/	
Seals intact? Y / N / NA	/	
Received good condition / cold	Y/N ✓	ice bath

Sample disposal instructions: ____ TEG Disposal @ $2.00 each ____ Return to client ____ Pickup

Serial Number 146641

SL SAVANNAH LABORATORIES & ENVIRONMENTAL SERVICES, INC.

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

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☐ 1900 Lakeside Drive, Mobile, AL 36693 — Phone: (334) 666-5633 — Fax: (334) 666-8696
☐ 10712 Benjamin Road, Suite 100, Tampa, FL 33634 — Phone: (813) 885-7427 — Fax: (813) 885-7049
☐ 100 Alpha Drive, Suite 110, Destrehan, LA 70047 — Phone: (504) 764-1100 — Fax: (504) 725-1163

SW-HU7-01

PROJECT REFERENCE: NAVN Sta Roosevelt Roads
PROJECT NO.: CTO-039
P.O. NUMBER:
PROJECT LOC. (State): PR
SAMPLER(s) NAME: Hector Kuss
PHONE: 787 717 0669
FAX: 787 282 4091 - 8002
CLIENT NAME: Baker Env
CLIENT PROJECT MANAGER: Tom Hallett
CLIENT ADDRESS (CITY, STATE, ZIP): Coraopolis, PA 15108

PAGE 1 OF 1

☒ STANDARD REPORT DELIVERY
☐ EXPEDITED REPORT DELIVERY (surcharge)
Date Due: _____

REQUIRED ANALYSES: VOCs

SAMPLE DATE	SAMPLE TIME	SL NO.	SAMPLE IDENTIFICATION	MATRIX TYPE: AQUEOUS (WATER)	SOLID OR SEMI-SOLID	AIR	NON-AQUEOUS LIQUID (NAPL)	NUMBER OF CONTAINERS SUBMITTED	REMARKS
7/1	830		99EA-01	X			X		
7/1			7-TCE-104 ✓	X			X		
7/1			7-TCE-105 ✓	X			X		
7/1			7-TCE-HU7 ✓	X			X		
7/1			7-TB-02 ✓	X			X		
7/1			7-TCE-102 ✓	X			X		

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME
				7/1/10	1700			

RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME
	7/2/	1000						

LABORATORY USE ONLY

RECEIVED FOR LABORATORY BY: (SIGNATURE)	DATE	TIME	CUSTODY INTACT	CUSTODY SEAL NO.	SL LOG NO.	LABORATORY REMARKS
			☐ YES ☐ NO			

CLIENTS FIELD COPY

SL SAVANNAH LABORATORIES & ENVIRONMENTAL SERVICES, INC.

Cl-A

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ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

Swanhoy

PROJECT REFERENCE | PROJECT NO | P.O. NUMBER

PROJECT LOC. (State) | SAMPLER(s) NAME | PHONE | FAX

CLIENT NAME | CLIENT PROJECT MANAGER

CLIENT ADDRESS (CITY, STATE, ZIP)

PAGE 3 OF 3

☒ STANDARD REPORT DELIVERY

☐ EXPEDITED REPORT DELIVERY (surcharge)

Date Due: ____

SAMPLE DATE	SAMPLE TIME	SL NO.	SAMPLE IDENTIFICATION	MATRIX TYPE: AQUEOUS/WATER	SOLID OR SEMI-SOLID	AIR	NONAQUEOUS LIQUID (SAMPLE)	REQUIRED ANALYSES: VOC	SVOC	NUMBER OF CONTAINERS SUBMITTED						REMARKS
6/28			9-BG-GWD4	X				X								
6/28			9-TKB3													
6/28			7-TCE-15	X				X								

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME
RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME

LABORATORY USE ONLY

RECEIVED FOR LABORATORY BY: (SIGNATURE)	DATE	TIME	CUSTODY INTACT ☐ YES ☐ NO	CUSTODY SEAL NO.	SL LOG NO.	LABORATORY REMARKS:

CLIENT - FIELD COPY

Serial Number: 14667

SL SAVANNAH LABORATORIES & ENVIRONMENTAL SERVICES, INC.

