N65928.AR.000694
NTC ORLANDO
5090.3a

FINAL REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORK PLAN STUDY AREA 12, 13 AND 14 AREA C NTC ORLANDO FL

10/1/1997

ABB ENVIRONMENTAL

7457-10.0-204
03.04.04.0001
1D-00181

FILE COPY

# REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN

## OPERABLE UNIT 4
## STUDY AREAS 12, 13, AND 14 - AREA C

## NAVAL TRAINING CENTER
## ORLANDO, FLORIDA

**UNIT IDENTIFICATION CODE: N65928**
**CONTRACT NO.: N62467-89-D-0317/135**

**OCTOBER 1997**

SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORTH CHARLESTON, SOUTH CAROLINA
29419-9010

# REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN

## OPERABLE UNIT 4
## STUDY AREAS 12, 13, AND 14 - AREA C

## NAVAL TRAINING CENTER
## ORLANDO, FLORIDA

Unit Identification Code: N65928

Contract No.: N62467-89-D-0317/135

Prepared by:

ABB Environmental Services, Inc.
2590 Executive Center Circle, East
Tallahassee, Florida 32301

Prepared for:

Department of the Navy, Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29418

Barbara Nwokike, Code 1873, Engineer-in-Charge

October 1997

SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

This document that describes the Remedial Investigation and Feasibility Study for Operable Unit 4, Naval Training Center, Orlando, Florida, has been prepared under the direction of a Florida-Registered Professional Engineer. The work and professional opinions rendered in this report were conducted or developed in accordance with commonly accepted procedures consistent with applicable standards of practice.

Harlan Faircloth, P.E.
Professional Engineer No.: 0051359
Expires: 2/28/99

Date: 11-6-97

CERTIFICATION OF TECHNICAL
DATA CONFORMITY (MAY 1987)

The Contractor, ABB Environmental Services, Inc., hereby certifies that, to the best of its knowledge and belief, the technical data delivered herewith under Contract No. N62467-89-D-0317/135 are complete and accurate and comply with all requirements of this contract.

DATE: October 28, 1997

NAME AND TITLE OF CERTIFYING OFFICIAL: John Kaiser
Task Order Manager

NAME AND TITLE OF CERTIFYING OFFICIAL: Mark Salvetti, P.E.
Project Technical Lead

(DFAR 252.227-7036)

# FOREWORD

To meet its mission objectives, the U.S. Navy performs a variety of operations, some requiring the use, handling, storage, or disposal of hazardous materials. Through accidental spills and leaks and conventional methods of past disposal, hazardous materials may have entered the environment in ways unacceptable by today's standards. With growing knowledge of the long-term effects of hazardous materials on the environment, the Department of Defense (DOD) initiated various programs to investigate and remediate conditions related to suspected past releases of hazardous materials at their facilities. Two of these programs are the Installation Restoration (IR) program and the Base Realignment and Closure (BRAC) program.

The IR program complies with the Base Closure and Realignment Act of 1988 (Public Law 100-526,102 Statute 2623) and the Defense Base Closure and Realignment Act of 1990 (Public Law 101-510, 104 Statute [1808]), which require the DOD to observe pertinent environmental legal provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Executive Order 12580, and the statutory provisions of the Defense Environmental Restoration Program (DERP), the National Environmental Policy Act (NEPA), and any other applicable statutes that protect natural and cultural resources.

Originally, the Navy's part of this program was called the Naval Assessment and Control of Installation Pollutants (NACIP) program. Early reports reflect the NACIP process and terminology. The Navy eventually adopted the program structure and terminology of the standard IR program.

The IR program is conducted in several stages as follows:

- Preliminary Assessment (PA),
- A site Inspection (SI) (formerly the PA and SI steps were called the Initial Assessment Study [IAS] under the NACIP program),
- Remedial Investigation and Feasibility Study (RI/FS), and
- Remedial Design and Remedial Action (RD/RA).

The goal of the BRAC program is to expedite and improve environmental response actions to facilitate the disposal and reuse of a BRAC installation while protecting human health and the environment.

The Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM), the U.S. Environmental Protection Agency, and the Florida Department of Environmental Protection collectively coordinate the cleanup activities through the BRAC cleanup team, called the Orlando Partnering Team in Orlando. This team approach is intended to foster partnering, accelerate the environmental cleanup process, and expedite timely, cost-effective, and environmentally responsible disposal and reuse decisions.

Questions regarding the BRAC program at Naval Training Center, Orlando should be addressed to the SOUTHNAVFACENGCOM BRAC Environmental Coordinator, Mr. Wayne Hansel, Code 18B7, at (407) 646-5294 or SOUTHNAVFACENGCOM Engineer-in-Charge, Ms. Barbara Nwokike, Code 1873, at (803) 820-5566.

## EXECUTIVE SUMMARY


This RI/FS workplan has been developed by ABB Environmental Services, Inc. (ABB-ES), to enable proper conduct of work at Operable Unit (OU) 4. OU 4 consists of Study Areas 12, 13, and 14 at Area C, Naval Training Center (NTC), Orlando. The workplan has incorporated elements of the Project Operations Plan (ABB-ES, 1997), which contains the requirements of a Quality Assurance Project Plan, Health and Safety Plan, and elements of a Field Sampling Plan (FSP) related to sampling equipment, procedures, and sample handling and analysis. Other FSP elements specific to this site, including sampling objectives and sample location and frequency, are addressed in this workplan.

Several investigations have already occurred at OU 4, either under the Base Realignment and Closure site screening program or under subsequent efforts to characterize the contamination discovered during site screening. These efforts have identified a plume of chlorinated solvent contaminated groundwater migrating from the former base laundry and into the adjacent Lake Druid. Source areas appear to be multiple, and are likely located adjacent and beneath the former laundry Building 1100. An interim action, consisting of two recirculation wells, is being implemented to intercept the majority of the contaminated groundwater before reaching Lake Druid.

This workplan outlines the approach proposed to characterize portions of OU 4 that represent data gaps in the site conceptual model developed during the investigations described above. These data gaps will be addressed through better characterization of groundwater contamination located upgradient and side gradient of the main source area(s), determination of the potential for off-site migration to the north of OU 4, and characterization of contaminated soils. These results will be used to establish the nature and distribution of contaminants at OU 4, identify potential threats to public health or the environment, and evaluate potential remedial alternatives based on engineering factors, implementability, environmental and public health concerns, and costs.

This workplan is intended to be a dynamic document permitting flexibility during the conduct of this investigation at NTC, Orlando. The workplan has incorporated concepts promulgated by the Superfund Accelerated Cleanup Model program, developed by the U.S. Environmental Protection Agency to streamline and standardize environmental investigations.

## TABLE OF CONTENTS

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

## TABLE OF CONTENTS (Continued)

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

## TABLE OF CONTENTS (Continued)

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

## LIST OF FIGURES

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

## LIST OF TABLES

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

# GLOSSARY

| | |
|---|---|
| ABB-ES | ABB Environmental Services, Inc. |
| AOC | area of concern |
| ARAR | applicable or relevant and appropriate requirements |
| AWQC | Ambient Water Quality Criteria |
| | |
| bls | below land surface |
| BRAC | Base Realignment and Closure Program |
| BTEX | benzene, toluene, ethylbenzene, and xylenes |
| | |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFR | Code of Federal Regulations |
| CLP | Contract Laboratory Program |
| COC | contaminant of concern |
| CPC | contaminants of potential concern |
| CT | central tendency |
| | |
| DCE | dichloroethene |
| DOD | Department of Defense |
| DOT | Department of Transportation |
| DPT | direct push technology |
| DQO | data quality objective |
| DRMO | Defense Reutilization and Marketing Office |
| | |
| ECD | electron capture detector |
| ECPC | ecological contaminant of potential concern |
| EPC | exposure point concentration |
| ERA | ecological risk assessment |
| | |
| FDEP | Florida Department of Environmental Protection |
| FFI | focused field investigation |
| FGFWFC | Florida Game and Fresh Water Fish Commission |
| FID | flame ionization detector |
| FR | Federal Register |
| FRED | Fast Retrieval of Environmental Data |
| FS | Feasibility Study |
| FSA | Field Staging Area |
| FSP | Field Sampling Plan |
| | |
| GC | gas chromatograph |
| GPR | Ground Penetrating Radar |
| GPS | Global Positioning System |
| | |
| HEAST | Health Effects Assessment Summary Table |
| HHRA | human health risk assessment |
| HI | hazard index |
| HQ | hazard quotient |
| HSA | hollow-stem auger |
| | |
| IAS | Initial Assessment Study |
| ID | inside diameter |

| | |
|---|---|
| IDW | Investigation-Derived Waste |
| IR | Installation Restoration |
| IRA | interim remedial action |
| IRIS | Integrated Risk Information System |
| LDR | Land Disposal Restriction |
| MCL | maximum contaminant level |
| MDL | method detection limit |
| mℓ | milliliters |
| μg/kg | micrograms per kilogram |
| μg/ℓ | micrograms per liter |
| MS/MSD | matrix spike and matrix spike duplicate |
| NACIP | Naval Assessment and Control of Installation Pollutants |
| NAPL | nonaqueous-phase liquid |
| NTC | Naval Training Center |
| OAFB | Orlando Air Force Base |
| OPT | Orlando Partnering Team |
| OU | operable unit |
| PAH | polynuclear aromatic hydrocarbons |
| PARCC | precision, accuracy, representativeness, comparability, and completeness |
| PCB | polychlorinated biphenyls |
| PCE | perchloroethene |
| PDE | potential dietary exposure |
| PLD | Project Logic Diagram |
| POP | Project Operations Plan |
| ppb | parts per billion |
| PPE | personal protective equipment |
| QA/QC | quality assurance/quality control |
| QC | quality control |
| RAGS | Risk Assessment Guidance for Superfund |
| RAO | remedial action objective |
| RCRA | Resource Conservation and Recovery Act |
| RI | Remedial Investigation |
| RI/FS | Remedial Investigation and Feasibility Study |
| RME | reasonable maximum exposure |
| ROD | Record of Decision |
| RPD | relative percent difference |
| RTVs | reference toxicity values |
| SA | Study Area |
| SACM | Superfund Accelerated Cleanup Model |
| SCG | Soil Cleanup Goals |
| SCM | site conceptual model |
| SDWA | Safe Drinking Water Act |

## GLOSSARY (Continued)

| | |
|---|---|
| SI | site inspection |
| SOUTHNAV-FACENGCOM | Southern Division, Naval Facilities Engineering Command |
| SQL | sample quantitation limit |
| SVOC | semivolatile organic compound |
| TAL | target analyte list |
| TBC | to-be-considered |
| TCE | trichloroethene |
| TCL | target compound list |
| TCLP | toxicity characteristic leaching procedure |
| TOC | top of casing |
| TPH | total petroleum hydrocarbons |
| UCL | upper confidence level |
| USEPA | U.S. Environmental Protection Agency |
| USGS | U.S. Geological Survey |
| VC | vinyl chloride |
| VOC | volatile organic compound |
| WWTP | Waste Water Treatment Plant |

# 1.0 INTRODUCTION

ABB Environmental Services, Inc. (ABB-ES), under contract to Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM), has prepared this Remedial Investigation and Feasibility Study (RI/FS) Workplan for Operable Unit (OU) 4, which consists of Study Area (SA) 12 (Defense Reutilization and Marketing Office [DRMO] Warehouses and Salvage Yard), SA 13 (former base laundry and drycleaning facility), and SA 14 (DRMO Storage Area) at Naval Training Center (NTC) in Orlando, Florida. The RI/FS is being conducted under Contract Number N62467-89-D-0317-135.

The approach to the RI/FS at OU 4 was developed in conjunction with the Orlando Partnering Team (OPT), which includes representatives from the Florida Department of Environmental Protection (FDEP), the U.S. Environmental Protection Agency (USEPA) Region IV, SOUTHNAVFACENGCOM and their consultants, and the NTC, Orlando Public Works Department.

The following sections describe the regulatory and facility background for NTC, Orlando.

**1.1 REGULATORY BACKGROUND**. To meet its mission objectives, the U.S. Navy performs a variety of operations, some requiring the use, handling, storage, or disposal of hazardous materials. Through accidental spills and leaks and conventional methods of past disposal, hazardous materials may have entered the environment in ways unacceptable by today's standards. With growing knowledge of the long-term effects of hazardous materials on the environment, the Department of Defense (DOD) initiated various programs to investigate and remediate conditions related to suspected past releases of hazardous materials at their facilities. Two of these programs are the Installation Restoration (IR) program and the Base Realignment and Closure (BRAC) program.

The IR program complies with the Base Closure and Realignment Act of 1988 (Public Law 100-526,102 Statute 2623) and the Defense Base Closure and Realignment Act of 1990 (Public Law 101-510,104 Statute [1808]), which require the DOD to observe pertinent environmental legal provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Executive Order 12580, and the statutory provisions of the Defense Environmental Restoration Program, the National Environmental Policy Act, and any other applicable statutes that protect natural and cultural resources.

Originally, the Navy's part of this program was called the Naval Assessment and Control of Installation Pollutants (NACIP) program. Early reports reflect the NACIP process and terminology. The Navy eventually adopted the program structure and terminology of the standard IR program.

The goal of the BRAC program is to expedite and improve environmental response actions to facilitate the disposal and reuse of a BRAC installation while protecting human health and the environment.

**1.2 FACILITY BACKGROUND**. NTC, Orlando encompasses 2,072 acres in Orange County, Florida, and consists of four discrete facilities: Main Base, Area C, Herndon Annex, and McCoy Annex (Figures 1-1 and 1-2). The history of NTC, Orlando dates to the construction of the original Orlando Municipal Airport prior to 1940. In August 1940, the municipal airport was taken over by the U.S. Army Air Corps. Shortly thereafter, the construction program for Orlando Air Base began, culminating in its official opening on December 1, 1940. During the following 2 years, the Army Air Corps acquired additional property, and auxiliary landing fields were built in the surrounding area. The U.S. Army Air Corps conducted operations at the Main Base and Area C from 1940 to 1947.

In 1947, the U.S. Air Force assumed command of the facilities as the Orlando Air Force Base (OAFB). The base was deactivated on October 28, 1949, and remained on standby status until January 1, 1951, when it was reactivated as an Aviation Engineers' training site. Other Air Force units arrived, and the Military Airlift Command assumed full jurisdiction of the base in 1953.

The Navy began moving its Training Device Center from Port Washington, New York, to OAFB on September 15, 1965, and finished the move in June 1967. In 1968, the Air Force ceased operations at OAFB, Area C, and Herndon Annex. The property was commissioned as NTC, Orlando on July 1, 1968.

The stated mission of NTC, Orlando was to exercise command over, and coordinate the efforts of, the assigned subordinate activities in recruit training of enlisted personnel; provide initial skill, advanced, and/or specialized training for officer and enlisted personnel of the regular Navy and Naval Reserve; and to support other activities as directed by a higher authority (ABB-ES, 1994a).

Area C (Figures 1-2 and 1-3) occupies approximately 46 acres and is located approximately 1 mile west of the Main Base off Maguire Boulevard. Area C served as a supply center for NTC, Orlando and includes a laundry and drycleaning facility, and the DRMO. The laundry and drycleaning facility closed in the fall of 1994. Area C is surrounded by urban development, including single- and multifamily residential developments to the north and south, Lake Druid to the west, and an office park to the east. Lake Druid is approximately 300 feet west of Port Hueneme Avenue. It is semicircular in shape, approximately 1,200 feet at maximum length, by 800 feet. Approximately one-third of the lake is surrounded by undeveloped land to the east, owned by NTC, Orlando. It is mostly forested and the shoreline is thick with floating emergent plants. The remainder of the lake is surrounded by approximately 3/4-acre residential and properties. There are no industrial facilities adjacent to Area C. Further discussions of the Main Base, Herndon Annex, and McCoy Annex may be found in the Project Operations Plan (POP) (ABB-ES, 1997a).

**1.3 PREVIOUS ENVIRONMENTAL INVESTIGATIONS**. Previous investigative activities at NTC, Orlando include an initial assessment study (IAS) conducted in 1985 by C.C. Johnson (1985) and a verification study conducted in 1986 by Geraghty & Miller (1986).

The first phase of the IR program at NTC, Orlando was the IAS conducted in 1985 (C.C Johnson, 1985). This program included an archival search and site walkovers at all four facilities of NTC, Orlando. The IAS identified one potentially contaminated site at Area C, an old boiler building for the laundry facility, but

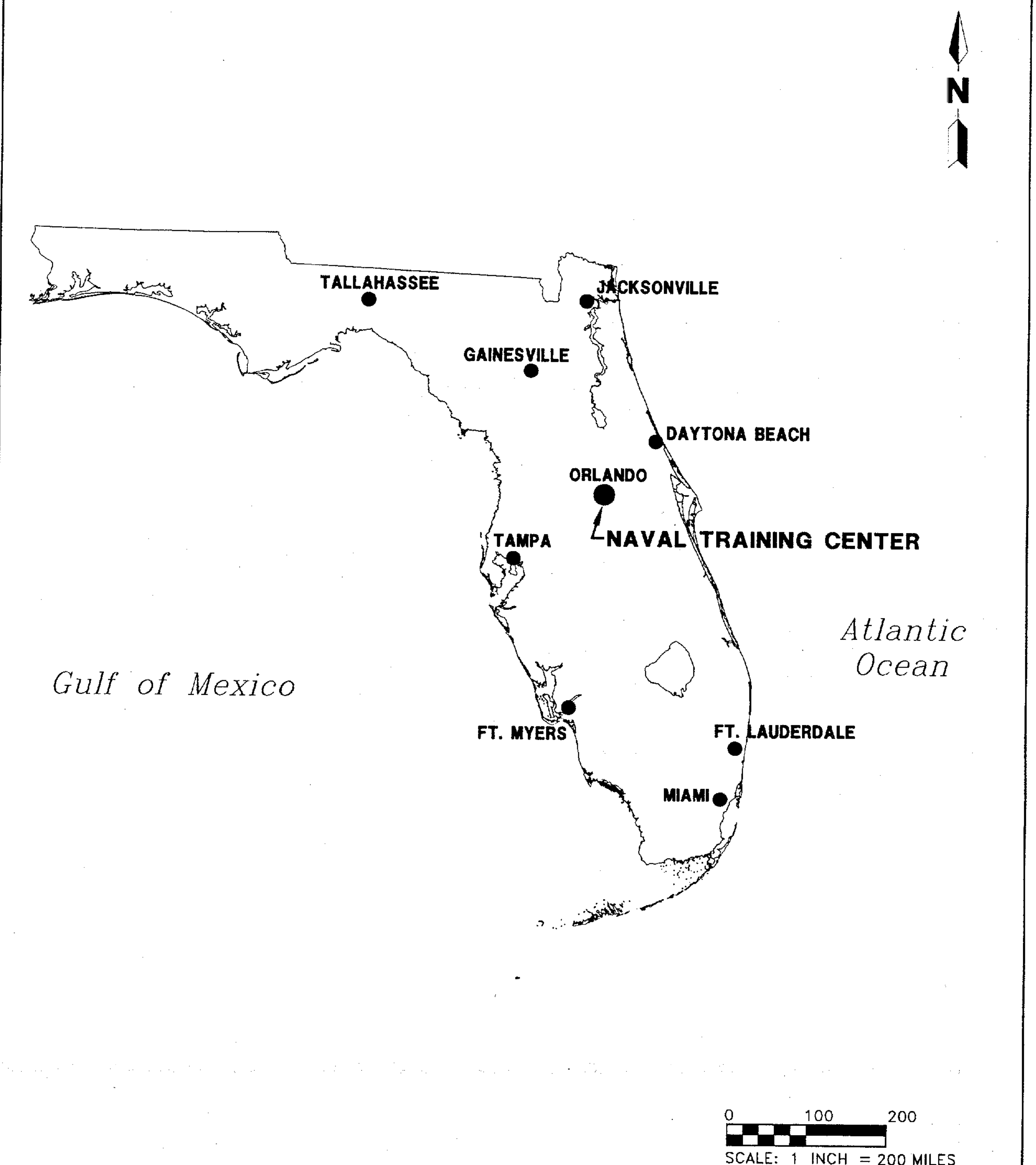



**FIGURE 1-1**
**VICINITY MAP**

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN OPERABLE UNIT 4**

**NAVAL TRAINING CENTER ORLANDO, FLORIDA**

H:\OLD\NAVFLA.DWG, BB-RPN 07/01/97 14:34:42, AutoCAD R12

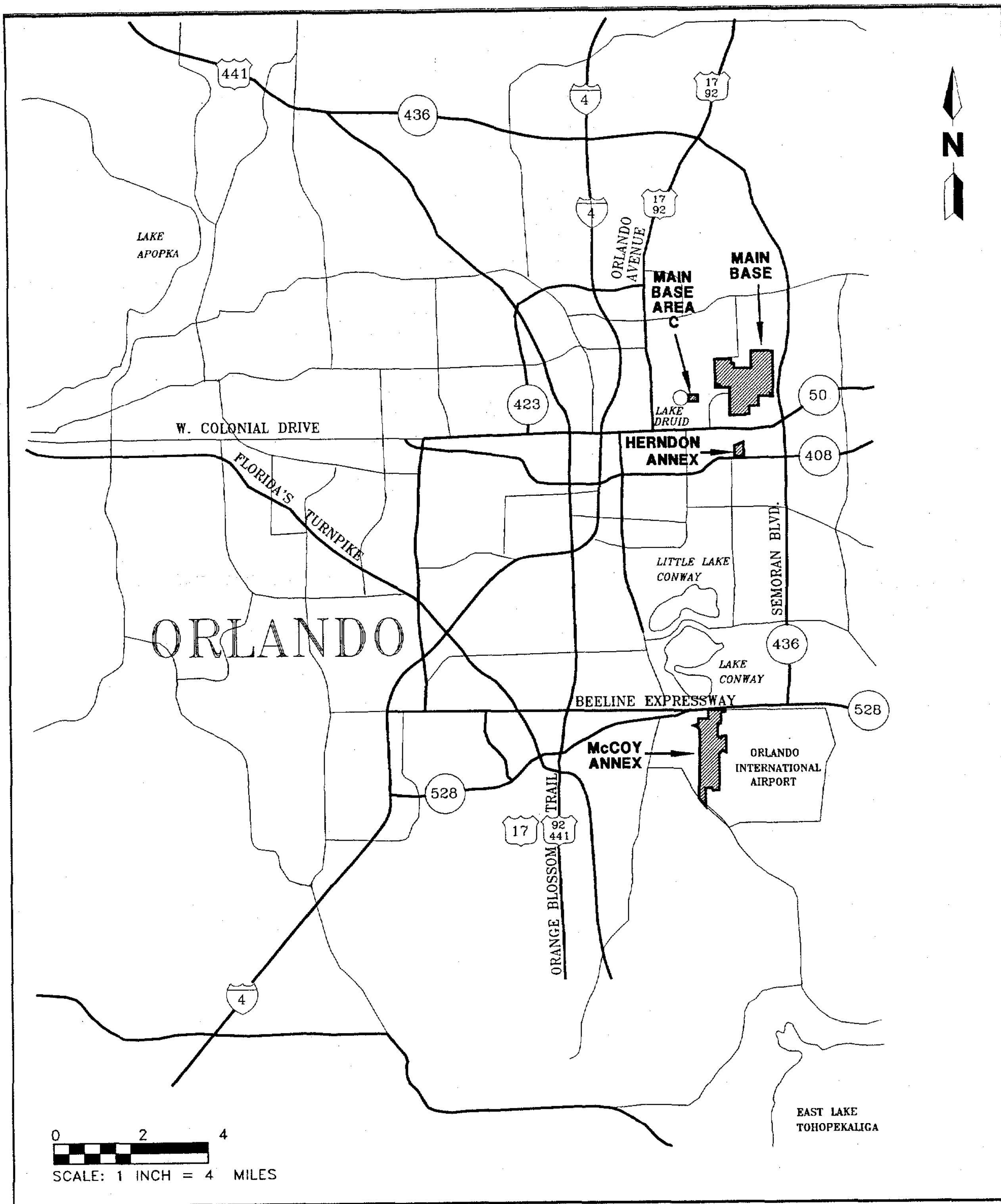


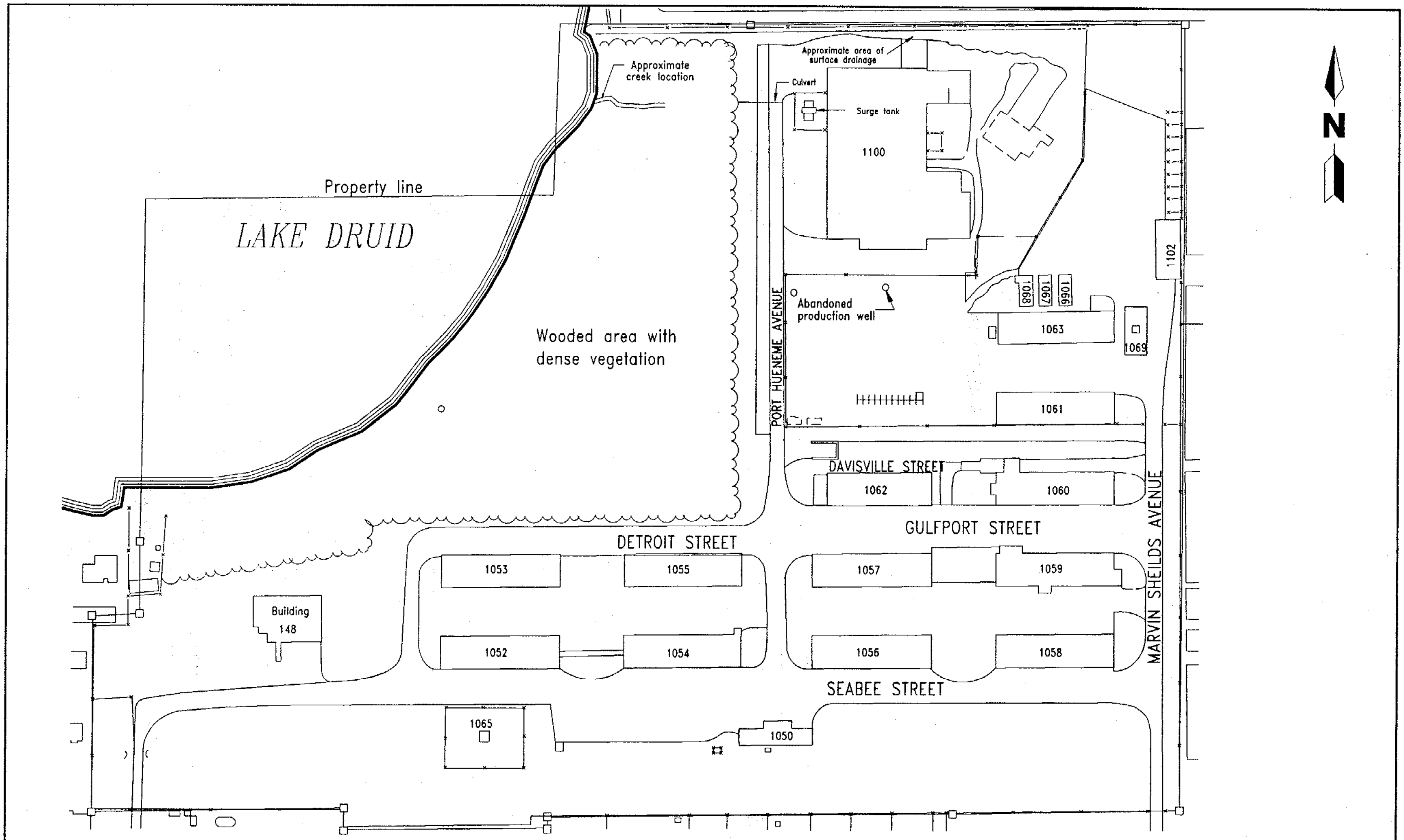

**FIGURE 1-2**
**NTC, ORLANDO**
**SITE LOCATION MAP**

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN OPERABLE UNIT 4**

**NAVAL TRAINING CENTER ORLANDO, FLORIDA**

H:\OLD\IRA\OU4\FFI\SITELOC.DWG, BB-RPN 07/02/97 13:40:49, AutoCAD R12

NTC-RIFS.OU4
ASW.10.97




0 125 250

SCALE: 1 INCH = 250 FEET

H:\OLD\IRA\AREAC.DWG, BB-RPN 07/01/97 14:54:44, AutoCAD R12

**FIGURE 1-3**
**MAP OF AREA C**

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN OPERABLE UNIT 4**

**NAVAL TRAINING CENTER ORLANDO, FLORIDA**

did not recommend it as one of the five sites identified basewide for further study. The boiler facility was constructed in the early 1940s. The boilers were removed in 1972, and the building was partially demolished in 1979. The building was completely removed in the mid-1980s.

A verification study was performed in 1986 (Geraghty & Miller, 1986). The verification study did not include any sites at Area C.

Descriptions of IR and BRAC program investigative activities at NTC, Orlando can be found in the POP (ABB-ES, 1997a), the BRAC Cleanup Plan (ABB-ES, 1996a), the Background Sampling Plan (ABB-ES, 1994b), and the BRAC Environmental Baseline Survey (ABB-ES, 1994a).

To facilitate their assessment, the IR program sites at NTC, Orlando have been separated into groups known as operable units (OUs). An OU is composed of sites that

- are in close proximity to each other,
- have similar contaminant exposure histories, and/or
- will likely require similar remedial measures.

<u>1.4 PURPOSE OF THE RI/FS</u>. ABB-ES has prepared this workplan for conducting an RI/FS within Area C, which is composed of previously designated SAs 12, 13, and 14 and has been designated as OU 4 (ABB-ES, 1996b).

The RI/FS will be conducted in accordance with the methods described in the USEPA *Conducting Remedial Investigations and Feasibility Studies* under CERCLA (USEPA, 1988a).

The objectives of the investigations are to

- determine the nature and distribution of contaminants at the site;
- identify potential threats to public health or the environment posed by the potential release of contaminants from the site; and
- evaluate potential remedial alternatives based on engineering factors, implementability, environmental and public health concerns, and costs.

This workplan presents the technical scope of services necessary to achieve these objectives and the schedule for conducting field activities, preparing reports, and developing and evaluating remedial alternatives. The program has been designed to be as efficient and streamlined as possible to effect a rapid data acquisition and evaluation process during the RI/FS. To this end, investigators begin with the understanding that it will not be possible to completely characterize this site or any other similar site with even a very large number of explorations and chemical analyses. Rather, the approach will be to sufficiently characterize the site with a limited number of explorations and analyses that will permit development and refinement of a conceptual model based on reasonable conclusions drawn from the data. Remedial alternatives will be selected such that planned contingencies may be invoked at any time during the investigation when it becomes apparent that probable conditions have given way to deviations in those assumptions. Thus, a working hypothesis will have been formulated, which will evolve and grow along with increased knowledge. In this way, a balance between managed uncertainties and the implementation of remedial alternatives is achieved, resulting in improved efficiencies.

The workplan consists of the 10 chapters and 3 appendices described below:

- Chapter 1.0 provides an introduction to the process and a description of the components of the workplan.
- Chapter 2.0 summarizes the site background and setting and includes a description of the site and its history, hydrogeologic setting, a summary of the results of previous investigations, and an evaluation of data needs.
- Chapter 3.0 describes the approach for conducting the Remedial Investigation (RI) and identifies the data needs that must be addressed.
- Chapter 4.0 provides the rationale and task-by-task approach for the field investigations at OU 4.
- Chapter 5.0 describes the laboratory analytical program.
- Chapter 6.0 describes the risk assessment process.
- Chapter 7.0 describes how investigation-derived wastes (IDW) generated during the field investigations will be managed.
- Chapter 8.0 describes the RI report.
- Chapter 9.0 describes the Feasibility Study (FS) report.
- Chapter 10.0 contains the project schedule.
- Appendix A includes analytical summary tables for previous investigations conducted at OU 4 under Contract Task Order 107. These investigations include site-screening, the focused field investigation (FFI) along the shore of Lake Druid, and the source confirmation study.
- Appendix B contains a synopsis of potential Federal and State applicable or relevant and appropriate requirements (ARARs) that may apply during the OU 4 RI/FS.
- Appendix C consists of the health and safety plan addendum for OU 4.

The workplan has incorporated elements of the POP (ABB-ES, 1997a), which contains the requirements of a Quality Assurance Project Plan, Health and Safety Plan, and elements of a Field Sampling Plan (FSP) related to sampling equipment, procedures, and sample handling and analysis. Other FSP elements specific to this site, including sampling objectives and sample location and frequency, will be addressed in this workplan.

# 2.0 SITE BACKGROUND AND SETTING

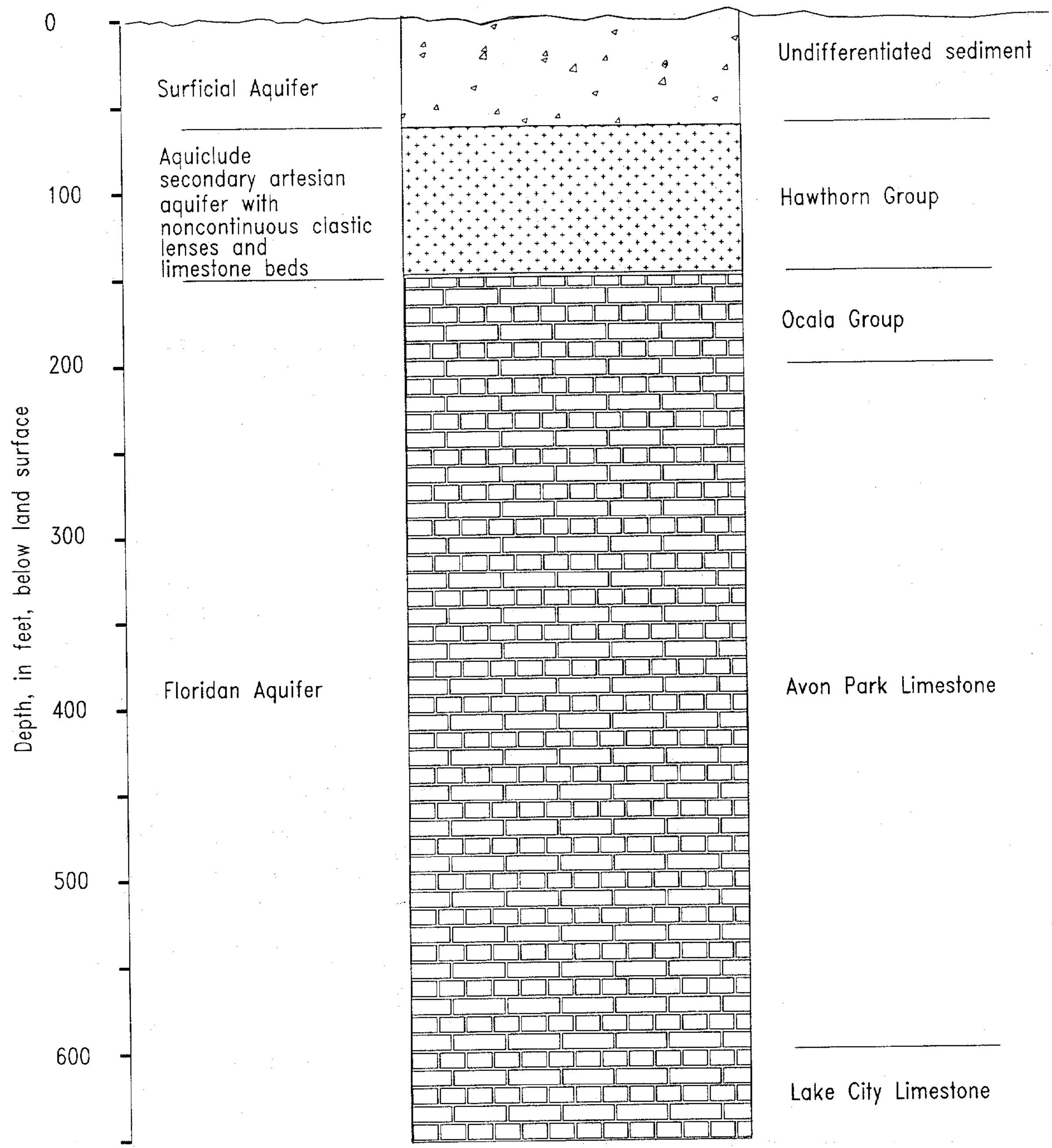
As mentioned previously, OU 4 is within Area C and represents SA 12 (DRMO Warehouses and Salvage Yard), SA 13 (Former Base Laundry and Drycleaning Facility), and SA 14 (DRMO Storage Area) (Figure 1-3). This chapter presents the site background and physical setting, and includes the results of IR program investigations conducted to date at OU 4.

**2.1 HYDROGEOLOGIC SETTING.** This section presents a discussion of the hydrogeologic framework for the area of NTC, Orlando. A general characterization of the major lithologic units and aquifers at NTC, Orlando is presented along with a summary of available documented information for OU 4, Area C. The POP (ABB-ES, 1997a) contains a detailed discussion of the regional physical characteristics (topography, geology, hydrogeology, soil, and surface water hydrology) of NTC, Orlando. This information will not be reproduced in this workplan. Rather, a conceptual framework of the hydrogeologic setting, as it applies to the evaluation of contaminant migration in groundwater, will be described.