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900 Lakeside Drive, Mobile, AL 36693 — Phone: (334) 666-6693 — Fax: (334) 666-6696
5712 Benjamin Road, Suite 100, Tampa, FL 33634 — Phone: (813) 855-7427 — Fax: (813) 885-7049
100 Alpha Drive, Suite 110, Destrehan, LA 70047 — Phone: (504) 764-1100 — Fax: (504) 725-1163

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

SWM49-06

PROJECT REFERENCE	PROJECT NO.	P.O. NUMBER
Naval Sta Roosevelt	CTO-099	

PROJECT LOC. (State)	SAMPLER(s) NAME	PHONE	FAX
PR	Mark Kiser	[illegible]	[illegible]

CLIENT NAME	CLIENT PROJECT MANAGER
ONCEA ENV	Tom Fuller

CLIENT ADDRESS (CITY, STATE, ZIP): Carolina 15108

MATRIX TYPE: AQUEOUS (WATER) / SOLID OR SEMISOLID / AIR / NONAQUEOUS LIQUID (oil, solvent, etc.)

REQUIRED ANALYSES: SVOC / MATRIX TOTAL / BTEX / VOC

PAGE 1 OF 1

☒ STANDARD REPORT DELIVERY

☐ EXPEDITED REPORT DELIVERY (surcharge)

Date Due

SAMPLE DATE	SAMPLE TIME	SL NO.	SAMPLE IDENTIFICATION	AQUEOUS (WATER)	SOLID OR SEMISOLID	AIR	NONAQUEOUS LIQUID	SVOC	MATRIX TOTAL	BTEX	VOC					REMARKS
6/29			9GW01	X				X			X					
6/29			9GW01D	X				X			X					
6/29			9GW01MS	X				X			X					
6/29			9GW01MSD	X				X			X					
6/29			9GW02	X				X								
6/29			9-DUP-GW01	X					X							
6/29			7-TCE-MS	X							X					
6/29			7-TCE-1S	X							X					
6/29			7-TCE-2D	X							X					
6/29			7-TCE-1D	X							X					
6/29			7-TCE-3D	X							X					
6/29			9SD-01	X	X		X	X	X	X	X	X				
6/29			9SD-01MS/MSD	X	X		X	X			X	X				

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME
			[signature]	6/29	1400			

RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME
[signature]	6/29	1400						

LABORATORY USE ONLY

RECEIVED FOR LABORATORY BY: (SIGNATURE)	DATE	TIME	CUSTODY INTACT	CUSTODY SEAL NO.	SL LOG NO.	LABORATORY REMARKS:
			☐ YES ☐ NO			

CLIENT FIELD COPY

Serial Number 146540

SL SAVANNAH LABORATORIES & ENVIRONMENTAL SERVICES, INC.

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

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☐ 6712 Benjamin Road, Suite 100, Tampa, FL 33634 — Phone: (813) 885-7427 — Fax: (813) 885-7049
☐ 100 Alpha Drive, Suite 110, Destrehan, LA 70047 — Phone: (504) 764-1100 — Fax: (504) 725-1183

SWMU 9-10

PROJECT REFERENCE	PROJECT NO	P.O. NUMBER
Main St Roos Rocks	CTO-049	

PROJECT LOC. (State): PR
SAMPLER(s) NAME: Mark Kimes
PHONE: (787) 717-0069
FAX: (412) 269-2002
CLIENT NAME: Baker Env.
CLIENT PROJECT MANAGER: Tom Fuller
CLIENT ADDRESS (CITY, STATE, ZIP): Coraopolis, PA 15108

MATRIX TYPE: AQUEOUS (WATER) / SOLID OR SEMI-SOLID / AIR / NONAQUEOUS LIQUID (oil, solvent, etc)

REQUIRED ANALYSES: VOCs / Cyanide / Sulfide

PAGE 1 OF 1

☒ STANDARD REPORT DELIVERY
☐ EXPEDITED REPORT DELIVERY (surcharge)
Date Due: _____