Three major lithologic units underlie NTC, Orlando (Figure 2-1). These are (1) the surficial sands and clays of Holocene and Pleistocene age; (2) the clays, sands, and carbonates of the Hawthorn Group (Miocene); and (3) the underlying Eocene carbonates of the Ocala, Avon Park, and Lake City Limestones. The principal aquifers correspond to these lithologic units. The aquifers are (1) the surficial aquifer, (2) intermediate aquifer and confining zone within the Hawthorn Group (formerly referred to as the secondary artesian aquifer), and (3) the Floridan aquifer system.

The sediments of the Hawthorn Group contain the intermediate aquifer (which may have more than one water-producing zone) and collectively act as a confining unit for both the surficial aquifer and the Floridan aquifer system. The Hawthorn Group acts as a lower aquitard for the surficial aquifer by impeding the downward migration of groundwater and an upper aquitard for the Floridan aquifer system causing it to be confined or semiconfined. The Hawthorn Group is 80 to 100 feet thick on the eastern side of Orlando, as presented in geologic sections by Lichtler and others (1968).

The net effect of the Hawthorn Group in the hydrogeologic framework for the NTC, Orlando area is to restrict the vertical flow of groundwater in the surficial aquifer and cause the primary direction of groundwater flow (in the surficial aquifer) to be horizontal. This is important in the consideration of the potential transport of contaminants in groundwater. Horizontal flow in the surficial aquifer is a common occurrence in the northern and central parts of Florida where the Hawthorn Group is present. The potential does exist in the NTC, Orlando area for groundwater to migrate vertically into the intermediate aquifer and eventually into the Floridan aquifer system, depending on the elevation of the potentiometric surface for these two lower aquifers, relative to the elevation of the water table. The low vertical permeability of the clayey Hawthorn Group sediments, however, would result in extremely slow vertical flow rates (i.e., long travel times) relative to horizontal flow rates in the surficial aquifer. The prevalence of Karst activity and sinkhole development throughout the greater Orlando area must be considered in any hydrogeologic characterization.




Source: Lichtler, et al, 1968

**FIGURE 2-1**
**GENERALIZED HYDROSTRATIGRAPHIC COLUMN**

H:\OLD\GRINDER\175700.DWG, BB-RPN 07/02/97 13:49:32, AutoCAD R12

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN OPERABLE UNIT 4**

**NAVAL TRAINING CENTER ORLANDO, FLORIDA**

For these reasons, the primary unit of hydrogeologic interest to the investigation of potential groundwater contamination at OU 4 will be the surficial aquifer. The Holocene and Pleistocene sediment that contains the surficial aquifer is primarily sand with varying amounts of silt and clay. On the eastern side of Orlando, the sediment ranges in thickness from approximately 60 to 90 feet, based on geologic sections presented by Lichtler and others (1968). Groundwater flow in the surficial aquifer, as discussed above, is generally horizontal, following topography to the nearest surface water body or drainage ditch that intersects the water table. Following is a discussion of the conceptual understanding of groundwater flow in the surficial aquifer at OU 4 on which the groundwater investigations will be planned.

The OU 4 topography (Figure 2-2) and the drainage structures in the area create a situation in which groundwater flow (following topography) travels westerly toward Lake Druid. Potentiometric data collected in January 1997 (Figure 2-3) is consistent with this interpretation of groundwater flow directions.

Existing groundwater monitoring wells at OU 4 have been completed in the surficial aquifer from depths of 11 to 64 feet below land surface (bls). Stratigraphic information obtained within the surficial aquifer indicates the subsurface is relatively homogeneous, composed of fine sand interbedded with silty and/or clayey fine sand. Grain size plots can be referenced in the Interim Remedial Action Focused Field Investigation Report, Operable Unit 4 (ABB-ES, 1996c).

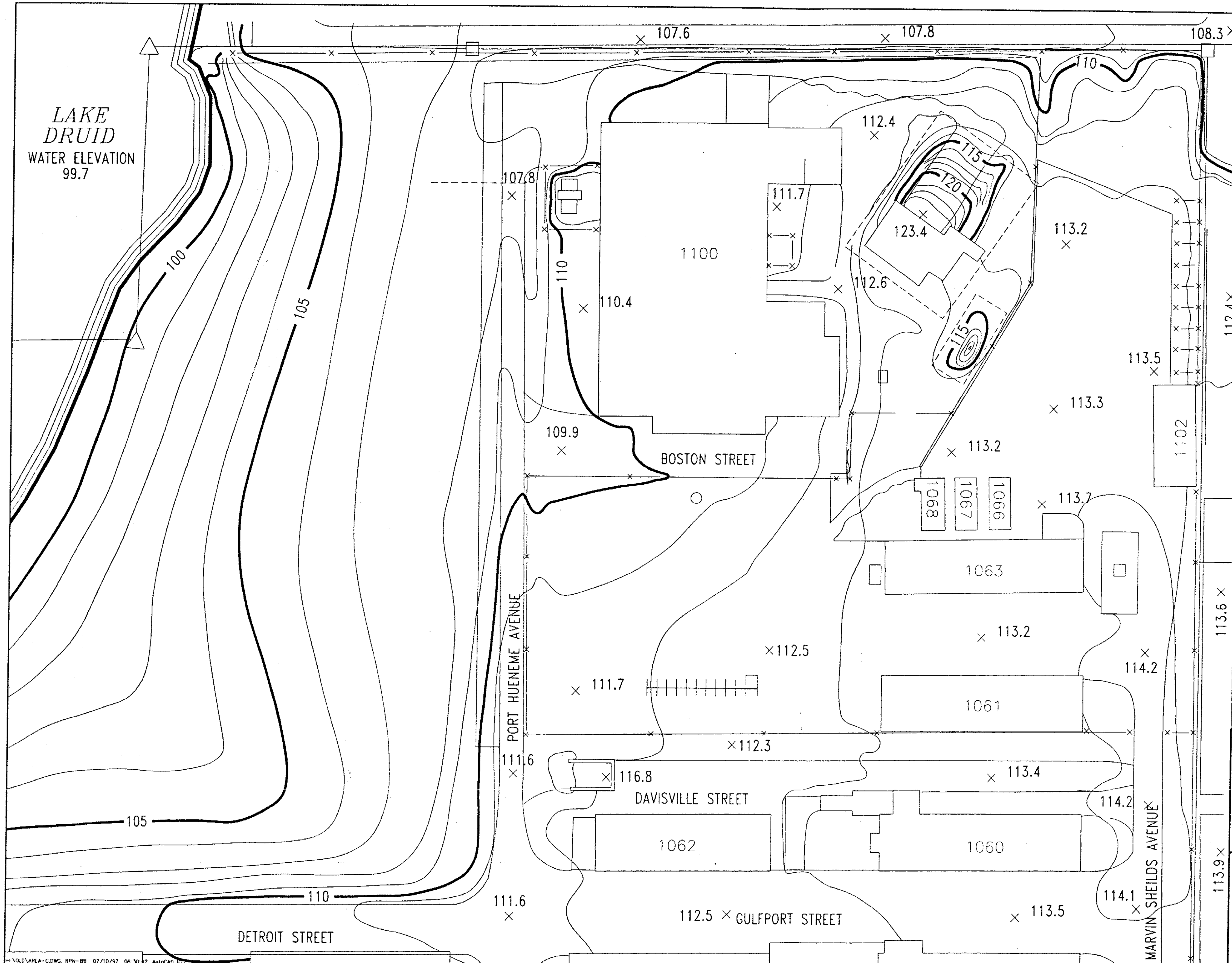
The soil density of the surficial aquifer typically ranges from medium dense to dense, with the exception of a hard layer (very dense) approximately 15 feet bls, with varying thickness averaging about 5 feet. No strata has been identified that would act as a hydraulic or chemical confining layer or barrier. Geologic sections presented by Lichtler and others (1968) also indicate that clays have been identified in the surficial sands in the Orlando area. For these reasons, the conceptual framework of groundwater flow at OU 4 will assume that the entire thickness of the surficial sand unit is available for the potential transport of contaminants in the surficial aquifer.

The conceptual understanding of the groundwater flow at OU 4 presented above is summarized below. This understanding will form the basis on which the groundwater investigation will be planned.

- The aquifer of primary interest to the groundwater investigation at OU 4 is the surficial aquifer.
- Groundwater flow in the surficial aquifer is primarily horizontal and flows westerly toward Lake Druid.
- The entire thickness of the surficial sand (from the water table to the top of the Hawthorn Group) is available for the potential transport of contaminants and will be assessed during the investigation.

## 2.2 SITE BACKGROUND AND CONDITIONS.

**2.2.1 SA 12, Background and Conditions** SA 12 includes DRMO warehouses (Buildings 1061 and 1063), the salvage yard, and the truck scales (Facility 1069). These buildings are located on Port Hueneme Avenue, in the northcentral portion of




**LEGEND**

Structure removed. Topography no longer accurate.

—100— Elevation contour (1-foot interval)

× 114.2 Ground elevation

0 50 100

SCALE: 1 INCH = 100 FEET

SOURCE: Naval Training Center Public Works Department, Storm Sewer Map, 1978

**FIGURE 2-2**
**TOPOGRAPHIC MAP OF OPERABLE UNIT 4**

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN OPERABLE UNIT 4**

**NAVAL TRAINING CENTER ORLANDO, FLORIDA**

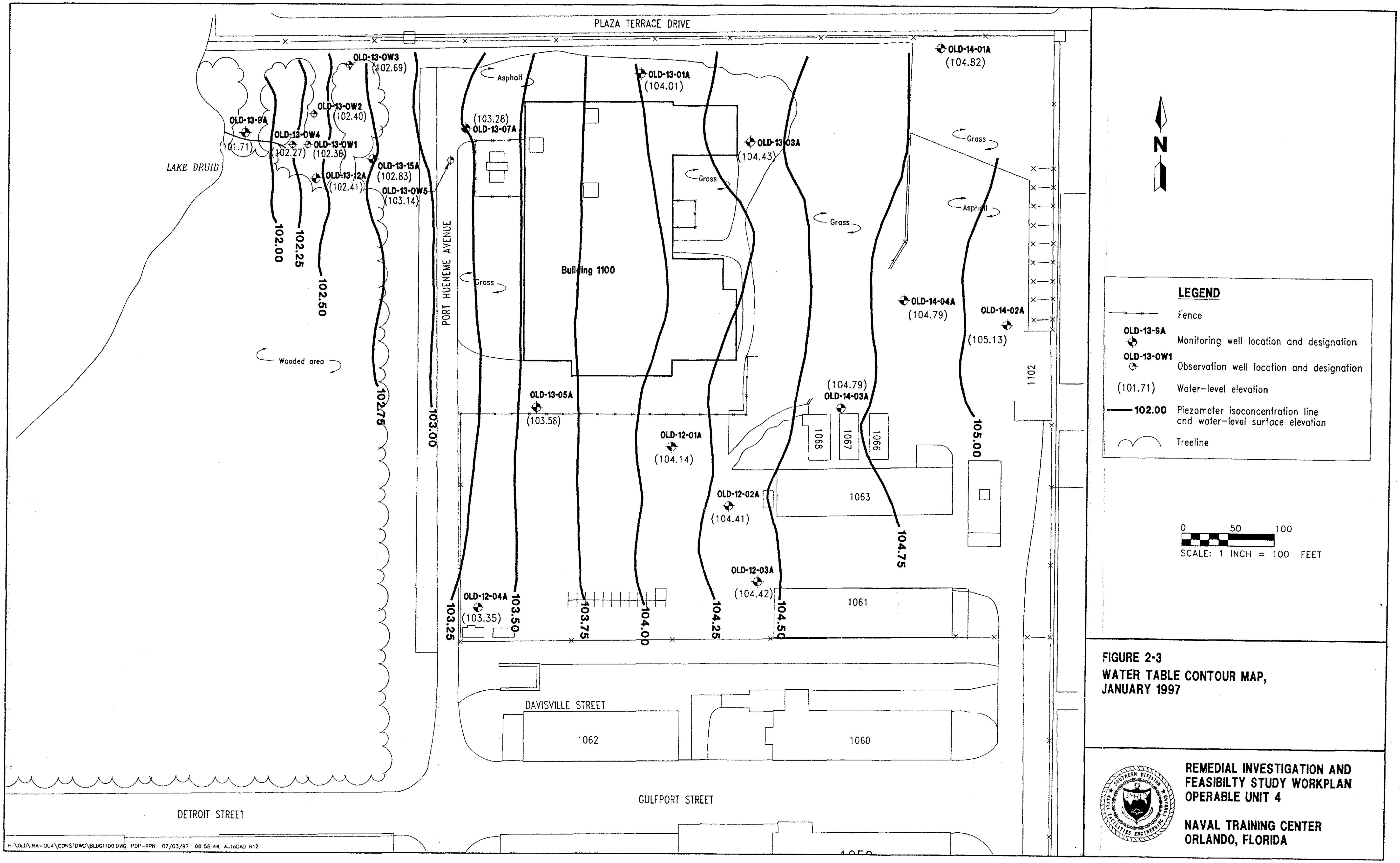



FIGURE 2-3
WATER TABLE CONTOUR MAP, JANUARY 1997

REMEDIAL INVESTIGATION AND FEASIBILTY STUDY WORKPLAN
OPERABLE UNIT 4

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Area C (Figure 2-4). The warehouse buildings were originally constructed in the early 1940s. Site use has reportedly remained consistent (i.e., salvage, scrap, and disposal yard) throughout its history. Based on review of aerial photographs, Building 1063 originally occupied approximately one-half the footprint of the current structure. The current warehouse is constructed of sheet metal walls and roof (i.e., a "Butler" building) on a concrete slab. It was constructed in 1963, replacing the original warehouse that had been destroyed by fire in 1962. Building 1063 has 9,600 square feet of floor space and steel racks for storing salvage materials. There is a flammables storage locker on the western side of the building. To the east of the building is the truck scale (Facility 1069), consisting of a concrete slab on a weighing mechanism. The asphalt paved salvage yard, located west of the warehouse, is occupied by rows of salvage scrap materials, concrete storage bins, and a drum storage area. There was also a transformer carcass storage area in the southwest corner of the SA. Salvage scrap items are also stored in this area, including desks, wheels, vehicles, transformers, and fencing. It is not known how long this area has been paved.

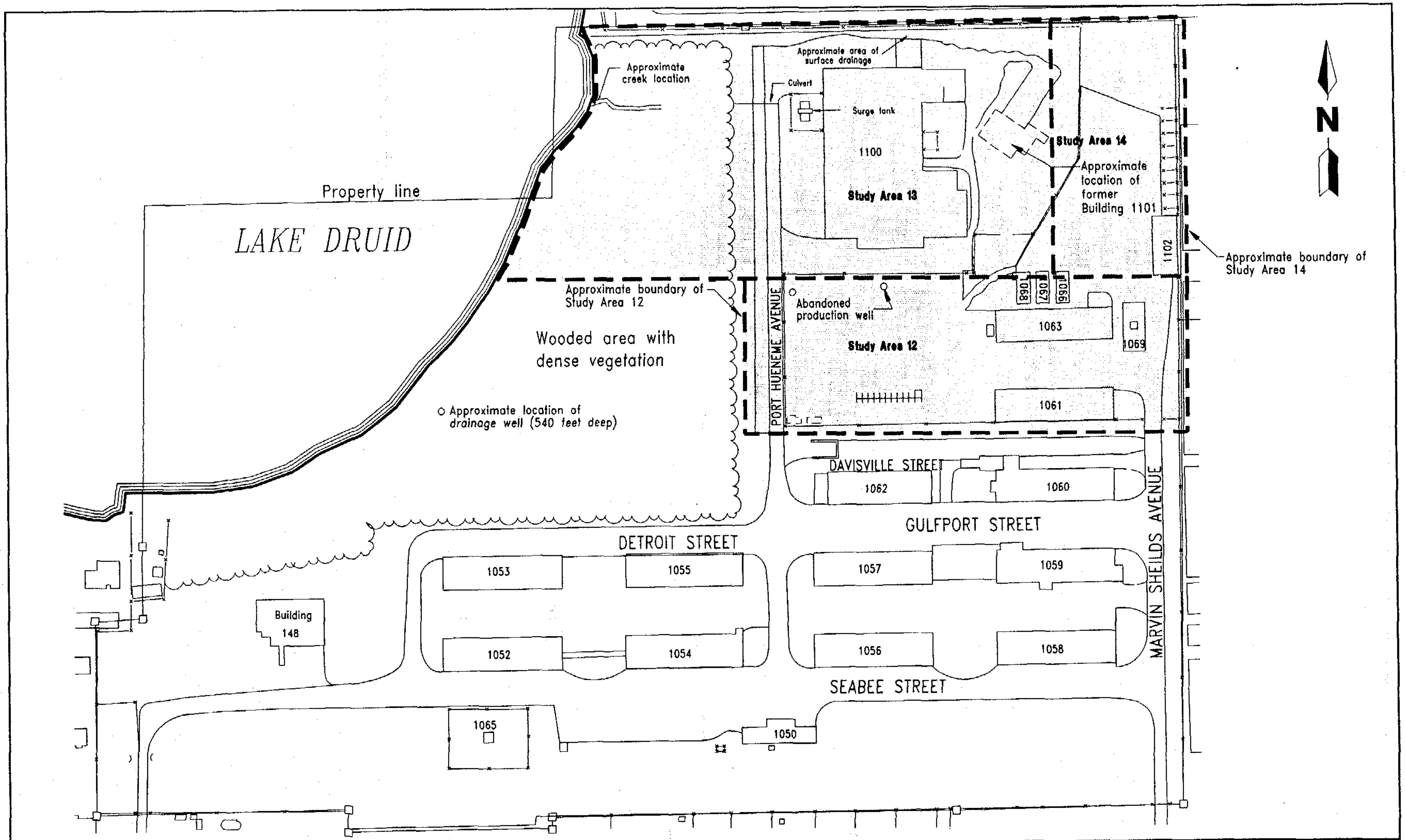
Historical records indicate this area was used to store small quantities (1 to 5 gallons) of hazardous waste between 1959 and 1985. These wastes were stored in the southwest corner of the salvage lot and included the following: paints, insecticides; asbestos; solvents, including trichloroethene (TCE) and methyl-ethyl ketone; ammonium hydroxide; sodium sulfide; and mercury. A more detailed description of SA 12 can be found in the BRAC Site Screening Report (ABB-ES, 1996b).

<u>2.2.2 SA 13, Background and Conditions</u> Buildings 1100 and 1101 are located in the northern end of Area C at Port Hueneme Avenue and Davisville Street (Figure 2-4). Building 1101 was a boiler house, located east of Building 1100, that was partly demolished in 1979 and completely removed in the mid-1980s.

Building 1100 (Figure 2-5), constructed in 1943, is a single-story wood-framed structure that has always been used as an industrial laundry and drycleaning facility that serves the entire military base. The building occupies 54,916 square feet. The surrounding property is paved asphalt, except for small areas north, east, and west of the building that are landscaped and grass covered. The paved areas around the perimeter of the building include roads and parking lots. Prior to construction of the facility in 1943, the land was undeveloped.

As part of the IAS, a brief description of the former laundry processes were described as follows: The laundry facility was built sometime around 1941 by the U.S. Army Air Corps (predecessor of the Air Force) for the purpose of cleaning all base uniforms and clothing. An Orlando Army Air Base sewer drawing from 1946 indicates a sanitary sewer connection was present at the laundry, presumably for disposal of laundry wastewater. Drycleaning machines were operated by the Air Force from at least 1958 and possibly earlier. The Air Force operated the laundry facility until 1968, at which time the U.S. Navy took over operations. Since the Navy has been operating the facility, all conventional wash water discharged to the sewer system via a surge tank/equalization basin (C.C. Johnson, 1985).

From 1958 to 1967, the drycleaning operations at Building 1100 generated approximately 25 gallons per month of tetrachloroethene (PCE) "still bottoms" for onbase disposal. "Still bottoms" or "stills" were a distillation by-product of solvent recovery common to early drycleaning operations. The still bottoms were allegedly disposed of in the North Grinder Landfill (OU 1). Diatomaceous earth




0 125 250

SCALE: 1 INCH = 250 FEET

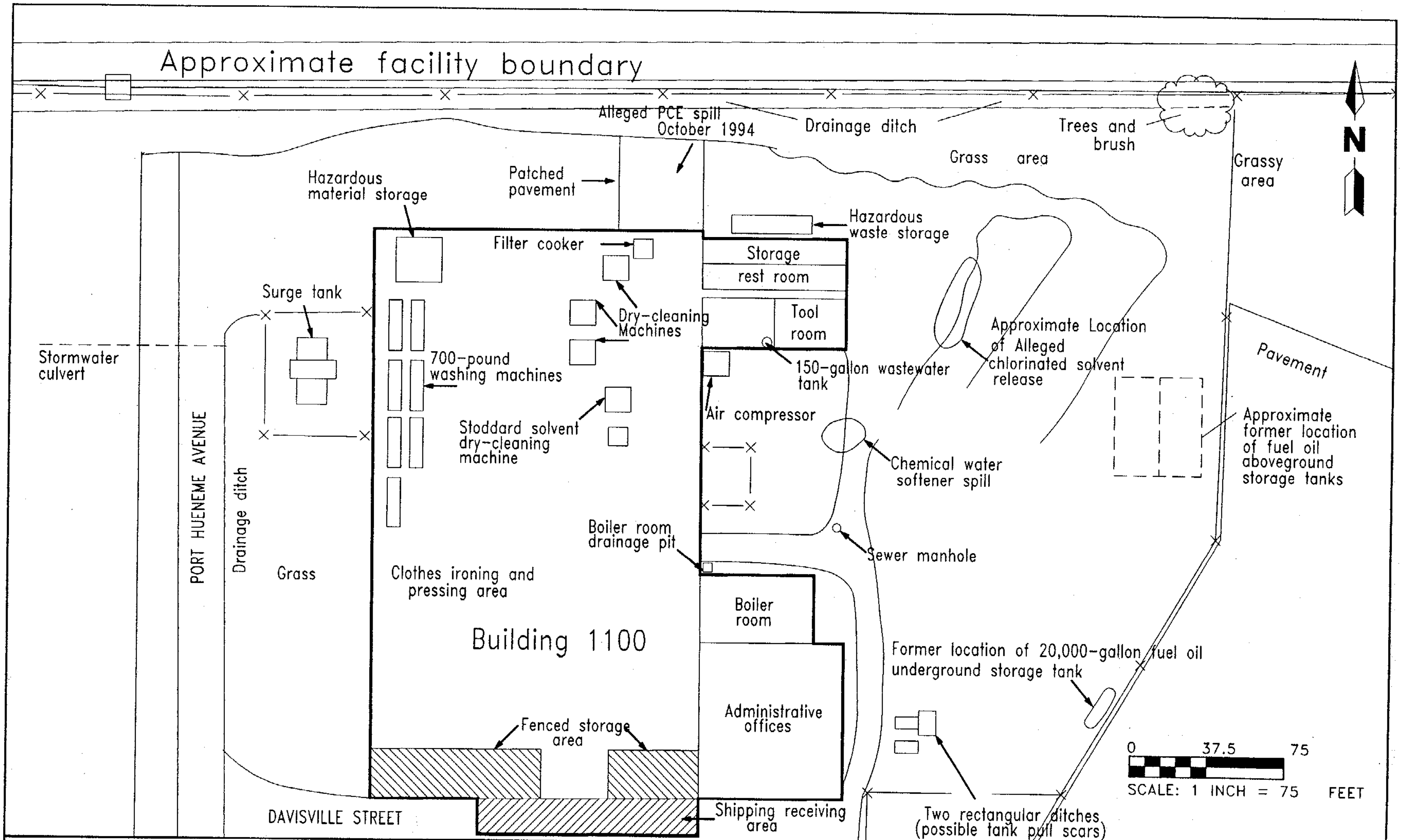
H:\OLD\IRA\AREAC.DWG, RPN-BB 07/10/97 09:42:13, AutoCAD R12

**FIGURE 2-4**
**LOCATION OF STUDY AREAS 12, 13, AND 14**
**AREA C**

SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN**
**OPERABLE UNIT 4**

**NAVAL TRAINING CENTER**
**ORLANDO, FLORIDA**




**LEGEND**

PCE Perchloroethylene (tetrachloroethene)

Source: Environmental Baseline Survey (ABB-ES, 1994a)

H:\OLD\AREA-C.DWG, RPN-BB 07/10/97 09:55:37, AutoCAD R12

**FIGURE 2-5**
**BUILDING 1100**
**FORMER LAUNDRY FACILITY**

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN OPERABLE UNIT 4**

**NAVAL TRAINING CENTER ORLANDO, FLORIDA**

filters removed soil from the solvent. The IAS reported that from 1958 to 1967, about 70 pounds of these filters were disposed of weekly in the North Grinder Landfill. In the mid 1970s, paper filter cartridges replaced the earth filters. In 1984, cartridge strippers were added to remove PCE by using a steam technology. From 1968 to early 1985, the waste filters and still bottoms were placed in dumpsters and hauled off-base by a waste disposal contractor. By 1985, all spent cartridges and still bottoms were handed over to the Defense Property Disposal Office, later referred to as the DRMO (C.C. Johnson, 1985).

Review of engineering drawings indicates that there may have been a production well located north of Area C, in what is now the condominium complex. There is also a deep drainage well (over 500 feet deep) near the shore of Lake Druid, approximately 600 feet southwest of Building 1100 (Figure 2-4).

Laundry operations ceased in the fall of 1994, and the facility is currently inactive. All of the laundry and drycleaning equipment has been removed from the building.

A more detailed description of SA 13 can be found in the BRAC Site Screening Report (ABB-ES, 1996b).

**2.2.3 SA 14, Background and Conditions** SA 14 includes Building 1102 and the surrounding paved and grassed areas. The facility is located off Marvin Shields Avenue in the northwest portion of Area C (Figure 2-4). The facilities are used for indoor and outdoor storage of salvageable equipment and materials, in support of DRMO operations. The facility includes a rectangular, one-story corrugated steel building (3,840 square feet) constructed on a concrete slab with a gabled roof. The surrounding salvage yard is currently asphalt paved. The building was originally constructed in 1969. Prior to that time, the area between the base laundry (to the northwest) and the current structure was used as a scrap and salvage yard. Equipment and materials currently stored at this location during the environmental baseline study included office furniture, mattresses, refrigerators, and drycleaning equipment.

A documented release of 3 gallons of PCE from scrap drycleaning equipment occurred in 1989. Remediation included the removal and disposal of approximately 20 drums of contaminated soil and asphalt. However, the exact location of the release was not indicated (ABB-ES, 1994a).

A more detailed description of SA 14 can be found in the BRAC Site Screening Report (ABB-ES, 1996b).

**2.3 BRAC INVESTIGATIONS**. BRAC investigations at Area C began with site-screening. SAs 12, 13, and 14 were each evaluated separately, beginning in early 1995. Groundwater contamination was detected in all three SAs, particularly SA 13. Additional focused investigations were subsequently conducted at SA 13 to evaluate Lake Druid and identify the potential source(s) of volatile organic compound (VOCs) detected in the lake. SAs 12, 13, and 14 were formally designated OU 4 in December 1995. All investigations conducted to date are summarized in Table 2-1.

A site-screening investigation was conducted from January to April 1995 at SAs 12, 13, and 14, which included a geophysical survey, a soil gas survey, surface

## Table 2-1
## BRAC Investigations
## Study Areas 12, 13, and 14 - Operable Unit 4

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Investigation | Date | Techniques Employed | Report Reference |
|---|---|---|---|
| Site Screening at SAs 12, 13, and 14 | January 1995 to April 1995 | Geophysics, soil gas, surface and subsurface soil sampling. Shallow and deep groundwater sampling. | BRAC Environmental Site-Screening Report, NTC, Orlando, Florida, ABB-ES 1996b. |
| Lake Druid Sampling | December 1995 | Surface water and sediment sampling. | Interim Remedial Action Focused Field Investigation Report OU 4, NTC, Orlando, Florida, ABB-ES 1996c. |
| SA 13 Groundwater Delineation | December 1995 | Groundwater sampling via TerraProbe℠ | Interim Remedial Action Focused Field Investigation Report OU 4, NTC, Orlando, Florida, ABB-ES 1996c. |
| OU 4 Focused Field Investigation | May 1996 | Surface water, sediment, and groundwater sampling. Permanent wells, TerraProbe℠ cone penetrometer. | Interim Remedial Action Focused Field Investigation Report OU 4, NTC, Orlando, Florida, ABB-ES 1996c. |
| OU 4 Pumping Test | August 1996 | Eighteen-hour constant rate pumping test. | Letter Report, Pumping Test Implementation and Results, NTC, Orlando, Florida, ABB-ES 1996d. |
| OU 4 Focused Source Investigation | March-April 1997 | Subsurface soil and groundwater sampling beneath laundry building using TerraProbe℠. | Technical Memorandum, Interim Remedial Action, Focused Investigation/Source Confirmation, Building 1100 Surge Tank, NTC, Orlando, Florida, ABB-ES 1997b. |

Notes: BRAC = Base Realignment and Closure.
RI/FS = remedial investigation and feasibility study.
SA = study area.
OU = operable unit.
NTC = Naval Training Center.
ABB-ES = ABB Environmental Services, Inc.
℠ = service mark.

and subsurface soil sampling, and the installation of 16 monitoring wells to evaluate groundwater. Twelve wells were placed to evaluate the shallow surficial aquifer, and four wells in the immediate vicinity of the laundry were screened at the base of the surficial aquifer, approximately 60 feet bls. Saturated soil samples were collected approximately every 6 feet during installation of each deep well and analyzed for VOCs on a field gas chromatograph (GC). Combined with the shallow and deep groundwater samples collected from the monitoring wells, the field GC data provided an evaluation over the complete thickness of the surficial aquifer. These results are summarized by SA in the following subsections.

<u>2.3.1 SA 12, Investigation Summary and Results</u> The site-screening program for this SA included collection and analysis of surface soil, subsurface soil, and groundwater samples at four locations. Four soil borings, 12B001 through 12B004, were advanced with hollow-stem auger (HSA) to a depth of 15 feet bls. Soil samples were collected continuously with a split-spoon sampler and field screened with a flame ionization detector (FID) for VOCs. Surface and subsurface soil samples were collected at each soil boring location, including a sample duplicate from boring 14B004. Surface soil samples were collected from immediately below the asphalt at an interval of zero to 1 foot bls. Subsurface soil samples were collected from the interval immediately above the water table (4 to 6 feet bls). Each of the four soil borings was completed as a shallow monitoring well.

A complete set of soil and groundwater analytical results for SA 12 is presented in the Site Screening Report (ABB-ES, 1996b). The positive detections in soil are shown in Appendix A, Tables A-1 and A-2. No compounds or analytes were detected in surface soil samples above screening criteria. PCE was detected at a concentration of 8 micrograms per liter ($\mu g/\ell$) in monitoring well OLD-12-01A. TCE was also present at a concentration of 2 $\mu g/\ell$, below the FDEP maximum contaminant level (MCL) of 3 $\mu g/\ell$. The positive detections in groundwater are summarized in Appendix A, Table A-3, and in Appendix B, Figure B-2. Groundwater analytical VOC results for all of OU 4 (SAs 12, 13, and 14) are shown in Appendix B, Figure B-2. A discussion of the results can be found in the Site Screening Report (ABB-ES, 1996b).

<u>2.3.2 SA 13, Investigation Summary and Results</u> The site-screening investigations at SA 13 included geophysics, a passive soil gas survey, and collection and analysis of subsurface soil and groundwater samples.

The geophysical program consisted of an initial vertical gradiometer (magnetometer) survey followed by a confirmatory Ground Penetrating Radar (GPR) survey focused on anomalies identified by the magnetometer. The geophysical data did not define any areas requiring additional investigation or underground storage tanks.

Results from the soil gas survey are shown in Appendix B, Figure B-3. The highest concentration of PCE was mapped in the vicinity north of Building 1100, which is consistent with the documented release of drycleaning solvent in October 1994. The PCE detection northwest of Building 1100 corresponds to a location where VOC concentrations in groundwater are among the highest detected at OU 4. The VOCs detected northeast of Building 1100 are in the vicinity of a reported release of chlorinated solvents.

Four nested pairs of groundwater monitoring wells were installed in the surficial aquifer at locations surrounding Building 1100 (Appendix B, Figure B-2).

During monitoring well installation, deep and shallow soil borings were advanced with HSA. Soil borings 13B001 through 13B008 correspond to monitoring wells OLD-13-01 through OLD-13-08, respectively. Soil samples were collected continuously with a split-spoon sampler and field-screened with an FID. Soil samples collected from the deep borings at SA 13 were also analyzed with a transportable GC at a rate of one sample per 6 linear feet, or as indicated by FID screening. The results of the field GC screening are shown in Appendix A, Table A-4. Soil samples were collected from selected shallow and deep borings and submitted for total petroleum hydrocarbons (TPH) and full suite Contract Laboratory program (CLP) target compound list (TCL) and target analyte list (TAL) laboratory analyses in accordance with USEPA Level IV Data Quality Objectives (DQOs). In general, sampling locations were selected from intervals with the highest VOC concentration as determined by FID screening or at the interval above the water table.

A summary of positive detections in soil and groundwater analytical results is presented in Appendix A, Tables A-5 to A-7. Arsenic and beryllium were detected in soil at four locations, but at concentrations only marginally above background screening values. The primary contaminants of concern (COCs) were chlorinated solvents. VOCs above FDEP MCLs were detected in all four shallow monitoring wells. Trace concentrations of VOCs were only detected in two of four deep monitoring wells (OLD-13-02C and -08C). See Appendix B, Figure B-2 for groundwater VOC results.

After review of the above site-screening data, the NTC, Orlando Restoration Advisory Board requested sampling of surface water and sediment along the Lake Druid shoreline, downgradient of SA 13. On November 29, 1995, surface water and sediment samples were collected along the shoreline of Lake Druid (Appendix B, Figure B-2). These samples were analyzed by an off-site laboratory using USEPA Method 8010. PCE, TCE, cis-1,2-dichloroethene (cis-DCE), 1,1-DCE, and vinyl chloride (VC) were detected at these locations in concentrations as high as 9.4 $\mu g/\ell$, 370 $\mu g/\ell$, 1,100 $\mu g/\ell$, 1.5 $\mu g/\ell$, and 15 $\mu g/\ell$, respectively. At some locations, TCE and cis-DCE were detected in surface water at concentrations greater than had been detected in groundwater collected from the monitoring wells during site-screening.

Lake Druid is a Class III surface water, as described in Florida Administrative Code 62-302, Surface Water Quality Standards. Comparing surface water quality standards for a Class III body, concentrations of PCE and TCE were above the numeric standards. Vinyl chloride concentrations also exceeded minimum criteria (the detection limit), as specified in Florida Chapter 62-302.500. There are no specific published standards for cis-DCE. However, cis-DCE was present in surface water at concentrations exceeding the Florida MCL (70 $\mu g/\ell$). This concentration has been established as the performance standard for cis-DCE in groundwater discharging to the lake for the OU 4 Interim Remedial Action (IRA) (ABB-ES, 1997d). The highest surface water and sediment VOC concentrations were detected where the creek enters the lake.

On December 11, 1995, additional surface water and sediment samples were collected in Lake Druid approximately 50 feet west of the November locations. The water depth was approximately 4 feet. Cis-DCE was detected in surface water collected from each location farther out in the lake. TCE was also detected in surface water from sample location 13D/W00801. TCE and PCE were detected in sediment from this location and from location 13W/D00901. Chlorinated solvent concentrations from the locations farther out in the lake were generally lower than at the shoreline. None of the constituents detected were above surface water quality standards.

During the week of December 18, 1995, groundwater samples were collected from the area between Lake Druid and Building 1100 to further delineate groundwater contamination and to identify the possible source of the elevated VOCs in Lake Druid. Samples were collected from temporary wells installed by hand auger in the heavily vegetated areas and from TerraProbe℠ borings placed in open areas. Sample points were placed along north-south lines adjacent to Building 1100 as well as along the northern fenceline. Sample locations are shown in Appendix B, Figure B-4.

Samples collected from the temporary wells were limited to the water table and were screened with a portable GC and sent off-site for laboratory analysis. No VOCs were detected in these shallow monitoring wells.

Samples were collected from three depth intervals at each TerraProbe℠ boring: at the water table, at approximately 18 bls, and at 30 feet bls. Analysis of the TerraProbe℠ samples included field GC and an off-site laboratory. The results of this phase of screening showed that PCE, cis-DCE, and TCE were present at total concentrations over 1,000 $\mu g/\ell$ down to 30 feet in depth, below which samples were not taken. Total VOC concentrations over 7,000 $\mu g/\ell$ were detected 30 feet bls at location 13Q011, northwest of the surge tank. These data are summarized in Appendix A, Table A-8.

Additional investigations have occurred at SA 13, but are considered focused because they were intended to address only specific areas, such as the pathways for VOCs to reach the lake and a source confirmation conducted beneath the laundry building. This work occurred after the designation of OU 4 and is described below in Subsection 2.3.4.

<u>2.3.3 SA 14, Building 1102 Investigative Summary and Results</u> The site-screening investigations at SA 14 included geophysics, a passive soil gas survey, and collection and analysis of surface and subsurface soil and groundwater samples.

The magnetometer and GPR surveys did not define any disposal areas that would require additional investigation.

The soil gas survey was conducted concurrently with the adjacent SA 13. Results of the soil gas survey are shown in Appendix B, Figure B-3. PCE was detected at 1.9 $\mu g/\ell$ in the vicinity of monitoring well OLD-14-02, approximately 30 feet northwest of the northwest corner of Building 1102. No other chlorinated solvents or petroleum-related hydrocarbons were detected in the soil gas survey at SA 14.

A summary of positive detections in surface and subsurface soil analytical results is presented in Appendix A, Tables A-9 and A-10. No compounds or analytes were detected above screening criteria in surface soil. PCE was detected at 11 micrograms per kilogram ($\mu g/kg$) in surface soil from boring 14B002, corresponding to the soil gas detection in this area. Arsenic and beryllium were detected in subsurface soil (10 feet bls) above background and residential screening criteria at boring 14B001. However, at this depth residential standards would not apply, and the detections likely represent locally elevated background concentrations. PCE and TCE were detected above the FDEP MCL in groundwater from monitoring well OLD-14-04A. A trace of PCE (1.37J $\mu g/\ell$) was also detected in groundwater from monitoring well OLD-14-02A. See Appendix B, Figure B-2, and Appendix A, Table A-11, for groundwater analytical results.

Antimony was detected in groundwater above the FDEP MCL of 6 $\mu g/\ell$ in monitoring wells OLD-14-02A (10.1 $\mu g/\ell$), OLD-14-03A (17.6 $\mu g/\ell$), and OLD-14-04A (10.5B $\mu g/\ell$).

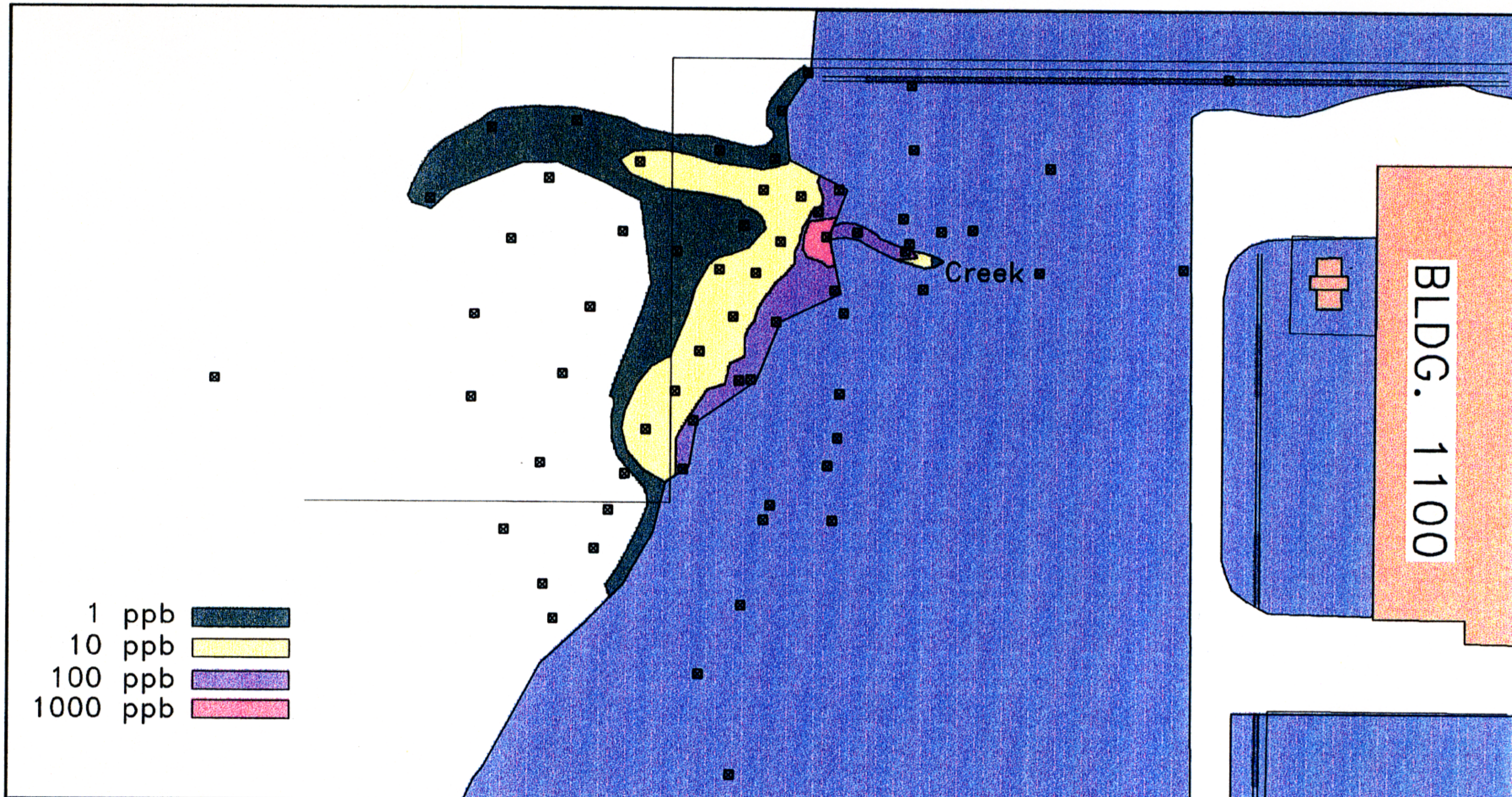
2.3.4 OU 4 FFI In May 1996, an FFI was performed to (1) define the extent of contamination in Lake Druid's surface water and sediment, (2) evaluate the source of volatile organics in Lake Druid, (3) delineate the horizontal and vertical extent of VOC contaminants in the groundwater along the lakeshore, (4) collect physical characteristics of the lake, and (5) support a focused IRA to mitigate VOCs in Lake Druid. In order to meet the proposed objectives, a field program was initiated that included surface water and sediment sampling, collection of groundwater samples within the surficial aquifer using direct-push technology (DPT), monitoring and drive point well installation and sampling, and a site hydrogeologic characterization study. Sampling locations are shown in Appendix B, Figures B-5, B-6, and B-7.

The analytical program for the investigation included onsite laboratory analyses for 10 target VOCs using a GC. Results of the DPT groundwater investigation indicated that the width of the groundwater VOC plume extends approximately 500 feet from just south of the north fenceline down the shoreline of Lake Druid. VOCs were detected in groundwater at depths ranging from 4 to 68 feet bls and include chlorinated solvents, primarily cis 1,2-DCE, TCE, and PCE. Analytical results are summarized in Appendix A, Tables A-12.

Chlorinated VOCs (VC, DCE, TCE, PCE) were also identified in the drive point well samples, as well as the sediment and surface water samples. Sediment and surface water samples were collected and VOCs delineated from within the creek, along the shoreline, and out into Lake Druid at approximately 25-foot intervals. The highest VOC concentrations were concentrated in the area around the creek's mouth. The six drive point wells, installed near the shoreline, in the creek, and out in the lake, were screened into the subsurface just below the sediment bottom of the lake. The drive point wells indicated groundwater contaminated with the target chlorinated compounds just below the lake's sediment bottom. Water elevations of the lake and in the drive points indicated an upwelling of groundwater into the lake at these locations. Analytical data from Lake Druid are summarized in Appendix A, Table A-12.

Figures 2-6 and 2-7 show the extent of total chlorinated VOCs in the surface water and sediment at Lake Druid based on the onsite lab analytical results. A plan view of the total VOC concentrations in groundwater between the laundry and Lake Druid in shown as Figure 2-8. Appendix B, Figure B-8 shows the location of cross-section lines parallel to the lakeshore and east-west between the laundry and the lake. Appendix B, Figure B-9 is the cross section showing the distribution and concentration of total VOCs in groundwater along the shoreline of Lake Druid. Appendix B, Figure B-10 is the cross section showing the distribution and concentration of total VOCs in groundwater running east-west between Lake Druid and the laundry. All of the Lake Druid and groundwater plume figures are based on onsite laboratory GC data.

The results of the FFI along the lakeshore indicated that contaminated groundwater appears to be the source of VOCs detected in Lake Druid. It has been estimated that approximately 25 pounds per year of total VOCs enter Lake Druid via




**NOTE:**
VOC = volatile organic compound

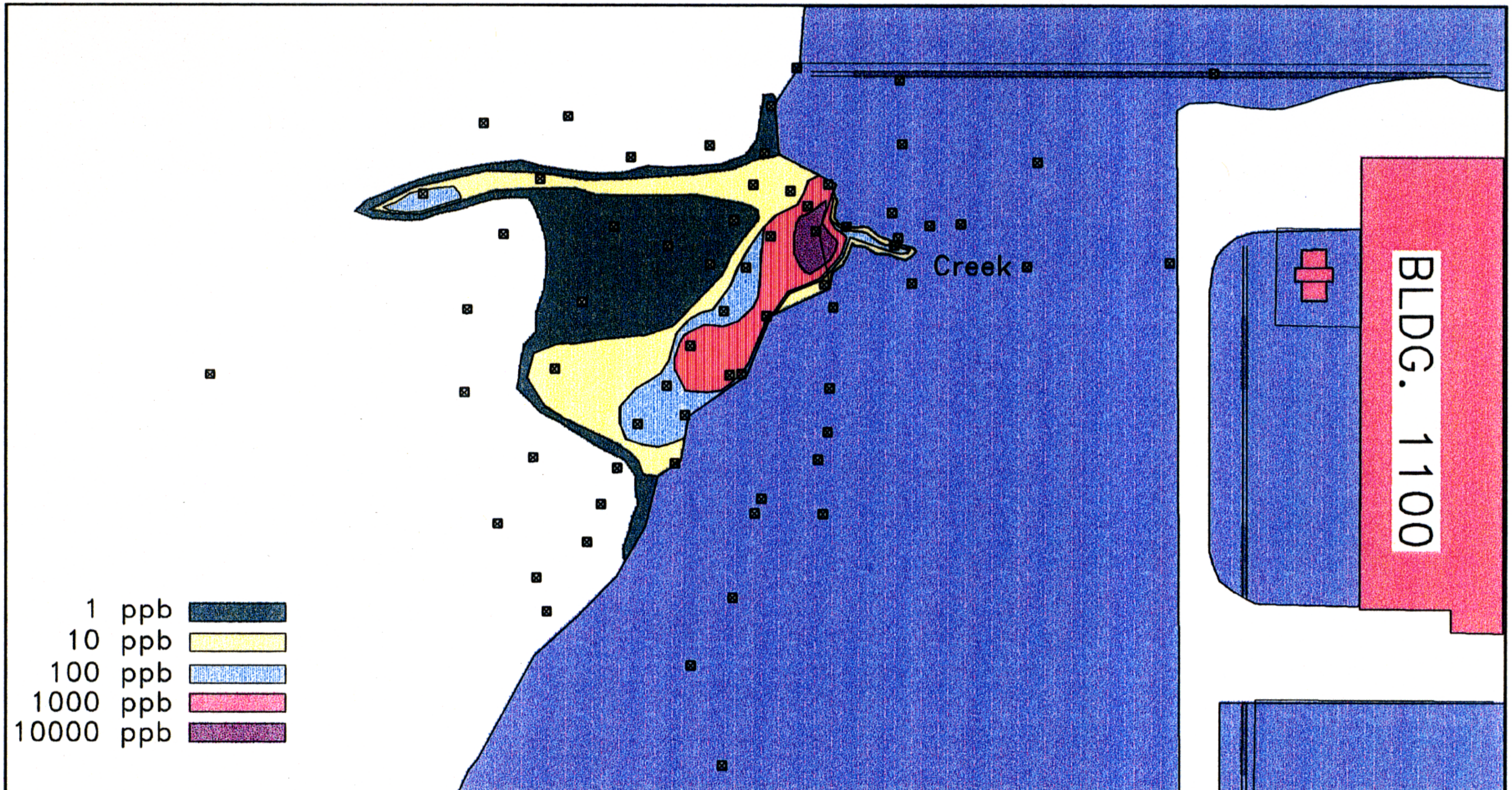
H:\OLD\BRAC\TCAR\8519F001 & T:\8556-07\8556F001\RDC\7-10-97

**FIGURE 2-6**
**PLAN VIEW, VOC CONCENTRATIONS IN SURFACE WATER**

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN**
**OPERABLE UNIT 4**

**NAVAL TRAINING CENTER**
**ORLANDO, FLORIDA**

00181DB3V



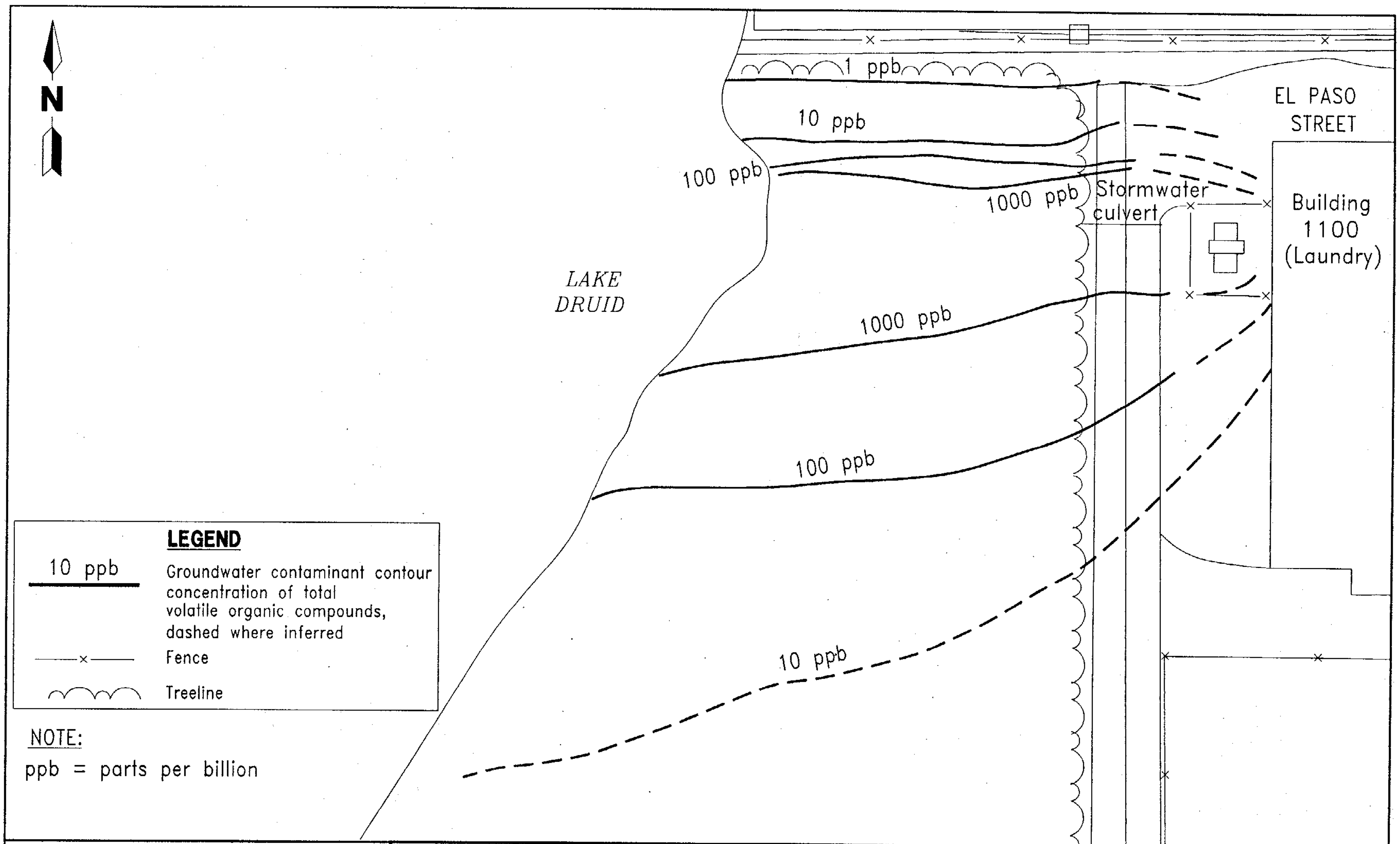

**NOTE:**
VOC = volatile organic compound

**FIGURE 2-7**
**PLAN VIEW, VOC CONCENTRATIONS IN SEDIMENT**

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN**
**OPERABLE UNIT 4**

**NAVAL TRAINING CENTER**
**ORLANDO, FLORIDA**

H:\OLD\BRAC\TCAR\8519F002 & T:\8556-07\8556F002\RDC\7-10-97




0 50 100
SCALE: 1 INCH = 100 FEET

H:\OLD\AREAC\IRA\FF-STUDY.DWG, PDP-RPN 07/02/97 14:39:33, AutoCAD R12

**FIGURE 2-8**
**SITE PLAN VIEW DEPICTING TOTAL VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER**

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN OPERABLE UNIT 4**

**NAVAL TRAINING CENTER ORLANDO, FLORIDA**

groundwater. Approximately 1 to 5 pounds of VOCs are present in Lake Druid sediments (ABB-ES, 1997c).

<u>2.3.5 OU 4 Pumping Test</u> A constant-rate pumping test was performed at SA 13 in August 1996. A 5-inch diameter extraction well was installed in the wooded area in the vicinity of DPT location Q010 (Appendix B, Figure B-8). The aquifer was pumped for 18 consecutive hours at a rate of approximately 40 gallons per minute.

The purpose of this study was to support future remedial actions by providing characteristic aquifer parameters and by refining the site conceptual model (SCM). Analysis of the pumping test data produced these aquifer parameter values:

- coefficient of transmissivity (T) equals $1.96 \times 10^3$ square feet per day,
- hydraulic conductivity (K) equals 32.69 feet per day, and
- storage coefficient (S) equals 0.13.

Previous subsurface investigations encountered a distinct dense sand horizon throughout most of the site. The effect of this unit on the site hydrogeology was a consideration for analysis of the pumping test data. Aquifer response during the pumping test suggests that the dense layer may delay groundwater migration from the upper few feet of the surficial aquifer, but does not act as a hydraulic barrier.

<u>2.3.6 OU 4 Focused Source Confirmation</u> The OU 4 investigations described above suggested that the area around the surge tank at the northwest corner of Building 1100 could be a source of groundwater contamination between the laundry and Lake Druid.

This source confirmation investigation was conducted to determine if the area around the surge tank was a primary source of groundwater contamination. If confirmed as a source, an additional IRA recirculation well could be installed near the surge tank.

The focused investigation/source confirmation concentrated on the area upgradient of the surge tank, primarily under the laundry itself. This was the most likely location for additional sources associated with the storage and use of PCE in the drycleaning process. If VOC concentrations in soil and groundwater under the laundry were comparable to the concentrations immediately downgradient of the surge tank, then other source(s) besides the surge tank were likely contributing to the plume. However, if VOC concentrations under the laundry were much less than nearer the surge tank, then the surge tank would likely be the primary source of VOCs. The TerraProbe℠ and an onsite laboratory were used to collect and analyze subsurface soil and groundwater samples from beneath the laundry.

**2.3.6.1 Subsurface Soil Characterization** The TerraProbe℠ was used to collect soil samples from both vadose and saturated zones at 12 locations in and around the laundry facility, as shown in Appendix B, Figure B-11.

Vadose zone soils were collected from each soil sampling location continually from the surface down to the water table at 4-foot intervals.

Saturated zone soils were collected from each soil sampling location, at 4-foot intervals, from the water table down to 28 feet bls or refusal. All subsurface soil sampling results are provided in Appendix A, Tables A-13 and A-14.

Contaminant concentrations in soil within the percent range of the solubility limit for a particular compound are generally an indicator of nonaqueous-phase liquid (NAPL) presence (residual saturation) (Cohen et. al., 1992). The highest VOC concentration in soil measured by the laboratory was 430 parts per billion (ppb) of PCE at U4P015.

In general, soil VOC concentrations decreased with depth. The low concentrations detected may be present from the volatilization of a release some distance away and do not suggest the presence of residual NAPL at these sample locations.

2.3.6.2 **Groundwater Characterization** The TerraProbe℠ was used to collect groundwater samples at 14 locations beneath the floor and around Building 1100, as shown in Appendix B, Figure B-11. Groundwater samples were also collected from monitoring wells OLD-13-01A through OLD-13-08C and microwells OLD-13-18B through OLD-13-20B (Appendix B, Figure B-12).

Groundwater Collected Via TerraProbe℠. Groundwater samples were collected via TerraProbe℠ and sent to either onsite and/or off-site laboratories for VOC analysis. Complete results are summarized Appendix A, Tables A-15 and A-16.

The highest groundwater VOC concentrations were detected at locations U4Q014, U4Q015, and U4Q020 under the laundry, location U4Q026 between the laundry and the surge tank, and northeast (upgradient) of the laundry at location U4Q024 (primarily cis-DCE). At several locations, PCE and TCE were found at concentrations in the 1 to 3 milligrams per liter range.

Typically, VOC concentrations in groundwater greater than one percent of the aqueous solubility limit are suggestive of NAPL presence (Cohen, et. al., 1992). The highest VOC concentration in groundwater collected via TerraProbe℠ was 8,600 $\mu g/\ell$ PCE and 15,000 $\mu g/\ell$ TCE at location U4Q015 (16 to 18 feet bls, as measured by the off-site laboratory). Considering 15,000 $\mu g/\ell$ TCE is the byproduct of the degradation of 19,000 $\mu g/\ell$ PCE, the equivalent PCE concentration in this sample is approaching 20 percent of the theoretical solubility for PCE. Similar PCE concentrations were also detected at location U4Q020, based on a comparison of "E" qualified field GC data. These results suggest a strong possibility that a source area of residual NAPL is present beneath the laundry, possibly at more than one location.

Also, due to the depth limitations of the TerraProbe℠, reaching refusal at approximately 30 feet bls, vertical contaminant delineation at many locations was not possible. The highest VOC concentrations measured at locations such as U4Q015, U4Q016, and U4Q020 were at the last interval sampled.

Groundwater Collected from Monitoring Wells and Microwells. Groundwater samples from monitoring wells and microwells were sent to the off-site laboratory. Analytical results are included in Appendix A, Table A-17.

The results from monitoring well and microwell sampling generally indicate lower groundwater VOC concentrations than those collected from TerraProbe℠ sampling. This may be attributed to the monitoring wells having longer screen lengths, causing dilution of the sample. Also, the microwells were set in the same locations as the TerraProbe℠ groundwater samples. These wells are approximately 4 to 5 feet deeper than the last TerraProbe℠ collection interval and may be near the lower depth limit of contamination.

The highest VOC concentration detected in groundwater from a monitoring well was 28,000 µg/ℓ PCE, collected from monitoring well OLD-13-07A, located off the northwest corner of Building 1100. This was a considerable change when compared to the only other round of monitoring well sampling in April 1995, when 680 µg/ℓ PCE was detected. This significant increase could be attributed to a source migration to very near the monitoring well. If source migration occurred, it may have been enhanced by some of the investigative work and will be a concern for future assessments. The 28,000 µg/ℓ PCE concentration approaches 20 percent of the solubility for that compound, indicating a very strong argument for NAPL presence.

Another noticeable concentration change occurred during the resampling of monitoring well OLD-13-08C (deep), which resulted in a PCE concentration of 14 µg/ℓ (FDEP MCL for PCE is 3 µg/ℓ). Previous deep monitoring well sampling results never indicated VOC concentrations above the MCL.

## 3.0 APPROACH OVERVIEW AND DATA NEEDS

**3.1 APPROACH OVERVIEW**. The current system for Superfund cleanups is based on two programs: remediation and removal. The remedial program is traditionally structured toward long-term remedies that address risk as predicted under future scenarios. This traditional process has lead to long study-based investigations to enable detailed alternative selection and evaluation of proposed remedies.

Recognizing that the process is both slow and expensive, USEPA sought to encourage flexibility in the program through the Superfund Accelerated Cleanup Model (SACM) program (USEPA, 1992c). SACM encourages early actions, or ways to focus the RI/FS parts of an investigation. This is especially true for certain types of sites with similar characteristics. The goal of SACM is to accelerate the entire remedial process.

Based on information collected from these types of sites previously investigated, presumptive remedies are considered a tool of acceleration within SACM that should be applied when appropriate. Presumptive remedies are preferred technologies for common categories of sites, based on historical RI/FS investigations within the Superfund program. They are a tool within SACM used to accelerate cleanup. Thus, past experience can streamline or focus the site investigation and remedy selection and reduce the cost and time required to remediate.

USEPA promulgated presumptive remedy guidance for sites with contaminated groundwater in October 1996 (USEPA, 1996a). This guidance presents a presumptive response strategy and presumptive remedies for *ex situ* treatment of groundwater for sites where *ex situ* treatment is a component of the groundwater remedy. The response strategy integrates site characterization, early actions, remedy selection, performance monitoring, remedial design, and remedy implementation activities into a comprehensive, overall response strategy. The response strategy provides a mechanism for selecting achievable remediation objectives, resulting in significant time and cost savings for the overall response to contaminated groundwater. However, this response strategy will not necessarily streamline the RI/FS phase. To a large extent, the presumptive response strategy has already been implemented at OU 4 and will continue to be used to guide the selection of a final remedy.

To achieve the goals of SACM, uncertainties inherent in the RI/FS process must be recognized in the work planning phase. A common misconception is that uncertainties can be reduced early in the life of the project. It is reasoned that time and resources invested during the investigation and study phases can yield a high degree of certainty in the expected results and thus prevent large expenses later. However, as has been demonstrated in previous Superfund projects, major technical uncertainties exist in all of the key components of hazardous waste site characterization and remediation. There remains uncertainty in characterizing the affected media, predicting contaminant fate and transport, assessing risk, and predicting technology performance. These uncertainties have the following consequences for the traditional approach to site remediation:

- It is traditionally assumed that more study will progressively reduce uncertainty by meaningful amounts. For all but the simplest of waste sites, this has not been the case. Because of the high degree of heterogeneity within the overburden, the marginal value of collecting and analyzing more samples declines rapidly once general site conditions are ascertained.

- Traditionally, the expectation for remedial design is that the constructed remedy will closely resemble the alternative selected in the Record of Decision (ROD). Because of the high degree of uncertainty associated with complex hazardous waste sites, engineers and scientists inevitably enter the implementation phase with many unresolved questions. Under the traditional approach, many of these unknowns are not acknowledged and, thus, are only detected as a result of a failure of the remedy.

- In the presence of uncertainty, individuals adopt different assumptions and interpretations. The traditional approach does not ultimately distinguish between interpretations, and the implementation phase recognizes only one interpretation: equally valid interpretations are not recognized.

Uncertainty need not handicap a project as long as it is recognized as a factor from the beginning and as long as it is possible to observe and continuously test the working model of the site as implementation proceeds. An approach is suggested to address uncertainties common at hazardous waste sites. This approach relies on robust and flexible designs that can be modified during implementation to meet conditions as they are found. It is far safer to recognize uncertainty and plan for it than to assume that state-of-the-art technology will make highly accurate predictions and provide the necessary answers. It is this premise that has spawned programs such as SACM and related concepts, including presumptive remedies and streamlining.

The following steps lead to the identification of the most probable conditions and account for reasonable deviations from those site interpretations in the form of a conceptual site model to be used during design and implementation. Monitoring and contingent actions to take if deviations are detected are also identified.

1. Planning sessions are conducted to sort through issues, review existing data, and screen possible remedial actions and technologies. A workplan is developed to give direction to the following investigation and analyses.

2. Information is gathered, and knowledge refined, of general site conditions and the nature and extent of contamination. Investigations are complete when it is possible to identify probable conditions (including associated risk), differentiate among alternatives, set monitoring requirements, and identify reasonable deviations. Probable site conditions are identified as those most likely to be occurring. Reasonable deviations are other interpretations of site conditions that could reasonably be occurring.

3. The most probable site conditions and reasonable deviations are established. Through this identification, conceptual designs incorporating both a base action and a contingent action can be developed and an ROD signed. The designed alternatives will identify probable technology performance and reasonable deviations from the expected performance.

4. Following remedy selection, remedial designs based on the most probable site conditions, plus designs covering contingencies for the agreed-upon reasonable deviations, are produced.

5. Key indicators (chemical, physical, and others) are selected for observation during remediation for both expected and deviant conditions. The selected parameters are measured and necessary modifications (contingent action) are made if deviations occur. Decisions on changes to the remedial action will be made on the basis of detected deviations and contingent actions developed.

This proposed approach recognizes that complete site characterization is not possible or necessary and, therefore, it will be necessary to manage remaining uncertainties. This approach emphasizes the collection of data only to support decisions. To make these decisions, data must be available to support a human health risk assessment (HHRA), a qualitative ecological risk evaluation, and a feasibility study.

<u>3.2 **DATA-NEEDS EVALUATION**</u>. The following subsections evaluate the data following the proposed approach. This data-needs evaluation is developed based on the current SCM, exposure assessment, and a preliminary identification of remedial action technologies.

<u>3.2.1 **SCM**</u> The SCM is a framework within which the source/release mechanism and environmental pathways of potential concern are identified schematically on Figure 3-1. The SCM has been previously defined and refined throughout the execution of a very comprehensive IRA at OU 4 and will continue to be refined through this RI/FS. One of the objectives of this RI/FS is to identify data needs left from the IRA SCM and evaluate those needs to complete the definition of the SCM.

3.2.1.1 **SCM at OU 4** The current version of the SCM is best represented by the Project Logic Diagram (PLD) (Figure 3-2). This diagram identifies the critical or likely path for contaminant release and exposure pathways. The contaminant sources for this SCM are the fluids associated with the dry-cleaning processes at Building 1100. Source areas and release mechanisms are identified as those areas where releases of chlorinated solvents are documented or believed to have occurred and have migrated into the immediate environment. Once in the environment, contaminants can be transferred between media and transported away from the source and/or the site. These contaminants may affect multiple receptors through one or more exposure pathways. The following discussions elaborate on the key headings within the SCM.

<u>Contaminant Source</u>. The source of contamination has been identified during the IRA process as PCE associated with the industrial laundry and dry cleaning facility during its operation from 1943 to 1994.

<u>Contaminant Source/Release Mechanism</u>. The probable contaminant source/release mechanisms at OU 4 are

- operational spills on the ground surface outside the building during the loading and unloading of containers of PCE (ranging from 5- to 55-gallon containers);

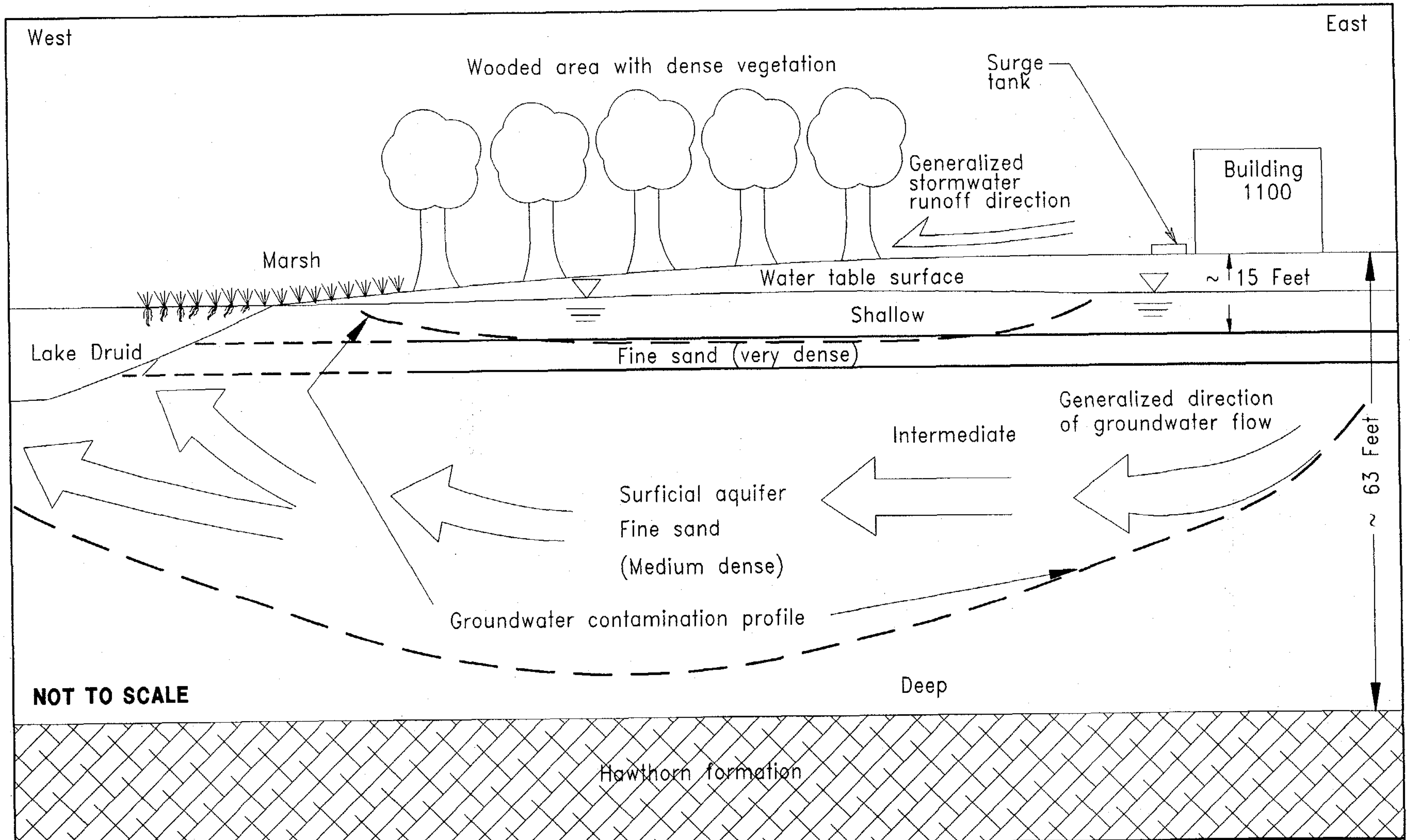



**FIGURE 3-1**
**SITE CONCEPTUAL MODEL**

H:\OLD\AREAC\IRA\SECTION.DWG, PDP-RPN 07/02/97 15:17:29, AutoCAD R12

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN**
**OPERABLE UNIT 4**

**NAVAL TRAINING CENTER**
**ORLANDO, FLORIDA**

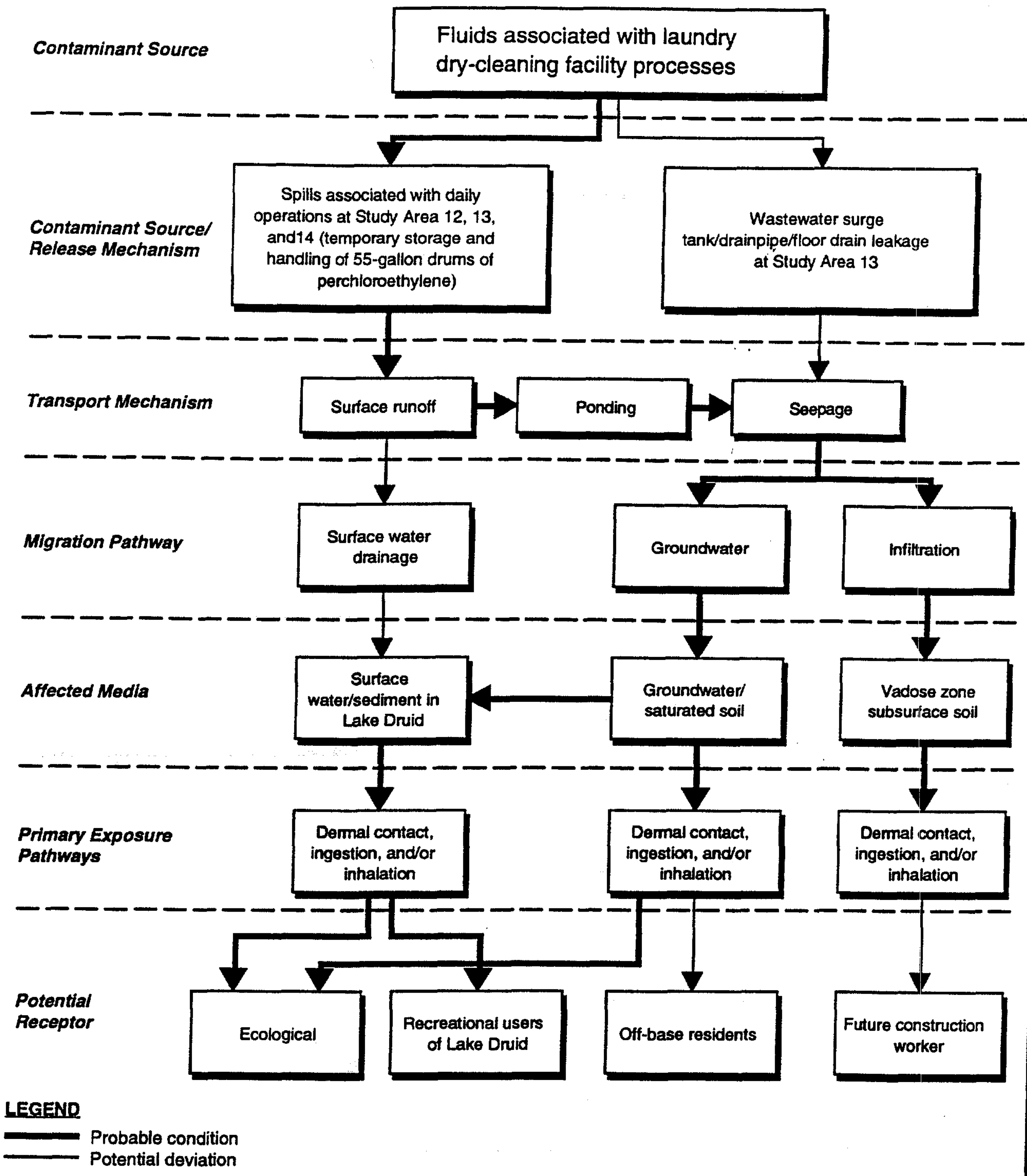



**FIGURE 3-2**
**SITE CONCEPTUAL MODEL: PROJECT LOGIC DIAGRAM**

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN OPERABLE UNIT 4**

**NAVAL TRAINING CENTER ORLANDO, FLORIDA**

2545-04 FIG 3-2 101497 HAS/MAW

- leaks associated with the collection and transport of wastewater from laundry and dry-cleaning machines; and

- spills inside the building transferring via leaks in floor drains, drainpipes, the surge tank, and/or sanitary sewer pipe and migrating to the subsurface.