SAMPLE DATE	SAMPLE TIME	SL NO.	SAMPLE IDENTIFICATION	AQUEOUS (WATER)	SOLID OR SEMI-SOLID	AIR	NONAQUEOUS LIQUID (oil, solvent, etc)	VOCs	Cyanide	Sulfide	REMARKS
			~~9-BGS-MW01~~								
6/29			7-TCE-4D-	X				X			
6/29			9-BG-GW01 ✓	X					X	X	
6/29			9-BG-GW01D ✓	X					X	X	
6/29			9-BG-GW01S ✓	X					X	X	
6/29			9-BG-GW01MW ✓	X					X	X	
6/29			9-BG-GW02 ✓	X						X	

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME
S. Campbell	6/29		[illegible]	6/29	1500			
RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME
[illegible]								

LABORATORY USE ONLY

RECEIVED FOR LABORATORY BY: (SIGNATURE)	DATE	TIME	CUSTODY INTACT	CUSTODY SEAL NO.	SL LOG NO.	LABORATORY REMARKS:
			☐ YES ☐ NO			

CLIENT'S FIELD COPY

Serial Number 140013

SL SAVANNAH LABORATORIES & ENVIRONMENTAL SERVICES, INC.

5102 LaRoche Avenue, Savannah GA 31404 — Phone: (912) 354-7858 — Fax: (912) 352-0165
2846 Industrial Plaza Drive, Tallahassee, FL 32301 — Phone: (904) 878-3994 — Fax: (904) 878-9504
900 Lakeside Drive, Mobile, AL 36693 — Phone: (334) 666-6633 — Fax: (334) 666-6596
6712 Benjamin Road Suite 100, Tampa, FL 33634 — Phone: (813) 885-7427 — Fax: (813) 885-7049
100 Alpha Drive, Suite 110, Destrehan, LA 70047 — Phone: (504) 764-1100 — Fax: (504) 725-1183

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

SWMU 9-11

PROJECT REFERENCE	PROJECT NO.	P.O. NUMBER
NWAI SDS Hoos. Road	CTO-099	

PROJECT LOC. (State)	SAMPLER(S) NAME	PHONE / FAX
PR	Mark Kimes	PHONE (787) 717-0669 / FAX (412) 269-2002

CLIENT NAME	CLIENT PROJECT MANAGER
Baker Esv	Tom Fuller

CLIENT ADDRESS (CITY, STATE, ZIP): Coraopolis, PA, 15108

MATRIX TYPE: AQUEOUS (WATER), SOLID OR SEMISOLID, AIR, NONAQUEOUS LIQUID (as: solvent, etc)

REQUIRED ANALYSES: VOC, SVOC, PP. Metals, Cyanide, Sulfide

PAGE 1 OF 2

☒ STANDARD REPORT DELIVERY
☐ EXPEDITED REPORT DELIVERY (surcharge)
Date Due: ____

SAMPLE DATE	SAMPLE TIME	SL NO.	SAMPLE IDENTIFICATION	MATRIX	VOC	SVOC	PP. Metals	Cyanide	Sulfide	REMARKS
6/29			9-SD02 ✓	X	X	X	X	X	X	
6/29			9-SD03 ✓	X	X	X	X	X	X	
6/29			9-SD04 ✓	X	X					
6/29			9-SD05 ✓	X	X					
6/29			9-SW02 ✓	X	X	X	X	X	X	
6/29			9-SW03 ✓	X	X	X	X	X	X	
6/29			9-SW04 ✓	X	X					
6/29			9-SW05 ✓	X	X					
6/30			9-TB-07 ✓	X	X					
6/30			7-TCE-Cal ✓	X	X					
6/30			7-TCE-Esd ✓	X	X					
6/30			7-TCE-Bxf ✓	X	X					
6/30			7-TCE-Esd ✓	X	X					

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME
[signature]	6/29		[signature]	6/30	1400			

RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME
[signature]	6/29							

LABORATORY USE ONLY

RECEIVED FOR LABORATORY BY: (SIGNATURE)	DATE	TIME	CUSTODY INTACT	CUSTODY SEAL NO.	SL LOG NO.	LABORATORY REMARKS:
			☐ YES ☐ NO			

CLIENTS FIELD COPY

APPENDIX C
RISK ASSESSMENT CALCULATIONS

TABLE A.1
CONSTRUCTION WORKERS
INCIDENTAL INGESTION OF GROUNDWATER
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
SWMU 7, NAVAL STATION ROOSEVELT ROADS

CDI (mg/kg/d)= (Cw*IR*ET*EF*ED)/(BW*AT)
ILCR = CDI*CSFo
HQ = CDI/RfDo

Parameter	Description	Construction Worker	
CDI	Chronic daily intake (mg/kg/d)	CS	(Chemical Specific)
ILCR	Incremental lifetime cancer risk	CS	
CSFo	Oral cancer slope factor (1/(mg/kg/d))	CS	
HQ	Hazard quotient	CS	
RfDo	Oral reference dose (mg/kg/d)	CS	
Cw	Concentration of chemical in water (mg/L)	CS	
IR	Ingestion Rate (L/hour)	0.05	
ET	Exposure time (hours/event)	8	
EF	Exposure Frequency (events/yr)	180	
ED	Exposure Duration (yrs)	1	
BW	Body weight (kg)	70	
ATc	Averaging time, carcinogens (d)	25550	
ATn	Averaging time, noncarcinogens (d)	365	

				Carcinogens			Noncarcinogens		
	Cw	CSFo	RfDo	CDI		% Contrib.	CDI		% Contrib.
COPCs	(mg/L)	1/(mg/kg/d)	(mg/kg/d)	(mg/kg/d)	ILCR	Total ILCR	(mg/kg/d)	HQ	HI
Chloromethane[1]	0.011	1.30E-02	NA	4.4E-07	5.8E-09	0.7%	3.1E-05	NA	NA
1,1-Dichloroethene	0.005	6.00E-01	9.00E-03	2.0E-07	1.2E-07	15.3%	1.4E-05	1.6E-03	0.2%
Trichloroethene	1.500	1.10E-02	6.00E-03	6.0E-05	6.6E-07	84.0%	4.2E-03	7.0E-01	99.8%
				Total ILCR:	7.9E-07	100.0%	HI:	7.1E-01	100.0%

(1) There is no established RfDo for Chloromethane

TABLE A.2
CONSTRUCTION WORKERS
INCIDENTAL DERMAL CONTACT WITH GROUNDWATER
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
SWMU 7, NAVAL STATION ROOSEVELT ROADS

DAD (mg/kg/d)= (Cw*CF*Kp*SA*EF*ED*ET)/(BW*AT)

ILCR = DAD*(CSFo/GI)
HQ = DAD/(RfDo*GI]

Parameter	Description	Construction Worker	
DAD	Dermally absorbed dose (mg/kg/d)	CS	(Chemical Specific)
ILCR	Incremental lifetime cancer risk	CS	
CSFo	Oral cancer slope factor (1/(mg/kg/d))	CS	
HQ	Hazard quotient	CS	
RfDo	Oral reference dose (mg/kg/d)	CS	
SA	Skin surface area available for contact (cm2)	5000	
EF	Exposure frequency (d/yr)	180	
ED	Exposure duration (yrs)	1	
ET	Exposure time (hrs/day)	8	
BW	Body weight (kg)	70	
ATc	Averaging time, carcinogens (d)	25550	
ATn	Averaging time, noncarcinogens (d)	365	
Cw	Concentration of chemical in water (mg/L)	CS	
CF	Conversion factor (L/cm3)	0.001	
Kp	Dermal permeability coefficient (cm/hour)	CS	
AF	Adjustment Factor for RfD and CSFo	CS	

							Carcinogens			Noncarcinogens	
COPCs	Cw (mg/L)	Kp (cm/hour)	CSFo 1/(mg/kg/d)	RfDo (mg/kg/d)	AF[2]	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI
Chloromethane[1]	0.011	0.0042	1.30E-02	NA	NA	1.9E-07	2.4E-09	0.2%	1.3E-05	NA	NA
1,1-Dichloroethene	0.005	0.016	6.00E-01	9.00E-03	NA	3.2E-07	1.9E-07	15.4%	2.3E-05	2.5E-03	0.2%
Trichloroethene	1.500	0.016	1.10E-02	6.00E-03	1	9.7E-05	1.1E-06	84.5%	6.8E-03	1.1E+00	99.8%
						Total ILCR:	1.3E-06	100.0%	HI:	1.1E+00	100.0%