The following specific information has been gained from previous investigations regarding the contaminant source/release mechanism:

- During the source investigation, the highest VOC concentration in soil measured by the laboratory was 430 ppb of PCE at U4P015.

- During the source investigation, groundwater was collected via TerraProbe℠, which resulted in 8,600 μg/ℓ PCE and 15,000 μg/ℓ TCE. Considering 15,000 μg/ℓ TCE is the byproduct of the degradation of 19,000 μg/ℓ PCE, the equivalent PCE concentration in this sample is approaching 20 percent of the theoretical solubility for PCE. Similar PCE concentrations were also detected at location U4Q020, based on a comparison of "E" qualified field GC data. These results suggest a strong possibility that a source area of residual NAPL is present beneath the laundry, possibly at more than one location.

- Contaminated groundwater appears to be the source of VOCs detected in Lake Druid. It has been estimated that approximately 25 pounds per year of total VOCs enter Lake Druid via groundwater. Approximately 1 to 5 pounds of VOCs are present in Lake Druid sediments (ABB-ES, 1997c).

Transport Mechanism. The following mechanisms provide the transportation for the contaminants:

- transport of the chlorinated solvents by stormwater and surface runoff into a drainage swale and possibly a culvert, thereby transported directly to the lake;

- ponding and seepage of contaminated surface runoff into the subsurface prior to the chlorinated solvents volatilizing into the atmosphere; and/or

- seepage of chlorinated solvents through the soil and into the groundwater, and in the instance of the surge tank, discharge of solvents directly into the groundwater.

Migration Pathway. The migration pathways listed below show the route by which the chlorinated solvents enter the immediate environment.

- Surface water runoff around the building ultimately flows into Lake Druid, impacting the surface water and sediment.

- Chlorinated solvents infiltrate through the vadose zone into the groundwater.

- Groundwater in the vicinity of Building 1100 flows in a westerly direction toward Lake Druid, thereby "carrying" dissolved-phase VOCs to the lake.

The specific information below has been gained from previous investigations regarding the migration pathway.

- Stratigraphic information obtained within the surficial aquifer indicates the subsurface is relatively homogeneous, composed of fine sand interbedded with silty and/or clayey fine sand.

- The soil density of the surficial aquifer typically ranges from medium dense to dense, with the exception of a hard layer (very dense) approximately 15 feet bls, with varying thickness averaging about 5 feet. No stratum has been identified that would act as a hydraulic or chemical confining layer or barrier.

- Results of the DPT groundwater investigation indicated that the width of the groundwater VOC plume extends approximately 500 feet from just south of the north fence line down the shoreline of Lake Druid. VOCs were detected in groundwater at depths ranging from 4 to 68 feet bls and include chlorinated solvents, primarily cis-1,2-DCE, TCE, and PCE.

- Aquifer characterization results from a pumping test indicated a hydraulic conductivity of 32.7 feet per day.

Affected Media. Media that have the possibility to be contaminated are listed below.

- Surface water and sediment in Lake Druid can be affected by two different pathways: by direct surface water runoff and through groundwater infiltration. The latter seems to be the best explanation, due to the results of the IRA.

- Vadose zone soil shows substantial concentrations of chlorinated solvents. This is due to the infiltration of the solvents into the ground surface and percolation to the groundwater.

- The groundwater may have been affected by chlorinated solvents being released directly into groundwater from beneath the surge tank and/or solvents infiltrating through the vadose zone soils.

The specific information below has been gained from previous investigations regarding the affected media.

- Lake Druid is a Class III surface water, as described in the Florida Administrative Code (FAC), Chapter 62-302, Surface Water Quality Standards. In comparing surface water quality standards for a Class III body, concentrations of PCE and TCE were above the numeric standards. Vinyl chloride concentrations also exceeded minimum criteria (the detection limit), as specified in Chapter 62-302.500, FAC. There are no specific published standards for cis-DCE. However, cis-DCE was present in surface water at concentrations exceeding the Florida MCL (70 $\mu g/\ell$). This concentration has been established as the performance standard for cis-DCE in groundwater discharging to the lake for the OU 4 IRA (ABB-ES, 1997d). The highest surface water and sediment VOC concentrations were detected where the creek enters the lake.

- No compounds or analytes were detected above screening criteria in surface soil. PCE was detected at 11 μg/kg in surface soil from boring 14B002, corresponding to the soil gas detection in this area. However, PCE was detected in subsurface soil above Florida Leachability-based Soil Cleanup Goals (SCG) near monitoring wells OLD-13-01A and OLD-13-07A and beneath the laundry building itself. Arsenic and beryllium were detected in subsurface soil (10 feet bls) above background.

- In general, during the source investigation, soil VOC concentrations decreased with depth. The low concentrations detected may be present from the volatilization of a release some distance away and do not suggest the presence of residual NAPL at these sample locations.

- The highest VOC concentrations in groundwater were detected in the vicinity of the surge tank and beneath the laundry building. Antimony was detected above the FDEP MCL only in monitoring wells at SA 14.

Primary Exposure Pathways. Organisms in the vicinity of OU 4 may be exposed to the COCs by the pathways listed below.

- Dermal contact may occur any time biota comes in contact with the surface water, lake sediment, groundwater, and/or soil.

- The ingestion of surface water, sediment, groundwater, and/or soils may occur at OU 4.

- Inhalation of VOCs may occur in and around Lake Druid from surface water and on occasions when the groundwater is used for irrigation purposes by the residents near the lake. Disturbing the soil may cause the volatilization of the compounds into the atmosphere. Volatilization could also occur into structures built over contaminated soil or shallow groundwater.

Potential Receptors. Listed below are all the possible receptors that may be exposed to the chlorinated solvents.

- Ecological receptors have the potential to be exposed via all three exposure pathways.

- Recreational users of Lake Druid are in direct contact with surface water and potentially sediment.

- Off-base residents have the potential to be exposed to the contaminated groundwater from OU 4 through irrigation wells, which they may have on their property, and via inhalation of vapors migrating into buildings from groundwater.

- Future construction workers could be exposed to the soils at OU 4, either during demolition of Building 1100 or during the construction of new structures at the site.

- Future residents could be exposed via groundwater ingestion and inhalation of released volatiles.

Additional data needs will be identified in the remainder of Chapter 3.0. The technical approach of the data collection will be discussed in Chapter 4.0.

3.2.1.2 **Data Needs for Completing the Definition of the SCM** The completion of the IRA activities at OU 4 helped clarify several key components of the SCM, including the following:

- source/release mechanisms,
- transport mechanisms,
- migration pathways,
- affected media, and
- primary exposure pathways.

One of the goals of the RI will be to fill in any gaps in our understanding of these components, along with any remaining elements of the PLD.

Areas to be addressed in this RI/FS workplan in support of refining the SCM are

- further assessment of source area(s);
- delineation of the southern extent of the groundwater plume, and determining its origin or source;
- investigation along the northern and eastern boundaries of the OU for possible off-base contaminant migration; and
- additional assessment of groundwater in the area of SAs 12 and 14, due to VOC and antimony (SA 14 only) detections in samples from monitoring wells installed during site-screening activities.

The critical pathway that the contamination appears to be following at OU 4 begins with the contaminants seeping into the groundwater, then ultimately being partitioned into dissolved-phase constituents that migrate through groundwater into Lake Druid. Supporting data can be found in the FFI (ABB-ES, 1996c). The plan view of the contamination in the lake (Figure 2-6) compared to the plan view of the contamination in the groundwater leading to the lake (Figure 2-8) strongly supports groundwater as the most likely source for the lake contamination. Drive points installed in Lake Druid have also demonstrated that contaminated groundwater is upwelling into the lake. In addition to seepage and groundwater migration being a transport mechanism, surface runoff was also considered. Work completed during the FFI indicated that surface runoff was not the major contributor to the spread of the contamination. Surface soil samples collected at runoff locations showed little or no signs of chlorinated solvents. It is possible, however, that surface runoff in the past may have played a part in the spread of contamination to Lake Druid. However, the major contributor to the contamination of Lake Druid seems to be the groundwater.

<u>3.2.2 Exposure Assessment</u> Potentially site-related chemicals from OU 4 are solvents used in dry-cleaning operations, primarily PCE and its breakdown products. Antimony has also been detected in groundwater above FDEP MCLs at SA

14. These contaminants of potential concern (CPCs) are only of concern to human health and/or the environment when the following three conditions exist:

- there is a chemical source or release,
- there is an exposure route, and
- there are potential receptors.

At OU 4, there is a known potential source of contamination: the laundry and dry-cleaning facility. Based on site history and results from past investigations, releases of dry-cleaning solvents are assumed to have occurred and are present in the groundwater.

The following subsections describe potential receptors and exposure pathways that may be evaluated in the human health and ecological risk assessments (ERAs). These descriptions are based on observations at OU 4 and investigations conducted at other sites (e.g., OU 1). During the RI, exposure routes and receptors will be identified through human health and ecological surveys.

3.2.2.1 **Human Health** Potential receptors and exposure pathways that will be evaluated in the HHRA are described below.

<u>Potential Exposure Points</u>. Potential receptors exposed to contamination associated with OU 4 have been identified by considering present and future land and groundwater uses at Area C. Area C is located 1 mile west of the Main Base and is surrounded by urban development. OU 4 is located in the northern portion of Area C. OU 4 currently includes an abandoned dry-cleaning facility and the DRMO. The land directly adjacent to the north of OU 4 is an occupied apartment complex. Land in the northern proximity contains single family and multifamily residences. There are additional residences to the south of Area C. There is an office complex to the east, and Lake Druid is immediately adjacent to the west (an overgrown natural area separates the laundry facility and the lake).

Area C obtains its drinking water supply from the Orlando Utilities Commission and Winter Park Utilities (ABB-ES, 1997a). One of the Orlando Utilities Commission's supply wells is located at the southeast corner of the Main Base. The exact location of any private potable or irrigation wells near OU 4 will be determined in a well survey conducted during the RI as part of the human health survey.

All surface water in the vicinity of NTC, Orlando is classified by the State of Florida as Class III surface water suitable for fish and wildlife propagation and water contact sports (ABB-ES, 1997a). Groundwater in the surficial aquifer and the Floridan aquifer system at NTC, Orlando is classified as Class G-II groundwater suitable for potable use.

The receptors that are reasonable to consider under current exposure scenarios are maintenance workers, trespassers, and recreational users of Lake Druid. Although NTC, Orlando is slated for BRAC closure, and properties are being transferred from the Navy to private and local government owners, these current receptors are assumed to be representative of current onsite risks.

Recognizing probable future land uses, the following potential receptors have been identified:

- site maintenance workers, who perform routine lawn maintenance activities such as mowing, weed control, and irrigation system repairs;

- commercial workers (assumes only indoor exposures, i.e., minimal contact with site soils);

- excavation workers;

- recreational users (swimmers, boaters, and waders) of Lake Druid; and

- future residents.

Subsistence or supplemental fish ingestion will not be assessed as a potential exposure pathway, because potentially bioaccumulating contamination is not expected. Additionally, fish ingestion is not assumed to be a significant exposure pathway. This assumption will be confirmed during the OU 4 exposure assessment.

Potential Exposure Routes. The conceptual site model for OU 4 was presented in Subsection 3.2.1. The exposure pathways anticipated are shown in the conceptual model.

The reasonable potentially complete pathways to be considered are included below.

- Incidental ingestion and dermal contact with contaminants in soil and subsurface soil (excavation workers only). For evaluation of maintenance and excavation workers, inhalation is a potential exposure pathway for soil contaminants.

- Ingestion of and direct contact with groundwater via discharge to surface water or via irrigation by a future area resident. Because groundwater at OU 4 is very shallow (at less than 4 to 6 feet bls), potable surficial aquifer usage is not considered reasonable. The surficial groundwater is assumed to discharge into Lake Druid. Additionally, a potable water source is currently available to Area C.

- Contaminant exposure through ingestion of groundwater from within the Floridan aquifer. Existing data suggest that this is not probable or potential due to the presence of the Hawthorn Group, the principal aquitard impeding vertical flow between the surficial aquifer and the Floridan aquifer system.

3.2.2.2 **Ecological** The following paragraphs describe the potential ecological receptors and exposure pathways for OU 4. This information is based on previous investigations at OU 4 and other sites at NTC, Orlando.

Terrestrial Habitat and Receptors. Approximately 5 percent of the NTC, Orlando installation (roughly 100 acres basewide) is undeveloped, providing a limited amount of habitat for ecological receptors.

Three tree species provide the predominant vegetative cover at the base: live oak, slash pine, and cabbage palm. Wetland habitat is dominated by bald cypress (C.C. Johnson, 1985). Red maple and pines are additional dominant wetland tree species noted by ABB-ES ecologists during a brief reconnaissance of the installation (ABB-ES, 1994b). Additional information regarding vegetative cover types in the vicinity of OU 4 is not currently available, but will be obtained and incorporated into the habitat characterization of the RI.

Limited information is currently available regarding terrestrial fauna at NTC, Orlando and specifically at OU 4. Potential wildlife habitats in the vicinity of OU 4 will be evaluated and included in the RI.

Small mammals that may exist at the site include the eastern cottontail rabbit, hispid cotton rat, and cotton mouse.

Birds of prey such as the black vulture, turkey vulture, red-tailed hawk, red-shouldered hawk, bald eagle, and osprey may forage for prey items in the vicinity of the OU. Graminivorous birds, such as the mourning dove, are likely to be found occasionally in the grassy areas that comprise the majority of habitats at the site. Other bird species that may exist at NTC, Orlando include the brown-headed cowbird, brown thrasher, bobwhite quail, mockingbird, common grackle, killdeer, northern cardinal, blue jay, rufous-sided towhee, common flicker, peacock, and red-bellied woodpecker.

Several species of venomous snakes may exist in the area, including the eastern coral snake, dusky pygmy rattlesnake, and eastern diamondback rattlesnake. These snakes are among the top predators in the food chain at the installation. Rattlesnakes feed on rodents, birds, amphibians, and small reptiles. Coral snakes ingest other snakes, lizards, and amphibians.

Aquatic Habitat and Receptors. All surface water in the vicinity of NTC, Orlando is classified by the State of Florida as Class III waters, suitable for fish and wildlife propagation and water contact sports.

The majority of aquatic habitat in the vicinity of OU 4 is located in Lake Druid. This lake provides habitat for a number of fish species, likely including smallmouth bass, bluegill sunfish, redear sunfish, golden shiner, yellow bullheads, and killifish, as well as aquatic invertebrates (C.C. Johnson, 1985). According to the NTC, Orlando Master Plan Update (SOUTHNAVFACENGCOM, 1985), grass carp have been introduced into several of the larger lakes to control Florida elodea, an invasive, rapidly growing aquatic weed that chokes waterways, rendering them impassable to boat traffic (C.C. Johnson, 1985).

Amphibians that may live in the vicinity of OU 4 include frogs and toads, and possibly some salamanders. The Florida cottonmouth, a venomous aquatic snake inhabiting lakes, rivers, swamps, and ditches, also could exist in small, intermittent surface water bodies. Cottonmouths feed on fish, amphibians (e.g., frogs and salamanders), small- to medium-sized reptiles (e.g., lizards, small turtles, and baby alligators), small birds, and mammals. Turtles and other aquatic and semiaquatic reptiles (e.g., the American alligator) may exist in some of the lakes and other water bodies at the installation.

Rare, Threatened, and Endangered Species. Limited information is currently available regarding rare, threatened, and endangered species at NTC, Orlando. Additional information regarding rare, threatened, and endangered plants and animals will be requested from State and Federal authorities (i.e., Florida's Natural Heritage Program, the Florida Game and Fresh Water Fish Commission [FGFWFC], and the U.S. Fish and Wildlife Service) during the RI.

Exposure Pathways. The contaminant source for OU 4 is considered to be chlorinated solvents from the laundry and dry-cleaning facility. Contaminants from the source may migrate into environmental media. The contaminated media at OU 4 to which ecological receptors are potentially exposed include surface soil, surface water, sediment, and groundwater as it discharges to the surface.

Exposure of ecological receptors to contaminants can occur directly via contact with contaminated media or indirectly via the food chain. Exposures via the food chain are considered insignificant because the suspected contamination does not bioaccumulate. Therefore, higher trophic transfer and exposures to carnivorous and piscivorous wildlife will not be evaluated unless contaminants that bioaccumulate are detected during the RI.

Terrestrial wildlife, plants, and invertebrates may be exposed to contaminants in surface soil. It is likely that sediment-dwelling invertebrates may primarily be exposed to contaminants in sediment via groundwater discharging to Lake Druid. In addition, water column invertebrates, fish, and amphibians may also be exposed to contaminants in groundwater that have migrated to the surface water; however, impacts to these receptors may not be significant because groundwater concentrations would be diluted upon discharge to surface water.

**3.2.3 Preliminary Identification of Remedial Action Technologies** The identification of preliminary remedial action technologies requires the identification of ARARs, remedial action objectives (RAOs), and probable treatment technologies.

3.2.3.1 **ARARs** Identification of Federal and State ARARs, along with other available nonpromulgated advisories, to-be-considered (TBC) criteria and guidance material is mandated by Section 121(d) of the CERCLA (as amended by the Superfund Amendment of 1986) and is a key component in the planning, evaluation, and selection of remedial actions. Although NTC, Orlando is not a CERCLA site, the process of identifying ARARs for sites managed under the Navy's IR program may be useful in the development of cleanup goals and the determination of appropriate remedial actions.

Applicable Requirements. Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal or State law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances found at a CERCLA site (55 Federal Register [FR] 8814, March 8, 1990 [National Oil and Hazardous Substances Pollution Contingency Plan]). Examples of applicable requirements include cleanup standards and standards of control for a hazardous substance.

Relevant and Appropriate Requirements. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal or State law that, although not "applicable," address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site (55 FR 8814). For example, the MCLs promulgated under the Safe Drinking Water Act (SDWA) would be considered relevant and appropriate at a site where surface or groundwater contamination could affect a potential (not actual) drinking water source.

A table is presented in Appendix A of this workplan that represents a preliminary compilation of potential ARARs for OU 4. As site-specific contaminants are identified and remedial actions are evaluated during the FS, ARARs will be added to or removed from this list. The ARARs in the table are identified by the following categories: chemical-, location-, and action-specific ARARs, and TBC criteria.

Chemical-Specific ARARs. Chemical-specific requirements are standards that limit the concentration of a chemical found in or discharged to the environment. They govern the extent of site remediation by providing either actual cleanup levels or the basis for calculating such levels. Chemical-specific ARARs for a site may also be used to indicate acceptable levels of discharge for determining treatment and disposal requirements and to assess the effectiveness of future remedial alternatives.

Currently, there are no promulgated Federal or State chemical-specific ARARs that provide limits for the concentration of chemicals in soil. However, the State of Florida has provided guidance values for soil cleanups (FDEP, 1995).

Location-Specific ARARs. Location-specific ARARs govern site features (e.g., wetland, floodplains, wilderness areas, and endangered species) and manmade features (e.g., places of historical or archaeological significance). These ARARs place restrictions on concentrations of hazardous substances or the conduct of activities solely based on the site's particular characteristics or location.

Action-Specific ARARs. Action-specific ARARs are technology- or activity-based limitations controlling activities for remedial actions. Action-specific ARARs generally set performance or design standards, controls, or restrictions on particular types of activities. To develop technically feasible alternatives, applicable performance or design standards must be considered during the detailed analysis of remedial alternatives.

TBCs. In the absence of Federal or State promulgated regulations, there are other criteria, advisories, guidance values, and proposed standards that are not legally binding, but may serve as useful guidance for setting protective cleanup levels. These are not potential ARARs, but are TBC guidance.

The list of ARARs in Appendix A was used for the development of the probable remedial actions required at OU 4.

3.2.3.2 **Preliminary RAOs** Preliminary RAOs were identified through the assessment of the refined SCM and the preliminary list of ARARs for OU 4 (Appendix A).

The intent of an RAO is to specify the media, contaminant, and probable exposure pathway that must be addressed through a remedial action to protect the public and environment. The preliminary RAOs identified in this subsection were developed to protect public health and the environment for both existing and potential future site conditions as presented by the SCM. Under CERCLA guidance, the RAO should be calculated, on a cumulative basis, based on the list of CPCs detected in the media of concern and the corresponding acceptable exposure levels and routes. These criteria establish specific maximum allowable concentrations for each CPC detected at OU 4.

The probable contaminated media at OU 4 are surface water, sediment, subsurface soil, subsurface "source area," and groundwater; the potential contaminated medium is surface soil.

Based on previous investigations, the CPCs at OU 4 are mostly organic compounds, namely chlorinated solvents, with the exception of antimony found at SA 14. Based on the list of ARARs, probable and potential contaminated media, and exposure pathways, specific RAOs for each of the CPCs will be developed for OU 4 and presented within the FS. However, preliminary RAOs, presented in this document, were developed based on probable and potential exposure pathways to support the development of the RI sampling requirements and contingent actions.

Therefore, the preliminary RAO for OU 4 is "reducing high VOC concentrations within the surficial aquifer enough to allow natural processes to take over as the remedial alternative for the aquifer and Lake Druid."

3.2.3.3 **Preliminary Remedial Action Technologies** A limited evaluation of potential remedial action technologies was conducted to support the identification of data needs and development of remedial investigative requirements. The potential list of remedial technologies, including innovative and emerging technologies, was developed based on literature review and the SCM prepared for OU 4 (Figure 3-1). This SCM identified the probable and potential contaminated media and the potential exposure pathway(s) and receptor(s) to these contaminated media.

Surface Soil. Exposure to contamination in surface soil is considered possible. Access restrictions or surface controls may be viable remedial alternatives; however, excavation of the "hot spots" of contamination in the surface soil with onsite treatment or off-site disposal is likely. Onsite treatment could be accomplished with various technologies, including soil washing, biotreatment, solvent extraction, or thermal desorption (or a combination of these methods). Off-site disposal could entail the delivery of the contaminated soil to a landfill suitable to receive such wastes.

Subsurface Soil. Remediation of subsurface soil could also be an option if very high contaminant concentrations are found. Dewatering of the contaminated area and excavation of the hot spots (if identified) could occur with onsite treatment or off-site disposal methods similar to those mentioned for surface soil. Some of the *in situ* groundwater remedial technologies, such as air sparging, chemical oxidation or biotreatment, may also be useful in cleaning up subsurface soils.

Dense Nonaqueous-Phase Liquids Source Area. In order to reduce dissolved-phase VOC concentrations within the groundwater and invariably within the surface water, some source reduction alternative will likely have to be implemented. Source reduction actions may include a physical process such as air sparging or a biochemical treatment alternative such as an oxidation and nutrient injection technique.

Surface Water. Exposure to contamination in surface water may be considered likely. Access restrictions or controls may be viable interim remedial alternatives around the hot spots until natural processes, enhanced by source reduction and groundwater remediation, begin reducing contaminant levels to acceptable levels.

Sediment. Exposure to contamination in sediment may also be considered likely. Excavation of the hot spots could occur with onsite treatment or off-site disposal methods similar to those mentioned for surface soil. As with surface water, the reduction of source along with groundwater remediation may allow the natural processes to act as the appropriate remedial solution. Phytoremediation may also prove useful to augment the natural processes.

Groundwater. The release of contaminants to groundwater has been confirmed as an exposure pathway. *In situ* containment and treatment of the shallow groundwater contaminant plume downgradient of Building 1100 will be accomplished under the IRA activities by utilizing a network of recirculation wells. Potential *in situ* and *ex situ* technologies were also evaluated for the IRA and will continue to be evaluated throughout the RI/FS process.

Data collection during the RI will determine the need for an additional remedial action and support the evaluation of multiple treatment alternatives.

A preliminary list of remedial technologies and process options has been prepared based on the information available for OU 4. Within each technology, there may be several process options, such as biological treatment of contaminated groundwater by aerobic and anaerobic processes. Additional technologies and process options may be identified following the remedial investigation. The screening of the remedial technologies and development of remedial alternatives are discussed in Chapter 9.0 of this workplan.

**3.3 SUMMARY OF DATA NEEDS**. There are three purposes for collecting data at OU 4:

- to verify the existing data, probable conditions, and reasonable deviations (i.e., verify the conceptual site model);
- to support the HHRA and ecological evaluation; and
- to support the FS.

Only those probable conditions and reasonable deviations that will affect the outcome of the risk assessment and evaluation or the FS will be identified.

To identify data to collect during the RI, uncertainties in terms of probable conditions and reasonable deviations have been identified with respect to technology performance uncertainties (Table 3-1), site condition uncertainties (Table 3-2), and regulatory uncertainties (Table 3-3). Preliminary base actions and contingent actions to address the deviations have also been identified. Data needs to resolve unacceptable uncertainties with respect to site conditions, technology performance, and regulatory issues are identified in the tables. These data needs are consolidated with existing information to identify what data should be collected during the RI.

The media listed below will be collected during the RI.

- Soil. Surface soil samples (0 to 12 inches) will be systematically collected from within the OU to support a risk assessment and treatability evaluation. Subsurface soil samples will be collected from

**Table 3-1**
**Technology Performance Uncertainties**

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Technology | Probable Conditions | Data Needs | Potential Deviation | Contingent Action | Additional Data Needs |
|---|---|---|---|---|---|
| Institutional Controls | Implementation of zoning and deed restrictions for future land use. | Determine regulatory requirements for implementation of land-use restrictions and future long-term liability for potential operation and maintenance. | Additional requirements for limitations on use of groundwater or adjacent surface water bodies (i.e., Lake Druid). May also require FDEP reclassification of surface water bodies. | Limit surface water body access and provide potable water supply, if needed. | Collection of groundwater samples from the perimeter of OU 4, characterization of both surface water flow and groundwater flow direction, and quantification of the surface water and sediment quality. |
| Source Reduction | Source reduction mitigates migration of contaminants into affected media. Source control may include physical, chemical, or biological treatment. | Determine the clean upgradient boundary of the source area. The source area needs to be delineated in order to target an area for source reduction. The source area may need to be further quantified. | The source area may have an ongoing release (unlikely), or conversely, only residual contamination may be present. Multiple source areas may also be present and difficult to delineate. | Physically remove and/or control any ongoing releases to groundwater. Implement source reduction in areas of highest dissolved groundwater concentrations. | Source control will need to be measured to determine success. Analyze content and concentrations of contaminants for risk and regulatory evaluation. |
| Containment | Groundwater containment downgradient of the source reduces contaminant migration to potential receptors. It reduces potential VOC contamination of groundwater into nearby surface water bodies and sediment. | Assess soil lithology and chemical characteristics around the perimeter of the source area, structural and permeability characteristics of subsurface soil, and interaction of contaminants of potential concern with containment materials. | Mounding and/or depleting groundwater in the vicinity of the shoreline, thereby altering surface water elevation and vegetation. | Implement containment technology that presents little or no hydraulic effect on the groundwater table. | None expected. Data needs have been met to support the OU 4 IRA. Containment option is being implemented. |

Notes: RI/FS = Remedial Investigation and Feasibility Study.
FDEP = Florida Department of Environmental Protection.
OU = operable unit.
VOC = volatile organic compound.
IRA = interim remedial action.

## Table 3-2
## Site Condition Uncertainties and Data Needs

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Media | Probable Condition | Initial Action | Data Needs | Reasonable Deviation | Contingent Action | Additional Data Needs |
|---|---|---|---|---|---|---|
| Surface Soil | Pavement and buildings exist around most of OU 4. Pavement thickness is sufficient to prevent exposure from contaminants. There exists approximately 300 feet of undeveloped land between Port Hueneme Avenue and Lake Druid. | Institutional controls. | Verify probable condition. Measure the pavement thickness. Collect samples to evaluate composition of undeveloped area. Data will support institutional controls evaluation. | Surface soil in undeveloped area does not warrant remedial response. | Install proper cap. | Same as initial action. |
| Sediment | Sediment in Lake Druid has been adversely affected by groundwater contamination. | No action. | Verify probable condition through sampling sediment. Sample surface water and evaluate leachability of sediment. | Contaminated sediment is not flushing to surface water. | Evaluate removal of sediment or reduction of contaminant concentrations. | Estimate approximate area and depth of sediment contamination. Conduct ecological characterization of aquatic organisms. Evaluate risks and exposures associated with contamination. Evaluate *in situ* treatability or natural attenuation. |
| Groundwater | Contaminated groundwater has migrated to Lake Druid. | Source reduction, monitoring and containment. | Collect hydrologic and groundwater data to design and evaluate source reduction, hydraulic controls, and/or containment of plume not addressed by OU 4 IRA. | Contaminated groundwater has migrated off the base. | Determine extent of migration. Implement groundwater remedial system. | Conduct groundwater modeling to evaluate remedial systems. |
| Air | Gases are not being generated by the source area; thus, no gas is migrating from the existing pavement. | No action. | Collect data to evaluate if soil gases are being generated and/or migrating through the soil cover. | Soil gas is migrating into existing buildings and through pavement. | Evaluate possible venting/capture techniques. | Once source area is better defined, conduct model of venting. |
| Biota | Biota uptake does not pose a risk to human health due to the type of vegetative matter and current and future land uses, or terrestrial fauna due to the distance from the source area. | No action. | Same as surface soil and sediment. | Terrestrial and aquatic fauna are being exposed to contaminated materials, thus producing a possible risk to the food chain. | Monitor the sediment after source reduction measure has been implemented. | No additional data needed. CPCs do not bioaccumulate. |

Notes: RI/FS = Remedial Investigation and Feasibility Study.
OU = operable unit.
IRA = interim remedial action.
CPCs = chemicals of potential concern.

**Table 3-3**
**Regulatory Uncertainties and Data Needs**

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Issue | Initial Condition | Initial Action | Data Needs | Reasonable Deviation | Contingent Action | Additional Data Needs |
|---|---|---|---|---|---|---|
| Deed restrictions and/or covenants | Deed restrictions may be required for designated source area. | Reduce source area to effectively eliminate the need for any deed restrictions. | Determine if any buildings and/or structures are contaminant sources. Monitor source reduction effectiveness. | The building and/or structures contain residual contamination. Source area reduction not completely successful. | Incorporate structures into the restrictive covenant or remove contaminated materials. | Identify waste disposal characteristics. |
| Wetlands | Due to the presence of wetlands, wetland regulations are ARARs. | Modify action to consider impact on wetlands. May include wetland restoration. | Verification of wetlands. | No impacts to wetlands. | No limitations. | None. |
| Flood-plains | Floodplain restrictions limit feasible remediation, but can be mitigated. | Modify actions to compensate for increase in flood risk. | Floodplain and riparian zone delineation. | Unique riparian characteristics prohibit disturbance. | Sediment traps and institutional controls. | None. |

Notes: RI/FS = Remedial Investigation and Feasibility Study.
ARAR = applicable or relevant and appropriate requirements.

within the surficial aquifer in order to characterize lithology and chemical contamination, and to assist in evaluating fate and transport and aquifer treatability.

- Groundwater. Groundwater quality data and hydrologic information will be collected through installation of monitoring wells and other intrusive technologies (e.g., DPT) to evaluate the nature and extent of potential groundwater plume and source area, to further evaluate the hydrogeologic environment at OU 4, and to facilitate possible groundwater modeling. This information will be used to support the risk assessment and the FS.

- Sediment. Sediment samples will be collected along and near the shore of Lake Druid to evaluate possible contamination deposited as a result of contaminant migration from the source area. Leachability of the sediment will also be evaluated. This information will support the risk assessment and the FS.

- Surface Water. Surface water samples will be collocated with sediment samples to evaluate potential impact from contaminants that may have leached from the sediment to support the risk assessment and the FS.

## 4.0 TECHNICAL APPROACH

The technical approach to the individual tasks that comprise the field investigation is described below. Each of the field investigative tasks included in the approach is designed to support the SCM (Figure 3-1) and the data needs identified in Tables 3-1, 3-2, and 3-3. The field investigation and sampling effort will follow the procedures outlined in the POP for NTC, Orlando (ABB-ES, 1997a), for topographic surveying, documentation, field monitoring instrumentation, field equipment decontamination procedures, and quality assurance/quality control (QA/QC) procedures, including procedures for collection of groundwater, surface water, sediment, and soil samples. The field investigative tasks will include the following:

- collection of discrete groundwater samples with DPT from approximately 19 locations;
- collection of a minimum of 11 surface soil samples for chemical analyses in support of the risk evaluation;
- advancement of three soil borings through which a total of 12 subsurface soil samples will be collected for chemical analyses;
- collection of six surface water and sediment samples for full suite analysis to more completely characterize Lake Druid;
- installation of five shallow microwells at SA 14 to analyze the extent of antimony found during previous site screening;
- installation of approximately three monitoring well clusters, consisting of up to three monitoring wells at varying depths in each cluster;
- collection of 33 groundwater samples from both microwells and the new and existing monitoring wells for chemical analyses; and
- performance of aquifer characterization studies.

**4.1 DPT SAMPLING PROGRAM.** In order to collect groundwater characterization samples quickly and with minimal impact to the site, DPT methodology will be utilized. Two types of DPT technologies may be utilized during this investigation. The first, a large DPT rig, utilizes constant hydraulic pressure from a weighted or anchored base to force stainless steel rods into the subsurface. The larger rig is equipped with piezocones and hydrocones, which can be utilized if needed. The piezocone characterizes the penetrated soil, and the hydrocone collects groundwater samples from discrete depth intervals. The second, a smaller TerraProbe℠ unit, is van mounted and utilizes hydraulic pressure along with percussion hammering to advance stainless steel rods into the subsurface. Use of the TerraProbe℠ would be limited to groundwater sample collection in the upper portion of the surficial aquifer. A more detailed description of DPT methodology is presented in Section 4.4 of the NTC, Orlando POP.

DPT technology will be used to obtain groundwater samples at discrete depth intervals to determine the vertical and horizontal distribution of contaminants at selected locations. It is anticipated that the equipment will be capable of exploring the entire thickness of the surficial aquifer (approximately 65 feet). At each DPT sampling location groundwater will be collected at continuous 4- to 5-foot depth intervals beginning at the water table and completed to the top of the Hawthorne Group.

Approximately 19 DPT locations have been selected to further characterize source areas and the affected groundwater extent as identified from the SCM and other data needs, as shown on Figure 4-1. Nine sampling points will be positioned along the north and east fence lines to assess the potential for off-base contamination. The other 10 sampling locations will be positioned in various locations throughout the OU to fill any remaining data gaps. The location and selection of any additional DPT points will be left to the discretion of the project team and will be based on the results obtained at the first 19 DPT locations. A location survey for all DPT explorations will be completed with a global positioning system (GPS) rover and base station system capable of submeter accuracy.

No additional sampling has been proposed for the source areas believed to be beneath the laundry (ABB-ES, 1997b). Sampling techniques would be limited without removing portions of the building and roof to provide rig access. It is believed that the vertical extent of groundwater VOC contamination can be adequately addressed through evaluation of groundwater data collected outside the laundry building. Potential source areas are currently adequately characterized, and expenditure of additional effort in an attempt to better delineate sources beneath the laundry will not likely add significantly to the understanding of the site.

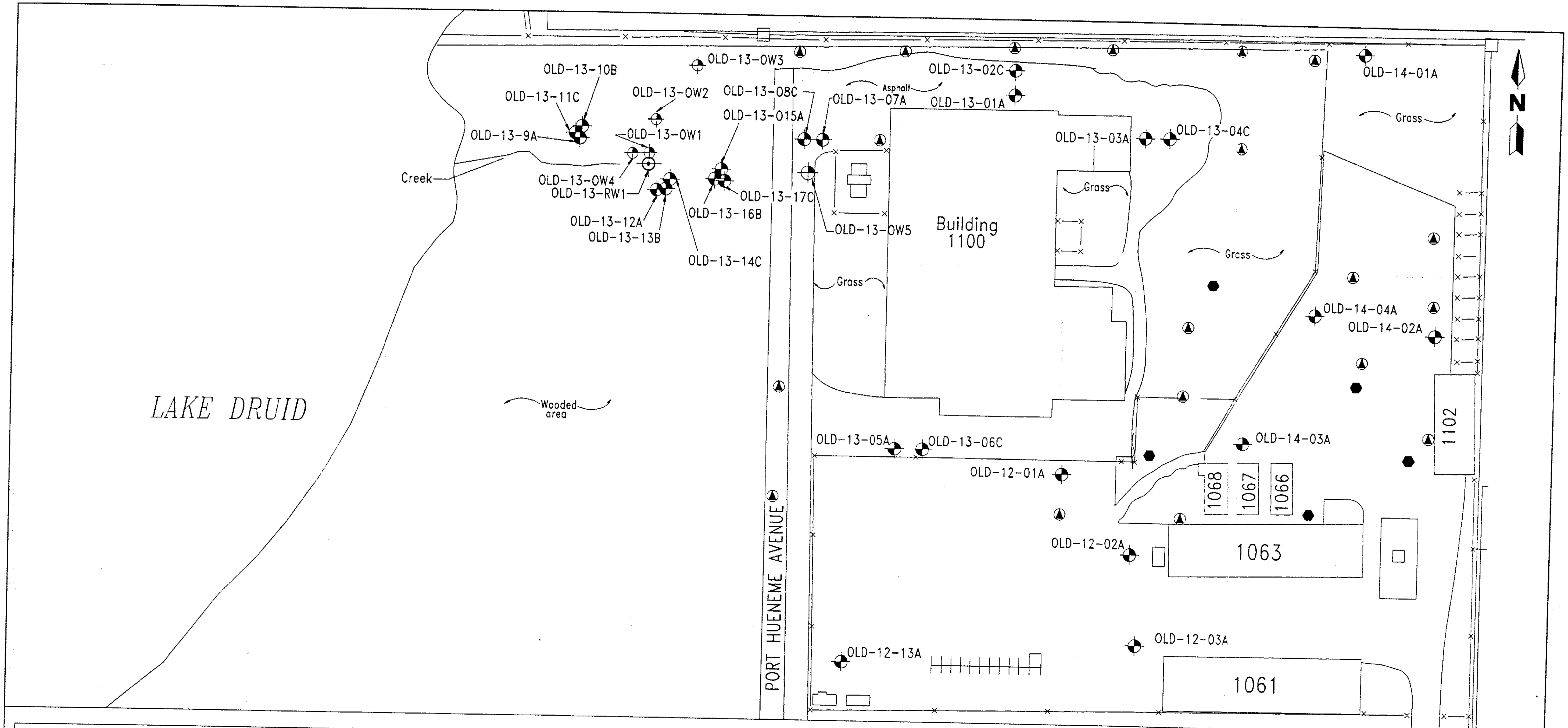
Groundwater analyses will be performed with a mobile field laboratory using GC with purge-and-trap concentrations for trace level detection of selected VOCs as described in Chapter 5.0. Samples will be collected in 40 milliliters (mℓ) Teflon™-sealed glass vials and analyzed on site using modified USEPA SW-846 Method 8010/8020. Quality control analyses will consist of a three point calibration of each analyte, method blank, matrix spike, and matrix spike duplicate and a continuing check calibration standard at a minimum of one per day. The data obtained during these activities are considered Level II and will be used for optimally positioning the new monitoring wells at OU 4.

## 4.2 SOIL SAMPLING PROGRAM

Surface and subsurface soil samples will be collected at OU 4 for chemical analysis in support of risk, fate and transport, and treatability evaluations.

### 4.2.1 Surface Soil Sampling

The surface soil sampling program will be conducted based on the sampling methodology presented in Section 3.2 to support a risk assessment evaluation. Eleven surface soil samples will be collected at points located systematically within area blocks located throughout the OU, as presented on Figure 4-2. Each sample will be collected from the central part of each block. Samples from unpaved areas will be collected within the depth range of zero to 1 foot bls. Samples from paved areas will be collected from just below the paving subgrade (0.5 to 1.5 feet bls), by using a spud bar to penetrate the pavement. A location survey for all surface soil sampling locations will be completed with a GPS rover and base station system capable of submeter accuracy.




**LEGEND**

| | | |
|---|---|---|
| OLD-13-OW1 | ⌖ | Observation well location and designation |
| OLD-13-10B | ◈ | Monitoring well location and designation |
| OLD-13-RW1 | ⊕ | Recovery well location and designation |
| | ▲ | Groundwater DPT sampling location |
| ——x——x | | Fence |
| | ● | Proposed Microwell locations |

NOTE:
DPT = Direct push technology

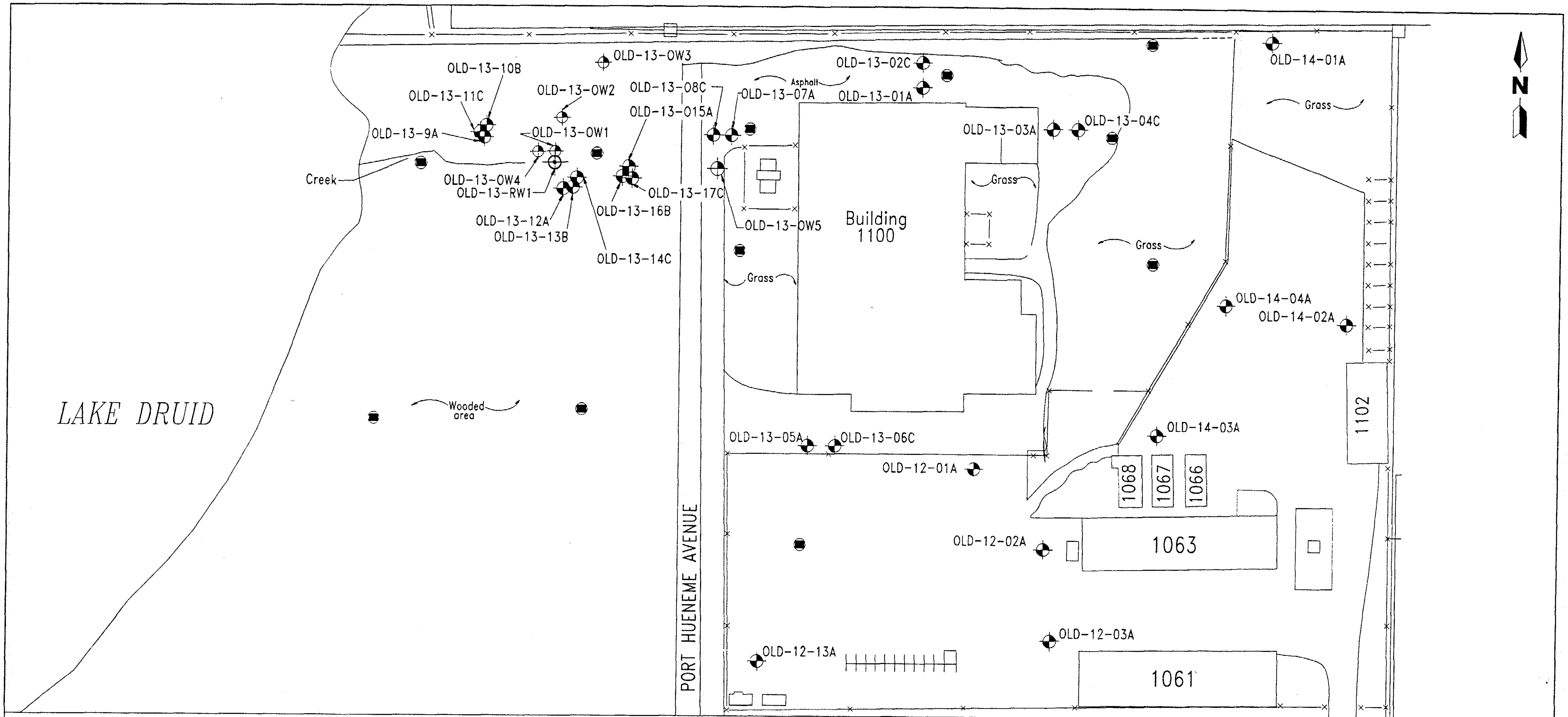
0 50 100
SCALE: 1 INCH = 100 FEET

**FIGURE 4-1**
**GROUNDWATER DPT SAMPLING PROGRAM**

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN OPERABLE UNIT 4**

**NAVAL TRAINING CENTER ORLANDO, FLORIDA**

K:\02545\02545-04\RIF\02545502.DWG, BB-PDP 10/14/97 13:09:22, AutoCAD R12




**LEGEND**

| | |
|---|---|
| OLD-13-OW1 | Observation well location and designation |
| OLD-13-10B | Monitoring well location and designation |
| OLD-13-RW1 | Recovery well location and designation |
| | Surface soil sampling locations |
| | Fence |

0 50 100

SCALE: 1 INCH = 100 FEET

K:\02545\02545-04\RIF\02545501.DWG, BB-PDP 10/14/97 13:50:01, AutoCAD R12

**FIGURE 4-2**
**SURFACE SOIL SAMPLING PROGRAM**

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN OPERABLE UNIT 4**

**NAVAL TRAINING CENTER ORLANDO, FLORIDA**

Surface soil samples will be collected using hand augers. The samples will be analyzed for CLP TCL VOCs, semivolatile organic compound (SVOCs), pesticides, PCBs, and CLP TAL inorganics in accordance with USEPA Level IV DQOs (Table 4-1). The surface soil samples collected for VOC analyses will be obtained directly from the hand auger and placed into the appropriate sample containers. Soil for nonvolatile parameters will be transferred from the hand auger to decontaminated glass bowls for mixing prior to placement in the appropriate sample containers. Further details regarding soil sample collection and preparation may be referenced in the NTC, Orlando POP.

The surface soil sampling data will be compared to the base background data as described in the background sampling plan (ABB-ES, 1994b).

<u>4.2.2 Subsurface Soil Sampling</u> Three soil borings will be advanced using Rotasonic™ drilling techniques. The Rotasonic™ drilling technique is advanced into unconsolidated and consolidated materials by combining vibrational and rotational forces to advance the drill pipe in the borehole. A 6-inch-diameter steel-casing pipe is advanced during the Rotasonic™ drilling for stability of the borehole, eliminating the need to drill and abandon soil borings specifically for the collection of subsurface soil samples. Twelve subsurface soil samples will be collected at various depth from the continuous core, four from each boring, for chemical analyses. Where possible, the soil borings will be used for the installation of monitoring wells. Soil sample identifications, soil sample depths, and associated analyses are listed in Table 4-2.

The locations for the subsurface soil sampling at OU 4 supporting this RI, will be based on an evaluation of the data provided by the preceding earlier phase of DPT groundwater sampling and will coincide with the monitoring well installations. Data from the DPT program will be compiled and evaluated along with previous data, to analyze the extent to which potential contaminants from OU 4 have migrated horizontally and vertically in the groundwater. Following this evaluation, the locations for the subsurface soil sampling program will be proposed to the OPT and the Navy.

Lithologic descriptions will be taken from 4-inch-diameter continuous cores, obtained through the advancement of the 6-inch-diameter casing pipe by the rotasonic drilling. The continuous cores will be screened for volatile organic vapors using an FID.

The objectives for collecting subsurface soil samples are (1) lithologic characterization, (2) chemical analyses for contaminant characterization, (3) analyses for fate and transport parameters, and (4) analyses for biological treatability characterization.

Subsurface soil samples collected for VOC analyses will be obtained directly from the 4-inch continuous cores and placed into the appropriate sample containers. Soil for nonvolatile parameters will be mixed in decontaminated glass bowls prior to placement in the appropriate sample containers. Sample containers will be packed on ice in a cooler at the drilling location. Further details regarding soil sample collection and preparation may be referenced in the NTC, Orlando POP.

<u>4.3 SURFACE WATER AND SEDIMENT SAMPLING PROGRAM</u>. Surface water and sediment samples will be collected from six locations in Lake Druid. Two of the locations

# Table 4-1
## Analytical Program Summary

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Sample Identification | Quantity | CLP/TCL VOCs | CLP/TCL SVOCs | CLP/TAL Inorganics | CLP/TCL Pesticides/PCBs | Other Secondary Parameters[1] |
|---|---|---|---|---|---|---|
| **Surface Soil** | 11 | 11 | 11 | 11 | 11 | |
| **QC Samples** | | | | | | |
| Duplicate | 2 | 2 | 2 | 2 | 2 | |
| Matrix Spike | 1 | 1 | 1 | 1 | 1 | |
| Matrix Spike Duplicate | 1 | 1 | 1 | 1 | 1 | |
| **Total Surface Soil** | 15 | 15 | 15 | 15 | 15 | |
| **Groundwater[2]** | 33 | 33 | 10 | 38 | 10 | 28 |
| **QC Samples** | | | | | | |
| Duplicate | 4 | 4 | 1 | 4 | 1 | 3 |
| Matrix Spike | 2 | 2 | 1 | 2 | 1 | 2 |
| Matrix Spike Duplicate | 2 | 2 | 1 | 2 | 1 | 2 |
| **Other QC Samples** | | | | | | |
| Trip Blanks | 8 | 8 | | | | |
| Equipment Blank | 8 | 8 | 3 | 8 | 3 | 8 |
| Field Blank | 8 | 8 | 3 | 8 | 3 | 8 |
| **Total Groundwater** | **65** | **65** | **51** | **57** | **51** | **51** |

See notes at end of table.

**Table 4-1 (Continued)**
**Analytical Program Summary**

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Sample Identification | Quantity | CLP/TCL VOCs | CLP/TCL SVOCs | CLP/TAL Inorganics | CLP/TCL Pesticides/PCBs | Other Secondary Parameters[1] |
|---|---|---|---|---|---|---|
| **Sediment** | 6 | 6 | 2 | 2 | 2 | 2 |
| **QC Samples** | | | | | | |
| Duplicate | 1 | 1 | 1 | 1 | 1 | 1 |
| Matrix Spike | 1 | 1 | 1 | 1 | 1 | 1 |
| Matrix Spike Duplicate | 1 | 1 | 1 | 1 | 1 | 1 |
| **Total Sediment** | 9 | 9 | 5 | 5 | 5 | 5 |
| **Surface Water** | 6 | 6 | 2 | 2 | 2 | 2 |
| **QC Samples** | | | | | | |
| Duplicate | 1 | 1 | 1 | 1 | 1 | 1 |
| Matrix Spike | 1 | 1 | 1 | 1 | 1 | 1 |
| Matrix Spike Duplicate | 1 | 1 | 1 | 1 | 1 | 1 |
| **Other QC Samples** | | | | | | |
| Trip Blanks | 3 | 3 | | | | |
| Equipment Blank | 3 | 3 | 3 | 3 | 3 | 3 |
| Field Blank | 3 | 3 | 3 | 3 | 3 | 3 |
| **Total Surface Water** | **18** | **18** | **11** | **11** | **11** | **11** |

[1] Other possible secondary parameters. For soils: phosphate (U.S. Environmental Protection Agency [USEPA] Method 300 or SW846 Method 9056), nitrate (USEPA Method 352.1), nitrite (USEPA Method 354.1), sulfate (USEPA Method 375.4), sulfide (USEPA Method 376.1), and total organic carbon (USEPA Method 415.1). For water: pH, hardness (USEPA Method 130.2), total dissolved solids (USEPA Method 160.1), total suspended solids (USEPA Method 160.2), phosphate (USEPA Method 300 or SW846 Method 9056), total alkalinity (USEPA Method 310.1).
[2] Groundwater samples are those collected from monitoring wells only. Direct-push technology groundwater samples will be analyzed for onsite VOCs only using a gas chromatograph.

Notes: RI/FS = Remedial Investigation and Feasibility Study.
CLP = contract laboratory program.
TCL = target compound list.
VOCs = volatile organic compounds.
SVOCs = semivolatile organic compounds.
TAL = target analyte list.
PCB = polychlorinated biphenyl.
QC = quality control.

**Table 4-2**
**Subsurface Soil Sampling Program**

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Boring ID | Estimated Total Depth (feet bls) | Estimated Sample Depth Intervals (feet bls) | Sample ID | CLP Analyses |
|---|---|---|---|---|
| OLD-13-28C | 60 | 8 to 10 | U4B02801 | TCL VOCs, TAL Inorganics, TOC |
| | | 20 to 22 | U4B02802 | TCL VOCs, TAL Inorganics, TOC |
| | | 38 to 40 | U4B02803 | TCL VOCs, TAL Inorganics, TOC |
| | | 56 to 58 | U4B02804 | TCL VOCs, TAL Inorganics, TOC |
| OLD-13-31C | 60 | 8 to 10 | U4B03101 | TCL VOCs, TAL Inorganics, TOC |
| | | 20 to 22 | U4B03102 | TCL VOCs, TAL Inorganics, TOC |
| | | 38 to 40 | U4B03103 | TCL VOCs, TAL Inorganics, TOC |
| | | 56 to 58 | U4B03104 | TCL VOCs, TAL Inorganics, TOC |
| OLD-13-34C | 60 | 8 to 10 | U4B03401 | TCL VOCs, TAL Inorganics, TOC |
| | | 20 to 22 | U4B03402 | TCL VOCs, TAL Inorganics, TOC |
| | | 38 to 40 | U4B03403 | TCL VOCs, TAL Inorganics, TOC |
| | | 56 to 58 | U4B03404 | TCL VOCs, TAL Inorganics, TOC |

Notes: RI/FS = Remedial Investigation and Feasibility Study.
ID = identification.
bls = below land surface.
CLP = Contract Laboratory Program.
TCL = target compound list.
VOC = volatile organic compound.
TAL = target analyte list.
TOC = total organic carbon.

will be sampled for full suite analysis, with the other four for VOCs only. One full suite surface water/sediment pair will be collected from the lake area where concentrations of chlorinated VOCs are present. The second full suite pair will be collected from a Navy-owned portion of the lake near (but beyond) the area of known VOC contamination. This second sample will serve as a control and will aid in the evaluation and interpretation of the results from the sample collected within the VOC-contaminated area. Approximate sample locations are shown on Figure 4-3. A location survey for all surface water and sediment sample locations will be completed with a GPS rover and base station system capable of submeter accuracy.

At locations where the surface water is greater than 1 foot in depth, a surface water sample will be collected from just under the surface of the lake and another will be collected directly above the sediment using a direct sampling device. At locations where the water depth is less than 1 foot, a single sample will be collected just above the sediment. Sediment samples will be collected using a polyethylene terephthalate sleeved, drive type device similar to that of a split spoon for minimizing sediment disturbance. The sediment sample will be collected in the removable sleeves approximately 2 feet in length and sent to the shore for transfer into appropriate sample containers.

More information on the details of field procedures for surface water and sediment sampling is available in the NTC, Orlando POP (ABB-ES, 1997a).

Surface water parameters collected for laboratory analysis are summarized in Table 4-1. In addition, total organic carbon, pH, hardness, total dissolved solids, total suspended solids, and total alkalinity will be obtained for treatability evaluations.

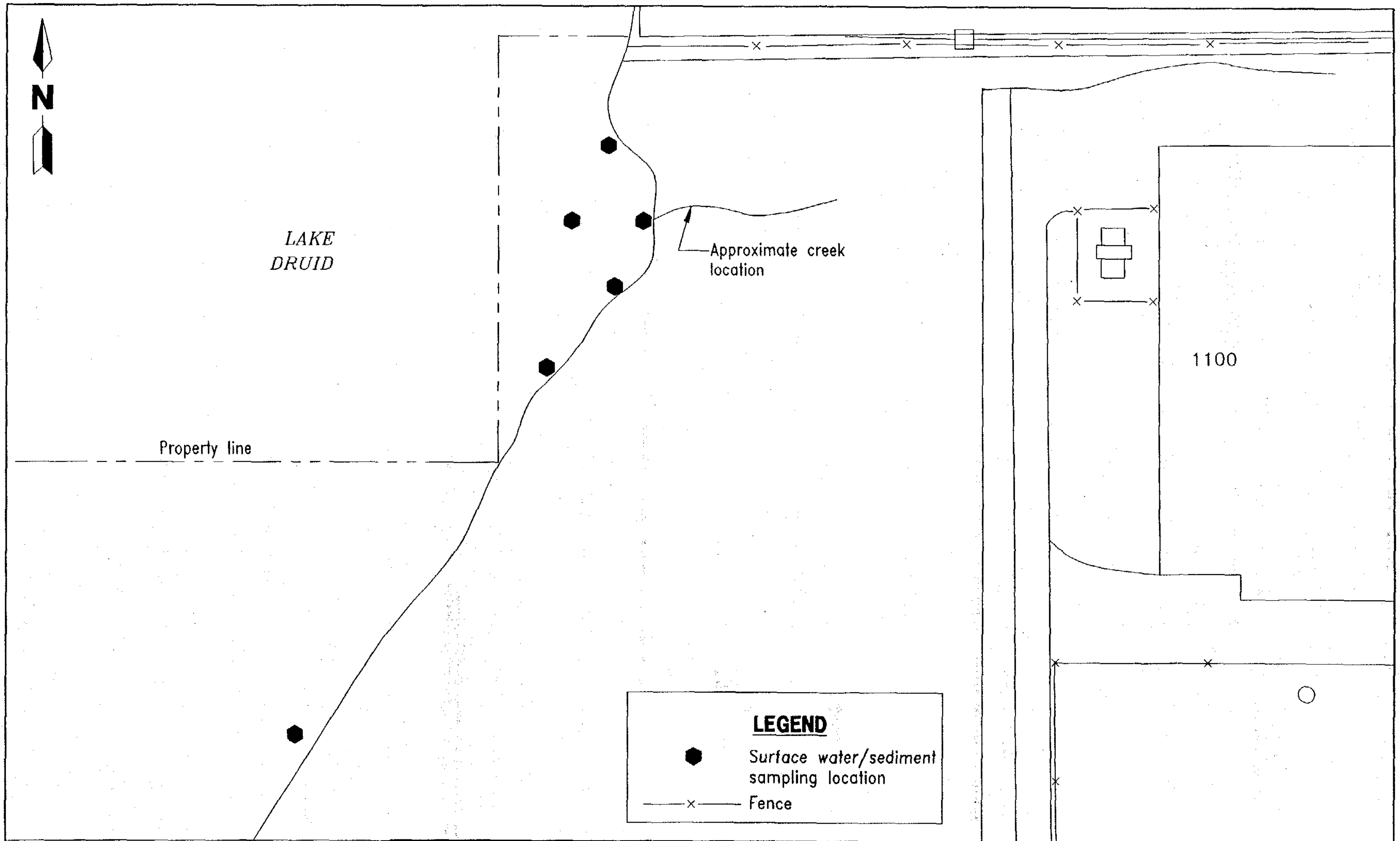
Sediment parameters collected for laboratory analysis are summarized in Table 4-1. Leachability analysis would also be completed on the sediment using surface water to determine the extent of leachability within the existing environment. In addition, total organic carbon and pH may be obtained for risk and treatability evaluations.

**4.4 MONITORING AND MICROWELL PROGRAM**. The objectives of the monitoring and microwell installation program for OU 4 are as follows:

- further characterization of the vertical and horizontal extent of groundwater contamination and
- the development of sufficient information to complete the risk assessment and the FS.

In addition to the characterization of potential groundwater contamination, the monitoring well installation program will be designed with the goal of establishing locations suitable for future groundwater monitoring at the operable unit, if required.

**4.4.1 Microwell Installation** Five shallow microwells will be installed at SA 14 to analyze the extent of antimony found during previous site-screening activities. These microwells enable groundwater to be sampled via peristaltic pump and Teflon™ tubing, similar to a conventional monitoring well. The




0 50 100
SCALE: 1 INCH = 100 FEET

K:\02545\02545-04\RIF\02545500.DWG, RPN-PDP 10/14/97 12:36:34, AutoCAD R12

**FIGURE 4-3**
**SURFACE WATER/SEDIMENT SAMPLING PROGRAM**

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN OPERABLE UNIT 4**

**NAVAL TRAINING CENTER ORLANDO, FLORIDA**

TerraProbe[SM] will be used to install these microwells at locations shown on Figure 4-1.

All microwells will be constructed of 0.5-inch-diameter, polyvinyl chloride prepacked screen and riser. These microwells will be constructed with 9 feet of 0.010-inch slotted screen prepacked with 20/40 silica sand. The microwells shall be installed to 15 feet bls through a 2-inch-diameter stainless steel casing fitted with an expendable point that is advanced using hydraulic pressure along with percussion hammering. After the desired depth is reached with the 2-inch-diameter casing, the prepacked screen(s) shall be lowered down the inside of the casing along with the required length of riser. The casing is then retracted because additional filter material will be added leaving behind the microwell. The microwell will then be completed in the same manner as a typical monitoring well.

<u>4.4.2 Monitoring Well Installation</u> The locations and depths for monitoring well installations at OU 4 supporting this RI will be based on an evaluation of the data provided by the DPT groundwater sampling program. Data from the program will be compiled and evaluated along with previous data to analyze the extent to which contaminants from OU 4 have migrated horizontally and vertically in the groundwater. Following this evaluation the proposed monitoring well installation program will be developed.

The result of the DPT sampling program along with the proposed monitoring well installation program will be presented to the OPT and the Navy in the form of a brief letter report to be followed by a meeting. The meeting will be a working session at which the final monitoring well locations and depths are agreed upon. This approach, a screening program followed by a working session to finalize monitoring well locations, will expedite the completion of the remedial investigation by identifying the probable conditions and reaching consensus on the identification and management of potential uncertainties with the program ultimately agreed upon.

For this program, the Rotasonic™ drilling technique will be used to install the monitoring wells. Monitoring well installation using Rotasonic™ drilling is similar to monitoring well construction using hollow-stem auger drilling. The well is constructed inside the outer, 6-inch inside diameter (ID) casing. The outer casing is pulled as the well materials are placed in the annular space.

The nine monitoring wells will be constructed using 2-inch-ID, PVC flush-threaded, Schedule 40 PVC riser with 0.020 slot PVC well screens. The bottom of the monitoring well shall be set approximately 1 to 2 feet above the total depth of the borehole. The filter pack will be placed in the annular space around the well screen from the bottom of the borehole to at least 2 feet above the screen using the tremie method. The filter pack material shall be a 20/30 clean quartz sand with a specific gravity of 2.6 to 2.7. A bentonite seal will be installed 2 to 3 feet in length above the filter pack and will be allowed sufficient hydration time. A fine sand "cap" (30/65 standard sand) will be placed at least 2 feet above the bentonite seal to provided a buffer support for the uncured grout column. A grout mixture of neat cement and 2 to 4 percent bentonite powder will be placed by tremie method from the top of the fine sand cap to within approximately 2 feet of the ground surface. Additional monitoring well installation and development details may be referenced in the NTC, Orlando POP.

Horizontal and vertical surveys will be required for all monitoring wells and will be completed with traditional surveying techniques, as described in the NTC, Orlando POP.

4.4.3 Monitoring and Microwell Sampling The 9 new and 19 existing monitoring wells along with at least 5 microwells will be purged and sampled using low-flow techniques. The purpose of using low-flow purging is to ensure that the sample taken is from the targeted aquifer zone.

Prior to purging, the breathing zone and the mouth of each well will be monitored for VOCs with a flame-ionization detector. Each well shall then be purged prior to sampling to clear the well of stagnant water, which is not representative of aquifer conditions. New 1/4-inch outside-diameter (OD) Teflon™ tubing will be lowered into each well and connected to an ISCO peristaltic pump for purging. During purging temperature, pH, conductivity, dissolved oxygen, and turbidity will be measured regularly. When the parameters, along with turbidity, have stabilized, a sample would be taken.

Monitoring well groundwater sampling for VOC analysis shall be collected as a grab sample by slowly purging a sample through the Teflon™ tubing. The tubing is removed from the well, and the groundwater sample is drained by gravity out of the Teflon™ tubing that had been in the well and into 40-mℓ vials.

For all other groundwater monitoring well sampling, a new 2.5-liter amber bottle will be used to create a vacuum collection assembly as shown on Figure 4-4. A rubber stopper, #5 size, is wrapped in a Teflon™ swatch and placed in the bottle mouth with two 1/4-inch-OD Teflon™ tubing sections inserted through two holes in the stopper. One piece of tubing will run up from the well, and the other will run to the peristaltic pump. A vacuum shall be created in the bottle, and the groundwater sample will slowly be drawn in. The 2.5-liter amber bottle is filled, and the contents are poured into the containers appropriate for each parameter and will be sent to the laboratory for analysis. The inlet of the tubing will be set at the midpoint of the screened interval in each monitoring well. Filtered inorganic samples will be collected by connecting a 0.45-micron filter in line between the well and the 2.5-liter bottle.

Groundwater samples collected from each monitoring well will be analyzed for CLP TAL metals and CLP TCL VOCs. Filtered groundwater samples will also be collected from SA 14 (where antimony was previously detected above Florida standards) and analyzed for CLP TAL metals. To support the risk assessment, 10 monitoring wells distributed across the operable unit will be sampled for full suite CLP/TCL and CLP/TAL parameters. The locations of these wells will be reviewed with the OPT prior to sampling. Parameters collected for laboratory analysis are summarized in Table 4-1. Proper quality assurance and quality control will be maintained during groundwater sampling and can be referenced in the NTC, Orlando POP (ABB-ES, 1997a) along with additional sampling and sampling preparation procedures.

4.5 AQUIFER CHARACTERIZATION SURVEY. An aquifer characterization program designed to support the SCM will be conducted. This program will include a groundwater elevation survey, a vertical head potential survey, and aquifer tests in newly installed monitoring wells to support evaluation of hydraulic conductivities.

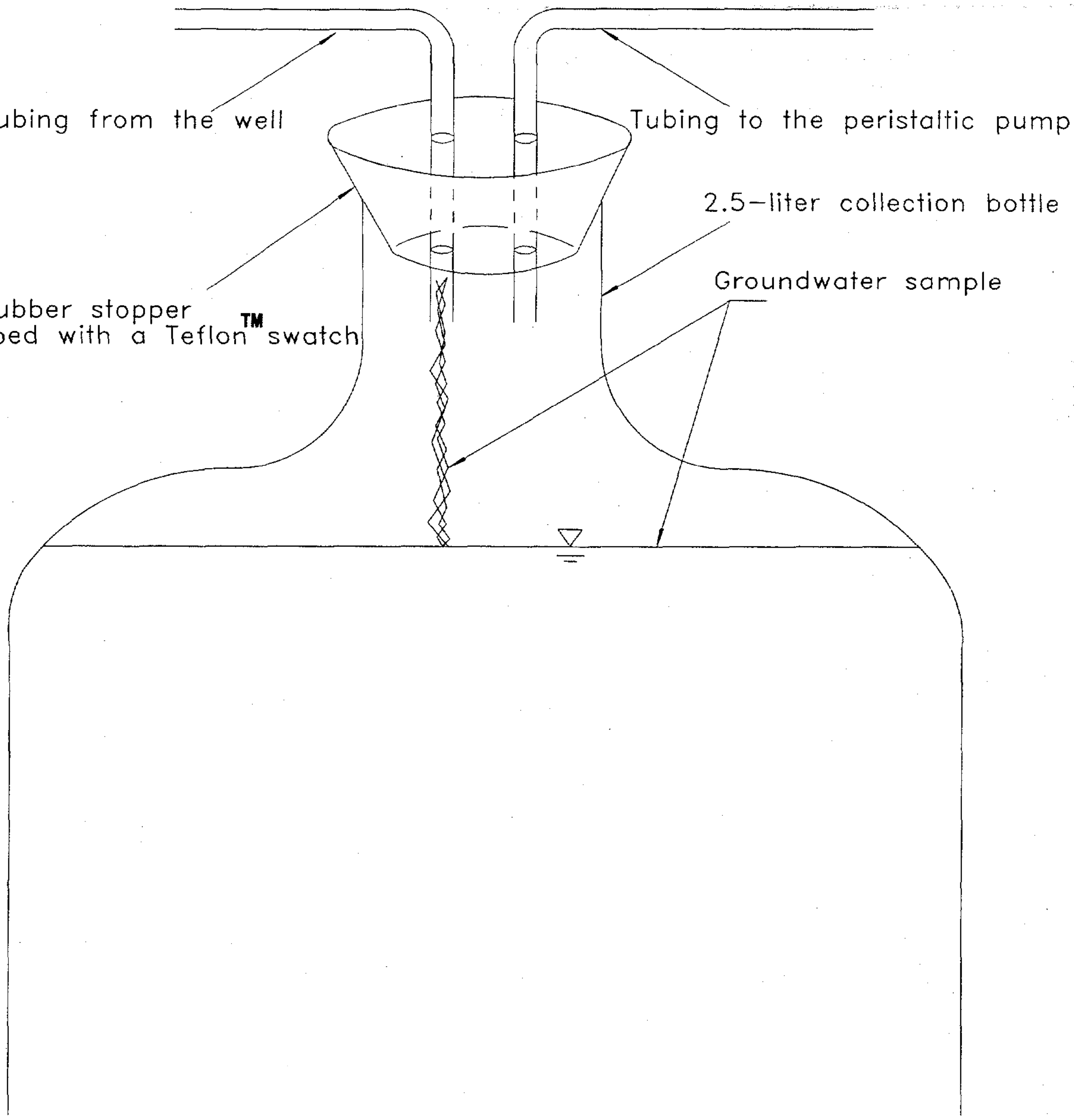



**FIGURE 4-4**
**LOW FLOW GROUNDWATER**
**SAMPLING DETAIL**

H:\OLD\AREAC\IRA\GWSAMPLE.DWG, PDP-RPN 07/02/97 11:19:56, AutoCAD R12

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN**
**OPERABLE UNIT 4**

**NAVAL TRAINING CENTER**
**ORLANDO, FLORIDA**

4.5.1 Groundwater Elevation Survey In order to further assess groundwater flow direction across the site, groundwater elevations in each of the new and existing monitoring wells will be measured. The horizontal and vertical coordinates of the monitoring wells will be surveyed by a Florida-licensed surveyor. The elevation of groundwater shall be determined by subtracting the depth of water below top of casing (TOC) from the elevation at the TOC. Three rounds of water-level measurements will be taken from all wells within the OU using a water-level indicator and will be represented as three potentiometric surface maps in the RI report.

4.5.2 Vertical Head Potential Survey A vertical head potential survey will be conducted in order to analyze the head potential changes between different areas of the surficial aquifer and the surface water in support of the SCM.

Vertical head potential in drive point wells situated along the shoreline, out in the lake, and in the creek will be analyzed by measuring the difference in water level between the groundwater inside the well and the surface water outside the well casing. By using the TOC as a reference, a higher water level inside the well than the surface water outside the well will indicate an upward potential from the surficial aquifer, i.e., water is flowing from the surficial aquifer into the lake, assuming there is a hydraulic connection. A lower water level inside the well than the surface water outside the well indicates a downward potential from the lake into the surficial aquifer, (i.e., assuming the aquifer material would allow flow, water would flow from the lake into the aquifer).

Vertical head potential within the surficial aquifer will be measured from monitoring well clusters that have both shallow and deep wells. The head potential is evaluated based on the elevation difference between the two wells in the cluster. If the shallow well indicates a higher groundwater elevation than the deep well, that portion of the aquifer has an upward potential; i.e., the groundwater velocity has a direction component toward the surface. If the shallow well indicates a lower groundwater elevation than the deep well, that portion of the aquifer has a downward potential (i.e., the groundwater velocity has a direction component toward the Hawthorne Group).

4.5.3 Aquifer Testing *In situ* hydraulic conductivity tests shall be performed on the nine monitoring wells installed during this investigation. Rising-head slug tests shall be run for all the wells; falling-head tests will be performed only on wells where the water table was above the screened interval of the monitoring well.

Before each test, the monitoring wells will be opened and allowed to equilibrate with ambient air conditions. A static water-level measurement shall be recorded after the well had equilibrated. A transducer will be lowered into the monitoring well far enough below the water surface to prevent any collisions with the slug. In shallow wells, the transducer will be lowered to within 2 feet of the bottom of the well so that accumulated silts that may have been in the bottom of the well will not interfere with the transducer sensing ports. In medium and deep wells, the transducer will be lowered to 15 feet below the water table.

Time shall be allowed for the transducer to equilibrate with the new conditions and water level to return to static. The transducer will be connected to a Hermit™ 1000c data logger or similar unit. After equilibrium is reached, the slug will be submerged and the data logger started. The slug test should be allowed to run a minimum of 10 minutes so that the step function of the data logger can be used. When the water level has recovered to at least 90 percent of static levels, the test is stopped. The slug shall be removed swiftly from the well, thus allowing the rising-head portion of the test to begin. The well is again allowed to recover to 90 percent of static water level before the test will be stopped.