(1) There is no established RfDo for Chloromethane
(2) There are no established adjustment factors for Chloromethane or 1,1 Dichloroethene, Region III recommends an adjustment factor of 1 for TCE

TABLE A.3
CONSTRUCTION WORKERS
INCIDENTAL INHALATION OF VOLATILES IN GROUNDWATER
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
SWMU 7, NAVAL STATION ROOSEVELT ROADS

DAD (mg/kg/d)= (Cw*K*IR*EF*ED*ET)/(BW*AT)

ILCR = DAD*(CSFo/GI)
HQ = DAD/(RfDo*GI]

Parameter	Description	Construction Worker	
ILCR	Incremental lifetime cancer risk	CS	
CSFo	Inhalation cancer slope factor (1/(mg/kg/d))	CS	
HQ	Hazard quotient	CS	
RfDo	Inhalation reference dose (mg/kg/d)	CS	
IR	Inhalation rate (m3/day)	12	*Assumes 1.8 m^3/hr * 8 hour day*
EF	Exposure frequency (d/yr)	180	
ED	Exposure duration (yrs)	1	
BW	Body weight (kg)	70	
ATc	Averaging time, carcinogens (d)	25550	
ATn	Averaging time, noncarcinogens (d)	365	
K	Volatilazation Factor (L/m3)	0.5	
Cw	Concentration of chemical in water (mg/L)	CS	

				Carcinogens			Noncarcinogens		
	Cw	CSFi	RfDi	DAD		% Contrib.	DAD		% Contrib.
COPCs	(mg/L)	1/(mg/kg/d)	(mg/kg/d)	(mg/kg/d)	ILCR	Total ILCR	(mg/kg/d)	HQ	HI
Chloromethane	0.011	3.50E-03	8.60E-02	6.6E-06	2.3E-08	0.4%	4.6E-04	5.4E-03	100.0%
1,1-Dichloroethene	0.005	1.75E-01	NA	3.0E-06	5.3E-07	8.8%	2.1E-04	_--	_--
Trichloroethene	1.500	6.00E-03	NA	9.1E-04	5.4E-06	90.8%	6.3E-02	_--	_--
				Total ILCR:	6.0E-06	100.00%	HI:	5.4E-03	100.00%

TABLE A.4
SUMMARY OF POTENTIAL RISKS FROM GROUNDWATER
CONSTRUCTION WORKER
REASONABLE MAXIMUM EXPOSURE
POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
SWMU 7, NAVAL STATION ROOSEVELT ROADS

	Noncarcinogenic Hazard	Carcinogenic Hazard
Ingestion	0.71	8E-07
Dermal Contact	1.13	1E-06
Inhalation	0.005	6E-06
Total HI	1.8	8E-06

STATESIDE LABORATORY ANALYTICAL DATA SUMMARY
SWMU 7 - TCE INVESTIGATION
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO

Location	Federal MCL (ug/l)	**EPA Region III Tap Water RBC** (ug/l)	"First Row" Temporary Wells						
			Shallow Wells				Deep Wells		
Sample ID			7TCE-As	7TCE-Bs	7TCE-Cs	7TCE-Es	7TCE-Ad	7TCE-Bd	7TCE-Cd
Sample Date			06/25/99	06/25/99	06/27/99	06/30/99	06/30/99	06/30/99	06/30/99
Sample Type			Primary	Primary	Primary	Primary	Primary	Primary	Primary
Volatile Organic Compounds (ug/l)									
Chloromethane	NE	2.11	10 U	10 U	10 U	10 U	10 U	10 U	100 U
1,1-Dichloroethene	7	0.04	5 U	**3.8** J	5 U	5 U	**5**	5 U	50 U
Trichloroethene	5	1.07	**55**	**92**	**25**	5 U	**140**	**66**	**1,500**

Notes:
Shading indicates exceedance of Federal MCL for drinking water.
Bold indicates exceedance of USEPA Region III Tap water RBC.
U - Not detected.
NE - Criteria Not Established.