The data will be downloaded to a computer for processing using the method of Bouwer and Rice (1976) as implemented in the Aqtesolv™ software program. For wells where the top of the screen is above the water table, the plot will be analyzed using the double straight line method (Bouwer and Rice, 1989) to account for filter pack drainage.

**4.6 OTHER INVESTIGATIONS**. In addition to the surface water, sediment, soil, and groundwater sampling results, other data are needed to meet the RI/FS data needs. The following subsections describe investigations that will collect this additional information.

**4.6.1 Ecological Survey** An ecological survey will be conducted to identify potential receptors and exposure pathways.

**4.6.2 Human Health Survey** A human health survey will be conducted to identify potential human receptors and exposure pathways. Subsection 4.4.9 of the POP describes the procedures for conducting the survey.

**4.7 DECONTAMINATION**. All equipment will be decontaminated prior to the field effort, during the sampling program, and at the conclusion of the sampling program in accordance with the procedures outlined in the NTC, Orlando POP. The decontamination procedures minimize the potential for cross contamination between sampling points and the transfer of contamination off the site. Field decontamination procedures during the field events will be documented in the field logbooks.

All deionized, carbon-filtered water used in the decontamination process will meet the criteria described in the USEPA Region 4 "Environmental Investigations Standard Operating Procedures and Quality Assurance Manual" (USEPA, 1996b).

The Rotasonic™ drill rig will be decontaminated upon arrival on site by procedures stated in the NTC, Orlando POP (ABB-ES, 1997a).

All down-hole equipment that comes in contact with the sampling medium, such as the core barrel, will be decontaminated by the following procedure prior to collection of each sample:

- wash and scrub thoroughly with Alconox™ and potable water,
- steam clean, and
- rinse thoroughly with potable water.

Any stainless-steel submersible pump used for development or purging shall be decontaminated by the following procedure:

- wash and scrub the exterior of the hose and pump with Alconox™ and potable water;

- pump a mixture of Alconox™ and potable water through pump and hose;

- pump deionized, carbon-filtered water through pump and hose; and

- rinse exterior of the hose and pump with deionized, carbon-filtered water.

All sampling equipment, including glass bowls and stainless-steel spoons used during soil sampling, will be decontaminated before sample collection by the following procedure:

- wash and scrub equipment thoroughly with Alconox™ and potable water;

- rinse thoroughly with deionized, carbon-filtered water;

- rinse thoroughly with nitric acid (glass only);

- rinse thoroughly with deionized, carbon-filtered water;

- rinse thoroughly with pesticide-grade isopropanol;

- rinse thoroughly with deionized, carbon-filtered water; and

- allow to air dry and wrap with aluminum foil.

Decontamination of all equipment shall occur at a temporary decontamination pad constructed on site as part of the RI field activities. The water collected from the pad will be pumped into a storage tank or drums where it will be disposed of in accordance with the IDW plan in Chapter 7.0. Sediment collected from the pad will be removed and stored in a roll-off storage container also specified in Chapter 7.0.

# 5.0 SAMPLE ANALYSES AND VALIDATION

**5.1 SAMPLE ANALYSIS AND DATA MANAGEMENT**. The following section describes the methods used to track and manage the environmental and quality control (QC) data generated during the investigation.

**5.1.1 Field Laboratory** A field laboratory will be established to help determine the extent of contamination. Surface water, sediment and surface soil samples will be analyzed for VOCs by capillary gas chromatography. Target analytes shall include PCE, TCE, DCE, and vinyl chloride. Quantitation levels of 3-5 ppb are suggested for this study and the analytical methods employed are designed to achieve them. These methods will be based on standard USEPA methods SW-846 (USEPA, 1992b): 5030 (purge and trap preparation), 8000A (GC calibration), 8010A (halogenated volatile organics), and 8020 (benzene, toluene, ethylbenzene, and xylenes [BTEX]) with modifications for field analysis.

The instrumentation used will be a Hewlett-Packard 5890 Series II gas chromatograph equipped with a DB-624, 0.53 mm diameter capillary column. It will be fitted with a tekmar purge and trap concentrator and several analytical detectors in series: a photoionization detector (for BTEX), and an electron capture detector (ECD) for chlorinated hydrocarbons. The ECD is very selective for halogenated compounds and should achieve sufficiently low quantitation limits for this study. Quantitation will be accomplished by means of Hewlett-Packard Chemstation Chromatography software package provided with the GC.

5.1.1.1 **Calibration** Chemical standards will be obtained from Supelco, Inc. or an equivalent supplier. All standard preparation records will be logged and coded by the field chemist in the GC run logbook.

All stock standards will be prepared from neat compound standards or certified mixes. Working standards will be made by serial dilutions of stock standards in the appropriate solvent (i.e., purge and trap grade methanol). All appropriate standards will be preserved by storing them in a refrigerator or cooler.

Prior to analyzing samples, the working range of the calibration will be determined by the expected range of contaminant concentrations. Instrument run conditions will be recorded in the GC run logbook. External calibration method is anticipated to be used as the primary method of analyte quantitation. USEPA method 8000A describes procedures to be used for the establishment of retention times and sample quantitation. A method detection limit (MDL) study will be completed prior to the start of sample analysis. This will consist of the preparation of seven replicates of a low-level standard in deionized water carried through the entire analytical procedure. The standard deviation is measured and is multiplied by 3.14 to establish the specific MDL for each analyte. A practical quantitation limit can then be estimated for each compound (generally a factor of 5 to 10 times the MDL depending on the matrix). These will be recorded in the GC run logbook.

Initial calibration should consist of a three- to five-point calibration curve covering the desired range of interest for each analyte. Quantitation of target VOCs may be calculated by a point-to-point method, but is not required. If the relative standard deviation is less than 30 percent for an analyte, linear regression may be used to interpolate the amount in the extract. This will be accomplished by the field chemist's use of Hewlett-Packard Chemstation chromatography software provided with the GC.

Continuing calibrations will be run at the beginning and end of each analytical run and will consist of a mid-level standard of all target analytes. All compounds must have a percent difference of thirty percent or less when compared to the initial calibration. Sample analysis will only proceed if no more than one compound per detector exceeds this criteria. If this is not met, a second standard will be run. If this also fails, a new initial calibration must be run. Sample identifications for these standards will be recorded in the GC run logbook. The field chemist will review each sample analysis chromatogram before analyzing the next sample. Target compound retention times will be compared to calibration standards and carryover potential will be evaluated. Additional descriptions of calibration procedures can be found in USEPA method 8000A.

5.1.1.2 **Sample Preparation** Sediment/surface soils will be prepared in accordance with USEPA SW-846 5030. This is a purge-and-trap procedure driving the VOCs from water in the purge chamber into a Tenax trap. Compounds are then desorbed into the GC for analysis. Routinely, 5 grams of soil are added to 5.0 mℓ of deionized water. Concentrations in soil samples will be calculated based on the dry weight. Percent moisture adjustments will be made to the raw data results. Surface water and groundwater samples will be prepared using 5.0 mℓ of sample. Run conditions for the purge and trap will be recorded in the GC run logbook.

5.1.2 QA/QC Samples QA/QC samples will be collected per the guidelines set forth in the POP. The following describes blank samples, duplicate samples, matrix spike/matrix spike duplicates, confirmatory samples, and field documentation.

5.1.2.1 **Blanks** Method blanks shall be run to ensure that sample preparation or other analytical procedures are not introducing target analytes. A method blank will be analyzed before any samples are analyzed and each day of analysis. The will be deemed acceptable if no target compounds exist above the detection limits established for the instrument. No samples shall be analyzed until a satisfactory method blank has been run.

Instrument/cleaning blanks will consist of blank deionized purge water run through the system and treated as a sample. They will be run at the discretion of the field chemist whenever a high level sample is run to ensure that target analytes are not being introduced by the instrument itself and that no carryover from the column or trap is occurring.

Rinseate blanks and trip blanks will be collected and run as needed to ensure that cross-contamination of samples is not occurring due to sampling equipment or sample storage. These blanks should be demonstrated to be free of all target analytes.

5.1.2.2 **Duplicate Samples** Field duplicate samples will be run at a level of 10 percent to measure the precision of both field and lab procedures. USEPA data validation guidance suggest that the relative percent difference (RPD) between soil field duplicates generally be within 50 percent and within 30 percent for aqueous samples. Laboratory duplicates will also be run (one per day of analysis) and compared to the previously described RPD criteria to examine laboratory precision.

5.1.2.3 **Matrix Spike and Matrix Spike Duplicate (MS/MSD)** Selected samples will be fortified with a spiking solution of the target analytes and carried through the entire analytical procedure. Five percent of the field samples will be selected for MS/MSD per the POP guidelines. Percent recovery of these target compounds will be quantitated, evaluated by the field chemist, and results recorded in the GC run logbook.

5.1.2.4 **Confirmatory Samples** Approximately ten percent of all field samples will be sent to an off-site certified laboratory for confirmatory analysis. Comparability will be based on agreement between the off-site/onsite lab using action level agreement (both above or below level of concern) as well as RPD criteria (30% for groundwater, 50% for soils).

5.1.2.5 **Field Documentation** A log of all GC analyses will be recorded in a bound notebook with sequentially numbered pages. The logbook will record the concentrations for all calibration standards injected, sample run number, sample identification, date, standard preparation code, sample volume and /or weight, and any additional information particular to the injection. After conclusion of the field effort, data will be processed by the data manager and provided for review. Raw data will includes chromatograms and calibration records from all standard, blank, and sample analyses used in the field program.

## 5.2 DATA VALIDATION.

The approach to providing reliable data that meet the DQOs, defined below, will include QA/QC requirements for each of the analytical data types generated during the field investigation. The QA/QC efforts for laboratory analyses will include collection and submittal of QC samples and the assessment and validation of data from the subcontract laboratories. Analytical data will be subjected to independent data validation by a subcontractor as described in the POP, Section 8.2, Validation (ABB-ES, 1997a).

Data quality indicators include the precision, accuracy, representativeness, comparability, and completeness (PARCC) parameters. These parameters will be used within the data validation process to evaluate data quality. The achievable limits for these parameters vary with the DQO level of the data. The limits used for laboratory analytical data in this program will be those set by the CLP for Level IV DQOs and as specified in the USEPA methods for Level III DQOs. PARCC parameters are described in the POP, Chapter 12.0, Data Assessment (ABB-ES, 1997a).

## 5.3 DATA EVALUATION.

The purpose of this task is to assess usability of validated data results based upon data comparisons to non-site-related conditions. Results that meet the DQO requirements and are considered usable will be compared with background sampling results from a recent investigation (ABB-ES, 1995). Results of the data evaluation will be documented in the RI report. The following data comparisons and evaluations will be made:

- evaluation of detection limits,
- evaluation of counting errors,
- evaluation of equilibrium data,
- evaluation of qualified data,
- comparison of laboratory and field blanks with sample results, and
- comparison of laboratory and field duplicate results.

COCs will be identified through evaluation of the following criteria:

- background sampling results,
- frequency of detection, and
- extent of contamination.

COCs will be used throughout the data evaluation, fate and transport assessment, risk assessment, SCM, and FS.

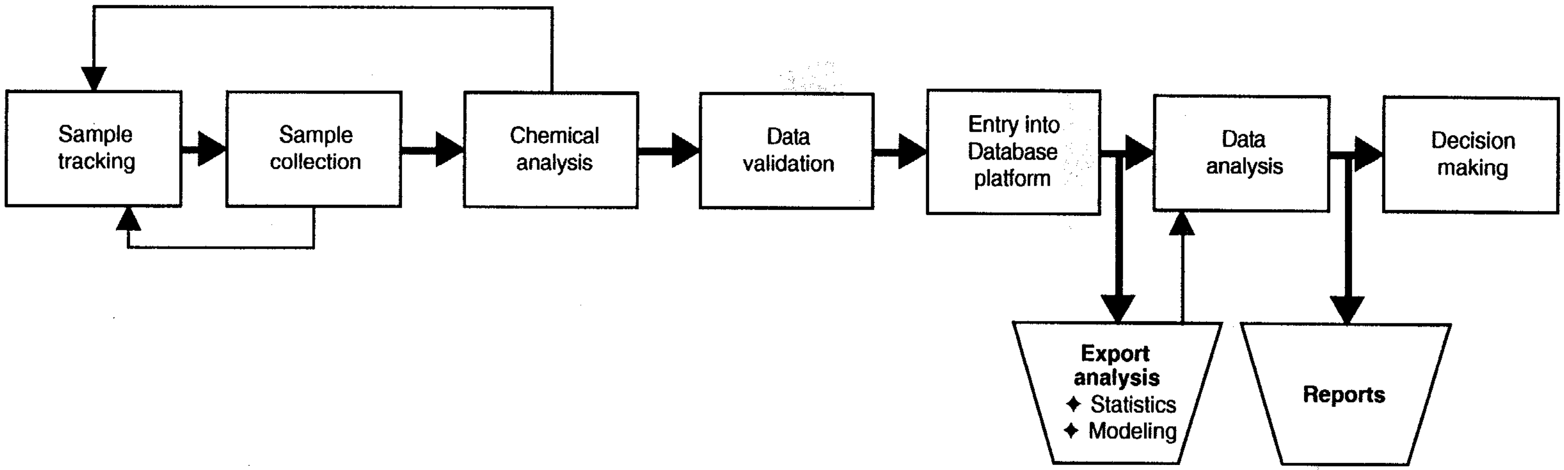
Statistical analyses will be used in the data evaluation process and will involve a variety of analytical methods including exploratory analyses and the use of the standard t-test and/or the Mann-Whitney test. The following briefly describes each of the methods along with their application.

Exploratory analyses consist of graphical methods including probability plots, boxplots, scatter plot matrices, and identity plots. Probability plots are used to identify data distributions. Boxplots graphically compare distributions from different data subsets (e.g., background versus contaminated media). Scatterplots and identity plots graphically display relationships among multiple variables and allow identification of variables that can best provide predicted values. Identification of best-predictor variables will be based upon investigative analyses and corroborated with comparison of goodness of fit statistics after fitting appropriate regression and/or classification and regression trees models.

Background to onsite comparisons will be made using either a standard t-test or a Mann-Whitney test. Assuming data are normally or lognormally distributed, the standard t-test will be used to evaluate whether differences between background and site-specific samples are statistically significant. If data are not normally distributed and/or cannot be transformed to meet the normality assumptions of the t-test, then comparisons between background and site-specific sampling results will be made using a Mann-Whitney test. The Mann-Whitney test is a nonparametric test analogous to the t-test, which makes no assumptions about the underlying distribution of the data being evaluated and is appropriately applied when data either do not exhibit a normal distribution or are too limited (in number) to evaluate the distribution.

**5.4 DATA MANAGEMENT**. The purpose of this task is to track and manage environmental and QC data collected from the field investigation from the time the data is obtained through data analysis and report evaluation. Coordination and management of the contracted laboratories is also part of this task. RI activities generate data, including sample locations, measurements of field parameters, and the results of laboratory analyses. Reports regarding the collection and analyses of sample data will also be generated. The RI process entails the flow of data collected in the field and generated by the analytical laboratory work to those involved in project evaluation and decision making. Figure 5-1 illustrates the data management life cycle and project information flow. Management of data collected during RI activities will provide accessibility of data to support environmental data analysis, risk assessments, and the evaluation of remedial action alternatives.

Samples will be tracked from the field collection activities to the analytical laboratories until disposal and will follow standard ABB-ES chain-of-custody procedures, which may include bar coding. These procedures are described in the




**LEGEND**

Flow path (thick line)
Tracking routine (thin line)

**FIGURE 5-1**
**DATA MANAGEMENT LIFE CYCLE**

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN OPERABLE UNIT 4**

**NAVAL TRAINING CENTER ORLANDO, FLORIDA**

8556-06 FIG 5-1 FINAL070897MAW

POP, Chapter 5.0, Sample Handling and Custody Procedures (ABB-ES, 1997a). Samples will be labeled and identified following the ABB-ES Standard Operating Procedures, Identification of Environmental Samples for the CLEAN Program. Sample information recorded from bar coding or chain-of-custody forms will be transferred (electronically or manually) into the sample tracking portion of the database management system (Fast Retrieval of Environmental Data [FRED]), thus, enabling the samples to be tracked through final disposition. The sample tracking system will produce reports to inform the project team of potential delays or problems related to sample analysis and validation.

Analytical results, applicable QA/QC data, validation flags, chain-of-custody information, and any other attributed information will be incorporated into FRED. All data will be verified after uploading to ensure completeness and accuracy. FRED resides on an ORACLE™ platform that is integrated with other programs to enable efficient data management and to support data evaluation, risk evaluation, remedial alternative selection, and report generation. FRED is capable of generating a variety of reports that were designed to support data evaluation and decision making. Integration of additional software packages to enhance data evaluation and the ability to make informed risk management decisions is in process.

Chemical and physical data collected during the RI will be used to characterize OU 4 and to evaluate the potential levels of risk posed to human health and the environment. Data will be summarized and plotted on scaled maps to facilitate the analysis of contaminant distribution and potential mechanisms of transport. Chemical data will be compared to ARARs, and COCs will be identified. Plausible exposure pathways and exposure scenarios will be evaluated to assess potential levels of risk posed by the COCs. Groundwater, solute transport, geochemical, and/or fate and transport modeling may be performed after initial data evaluation.

# 6.0 RISK EVALUATION

The following sections describe how the human health and ERAs for OU 4 will be conducted.

6.1 HHRA. The purpose of the HHRAs at OU 4 is to provide an evaluation of the potential risks to human receptors posed by chemicals present from past site operations.

The HHRAs will consist of the following components, which are discussed below: hazard identification, exposure assessment, toxicity assessment, risk characterization, comparison to health standards and guidelines, and uncertainty assessment.

The approach used in the HHRAs will be consistent with the following guidance:

- *Risk Assessment Guidance for Superfund (RAGS), Volume I, Human Health Evaluation Manual (Part A)*, Interim Final (USEPA, 1989a); and
- *Supplemental Guidance to RAGS: Regional Bulletin.* "Human Health Risk Assessment" (USEPA, 1995a).

6.1.1 Hazard Identification This section will present an overview of the type and extent of contamination present at OU 4 and will identify CPCs. CPCs will be selected based on factors such as comparison to background concentrations, frequency of detection, DQOs, and a comparison to Federal and Florida State screening criteria and ARARs.

6.1.2 Exposure Assessment The exposure assessment will evaluate the potential for human exposure to site-related contaminants. It will consist of the identification of potential human receptors and potential pathways of exposure based on the exposure point analysis (Subsection 3.2.2) and additional information gathered during the human health exposure survey (Subsection 4.6.2). Lastly, this section will estimate the exposure intake levels.

The results of field investigations and chemical analyses will be used to determine which potential exposure pathways need to be evaluated quantitatively. As discussed in the human health exposure assessment (Paragraph 3.2.2.1) and presented in the SCM (Subsection 3.2.1), the reasonable current and future potential exposure pathways include the following:

- current and future site maintenance workers - incidental ingestion of, dermal contact with, and inhalation of surface soils, and incidental ingestion of and dermal contact with surficial groundwater used for irrigation;
- current and future trespassers (and recreational users of Lake Druid) - incidental ingestion of, dermal contact with, and inhalation of surface soils, and incidental ingestion of and dermal contact with surface water, sediment, and the surficial groundwater used for irrigation;

- potential future commercial workers (assumes only indoor exposures) - minimal incidental ingestion of and dermal contact with site surface soils;

- potential future excavation workers - incidental ingestion of, dermal contact with, and inhalation of surface and subsurface soils;

- future recreational users - incidental ingestion of and dermal contact with surface soils, and incidental ingestion of and dermal contact with surface water, sediment, and the surficial groundwater via discharge to the surface water; and

- potential future area residents - incidental ingestion of and dermal contact with surface soils, surface water, and sediment as well as incidental ingestion and inhalation of volatiles (only) while showering while using the surficial groundwater as a potable water supply, and inhalation of volatiles migrating from groundwater into buildings.

Exposure point concentrations (EPCs) will be represented as the 95 percent upper confidence limit (UCL) of the mean (with concentrations from those contaminants not detected set equal to one-half their sample quantitation limit [SQL]). If, however, the UCL exceeds the maximum detected concentration, then the EPC will be set at the maximum.

Reasonable maximum exposure (RME) scenarios will be evaluated. If the risks resulting from the RME scenarios exceed the acceptable regulatory levels, then a central tendency (CT) exposure scenario will be evaluated. The CT exposure concentration will be represented by the 95 percent UCL on the arithmetic mean of all samples. If the UCL exceeds the maximum detected value due to high detection limits in a nondetected sample, then the EPC will be set at the maximum concentration.

<u>6.1.3 Toxicity Assessment</u> The most recent toxicity constants or dose-response values will be obtained from the USEPA Integrated Risk Information System (IRIS) database and the Health Effects Assessment Summary Tables (HEAST). If neither IRIS nor HEAST contains a toxicity constant for a particular CPC, then the USEPA Region 4 and the Environmental Criteria and Assessment Office will be contacted to determine if an appropriate surrogate toxicity value is available.

<u>6.1.4 Risk Characterization</u> The purpose of the risk characterization will be to combine the findings of the toxicity and exposure assessments to characterize the human health risks associated with past site operations.

Both cancer and noncancer risks will be estimated following the procedures established in RAGS (USEPA, 1989b) and the USEPA Region 4 bulletins (USEPA, 1995a-e). Excess lifetime cancer risks and hazard indices (HIs) will be calculated for the CPCs. Total receptor risks will be determined by subtotaling CPC risks and then adding risks for the appropriate individual media. These risk estimates will be compared to the National Contingency Plan target risk range for carcinogens of $10^{-4}$ to $10^{-6}$ and noncancer HI of 1 and to the FDEP target risk levels.

<u>6.1.5 Comparison to Health Standards and Guidelines</u> EPCs will be compared to available Federal and Florida State health standards and guidelines. These may

include but not be limited to soil, drinking water, surface water, and/or air standards and guidelines such as Florida SCGs, Federal and State MCLs, and ambient water quality criteria (AWQC).

__6.1.6 Uncertainty Analysis__ The prediction of human health risks involves a number of assumptions and uncertainties. In this section, the uncertainties in the risk evaluation will be identified and their potential effects upon the results of the risk evaluation will be discussed. Both site-specific and general risk assessment uncertainties and limitations will be included. If the risk results from the RME exposure scenarios exceed acceptable regulatory target levels, then the results of the CT exposure scenario will be presented in this section to provide some regulatory and risk perspective.

__6.2 ERA__. The purpose of the ERA at OU 4 is to provide an evaluation of the potential risks to ecological receptors posed by chemicals present from past site operations, including PCE and its breakdown products.

The ERAs will evaluate actual and potential adverse effects to ecological receptors associated with exposure to contamination in site media. The ERAs will consist of the following elements, which are discussed below in greater detail: site characterization, problem formulation, analysis, risk characterization, and uncertainty analysis.

Although NTC, Orlando is not a "Superfund" site, the ERAs for OU 4 will be conducted in accordance with current guidance available for Superfund sites including:

- *Risk Assessment Guidance for Superfund, Volume 2: Environmental Evaluation Manual* (USEPA, 1989b);
- *Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference* (USEPA, 1989d);
- *Ecological Assessment of Superfund Sites: An Overview* (USEPA, 1991a);
- *Framework for Ecological Risk Assessment* (USEPA, 1992a);
- USEPA Region IV Ecological Risk Assessment Bulletins, Nos. 1-4 (USEPA, 1995b, 1995c, 1995d, and 1995e);
- *Tri-Service Procedural Guidelines for Ecological Risk Assessments, Volumes I and II* (Wentsel et al., 1996); and
- *Proposed Guidelines for Ecological Risk Assessment: Notice* (USEPA, 1996a).
- Recent risk assessment guidance including the USEPA "Eco Update" bulletins (issued since 1991) and other publications (e.g., Maughan, 1993; Suter, 1993) will also be consulted.

Furthermore, the ERA for OU 4 will be consistent with review draft guidance issued by the USEPA Environmental Response Team, entitled *Ecological Risk Assessment*

*Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (USEPA, 1997).

6.2.1 Site Characterization The site characterization section of the ERAs will discuss the characteristic vegetative habitats and the wildlife, aquatic life, and rare, threatened, or endangered species that may potentially be found at OU 4 and downgradient of the site. The characterization, which will be based on a limited site reconnaissance that will occur during the RI, will identify dominant flora and fauna located at or potentially affected by the site. This characterization will serve as the basis for identifying potential ecological receptors at OU 4 and for further developing exposure scenarios for the ecological exposure assessment.

Information regarding the possible occurrence of rare, threatened, or endangered species at the site will be obtained from local, State, and Federal wildlife officials (i.e., Florida's Natural Heritage Program, FGFWFC, and the U.S. Fish and Wildlife Service). In addition, information on critical habitats in the vicinity of OU 4 will be provided.

6.2.2 Problem Formulation Problem formulation is the initial step of the ERA process whereby receptors, exposure pathways, and the assessment and measurement endpoints are selected for evaluation. Ecological exposures to constituents detected in site media (e.g., surface water and sediment) will be evaluated in the ERAs.

6.2.2.1 **Identification of Receptors** The ecological receptors that may potentially utilize the available habitat at OU 4 include terrestrial wildlife, plants, and invertebrates. In addition, aquatic organisms, including benthic (i.e., sediment-dwelling) and pelagic (i.e., water-column) invertebrates, fish, and amphibians may utilize the available aquatic habitat in Lake Druid.

All surface waters in the vicinity of NTC, Orlando, including Lake Druid, are classified by the State of Florida as Class III waters, suitable for fish and wildlife propagation and water contact sports.

6.2.2.2 **Identification of Exposure Pathways** Exposure pathways will be identified in the RI for the groups of ecological receptors discussed above. A complete exposure pathway contains the following four components:

- a contaminant source,
- a transport mechanism to a medium of ecological exposure,
- an exposure route (i.e., direct contact or ingestion), and
- a receptor.

Exposure pathways for OU 4 waste sources to ecological receptors will be depicted in a contaminant pathway model. The model will depict all potential exposure pathways; however, only certain pathways will be evaluated quantitatively, whereas other pathways will be evaluated qualitatively or not at all for reasons discussed in the ERA. Those pathways evaluated quantitatively will be shaded on the pathway model. The number of quantitative or qualitative assessments conducted for the ERA is necessary to focus the risk evaluation on the pathways for which (1) contaminant exposures are the highest and most likely to occur and (2) there are adequate data pertaining to the receptors, contaminant exposures, and toxicity for completion of risk analyses. Exposure pathways that will be evaluated will primarily include direct exposures.

Exposure pathways that will not be quantitatively evaluated include dermal exposures for terrestrial wildlife and food-chain exposures for reptiles and amphibians. Although dermal exposures may be a viable exposure pathway for amphibians, reptiles (particularly the gopher tortoise) and young, hairless mammals in subterranean dens (e.g., juvenile muskrats), dermal exposures represent an incomplete pathway for the majority of ecological receptors because fur, feathers, or chitinous exoskeleton limit the transfer of contamination across the dermis (i.e., dermal exposures may not result in populationwide effects). In addition, there are too few data relating dermal exposures to toxic responses in wildlife in order to feasibly evaluate this pathway. Potential food-chain exposures for reptiles and amphibians exist at OU 4, but are not quantitatively evaluated due to a lack of ingestion toxicity data relating contaminant exposures to adverse responses for these taxa. These exposure pathways that are not quantitatively evaluated will be discussed in Subsection 6.2.5, Uncertainty Analysis.

Food-chain exposures for higher trophic level ecological receptors are unlikely to occur because VOCs normally do not accumulate in animal tissue. The log $K_{ow}$ values, which measure a chemical's tendency to partition to lipid materials (including tissue), for VOCs are generally very low (less than 3.5). According to Suter (1993), analytes with log $K_{ow}$s less than 3.5 are unlikely to accumulate in animal tissue. Consequently, trophic transfer and food-chain exposures to carnivorous and piscivorous wildlife will not be evaluated, unless contaminants that bioaccumulate are detected during the RI.

6.2.2.3 **Assessment and Measurement Endpoints** The assessment and measurement endpoints selected for the OU 4 ERA are listed in Table 6-1. Assessment endpoints represent the ecological component to be protected, whereas the measurement endpoints approximate or provide a measure of the achievement of the assessment endpoint. Measurement endpoints provide a measurable response to a stressor that can be related to the valued characteristic selected as the assessment endpoint (USEPA, 1997). The measurement endpoints used to gauge the likelihood of population-level effects are literature-derived toxicological values based on laboratory measured effects on reproduction, growth, and survival. In addition to the assessment and measurement endpoints, Table 6-1 also presents the endpoint species, ecological CPCs, and decision points for each selected endpoint. The decision points represent a level at which potential risks will be further characterized.

6.2.3 Analysis The analysis section includes a hazard assessment and selection of CPCs, an exposure assessment, and an effects assessment.

6.2.3.1 **Hazard Assessment and Selection of Ecological CPCs** The hazard assessment includes a review of analytical data and selection of CPCs. CPCs are the analytes detected in environmental media that are considered in the ERAs to present a potential risk for ecological receptors.

A thorough discussion of data collection activities and a presentation of the analytical data will be provided in the RI. Analytical data for OU 4 will be evaluated to determine their validity for use in risk assessment pursuant to

**Table 6-1**
**Endpoints for Ecological Assessment**

RI/FS Workplan, Operable Unit 4
Study Area 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Assessment Endpoint | Endpoint Species | Ecological CPCs | Measurement Endpoint | Decision Point |
|---|---|---|---|---|
| Survival of terrestrial soil invertebrate populations | Earthworms | Chlorinated VOCs | Literature-reported invertebrate Reference Toxicity Values (RTVs) | Exceedance of RTV by study area surface soil concentrations |
| Reduction in small mouth bass populations | Small mouth bass | Chlorinated VOCs | Aquatic toxicity data specific to bass species | Exceedance of aquatic toxicity benchmarks by contaminant concentrations measured in surface water and groundwater discharging to Lake Druid |
| Reduction in the biomass of benthic invertebrate populations that represent a food source for fish | Freshwater benthic macroinvertebrates | Chlorinated VOCs | Freshwater invertebrate aquatic toxicity data (i.e., sediment benchmark values) | Exceedance of sediment benchmark values by contaminant concentrations measured in sediment from Lake Druid |

Notes: RI/FS = remedial investigation and feasibility study.
CPC = chemical of potential concern.
VOC = volatile organic compound.

national guidance, *Guidance for Data Useability in Risk Assessment (Parts A and B)* (USEPA, 1992d). The data validation process will be conducted in accordance with Naval Energy and Environmental Support Activity Level C validation requirements, which will include the following activities: sort data by medium, evaluate analytical methods, evaluate quantitation limits, evaluate data quality with respect to qualifiers and validation codes, and evaluate method blanks.

As part of the CPC selection process, potential site-related contamination will be considered for use in the ERA according to the criteria listed below.

- Inorganic CPCs will be selected by comparing site data to background values observed at NTC, Orlando. An analyte will not be selected as a CPC if the maximum detected concentration of an inorganic analyte is less than two times the mean of detected inorganic concentrations in the respective background samples (USEPA, 1991b; ABB-ES, 1995).

  In addition to screening CPCs based on background, Dutch Soil Cleanup Criteria "A" presented in the U.S. Fish and Wildlife Report, *Evaluating Soil Contamination* (Beyer, 1990), will be used for screening surface soil CPCs.

- In addition to screening CPC based on background, USEPA Region IV surface water screening criteria (USEPA, 1995d) will be used for screening surface water and groundwater CPCs, and USEPA Region IV sediment screening values will be used for screening sediment CPCs. If the maximum detected concentration of an analyte is less than the USEPA Region IV screening value, then the analyte will not be selected as a CPC for aquatic receptors.

- An analyte will not be selected as a CPC if it is detected in 5 percent or fewer of the samples analyzed, is not detected in any other media, and is not associated with significant ecological impacts.

- Calcium, magnesium, potassium, and sodium will be excluded as CPCs for both media, and iron will be excluded as a wildlife CPC for surface soils only; these analytes are considered to be essential nutrients. Furthermore, evidence suggests that there is little potential for toxic effects resulting from overexposure to these essential nutrients. The regulation of these inorganics by physiological mechanisms is highly controlled, suggesting that there is little, if any, potential for bioaccumulation, and available toxicity data demonstrate that high dietary intakes of these nutrients are well tolerated (National Academy of Sciences, 1977; National Research Council, 1982; 1984).

All CPCs selected for the ERAs will be summarized in tables that include the following: frequency of detection, range of detection limits, range of detected concentrations, average of detected concentrations, twice the average detected background concentration, the Dutch Soil Cleanup Criteria (for surface soil) (Beyer, 1990), the USEPA Region IV surface water screening value (for surface water) and sediment screening values (for sediment) (USEPA, 1995d), and a decision regarding the CPC status for each analyte. For those analytes that are retained as CPCs for the ERAs, the following information will also be provided: average of all concentrations (using one-half the SQL for nondetects), 95 percent UCL on the arithmetic mean (when the sample size is greater than or equal to 10), and RME and CT EPCs.

6.2.3.2 **Exposure Assessment** Exposure assessment is the process of estimating or measuring the amount of an ecological CPC in environmental media (surface soil or groundwater) to which an ecological receptor may be exposed via respective exposure pathways described in the conceptual site model. The following paragraphs discuss selection of EPCs, as well as the potential exposure pathways and how contaminant exposures will be estimated for each group of receptors (e.g., terrestrial wildlife, terrestrial plants, soil invertebrates, and aquatic organisms).

Selection of EPCs. Maximum and average EPCs will be chosen for all CPCs in media of concern at the OU to evaluate exposures to receptors. When the sample size is greater than or equal to 10, the maximum EPC will be equal to the lesser of the maximum detected concentration and the 95 percent UCL calculated on the log-transformed arithmetic mean (USEPA, 1992e). When the sample size is less than 10, the maximum EPC will be equal to the maximum detected concentration because the 95 percent UCL cannot be calculated. In this situation, the average concentration may not adequately represent "typical site conditions"; therefore, the risk characterization will focus on evaluation of maximum (or individual detected) concentrations.

RME scenarios will be evaluated. If the risks resulting from the RME scenarios exceed the decision point criteria, then a CT exposure scenario will be evaluated. The CT exposure concentration will be represented by the 95 percent UCL on the arithmetic mean of all samples. If the UCL exceeds the maximum detected value due to high detection limits in a nondetected sample, then the EPC will be set at the maximum concentration.

Terrestrial Wildlife. Incidental ingestion of CPCs in surface soil represents the primary exposure pathway for terrestrial wildlife at OU 4. However, bioaccumulation of CPCs via the food chain is not expected to be a significant exposure pathway because the suspected contaminants do not bioaccumulate. If necessary, mammalian and avian representative wildlife species will be selected for evaluation in a food-chain model, which considers many factors in estimating exposures via ingestion (i.e., site foraging frequency, habitat and foraging preferences, and dietary intake). The species selected will include species likely to be the most susceptible to exposures and effects from CPCs present at the site. The species that will be selected for food-chain modeling will represent various trophic levels and foraging guilds likely to accumulate organic compounds or other contaminants that may be detected during the RI.

Table 6-2 summarizes how contaminant exposure concentrations will be determined for surface soil CPCs for representative wildlife species evaluated in the food-chain model. It is unlikely that terrestrial wildlife exposures to surface soil, surface water, and sediment will be evaluated because food-chain exposures via this pathway are considered insignificant for VOCs. However, in the event that other contaminants that bioaccumulate are detected in surface soil, surface water, or sediment during the RI, equations to derive contaminant exposure concentrations for these media are also provided in Table 6-2. A total potential dietary exposure (PDE) will be estimated for each representative wildlife species for each surface soil, surface water, and sediment CPC according to the equations in

## Table 6-2
## Model for Estimation of Contaminant Exposures for Representative Wildlife Species

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

**Estimation of Contaminant Exposures Related to Surface Soil**

| | |
|---|---|
| Description: | Estimates the amount (dose) of a contaminant ingested and accumulated by a species via incidental ingestion of contaminated surface soil and ingestion of contaminated food items. |
| Soil Contaminant Concentration: | Maximum: The maximum detected concentration of the chemical of potential concern when the sample size is ≤ 9, and the lesser of the maximum detected concentration or the 95 percent upper confidence limit when the sample size is ≥ 10. |
| | Average: Average of all concentrations. If the average is greater than the maximum exposure point concentration (EPC), the maximum EPC will be selected. |
| Soil Exposure: | $$\underset{(mg/kg)}{\text{Soil Exposure}} = \left(\text{\% of Diet as Soil} \times \underset{(mg/kg)}{\text{Soil Concentration}}\right)$$ |
| Concentration of a Contaminant in Primary Prey Items ($T_N$): | $$\underset{(mg/kg)}{\text{Primary Prey Item Concentration}} = \left(BAF_{inv\ or\ plant} \times \underset{(mg/kg)}{\text{Soil Concentration}}\right)$$ |
| Concentration of a Contaminant in Secondary Prey Items ($T_N$): | $$\underset{(mg/kg)}{\text{Secondary Prey Item Concentration}} = \left(BAF_{mam\ or\ bird} \times \underset{(mg/kg)}{\text{Tissue Concentration of Prey Items}}\right)$$ |
| | where BAF = Bioaccumulation factor or mg/kg dry weight tissue over mg/kg dry weight soil for invertebrates and plants, and mg/kg dry weight tissue over mg/kg dry weight food for small mammals and small birds. |

See notes at end of table

## Table 6-2 (Continued)
## Model for Estimation of Contaminant Exposures for Representative Wildlife Species

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

Total Exposure Related to Surface Soil:

$$\underset{(mg/kg\ BW\text{-}day)}{PDE} = \frac{[P_1 \times T_1 + \ldots + P_N \times T_N + \text{soil exposure}] \times IR_{Diet} \times SFF \times .}{BW}$$

where
- PDE = Potential dietary exposure (mg/kgBW-day),
- $P_N$ = percent of diet composed of food item N,
- $T_N$ = contaminant concentration in food item N (mg/kg),
- $IR_{Diet}$ = food ingestion rate of receptor (kg of dry weight food or dietary item per day),
- BW = body weight (kg) of receptor,
- SFF = Site foraging frequency (site area [acres] divided by home range [acres]) (cannot exceed 1), and
- ED = Exposure duration (fraction of year species is expected to occur on site).

**Estimation of Contaminant Exposures Related to Surface Water and Sediment**

Description: Estimates the amount of a contaminant ingested and accumulated by a species resulting from ingestion of surface water, incidental ingestion of sediment, and ingestion of contaminated aquatic food items.

Notes: RI/FS = Remedial Investigation and Feasibility Study.
mg/kg = milligrams per kilogram.
kg = kilograms.
mg/kg BW-day = milligrams per kilograms of body weight per day.
≤ = less than or equal to.
≥ = greater than or equal to.

Table 6-2. This model considers exposure concentrations of ECPCs in prey items, the amount of surface soil, surface water, and sediment likely to be ingested, the receptor body weight, and the rate of food and water ingestion.

For each representative wildlife species, the estimated percentage of soil, surface water, and sediment in the overall diet will be multiplied by the concentration of each CPC in the respective media and the food or water ingestion rate (kilograms per day or liters per day) to determine the exposure concentration. Incidental ingestion associated with foraging activities will be based on available literature values. Inclusion of incidental ingestion in the food-chain model will address potential risks from any CPCs that may be present but are not likely to accumulate in food items (e.g., VOCs).

Terrestrial Plants and Invertebrates. Terrestrial plants and soil invertebrates may be exposed to contamination in surface soil by direct contact with and root uptake (plants) or ingestion (invertebrates) of these media.

Aquatic Receptors. Based on site conditions at OU 4, aquatic receptors in Lake Druid may be exposed to surface water, sediment, and groundwater CPCs via dermal contact and ingestion. As previously mentioned, the importance of these exposures will be evaluated in the RI.

6.2.3.3 **Ecological Effects Assessment** The ecological effects assessment will contain a description of the ecotoxicological effects (i.e., measurement endpoints) associated with the CPCs that relate to the assessment endpoints. Toxicological effects will be evaluated using concentration- or dose-response toxicity data for the identified ecological receptors. The methods used for identifying and characterizing ecological effects for terrestrial wildlife, terrestrial plants, soil invertebrates, and aquatic organisms are described in the following paragraphs.

Terrestrial Wildlife. Reference toxicity values (RTVs), representing a threshold for effects, will be identified from the literature for each CPC in surface soil for avian and mammalian representative wildlife receptors if contaminants that bioaccumulate are detected during the RI. The RTV relates the dose of a CPC in a chronic oral exposure with an adverse effect. Relevant effects associated with exposure will be identified in the ERA. The RTV will reflect the assessment endpoint chosen as the basis for establishing risk.

If no RTVs measuring effects on reproduction are available, or if reproduction measurement endpoints do not provide the most conservative estimate of risk, then RTVs measuring effects on growth or survival (i.e., low dose where 50 percent of animals in the studies die) will be considered as an ecologically relevant measure of population-level effects. RTVs will be derived separately for avian and mammalian species to the extent feasible. However, to conservatively estimate risks from exposure to all CPCs for all receptors, intertaxonomic surrogates may be used. The uncertainties associated with using intertaxonomic surrogates will be discussed in Subsection 6.2.5, Uncertainty Analysis.

Terrestrial Plants and Soil Invertebrates. Site-specific toxicity data for invertebrates are not available for OU 4; therefore, the results of toxicity studies from the literature that relate the soil concentrations of a contaminant with an adverse growth, reproduction, or survival effect on a test population will be used as a measure of the assessment endpoint.

Site-specific toxicity data are also unavailable for plants. Terrestrial plant exposures associated with direct contact with surface soil will be qualitatively evaluated in the field, based on visual observations of stressed vegetation. Available terrestrial habitat at OU 4 primarily consists of maintained grass and a forested area containing pine trees and palmettos. Available phytotoxicity data, which are based on agricultural crop yields, are not appropriate benchmarks to characterize potential risks to terrestrial plants at OU 4. In addition, available information indicates that VOCs do not bioaccumulate in plant tissue (Suter, 1993). Therefore, potential risks to terrestrial plants will be only qualitatively evaluated.

Aquatic Organisms. Site-specific toxicity data for aquatic organisms exposed to surface water, sediment, and groundwater CPCs are not available. Therefore, literature values that relate the concentration of a contaminant with an effect level (derived from data for adverse growth, reproduction, or survival effects of test populations) will be used as a measure of the assessment endpoint. Sources that will be considered in identifying benchmark values for aquatic receptors include USEPA AWQC (USEPA, 1991c), State of Florida Surface Water Quality Standards (Florida Legislature, 1995), and other sources of toxicological data, including the Aquatic Information Retrieval (AQUIRE) database. Sources that will be considered in identifying sediment benchmark values for aquatic receptors include National Oceanic and Atmospheric Administration (NOAA) Effects Range Low (ERL) and Effects Range Median (ERM) sediment guidelines (Long et al., 1993 and 1995), USEPA Sediment Quality Guidelines (SQG) based on equilibrium partitioning (USEPA, 1988b), and State of Florida sediment quality guidelines (MacDonald, 1994).

**6.2.4 Risk Characterization** A comparison of exposure information (Paragraph 6.2.3.2) with the appropriate concentration-response toxicity data (Paragraph 6.2.3.3) is the basis for risk characterization. The following paragraphs provide a discussion of the relationship between concentration-response toxicity data and the exposure dose (wildlife) or exposure concentrations (terrestrial plants, soil invertebrates, and aquatic organisms), and the potential for adverse effects in ecological populations.

Terrestrial Wildlife. If contaminants that bioaccumulate are detected during the RI, risks for the representative wildlife species associated with ingestion and bioaccumulation of CPCs in site media and prey items will be quantitatively evaluated using hazard quotients (HQs), which are calculated for each CPC by dividing the PDE by the selected RTV. HIs are determined for each receptor by summing the HQs for all CPCs. When the estimated PDE is less than the RTV (i.e., the HQ less than 1), it is assumed that chemical exposures are not associated with adverse effects on individual receptors, and there is a low potential for risk to wildlife populations. When an HI is greater than 1, a discussion of the ecological significance of the HQs comprising the HI is completed, and risks from exposure to average concentrations of CPCs are evaluated.

If necessary, the HQs and HIs for OU 4 will be calculated based on RME scenarios for each representative wildlife species. If the HIs for the RME scenario exceed one, the CT exposure scenarios will also be evaluated. A summary of risks to representative wildlife receptors will be provided in the ERA.

Terrestrial Plants and Invertebrates. Risks for terrestrial invertebrates will be evaluated based on a direct comparison of concentrations detected in surface soil to invertebrate toxicity benchmarks; these results will be tabulated and discussed in the OU 4 ERA. As previously discussed in Paragraph 6.2.3.3, risks for terrestrial plants will be qualitatively evaluated based on observations of stressed vegetation.

Aquatic Receptors. Risks for aquatic receptors will be characterized based on a direct comparison of concentrations of CPCs in surface water and groundwater with toxicity benchmarks for surface water and a comparison of CPCs in sediment with toxicity benchmarks for sediment; these results will be tabulated and discussed in the ERA for OU 4.

**6.2.5 Uncertainty Analysis** The objective of the uncertainty analysis is to discuss the assumptions of the ERA process that may over- or underestimate risks for ecological receptors. General uncertainties inherent in the risk assessment process and the OU 4 ERA will be discussed.

# 7.0 INVESTIGATIVE-DERIVED WASTE MANAGEMENT

The purpose of this task is for the management of IDW that is generated during studies conducted at Operable Unit 4.

This section contains definitions and identifies waste categories and classification methods, packaging requirements, and preferred management options. The approach outlined in this section emphasizes the following objectives:

- management of IDW in a manner that is protective of human health and the environment;
- minimization of IDW generation, thereby reducing costs and the use of limited storage facility capacity; and
- compliance, to the extent practical, with Federal and State requirements that are legally ARARs.

**7.1 DEFINITIONS**. An area of concern (AOC) is the area delineated by the areal extent of potential contamination on the project site. This boundary may contain varying concentrations and types of hazardous substances and may contain uncontaminated areas. For the purpose of this workplan, the AOC will be considered represented by SAs 12, 13, and 14.

USEPA "Contained-In" Policy requires any mixture of a non-solid waste (environmental media) and a Resource Conservation and Recovery Act (RCRA)-listed hazardous waste to be managed as a hazardous waste, as long as the material contains the listed hazardous waste above health-based standards.

Field Staging Area (FSA) is an area within the project site where IDW is stored until the site investigative activities are completed or a final disposal option is selected in an ROD. This area will be posted as the FSA and will be checked for leaking containers weekly during field activities. This area will remain active until all containers have been disposed appropriately. Additional empty drums, overpack, and absorbent materials will be kept at the FSA in the event of a leak or spill. The FSA is not considered an RCRA 90-day storage area.

Hazardous Constituents are those constituents listed in 40 Code of Federal Regulations (CFR) Part 261, Appendix VIII.

Hazardous Substances, for the purposes of this plan, shall have the meaning set forth by Section 101(14) of CERCLA, 42 U.S. Code 9601(14).

IDW is discarded materials resulting from site investigation activities, such as decontamination, which in present form possess no inherent value or additional usefulness without treatment. Such waste may be: solid, semi-solid, liquid, or gaseous material that may or may not be hazardous as defined in 40 CFR Part 261. IDW may include materials such as used personal protective equipment (PPE), decontamination fluids (wash and rinse), drilling muds and cuttings, pumped monitoring well fluids, purge water, soil, and other materials from collection of samples and contaminated spill materials.

IDW will be classified as RCRA hazardous waste if it meets one of the following criteria:

- contains a USEPA-listed hazardous waste identified in 40 CFR 261, or
- exhibits characteristics of hazardous waste, including ignitability, corrosivity, reactivity, or toxicity, as described in 40 CFR 261.

Land Disposal means placement in or on the land and includes, but is not limited to, placement in a landfill, surface impoundment, waste pile, injection well, land treatment facility, salt dome formation, underground mine or cave, or concrete vault or bunker intended for disposal.

Land Disposal Restrictions (LDRs) are restrictions that prohibit the land disposal of certain RCRA hazardous wastes unless specific treatment standards are met. The USEPA has established standards for specific hazardous wastes that are protective of human health and the environment when the wastes are land disposed. LDRs apply to waste management activities under RCRA and the SDWA, which controls underground injection of hazardous waste in deep wells.

Movement (Nonplacement) is an activity that consists of moving soil within the site, whether excavated or surface soil, along with RCRA hazardous wastes and CERCLA hazardous constituents contained in soil to consolidate the material within the AOC. Note that movement of soil with CERCLA constituents or radioactive constituents that do not contain RCRA hazardous waste would not trigger RCRA LDRs, even if moved outside the AOC.

Placement is an activity that consists of moving soil contaminated with RCRA hazardous wastes off-site or outside the AOC.

Wastewater is liquid waste consisting primarily of water without other liquid phases present that may result from groundwater well installation, development, and sampling activities, or from the cleaning of well installation or sampling equipment.

**7.2 GENERAL MANAGEMENT APPROACH**. The intent of this plan is to return as much as possible of the IDW (excluding PPE and decontamination liquids) generated from sampling activities back to the original source, thereby reducing the volume of waste to be containerized, stored, and managed. This approach minimizes IDW and does not add a greater threat to human health and the environment than existed prior to the investigation. Returning the IDW to the original source will also allow the IDW to be addressed in a manner consistent with the final remedy for the site.

Residuals from hand augers and borings will be returned to the borehole from which they originated. Additional clean fill material will be used to fill any remaining parts of the borehole resulting from the borehole residuals being tamped down.

Wastewater and PPE generated during decontamination operations and sampling activities will be containerized, centralized, and managed in accordance with this plan.

7.3 AREA OF CONCERN. Prior to development of this plan, the concept of returning the residual soil back to the original borehole was evaluated regarding compliance with applicable regulations. For RCRA land disposal restrictions to be applicable, the action must constitute "placement" of a restricted RCRA hazardous waste in a land disposal unit. To clarify whether "placement" occurs, the concept of AOC has been adopted.

IDW that is generated, moved, consolidated, stored, or redeposited within the boundaries of the AOC will not constitute "placement" or trigger LDRs (USEPA, 1992f). However, "placement" will occur as a result of either of the two following activities: (1) IDW is consolidated from different AOCs into a single AOC and redeposited, and (2) IDW is moved outside of an AOC (for example, for treatment or storage) and returned to the same or a different AOC.

7.4 WASTE HANDLING, SEGREGATION, AND PACKAGING. IDW will be containerized for characterization and classification. PPE will be composited into open-top, 55-gallon steel 17C U.S. Department of Transportation-approved drums with a plastic liner. Wastewater generated will be collected in a bulk polyethylene-type container able to be mounted to a transportable trailer or vehicle. Soil that can not be returned to its place of origin and drilling mud, will be stored in a lined roll-off container complete with a secured cover.

Waste containers that are filled will be securely closed, cleaned, and labeled. All labeling will include the date, the specific location (boring or well), waste type, and any field observations that may be appropriate. Labels will be completed with permanent markers and will be attached to the container when it is full or sampling activities are complete.

7.5 WASTE TRANSPORTATION, STORAGE, AND SAMPLING. All IDW generated during field activities will be stored in the appropriate containers at the FSA within the AOC. Wastewater from the bulk polyethylene-type container will be sampled for the TCL VOCs. Soil samples will be collected in a systematic manner for VOCs. The materials in the rolloff will be divided into three quadrants and sampled from the middle. Each sample will be collected individually and analyzed at an off-site laboratory for TCL VOCs.

IDW will be temporarily stored at the FSA pending analytical results of samples collected. Following receipt of the environmental and IDW sample results and comparison of these data to regulatory levels, disposal options and/or additional classification criteria will be determined by the Orlando Partnering Team (OPT). Additional information on the handling and temporary storage of IDW is contained in the POP, Section 4.10, Control and Disposal of IDW (ABB-ES, 1997a).

7.6 WASTE CLASSIFICATION CRITERIA. If needed for final disposal, the Navy will classify the IDW into the following two categories:

(1) nonhazardous waste
(2) RCRA hazardous waste

These categories are as defined in the definition section. IDW will be classified on the basis of environmental sample results for determining disposal options for

PPE and using IDW sample results for decontamination fluids and drilling residuals. If possible, IDW will be disposed of in a manner consistent with the final remedy.

To determine whether or not a waste is a listed waste under RCRA, the source must be identified. Site information, such as disposal records, investigation analyses, etc., will be used to determine source identity. When such documentation is unavailable, it will be assumed that the wastes are not RCRA-listed hazardous wastes. However, if documentation does confirm that IDW waste contains RCRA-listed waste resulting from disposal activities that occurred after the effective date of RCRA regulations (November 19, 1980), the IDW will be managed as a hazardous waste per USEPA's "Contained-In" Policy.

IDW classification (non-PPE) will be evaluated on the basis of comparison of analytical results obtained during the RI, to publicized regulatory guidance values for water, soil, and sediment. Soil and sediment results will be evaluated for hazardous characteristics, as determined by RCRA, by comparing sample analytical results to total extraction limits as described in 40 CFR 261, Appendix II, Method 1311, Toxicity Characteristic Leaching Procedure (TCLP), item 1.2, which states, "If a total analysis of the waste demonstrates that the individual contaminants are not present in the waste, or that they are present but at such low concentrations that the appropriate regulatory thresholds could not possibly be exceeded, the TCLP need not be run."

Thus, the IDW could not be considered an RCRA hazardous waste. If, however, the sample analytical results meet or exceed the total extraction limit for a constituent, then the IDW may need to be sampled and analyzed for TCLP parameters.

<u>7.7 DISPOSAL OPTIONS</u>. Wastewater, PPE, soil cuttings, and drilling muds and fluids are the types of IDW that are anticipated to be generated during the site investigation. The approach recommended in this plan is intended to minimize IDW generation and pursue management options consistent with the final remedy selected for the site.

<u>Wastewater</u>. Wastewater generated from decontamination activities and well installations will be temporarily stored at the FSA. Samples collected for characterization of this IDW will be evaluated for acceptability for disposal at the City of Orlando Waste Water Treatment Plant (WWTP). If the IDW wastewater contamination is at a level that cannot be disposed of at the WWTP, then the IDW wastewater will be stored at the FSA until discharge limits can be achieved through treatment.

<u>Soils and Drilling Fluids</u>. Analyses of samples collected that are representative of the applicable IDW will be evaluated regarding onsite disposal of soil IDW as discussed under Section 7.2, General Management Approach. If constituent levels detected are at concentrations that would not affect human health or the environment, then the IDW would be used as clean fill material in areas identified by the Navy. If concentrations are such that onsite disposal is not permitted, then the IDW will be stored at the FSA and disposed of, consistent with the final remedy.

PPE. The incidental contact with waste or contaminated media by PPE, which is typical of CERCLA site investigations, does not warrant management of PPE as hazardous, solid waste.

# 8.0 REMEDIAL INVESTIGATION REPORT

The draft RI report will be prepared in accordance with the guidance contained in *Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA, 1988a). The report will include appropriate sections on site background, investigation activities, physical characteristics, nature and extent of contamination, fate and transport, and risk evaluations (both human health and ecological assessments). Numerical modeling may be used to evaluate the nature and extent and fate and transport of contaminants detected within OU 4. Probable conditions and reasonable deviations, as depicted in the current site conceptual model, will be verified and/or revised and presented in the report.

After internal review, the document will be prepared for submission to the OPT for review. A final RI document will include a responsiveness summary based on comments received.

# 9.0 FEASIBILITY STUDY

The purpose of the FS is to identify and evaluate remedial action alternatives to minimize or eliminate exposure to contaminants from OU 4. The FS report for OU 4 will include a summary of RI results for each medium; summary of site risks; identification of ARARs; identification of remedial action objectives and general response actions; and identification, screening, and analysis of remedial technologies and alternatives. ARARs, preliminary remedial action objectives, and several potentially applicable technologies have been identified in Subsection 3.2.3 based on what is currently known about OU 4. These will be refined in the FS report based on the findings of the RI.

The approach for screening remedial technologies, developing and screening remedial alternatives, and evaluating alternatives in the FS report is presented in the following subsections.

**9.1 ALTERNATIVE TECHNOLOGY SCREENING.** Preliminary remedial technologies within the general response action categories of institutional controls, containment, and collection and treatment of surface water, sediment, leachate, and groundwater have been identified in this workplan to assist in focusing the scope of the RI/FS. These technologies have been identified for probable and potential contaminated media and exposure pathways (Table 9-1). The physical and chemical characteristics of the site may require consideration of certain technologies and make others infeasible. The purpose of the technology screening step in the FS process is to eliminate technologies that are infeasible or ineffective based on site conditions and contaminants found at OU 4, as identified in SCM of the RI report.

Technologies will be screened on the basis of effectiveness, implementability, and cost, as described below. The technology screening step will be conducted in tabular form.

Effectiveness considers the effect of a technology or process on the physical and chemical properties of the medium, individual compounds, and compound mixtures. It also considers the technology's reliability over time, its ability to meet chemical-specific ARARs or guidance values, and impacts to the community or environment during implementation.

Implementability focuses on the construction, operation, and performance of a technology. The evaluation of technologies against this criterion considers site-specific features such as topography, buildings, utilities, and available space in determining feasibility. A technology that has not been demonstrated or is not widely available may also be eliminated under this criterion.

Cost affects the practicality of certain technologies at a site. A technology can be eliminated on the basis of cost if it can be shown that the higher cost technology provides little or no advantage in effectiveness or implementability over another lower cost technology. At this stage, costs will be presented on an order-of-magnitude unit-cost basis (e.g., per acre or per gallon).

## Table 9-1
## Preliminary Remedial Actions

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Environmental Media | General Response Actions | Remedial Technologies | Process Options | Description | Evaluation Comments |
|---|---|---|---|---|---|
| Surface-Subsurface Soils | Limited action | Access restrictions | Deed restriction | All deeds for property within potentially contaminated areas would include restrictions on use of property. | Potentially viable. |
| | | | Fencing | Security fences installed around potentially contaminated areas to limit access. | Potentially viable. |
| | | | Zoning restrictions | Municipal zoning regulations would be revised to limit access, development, and use of the land. | Potentially viable. |
| | | | Groundwater restrictions | All deeds for property within potentially contaminated areas would include restrictions on development and use of groundwater. | Potentially viable. |
| | Containment | Surface controls | Vegetation | Seeding, fertilizing, and watering until a stand of vegetation has established itself. | Potentially viable. |
| | | | Grading | Reshaping of topography to manage infiltration and run-off to control erosion. | Potentially viable. |
| | | Cap | Native soil | Uncontaminated native soil placed over existing grade. | Viable in cases where direct contact is prime threat. Also may be viable in cases where majority of source is below water table and leaching is not a significant release mechanism. Unless engineered to do so, will not result in reduction in infiltration. |
| | Removal | Excavation | Mechanical excavation | Use of mechanical excavation equipment to remove and load contaminated soil for disposal. | Potentially viable. |
| | Disposal | Off-site disposal or discharge | RCRA landfill | Transport of excavated soil to an RCRA-permitted landfill. | Potentially viable. Treatment may be based on land disposal restrictions. |

See notes at end of table.

**Table 9-1 (Continued)**
**Preliminary Remedial Actions**

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Environmental Media | General Response Actions | Remedial Technologies | Process Options | Description | Evaluation Comments |
|---|---|---|---|---|---|
| Surface-Subsurface Soils (Cont.) | Treatment | Physical | Soil Washing | Soil is washed with various liquids, removing contamination. | Potentially viable. |
| | | | Solvent Extraction | Soil is washed with solvent and contamination is removed. | Potentially viable. |
| | | | Thermal treatment | Contaminated soil is thermally treated in a controlled oxygen-sufficient environment to destroy VOCs. | Potentially viable. Ash may require additional treatment for inorganics. |
| DNAPL Source Reduction | Reduction | Physical | Air sparging | Force an air bubble stream in contact with DNAPL to strip off product and reduce its mass. | Potentially viable. |
| | | Chemical treatment | Chemical oxidation | Oxidizing agents forced in contact with DNAPL product, therefore oxidizing the product and reducing its mass. | Potentially viable. |
| | | Chemical treatment | Surfactant flushing | Surfactants are injected to decrease interfacial tension and increase DNAPL solubility. Pilot study required. | Potentially viable. Could mobilize DNAPL downward. If not completely successful, could result in much higher groundwater concentrations. |
| Groundwater | No action | | | No action. | Not viable, must at least be source reduction. |
| | Containment | Vertical barriers | Permeable barrier | Groundwater flows though a permeable reactive wall, organic and inorganic contaminants are treated as they pass through the wall. | Potentially viable. |
| | | | Impermeable barrier | Trench around site or hot spot is excavated and filled with a bentonite slurry. Trench is backfilled with a soil- (or cement-) bentonite mixture. | Potentially viable. Effectiveness depends on site characteristics. Slurry wall should be keyed into aquitard or bedrock. |
| | Collection | Extraction | Extraction wells | Series of wells to extract contaminated groundwater. | Potentially viable. |

See notes at end of table.

## Table 9-1 (Continued)
## Preliminary Remedial Actions

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Environmental Media | General Response Actions | Remedial Technologies | Process Options | Description | Evaluation Comments |
|---|---|---|---|---|---|
| Groundwater (Cont.) | Treatment | Groundwater collection | Subsurface drains | System of perforated pipe laid in trenches to collect contaminated groundwater and lower the water table. | Potentially viable. |
| | | Physical *in situ* treatment | Recirculating wells | Groundwater enters well either through top or bottom, as it travels through well it is stripped of volatile contaminants then exits out opposite end, creating a recirculating cell. | Potentially viable. |
| | | | Air sparging | An air bubble stream is blown into the subsurface there by stripping contaminants from the groundwater. | Potentially viable. |
| | | *In situ* biological treatment | Aerobic | Nutrients injected to enhance aerobic microbe biodegradation organic wastes. | Potentially viable for organics. |
| | | | Anaerobic | Nutrients injected to enhance anaerobic microbe biodegradation organic wastes. | Potentially viable for organics. |
| | | | Natural Attenuation | Existing *in situ* bacteria population degrade contaminants before reaching receptors. | Potentially viable, if implemented following source reduction. |
| | | Chemical treatment | Chemical oxidation | Oxidizing agents added to waste for oxidation of heavy metals, unsaturated organics, sulfides, phenolics, and aromatic hydrocarbons to less toxic oxidation states. | Potentially viable. |
| | | | UV/oxidation | Destruction of organic contaminants using oxidizing agents and ultraviolet light. | Potentially viable. |
| | | | Metals precipitation | Inorganic constituents altered to reduce the solubility of heavy metals through the addition of a substance that reacts with the metals or changes the pH. | Not viable. |

See notes at end of table.

**Table 9-1 (Continued)**
**Preliminary Remedial Actions**

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Environmental Media | General Response Actions | Remedial Technologies | Process Options | Description | Evaluation Comments |
|---|---|---|---|---|---|
| Groundwater (Cont.) | Treatment (Cont.) | Chemical treatment (Cont.) | pH adjustment | Neutralizing agents (such as lime) added to adjust the pH. This may be done to neutralize a waste stream or to reduce the solubility of inorganic constituents as part of the metals precipitation process. | Not viable. |
| | | Physical treatment | Granular activated carbon adsorption | Passage of contaminated water through a bed of adsorbent so contaminants adsorb on the surface. | Potentially viable. |
| | | | Air stripping | Mixing of large volumes of air with water in a packed column or through diffused aeration to promote transfer of VOCs from liquid to air. | Potentially viable. |
| | | | Sedimentation | Suspended particles are settled out as a pretreatment or primary treatment step. | Not viable. |
| | | | Filtration | Used to filter out suspended particles. May be preceded be a coagulation and flocculation step to increase the effectiveness of sand filtration. | Not viable. |
| | Disposal | Off-site discharge | WWTP | Extracted groundwater discharged to local WWTP for further treatment. | Potentially viable. Requires permit from WWTP. |
| | | Onsite discharge | Surface water discharge | Discharge of treated effluent to an adjacent surfacewater body. A Federal and State NPDES permit would likely be required. | Potentially viable. |
| Surface Water, Sediment | Limited action | Access restrictions | Deed restriction | All deeds for property within potentially contaminated areas would include restrictions on use of property. | Potentially viable. |
| | | | Fencing | Security fences installed around potentially contaminated areas to limit access. | Potentially viable. |
| | | | Groundwater restrictions | All deeds for property within potentially contaminated areas would include restrictions on development and use of groundwater. | Potentially viable. |
| | Containment | Cap | Native material | Uncontaminated native material used to cap contaminated sediment. | Viable in cases where direct contact is prime threat. |

See notes at end of table.

## Table 9-1 (Continued)
## Preliminary Remedial Actions

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
*Orlando, Florida*

| Environmental Media | General Response Actions | Remedial Technologies | Process Options | Description | Evaluation Comments |
|---|---|---|---|---|---|
| Surface water, Sediment (Cont.) | Removal | Excavation | Mechanical excavation | Use of mechanical excavation equipment to remove and load contaminated sediment for disposal. | Potentially viable. Potential for secondary migration of contaminants via surface water during excavation. |
| | Disposal | Off-site disposal | RCRA landfill | Transport of excavated sediment to an RCRA-permitted landfill. | Potentially viable. Treatment may be based on land disposal restrictions. |
| | Treatment | Physical | Stabilization | Soil mixed with stabilizing reagents (e.g., lime or fly ash) that can stabilize contaminants. | Potentially viable for sediment contaminated with inorganics and low concentrations of organics. |
| | | | Soil Washing | Sediment is washed with various liquids, removing contamination. | Not viable. |
| | | | Solvent Extraction | Sediment is washed with solvent and contamination is removed. | Not viable. |
| | | | Thermal treatment | Contaminated sediment is thermally treated in a controlled oxygen-sufficient environment to destroy VOCs. | Potentially viable. Ash may require additional treatment for inorganics. |
| | | | Reclassification and/or restricted access of surface water bodies. | State re-classification of surface water bodies limiting use and access. | Not viable, as previously indicated by FDEP. |
| | | *In situ* biological treatment | Natural attenuation | Existing *in situ* bacteria population degrade contaminants before reaching receptors. | Potentially viable for surface water and sediment, after implementing groundwater containment. |
| | | | Phytoremediation | Native and/or introduced aquatic plants evapotranspire or destroy VOCs. | Potentially viable for surface water and sediment, after implementing groundwater containment. |

Notes: RI/FS = Remedial Investigation and Feasibility Study.
RCRA = Resource Conservation and Recovery Act.
VOCs = volatile organic compounds.
DNAPL = dense nonaqueous-phase liquid.
UV/oxidation = ultraviolet light and oxidation.
WWTP = waste water treatment plant.
NPDES = National Pollution Discharge Elimination System.
FDEP = Florida Department of Environmental Protection.

9.2 ALTERNATIVE DEVELOPMENT AND SCREENING. The technologies that remain following technology screening will be assembled into remedial alternatives that address each response objective established for the site. In addition to a No Action alternative, which is required under CERCLA to establish a baseline for comparison of alternatives, a number of other alternatives may be developed that focus on containment of contaminated source area subsurface soil, and address other media of concern (e.g., groundwater migrating from the site). For each alternative developed, a brief description of the components will be provided in the FS report.

Because of the nature of the site, few options may be available to adequately address the remedial action objectives. If few alternatives (i.e., less than six) are developed, it may not be necessary to conduct further screening to limit the number of alternatives to be evaluated. However, if the complexity of the site indicates that several options are potentially feasible, a second screening step may be required. The alternative screening would be conducted employing the same criteria used for technology screening, but would consider how the alternative components function together to meet the remedial action objectives.

9.3 ALTERNATIVE EVALUATION. Remedial alternatives will be evaluated in the FS report to provide information that will help decision makers select an appropriate remedial action for OU 4. The evaluation process will consist of (1) a detailed description of the alternative components, sufficient to support a conceptual design and a cost estimate accurate to +50/-30 percent; (2) an evaluation of each alternative against seven of the USEPA's nine evaluation criteria; and (3) a comparison of the alternatives relative to one another, with respect to the evaluation criteria. State and community acceptance are the two criteria within the nine that will not be evaluated, but will be addressed in the Proposed Plan and ROD.

Where appropriate, the description of alternatives may present preliminary design calculations, process flow diagrams, sizing of key components, and preliminary layouts and cross sections. The description may also include a discussion of limitations, assumptions, and uncertainties associated with each alternative.

The seven criteria that will be used to evaluate each alternative are described below.

Overall protection of human health and the environment considers how risks identified in the conceptual site model are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

Compliance with ARARs identifies how the alternative meets the Federal and State requirements regulating the chemical constituents, location of the site, and the type of action to be implemented.

Long-term effectiveness and permanence considers the integrity of the system or component over time, long-term management of waste, and magnitude of risk associated with contamination remaining in place.

Reduction of toxicity, mobility, or volume through treatment does not apply to the containment or other nontreatment components, but applies to treatment components for source area, groundwater, surface water, or sediment. This criterion considers the amount of material destroyed or treated, and the degree of expected contaminant reduction. It also includes an evaluation of the irreversibility of the treatment technology.

Short-term effectiveness considers the impacts on the surrounding community during construction and operation of the alternative. It also evaluates the amount of time required to achieve the response objectives.

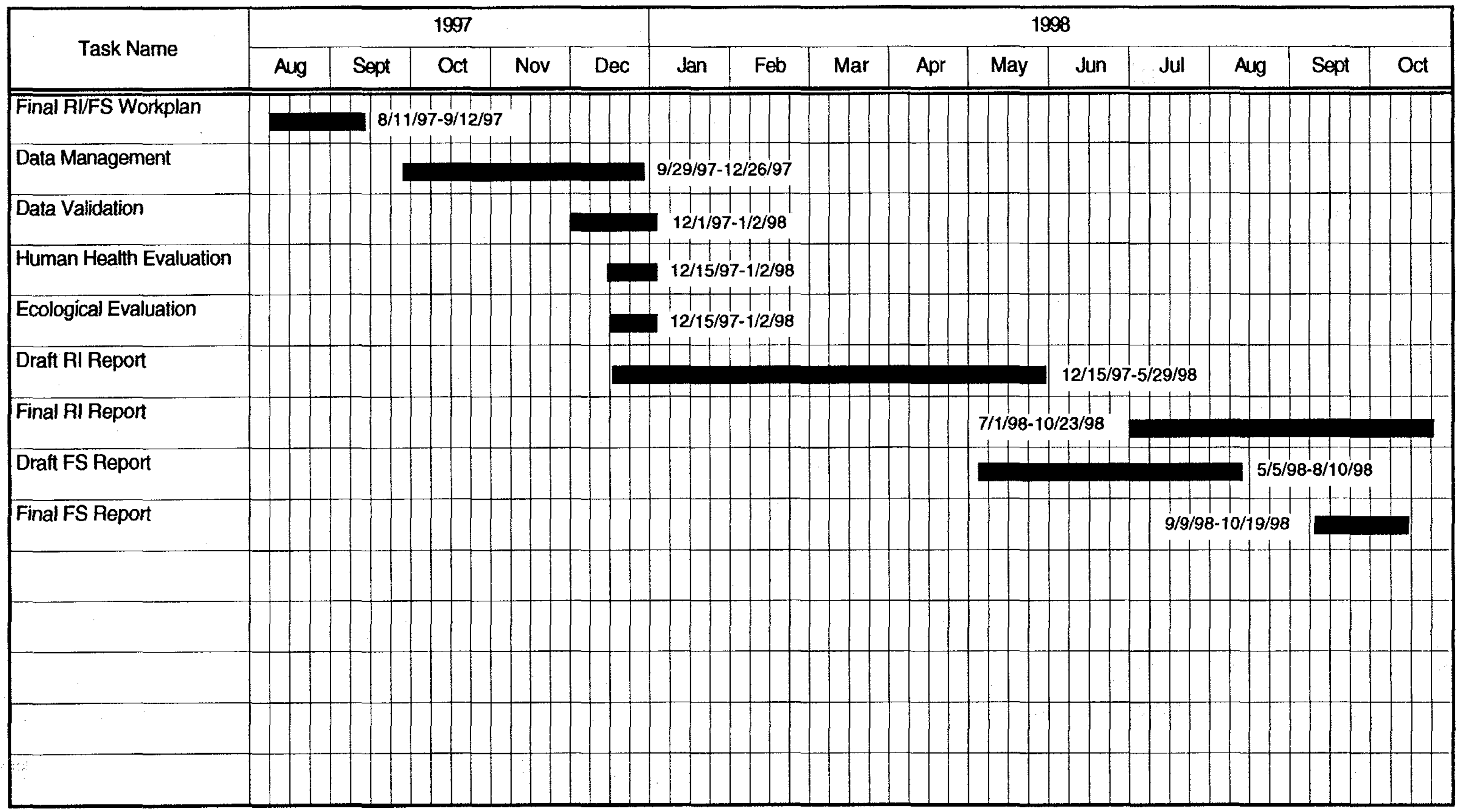
Implementability includes several factors, such as technical feasibility (i.e, the ability to construct and operate the alternative, the reliability of the technology, and the ability to monitor the effectiveness of the remedy), availability of materials and services, and administrative feasibility (i.e., the ease or difficulty of coordinating with or obtaining approvals from other agencies, and enforceability of deed restrictions).

Cost includes a line item cost estimate for construction and operation and maintenance costs, and a total present worth cost for the purpose of comparison with other alternatives. These cost estimates may be presented as a range of values with an accuracy of +50/-30 percent. The cost estimates will include a reasonable contingency factor to cover details and unforeseen circumstances. The estimates may be suitable for budgeting, but should not be considered the final construction cost estimates for the remedial action.

The comparative analysis of remedial action alternatives highlights the relative advantages and disadvantages of these alternatives relative to each of the seven evaluation criteria. This analysis will be presented as a written discussion for each alternative and will be summarized in tabular format for ease of comparison.

## 10.0 SCHEDULE

The anticipated schedules for the OU 4 project tasks are presented on Figures 10-1 and 10-2.