STATESIDE LABORATORY ANALYTICAL DATA SUMMARY
SWMU 7 - TCE INVESTIGATION
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO

Location	Federal MCL	**EPA Region III Tap Water RBC**	"Second Row" Temporary Wells					
			Shallow Wells		Deep Wells			
Sample ID			7TCE-1s	7TCE-4s	7TCE-1d	7TCE-2d	7TCE-3d	7TCE-4d
Sample Date	(ug/l)	(ug/l)	06/26/99	06/28/99	06/29/99	06/29/99	06/29/99	06/29/99
Sample Type			Primary	Primary	Primary	Primary	Primary	Primary
Volatile Organic Compounds (ug/l)								
Chloromethane	NE	2.11	**13**	10 U	10 U	10 U	**9** J	10 U
1,1-Dichloroethene	7	0.04	5 U	5 U	5 U	5 U	**3** J	5 U
Trichloroethene	5	1.07	5 U	5 U	5 U	5 U	**44**	5 U

Notes:
Shading indicates exceedance of Federal MCL for drinking water.
Bold indicates exceedance of USEPA Region III Tap water RBC.
U - Not detected.
NE - Criteria Not Established.

STATESIDE LABORATORY ANALYTICAL DATA SUMMARY
SWMU 7 - TCE INVESTIGATION
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO

Location Sample ID Sample Date Sample Type	Federal MCL (ug/l)	**EPA Region III Tap Water RBC** (ug/l)	"Third Row" Temporary Wells			Adjacent to 7MW07	Criteria Exceedance Summary				
			7TCE-102 07/01/99 Primary	7TCE-104 07/01/99 Primary	7TCE-105 07/01/99 Primary	7TCEMW7 07/01/99 Primary	Number Exceeding Federal MCL	Range Exceeding Federal MCL	Number Exceeding Tap Water RBCs	Range Exceeding Tap Water RBCs	Location Maximum Detect
Volatile Organic Compounds (ug/l)											
Chloromethane	NE	2.11	10 U	10 U	10 U	100 U	NE		2/18	9 J - 13	7TCE-1S
1,1-Dichloroethene	7	0.04	5 U	5 U	5 U	50 U	0/18		3/18	3 J - 5	7TCE-AD
Trichloroethene	5	1.07	**5.4**	5 U	5 U	**1,000**	9/18	5.4 - 1,500	9/18	5.4 - 1,500	7TCE-CD

Notes:
Shading indicates exceedance of Federal MCL for drinking water.
Bold indicates exceedance of USEPA Region III Tap water RBC.
U - Not detected.
NE - Criteria Not Established.

RISK STATS
STATESIDE LABORATORY ANALYTICAL DATA SUMMARY
SWMU 7 - TCE INVESTIGATION
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO

	Minimum Non-Detect	Maximum Non-Detect	Minimum Detected	Maximum Detected	Location of Maximum Detect	Frequency of Detection	Arithmatic Mean Positive Detects	Median Positive Detects
Volatile Organic Compounds (ug/l)								
Chloromethane	10 U	100 U	9 J	13	7TCE-1s	2/17	11	11
1,1-Dichloroethene	5 U	50 U	3 J	5	7TCE-Ad	3/17	3.9333	3.8
Trichloroethene	5 U	5 U	5.4	1500	7TCE-Cd	9/17	325.2667	66

RISK STATS
STATESIDE LABORATORY ANALYTICAL DATA SUMMARY
SWMU 7 - TCE INVESTIGATION
NAVAL STATION ROOSEVELT ROADS, CEIBA, PUERTO RICO

	Minimum Non-Detect	Arithmatic Mean Half Non-Detects	Standard Deviation	Upper 95% Confidence Level	Log Arithmatic Mean Half Non-Detects	Log Standard Deviation	Log Upper 95 % Confidence Level
Volatile Organic Compounds (ug/l)							
Chloromethane	10 U	11	14.8282	17.2788	1.9711	0.7762	15.4151
1,1-Dichloroethene	5 U	5.4	7.4066	8.5362	1.2633	0.7602	7.4314
Trichloroethene	5 U	173.3765	416.614	349.7872	2.8177	2.2213	3803.0492