**NOTES:**
RI = Remedial Investigation
FS = Feasibility Study

**FIGURE 10-1**
**PROJECT SCHEDULE**

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN OPERABLE UNIT 4**

**NAVAL TRAINING CENTER ORLANDO, FLORIDA**

2545-04 FIG 10-1FRAME101497MAW

NTC-RIFS.OU4
ASW.10.97

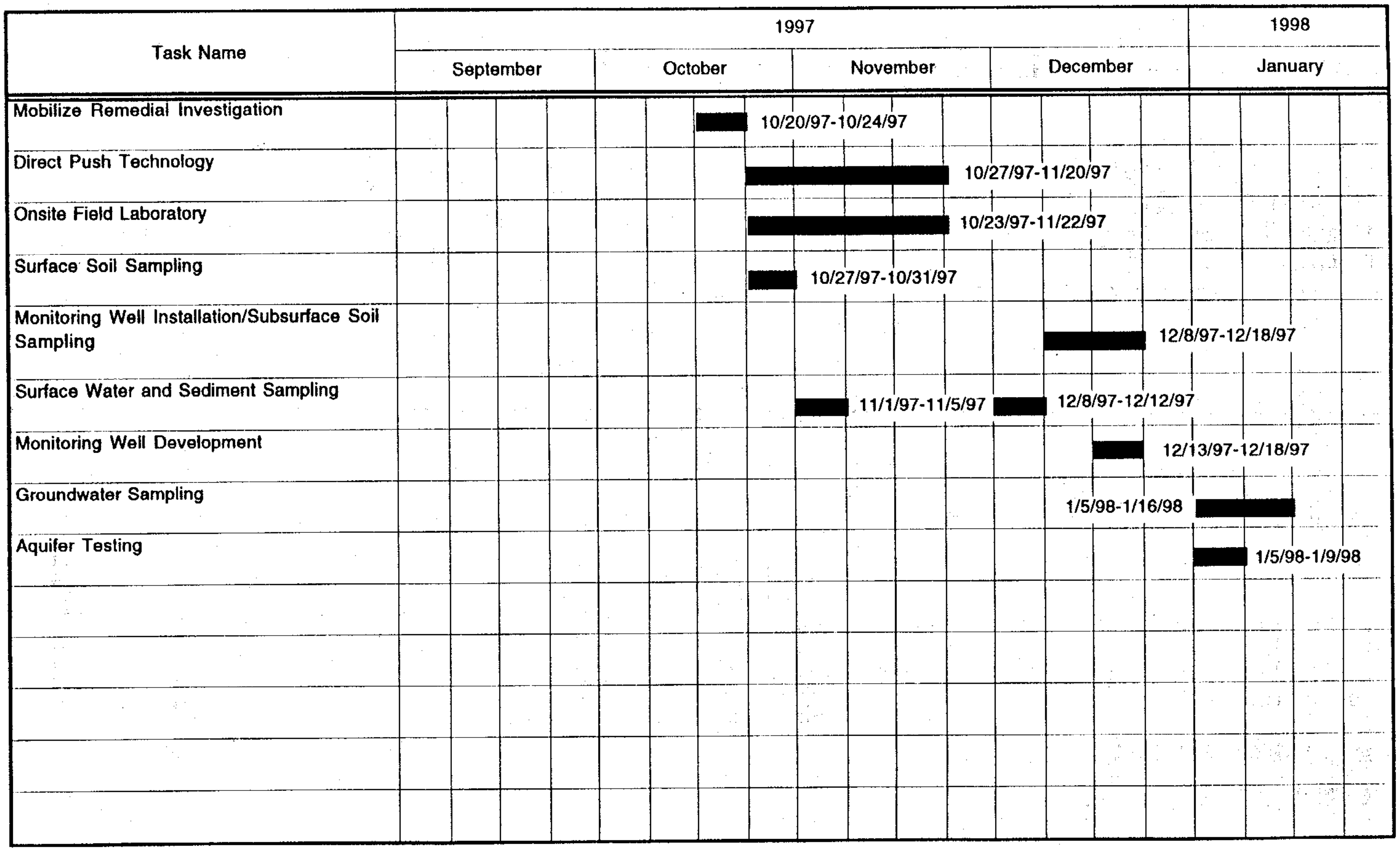



**FIGURE 10-2**
**FIELD INVESTIGATION SCHEDULE**

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN**
**OPERABLE UNIT 4**

**NAVAL TRAINING CENTER**
**ORLANDO, FLORIDA**

2545-04 FIG 10-2 FRAME101697MAW

# REFERENCES

ABB Environmental Services, Inc., (ABB-ES). 1994a. *Base Realignment and Closure Environmental Baseline Survey Report, Naval Training Center, Orlando, Florida*. Prepared for Southern Division, Naval Facilities Command (SOUTHNAVFACENGCOM), North Charleston, South Carolina (June).

ABB-ES. 1994b. *Background Sampling Plan (draft), Naval Training Center, Orlando, Florida*. Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina (October).

ABB-ES. 1995. *Background Sampling Report, Naval Training Center, Orlando, Florida*. Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina (August).

ABB-ES. 1996a. *Final Base Realignment and Closure Cleanup Plan, Naval Training Center, Orlando, Florida*. Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina (February).

ABB-ES. 1996b. *Base Realignment and Closure Environmental Site-Screening Report, Naval Training Center, Orlando, Florida*. Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina.

ABB-ES. 1996c. *Interim Remedial Action Focused Field Investigation Report, Operable Unit 4, Naval Training Center, Orlando, Florida*. Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina (November).

ABB-ES. 1997a. *Project Operations Plan for Site Investigations and Remedial Investigations, Naval Training Center, Orlando, Florida*. Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina (August).

ABB-ES. 1997b. *Technical Memorandum, Interim Remedial Action, Focused Investigation/Source Confirmation, Building 1100 Surge Tank, Naval Training Center, Orlando, Florida*. Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina (May).

ABB-ES. 1997c. *Focused Feasibility Study, Operable Unit 4, Naval Training Center, Orlando, Florida*. Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina (May).

ABB-ES. 1997d. *Interim Remedial Action, Conceptual Design and Performance Specification, Operable Unit 4, Naval Training Center, Orlando, Florida*. Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina (May).

Beyer, W.N. 1990. *Evaluating Soil Contamination*. Biological Report 90(2). U.S. Fish and Wildlife Service, Washington, D.C.

Bouwer, H., and R.C. Rice. 1976. "A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells." *Water Resources Bulletin* 12(3).

Bouwer, H., and R.C. Rice. 1989. "A Slug Test - An Update on Groundwater." *Water Resources Bulletin* 27(3).

Cohen, Robert M., A.P. Bryda, S.T. Shaw, and C.P. Spalding. 1992. "Evaluation of Visual Methods to Detect NAPL in Soil and Water." *Groundwater Monitoring and Remediation* (Fall) 132-139.

Florida Department of Environmental Protection (FDEP). 1995. "Soil Cleanup Goals for Florida." FDEP Memorandum (September 29); revised in "Applicability of Soil Cleanup Goals for Florida" Memorandum (January 19, 1996).

Florida Legislature. 1995. "Surface Water Quality Standards." Chapter 62-302, Florida Administrative Code. Tallahassee, Florida (January).

Geraghty & Miller. 1986. *Verification Study, Assessment of Potential Soil and Ground Water Contamination at Naval Training Center, Orlando, Florida.* Prepared for SOUTHNAVFACENGCOM, Charleston, South Carolina.

Johnson, C.C., & Associates. 1985. *Initial Assessment Study, Naval Training Center, Orlando, Florida.* Prepared for Navy Assessment and Control of Installation Pollutants Program, Naval Energy and Environmental Support Activity, Port Hueneme, California (September).

Lichtler, W.F., Warren Anderson, and B.F. Joyner. 1968. "Water Resources of Orange County, Florida." *Florida Bureau of Geology Report of Investigation 50.*

Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1993. "Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments." National Oceanic and Atmospheric Administration (September 15).

Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. "Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments." *Environmental Management* 19(1):81-97.

Maughan, J.T. 1993. *Ecological Assessment of Hazardous Waste Sites.* New York: Van Nostrand Reinhold.

MacDonald, D.D. 1994. *Approach to the Assessment of Sediment Quality in Florida Coastal Waters, Volume I: Development and Evaluation of Sediment Quality Assessment Guidelines.* Prepared for FDEP, Office of Water Policy, Tallahassee, Florida (November).

National Academy of Sciences. 1977. "Drinking Water and Health"; Safe Drinking Water Committee, Washington, D.C.

National Research Council (NRC). 1982. *Nutrient Requirements of Minks and Foxes.* 2nd rev. ed. Subcommittee on Furbearer Nutrition. Washington, D.C.: National Academy Press.

NRC. 1984. *Nutrient Requirements of Poultry*. Subcommittee on Poultry Nutrition. Washington, D.C.: National Academy Press.

Southern Division, Naval Facilities Engineering Command. 1985. Master Plan Update.

Suter, Glen W. 1993. *Ecological Risk Assessment*. Chelsea Michigan: Lewis Publishers.

U.S. Environmental Protection Agency (USEPA), Office of Pesticide Programs. 1986. *Hazard Evaluation Division Standard Evaluation Procedure*. Ecological Risk Assessment (USEPA 540/9-85-001), Office of Solid Waste and Emergency Response. Washington, D.C.

USEPA. 1988a. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*. Washington, D.C. (October).

USEPA. 1988b. *Interim Sediment Criteria Values for Nonpolar Hydrophobic Organic Chemicals*. SCD No. 17. Office of Water Regulations and Standards, Washington, D.C.

USEPA. 1989a. *Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part A)*. EPA/540/1-89/002, Interim Final. Washington, D.C. (December).

USEPA. 1989b. *Risk Assessment Guidance for Superfund, Volume 2: Environmental Evaluation Manual*. EPA/540/1-89/002. Washington, D.C. (December).

USEPA. Environmental Research Laboratory. 1989d. *Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference*. EPA 600/3-89/01. Corvallis, Oregon (March).

USEPA. Office of Solid Waste and Emergency Response. 1991a. *Ecological Assessment of Superfund Sites: An Overview*. Publication 9345.0-05I. Washington, D.C. (December).

USEPA. 1991b. *Baseline Risk Assessment Guidance Based on the National Contingency Plan and Directed to Federal Facilities*. USEPA Region IV, Waste Management Division. Atlanta, Georgia (April).

USEPA, 1991c. *Water Quality Criteria Summary*. Washington, D.C. (May 1).

USEPA. 1992a. *Framework for Ecological Risk Assessment*. EPA/630/R-92/001. Washington, D.C. (February).

USEPA. 1992b. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846*. 3rd ed. Washington, D.C.

USEPA. Office of Emergency and Remedial Response. 1992c. *Superfund Accelerated Cleanup Model*. PB92-963263, Publication 9203.1-01. Washington, D.C. (March).

## REFERENCES (Continued)


USEPA. Office of Emergency and Remedial Response. 1992d. *Guidance for Data Useability in Risk Assessment (Parts A and B)*. Publication 9285.7-09A. Washington, D.C. (April).

USEPA. Office of Solid Waste and Emergency Response. 1992e. *Supplemental Guidance to RAGS: Calculating the Concentration Term*. Publication 9285.7-081. Washington, D.C. (May).

USEPA. 1992f. *Guide to Management of Investigation-Derived Waste*. Publication 9345.3-03FS. Washington, D.C. (April).

USEPA. 1995a. *Supplemental Guidance to RAGS: Region 4 Bulletin*. "Human Health Risk Assessment." USEPA Region IV Waste Management Division. Atlanta, Georgia (November).

USEPA. 1995b. *Supplemental Guidance to RAGS: Region 4 Bulletin*. "Preliminary Risk Evaluation, Ecological Risk Assessment, Bulletin No. 1." USEPA Region IV Waste Management Division. Atlanta, Georgia (November).

USEPA. 1995c. *Supplemental Guidance to RAGS: Region 4 Bulletin*. "Ecological Screening Values, Ecological Risk Assessment, Bulletin No. 2." USEPA Region IV Waste Management Division. Atlanta, Georgia (November).

USEPA. 1995d. *Supplemental Guidance to RAGS: Region 4 Bulletin*. "Endpoint Selection. Ecological Risk Assessment, Bulletin No. 3." USEPA Region IV Waste Management Division. Atlanta, Georgia (November).

USEPA. 1995e. *Supplemental Guidance to RAGS: Region 4 Bulletin*. "Natural Resource Trustees, Ecological Risk Assessment, Bulletin No. 4." USEPA Region IV Waste Management Division. Atlanta, Georgia (November).

USEPA. 1996a. *Proposed Guidelines for Ecological Risk Assessment*: Notice. *Federal Register*. 61(175) 47552-47631. Washington, D.C. (September 9).

USEPA, 1996b. *USEPA Region IV Environmental Investigations Standard Operating Procedures and Quality Assurance Manual* (EISOPQAM). Washington, D.C. (May).

USEPA. Office of Solid Waste and Emergency Response. 1996c. *Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites*. EPA/540/R-96/023. Washington, D.C. (October).

USEPA. 1997. *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments*. USEPA Environmental Response Team. Washington, D.C.

Wentsel, R.S., T.W. La Point, M. Simini, R.T. Checkai, D. Ludwig, and L.W. Brewer. 1996. *Tri-Service Procedural Guidelines for Ecological Risk Assessments, Volumes I and II*. Written for the Air Force Center for Environmental Excellence, the Army Environmental Center, and the Naval Facilities Engineering Service Center (June).

# APPENDIX A

## SUMMARY OF ANALYTICAL DETECTIONS
## OU 4 PREVIOUS INVESTIGATIONS

# Table A-1
## Summary of Detections in Surface Soil
## Analytical Results, Study Area 12

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Lab Identifier:<br>Collection Data:<br>Feet bls: | Background [1] Screening | SCG [2] | RBC [3] for Residential Soil | RBC [3] for Industrial Soil | 12B00101<br>02/25/95<br>1 | 12B00201<br>02/25/95<br>1 | 12B00301<br>02/25/95<br>1 | 12B00401<br>02/25/95<br>1 | 12B00401D<br>02/25/95<br>1 |
|---|---|---|---|---|---|---|---|---|---|
| **Volatile Organics (μg/kg)** | | | | | | | | | |
| Acetone | -- | 260,000 | 7,800,000 n | 200,000,000 n | -- | -- | -- | -- | 16 |
| **General Chemistry (mg/kg)** | | | | | | | | | |
| Total Petroleum Hydrocarbons | NA | ND | ND | ND | 7.6 | -- | -- | 11.7 | 9.1 |
| **Inorganics (mg/kg)** | | | | | | | | | |
| Aluminum | 2,088 | 75,000 | 78,000 n | 1,000,000 n | 59.9 | 8.8 B | 16.8 B | 1,020 | 806 |
| Arsenic | 1.0 | 0.8 | 0.43 c/23 n | 3.8 c/610 n | -- | -- | -- | 0.56 B | -- |
| Barium | 8.7 | 5,200 | 5,500 n | 140,000 n | 1.5 B | 0.3 B | 0.25 B | 3.9 B | 3.6 B |
| Calcium | 25,295 | ND | 1,000,000 | 1,000,000 | 994 B | 1,410 | 215 B | 3,610 | 3,400 |
| Chromium | 4.6 | 290 | 390 n | 10,000 n | 0.71 B | -- | 0.84 B | 3.1 | 1.1 B |
| Copper | 4.1 | ND | 3,100 n | 82,000 n | -- | -- | -- | 0.49 B | -- |
| Iron | 712 | ND | 23,000 n | 610,000 n | 19.8 B | 14.4 B | -- | 373 | 322 |
| Lead | 14.5 | 500 | 400 | 400 | 0.46 B | -- | 0.37 B | 1.6 | 2 |
| Magnesium | 328 | ND | 460,468 | 460,468 | 23 B | 13.9 B | 8.2 B | 65.2 B | 59.9 B |
| Manganese | 8.1 | 370 | 1,800 n | 47,000 n | 0.68 B | 0.52 B | 0.53 B | 2.7 B | 2.2 B |
| Nickel | 4.4 | 1,500 | 1,600 n | 41,000 n | -- | -- | -- | 2.8 B | -- |
| Vanadium | 3.1 | 490 | 550 n | 14,000 n | -- | -- | -- | 0.96 B | 0.94 B |
| Zinc | 17.2 | 23,000 | 23,000 n | 610,000 n | 0.97 B | -- | -- | 1 B | 0.96 B |

See notes at end of table.

# Table A-1 (Continued)
## Summary of Detections in Surface Soil
## Analytical Results, Study Area 12

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Lab Identifier:<br>Collection Data:<br>Feet bls: | Background [1] Screening | SCG [2] | RBC [3] for Residential Soil | RBC [3] for Industrial Soil | 12B00101<br>02/25/95<br>1 | 12B00201<br>02/25/95<br>1 | 12B00301<br>02/25/95<br>1 | 12B00401<br>02/25/95<br>1 | 12B00401D<br>02/25/95<br>1 |
|---|---|---|---|---|---|---|---|---|---|

[1] The background screening value is twice the average of detected background concentrations for inorganic analytes. For organic compounds, values are the mean of detected background concentrations, presented for comparison purposes only.
[2] "Soil Cleanup Goals for Florida" (Florida Department of Environmental Protection [FDEP] memorandum, September 29, 1995). Values indicated are from a residential scenario. Arsenic value is as revised in "Applicability of Soil Cleanup Goals in Florida" (FDEP memorandum, January 19, 1996).
[3] "Risk-Based Concentration Table", USEPA Region III, May, 1996, R.L. Smith. RBC for chromium is based on chromium VI. RBC for lead is not available, value is Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites" (OSWER directive 9355-4-12). For essential nutrients (calcium, magnesium, potassium, and sodium) screening values were derived based on recommended daily allowances.

Notes: RI/FS = Remedial Investigation and Feasibility Study.
n = noncarcinogenic effects.
μg/kg = micrograms per kilogram.
mg/kg = milligrams per kilogram.
-- = analyte/compound was not detected at reporting limit.
NA = not applicable.
ND = not determined.
B = Reported concentration is between the instrument detection limit and the contract required detection limit.
bls = below land surface.
SCG = soil cleanup goals.
RBC = risk-based concentration.

All inorganic results expressed in mg/kg soil dry weight; organics in μg/kg soil dry weight.

**Table A-2**
**Summary of Detections in Subsurface Soil**
**Analytical Results, Study Area 12**

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Lab Identifier: / Collection Date: / Feet bls: | Background [1] Screening | SCG [2] | RBC [3] for Residential Soil | RBC [3] for Industrial Soil | 12B00102 / 02/27/95 / 6 | 12B00202 / 02/27/95 / 6 | 12B00302 / 02/28/95 / 6 | 12B00402 / 02/25/95 / 6 |
|---|---|---|---|---|---|---|---|---|
| **Volatile Organics (µg/kg)** | | | | | | | | |
| Acetone | -- | NA | 7,800,000 n | 200,000,000 n | 16 | 32 | 49 | -- |
| Tetrachloroethene | -- | 30 [4] | 12,000 c | 110,000 c | 11 J | -- | -- | -- |
| **General Chemistry (mg/kg)** | | | | | | | | |
| Total Petroleum Hydrocarbons | NA | NA | ND | ND | 209.7 | 11.7 | 21.7 | 4.9 |
| **Semivolatile Organics (µg/kg)** | | | | | | | | |
| Fluoranthene | -- | NA | 3,100,000 n | 82,000,000 n | 260 J | -- | 110 J | -- |
| Pyrene | -- | NA | 2,300,000 n | 61,000,000 n | 200 J | -- | 110 J | -- |
| Chrysene | -- | NA | 88,000 c | 780,000 c | 160 J | -- | 110 J | -- |
| Benzo(b)fluoranthene | -- | NA | 880 c | 7,800 c | 160 J | -- | -- | -- |
| Benzo(k)fluoranthene | -- | NA | 8,800 c | 78,000 c | 130 J | -- | -- | -- |
| Benzo(a)anthracene | -- | NA | 880 c | 7,800 c | 110 J | -- | -- | -- |
| Benzo(g,h,i)perylene | -- | NA | 2,300 n | 61,000 n | 120 J | -- | -- | -- |
| **Pesticides/PCBs (µg/kg)** | | | | | | | | |
| 4,4'-DDE | 130 | NA | 1,900 c | 17,000 c | 5.2 J | -- | -- | -- |
| 4,4'-DDT | 87 | NA | 1,900 c | 17,000 c | 23 J | -- | -- | -- |
| Aroclor-1260 | -- | NA | 83 c | 740 c | 110 J | -- | -- | -- |
| **Inorganics (mg/kg)** | | | | | | | | |
| Aluminum | 2,119 | NA | 78,000 n | 1,000,000 n | 665 | 310 | 390 | 750 |
| Arsenic | 1.1 | NA | 0.43 c/23 n | 3.8 c/610 n | 0.6 B | -- | 0.67 J | -- |

See notes at end of table.

# Table A-2 (Continued)
## Summary of Detections in Subsurface Soil
## Analytical Results, Study Area 12

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Lab Identifier:<br>Collection Date:<br>Feet bls: | Background [1] Screening | SCG [2] | RBC [3] for Residential Soil | RBC [3] for Industrial Soil | 12B00102<br>02/27/95<br>6 | 12B00202<br>02/27/95<br>6 | 12B00302<br>02/28/95<br>6 | 12B00402<br>02/25/95<br>6 |
|---|---|---|---|---|---|---|---|---|
| **Inorganics (mg/kg) (Continued)** | | | | | | | | |
| Barium | 3.6 | NA | 5,500 n | 140,000 n | 6.3 B | -- | -- | 2.1 B |
| Beryllium | -- | NA | 0.15 c | 1.3 c | 0.11 B | -- | -- | -- |
| Cadmium | -- | NA | 39 n | 1,000 n | 0.72 B | -- | -- | -- |
| Calcium | 115 | NA | 1,000,000 | 1,000,000 | 46,700 J | 147 J | 25,900 J | 1,190 |
| Chromium | 3.7 | NA | 390 n | 10,000 n | 2.2 B | 0.62 B | 0.82 B | 1.7 B |
| Iron | 264 | NA | 23,000 n | 610,000 n | 208 J | 5.7 J | 143 J | 52.1 |
| Lead | 3.9 | NA | 400 | 400 | 14.5 J | 1.2 J | 3 J | 1.7 |
| Magnesium | 32.8 | NA | 460,468 | 460,468 | 659 B | 6.2 B | 192 B | 16.5 B |
| Manganese | 2.1 | NA | 1,800 n | 47,000 n | 23.9 | -- | 4.5 | 0.8 B |
| Mercury | -- | NA | 23 n | 610 n | 0.05 | 0.06 | 0.05 | -- |
| Nickel | -- | NA | 1,600 n | 41,000 n | 2.3 B | -- | -- | -- |
| Sodium | -- | NA | 1,000,000 | 1,000,000 | 46 B | -- | -- | -- |
| Vanadium | 3.4 | NA | 550 n | 14,000 n | 1.1 J | -- | 2 J | 0.46 B |
| Zinc | 5.6 | NA | 23,000 n | 610,000 n | 44.4 | -- | 0.96 B | -- |

See notes at end of table.

# Table A-2 (Continued)
## Summary of Detections in Subsurface Soil
## Analytical Results, Study Area 12

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Lab Identifier:<br>Collection Date:<br>Feet bls: | Background [1] Screening | SCG [2] | RBC [3] for Residential Soil | RBC [3] for Industrial Soil | 12B00102<br>02/27/95<br>6 | 12B00202<br>02/27/95<br>6 | 12B00302<br>02/28/95<br>6 | 12B00402<br>02/25/95<br>6 |
|---|---|---|---|---|---|---|---|---|

[1] The background screening value is twice the average of detected background concentrations for inorganic analytes. For organic compounds, values are the mean of detected background concentrations, presented for comparison purposes only.
[2] "Soil Cleanup Goals for Florida" (Florida Department of Environmental Protection memorandum, September 29, 1995). Values indicated are for a leaching scenario, and only apply to tetrachloroethene (PCE). PCE is the only organic constituent present in subsurface soil and also present in groundwater above Florida Groundwater Guidance Concentrations.
[3] "Risk-Based Concentration Table", USEPA Region III, May, 1996, R.L. Smith. RBC for chromium is based on chromium VI. RBC for lead is not available, value is Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites (OSWER directive 9355-4-12). For essential nutrients (calcium, magnesium, potassium, and sodium) screening values were derived based on recommended daily allowances.
[4] Leachability-based SCG.

Notes: RI/FS = Remedial Investigation and Feasibility Study.
n = noncarcinogenic effects.
c = carcinogenic effects.
μg/kg = micrograms per kilogram.
mg/kg = milligrams per kilogram.
-- = analyte/compound was not detected at reporting limit.
ND = not determined.
NA = not analyzed.
J = estimated value.
B = Reported concentration is between the instrument detection limit and the contract required detection limit.
bls = below land surface.
PCB = polychlorinated biphenyl.
DDE = dichlorodiphenyldichloroethene.
DDT = dichlorodiphenyltrichloroethane.
USEPA = U.S. Environmental Protection Agency.
OSWER = Office of Solid Waste and Emergency Response.
SCG = soil cleanup goals.
RBC = risk-based concentration.

All metals results expressed in mg/kg soil dry weight; organics in μg/kg soil dry weight.

## Table A-3
## Summary of Detections in Groundwater
## Analytical Results, Study Area 12

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Well ID:<br>Lab Identifier:<br>Collection Date: | Background[1] Screening | FDEPG | FEDMCL | RBC[2] for Tap Water | OLD-12-01A<br>12G00101<br>03/09/95 | OLD-12-02A<br>12G00201<br>03/09/95 | OLD-12-03A<br>12G00301<br>03/09/95 | OLD-12-04A<br>12G00401<br>03/09/95 |
|---|---|---|---|---|---|---|---|---|
| **Volatiles (μg/ℓ)** | | | | | | | | |
| Trichloroethene | -- | 3[5] | 5 | 1.6 c | 2 | -- | -- | -- |
| Tetrachloroethene | -- | 3[5] | 5 | 1.1 c | 8 | -- | -- | -- |
| **Inorganics (μg/ℓ)** | | | | | | | | |
| Aluminum | 4,067 | 200[3] | -- | 37,000 n | 409 | 930 | 179 B | 486 |
| Barium | 31.4 | 2,000[5] | 2,000 | 2,600 n | 9.9 B | 4.9 B | 11.2 B | 7.2 B |
| Beryllium | -- | 4[5] | 4 | 0.016 c | 1.1 B | 0.31 B | -- | -- |
| Cadmium | 5.6 | 5[5] | 5 | 18 n | 3.2 B | -- | -- | -- |
| Calcium | 36,830 | ND | ND | 1,000,000 | 125,000 | 33,300 | 46,200 | 48,100 |
| Iron | 1,227 | 300[3] | ND | 11,000 n | 223 | 34.9 B | 54.6 B | 27.1 B |
| Magnesium | 4,560 | ND | ND | 118,807 | 5,030 | 2,610 B | 3,890 B | 1,680 B |
| Manganese | 17.0 | 50[3] | ND | 840 n | 26.7 | 4.9 B | 32.8 | 4.9 B |
| Mercury | 0.12 | 2[5] | 2 | 11 n | 0.12 B | 0.12 B | -- | 0.12 B |
| Potassium | 5,400 | ND | ND | 297,016 | 1,380 B | 1,860 B | 3,560 B | 911 B |
| Selenium | 9.7 | 50[5] | 50 | 180 n | -- | -- | 5.5 | 3.1 B |
| Sodium | 18,222 | 160,000[5] | ND | 396,022 | 29,700 | 2,860 B | 5,910 | 2,600 B |
| Vanadium | 20.6 | 49[4] | ND | 260 n | 3.3 B | 6.8 B | 4 B | 6.8 B |

See notes at end of table.

# Table A-3 (Continued)
## Summary of Detections in Groundwater
## Analytical Results, Study Area 12

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Well ID:<br>Lab Identifier:<br>Collection Date: | Background [1] Screening | FDEPG | FEDMCL | RBC[2] for Tap Water | OLD-12-01A<br>12G00101<br>03/09/95 | OLD-12-02A<br>12G00201<br>03/09/95 | OLD-12-03A<br>12G00301<br>03/09/95 | OLD-12-04A<br>12G00401<br>03/09/95 |
|---|---|---|---|---|---|---|---|---|

[1] Groundwater background screening value is twice the average of detected concentrations for inorganic analytes. For organic compounds, values are the mean of detected concentration, presented for comparison purposes only.
[2] "Risk-Based Concentration Table", USEPA Region III, May 1996, R.L. Smith. RBC for chromium is based on chromium VI. RBC for lead is not available, value is treatment technology action limit for lead in drinking water distribution system identified in Drinking Water Standards and Health Advisories" (USEPA, 1995). For essential nutrients (calcium, magnesium, potassium, and sodium) screening values were derived based on recommended daily allowances.
[3] Secondary Standard.
[4] Systemic Toxicant.
[5] Primary Standard.

Notes: RI/FS = Remedial Investigation and Feasibility Study.
ID = identifier.
$\mu g/\ell$ = micrograms per liter.
-- = analyte/compound was not detected at reporting limit.
B = Reported concentration is between the instrument detection limit and the contract required detection limit.
n = noncarcinogenic effects.
ND = not determined.
c = carcinogenic effects.
MCL = maximum contaminant levels.
FDEPG = Florida Department of Environmental Protection, Groundwater Guidance Concentrations, June 1994.
FEDMCL = Federal Maximum Contaminant Levels, Primary Drinking Water Regulations and Health Advisories, February 1996.
RBC = risk-based concentration.

*Bolded/shaded value indicates exceedance of regulatory guidance and background.*

## Table A-4
## Field GC Results, Study Area 13

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| | SAMPLE ID | DEPTH (FT) | BENZENE | TOLUENE | ETHYLBENZENE | M-,P-XYLENE | O-XYLENE | TCE | PCE | DCA | ΣBETX | Σchlor | ΣVOCs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 13P00201 | 6 | | | | | | | 601.0 | | | 601.0 | 601.0 |
| 2 | 13P00202 | 12 | | | | | | | 6.3 | | | 6.3 | 6.3 |
| 3 | 13P00203 | 18 | | | | | | | 0.5 | | | 0.5 | 0.5 |
| 4 | 13P00204 | 24 | | 3.8 | | | | | 1252.0 | | 3.8 | 1252.0 | 1255.8 |
| 5 | 13P00205 | 30 | | | | | | | 26.7 | | | 26.7 | 26.7 |
| 6 | 13P00206 | 36 | | | | | | | 6.3 | | | 6.3 | 6.3 |
| 7 | 13P00207 | 42 | | | | | | | 204.0 | | | 204.0 | 204.0 |
| 8 | 13P00208 | 48 | | | | | | | 13.1 | | | 13.1 | 13.1 |
| 9 | 13P00209 | 54 | | | | | | | 12.5 | | | 12.5 | 12.5 |
| 10 | 13P00210 | 60 | | | | | | | | | | | |
| 11 | 13P00211 | 64 | | 12.0 | | 3.9 | 0.7 | | 6.5 | | 16.6 | 6.5 | 23.1 |
| 12 | 13P00401 | 6 | | | | | | | 16.0 | | | 16.0 | 16.0 |
| 13 | 13P00402 | 8 | | | | | | 2.6 | 115.0 | | | 117.6 | 117.6 |
| 14 | 13P00403 | 12 | | | | | | | 4.6 | | | 4.6 | 4.6 |
| 15 | 13P00404 | 18 | | | | | | | | | | | |
| 16 | 13P00405 | 24 | | | | | | | | | | | |
| 17 | 13P00406 | 30 | | | | | | | | | | | |
| 18 | 13P00407 | 36 | | | | | | | | | | | |
| 19 | 13P00408 | 42 | | | | | | | | | | | |
| 20 | 13P00409 | 48 | | | | | | | | | | | |
| 21 | 13P00410 | 54 | | | | | | | | | | | |
| 22 | 13P00411 | 60 | | | | | | | | | | | |
| 23 | 13P00412 | 66 | | | | | | | | | | | |
| 24 | 13P00601 | 6 | | | | | | | 9.1 | | | 9.1 | 9.1 |
| 25 | 13P00602 | 12 | | | | | | | | | | | |
| 26 | 13P00603 | 18 | | | 0.8 | 9.5 | 3.2 | | 0.8 | | 13.5 | 0.8 | 14.3 |
| 27 | 13P00604 | 24 | | 4.0 | | 4.9 | 6.9 | | | | 15.8 | | 15.8 |
| 28 | 13P00605 | 30 | | | | | 4.8 | | | | 4.8 | | 4.8 |
| 29 | 13P00606 | 36 | | | | | | | | | | | |
| 30 | 13P00607 | 42 | | | 1.0 | 10.0 | 4.4 | | | | 15.4 | | 15.4 |
| 31 | 13P00608 | 48 | | | | 5.0 | | | | | 5.0 | | 5.0 |
| 32 | 13P00609 | 54 | | | | | | | | | | | |
| 34 | 13P00610 | 60 | | | | | | | | | | | |
| 35 | 13P00801 | 6 | | | | | | 21.0 | 702.0 | | | 723.0 | 723.0 |
| 36 | 13P00802 | 12 | | | | | | 14.0 | 2522.0 | | | 2536.0 | 2536.0 |
| 37 | 13P00803 | 18 | | | | | | 1294.0 | 3774.0 | | | 5068.0 | 5068.0 |
| 38 | 13P00804 | 24 | | | | | | 284.0 | 5.8 | | | 289.8 | 289.8 |
| 39 | 13P00805 | 30 | | | | | | | 11.6 | | | 11.6 | 11.6 |
| 40 | 13P00806 | 36 | | | | | | 8.6 | 9.3 | | | 17.9 | 17.9 |
| 41 | 13P00807 | 42 | | | | | | | | | | | |
| 42 | 13P00808 | 48 | | | | | | | | | | | |
| 43 | 13P00809 | 54 | | | | | | | | | | | |
| 44 | 13P00810 | 60 | | | | | | | 2.8 | | | 2.8 | 2.8 |
| 45 | 13P00811 | 64 | | | | | | | 6.6 | | | 6.6 | 6.6 |

# Table A-5
## Summary of Detections in Soil
## Analytical Results, Study Area 13

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Lab Identifier<br>Collection Date<br>Feet bls | Background [1] (Subsurface/ Surface) | SCG [2] | RBC [3] for Residential Soil | RBC [3] for Industrial Soil | 13B00101<br>02/26/95<br>6 | 13B00401<br>03/31/95<br>6 | 13B00501<br>02/26/95<br>1 | 13B00701<br>04/03/95<br>16 | 13B00801<br>03/30/95<br>4 | 13B00802<br>03/30/95<br>62 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Volatiles (µg/kg)** | | | | | | | | | | |
| Acetone | --/-- | 260,000 | 7,800,000 n | 200,000,000 n | 130 | -- | 42 | -- | -- | -- |
| Carbon disulfide | --/-- | 5,200 | 7,800,000 n | 200,000,000 n | -- | -- | -- | -- | -- | 1 J |
| 2-Butanone | --/-- | 2,200,000 | 47,000,000 n | 1,000,000,000 n | -- | -- | -- | -- | -- | -- |
| 1,2-Dichloroethene (total) | --/-- | 62,000 | 700,000 n | 18,000,000 n | 6 J | -- | -- | 10 J | -- | -- |
| Trichloroethene | --/-- | 6,500/10 [4] | 58,000 c | 520,000 c | 2 J | -- | -- | 4 J | -- | -- |
| Tetrachloroethene | --/-- | 12,000/30 [4] | 12,000 c | 110,000 n | 31 | -- | 4 J | 220 | 2 J | -- |
| **General Chemistry** | | | | | | | | | | |
| pH | ND | ND | ND | ND | NA | NA | NA | 7.42 | NA | NA |
| **Total Petroleum Hydrocarbons (mg/kg)** | | | | | | | | | | |
| Total Petroleum Hydrocarbons | NA/NA | ND | -- | -- | 8.2 | 16.8 | 17.6 | 6.2 | 15.6 | 6.6 |
| **Inorganics (mg/kg)** | | | | | | | | | | |
| Aluminum | 2,119/2,088 | 75,000 | 78,000 n | 1,000,000 n | 196 | 503 | 2,180 | 629 | 1,430 | 2,320 |
| Arsenic | 1.1/1.0 | 0.8 | 0.43 c/23 n | 3.8 c/610 n | 0.78 B | -- | 0.72 B | 0.17 B | -- | 1.5 B |
| Barium | 3.6/8.7 | 5,200 | 5,500 n | 140,000 n | -- | 0.4 B | 5.7 B | 2.5 B | 1.6 B | 33.8 B |
| Beryllium | --/0.09 | 0.2 | 0.15 c | 1.3 c | 0.28 B | -- | 0.13 B | -- | -- | 0.23 B |

See notes at end of table.

## Table A-5 (Continued)
## Summary of Detections in Soil
## Analytical Results, Study Area 13

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Lab Identifier<br>Collection Date<br>Feet bls | Background [1] (Subsurface/ Surface) | SCG [2] | RBC [3] for Residential Soil | RBC [3] for Industrial Soil | 13B00101<br>02/26/95<br>6 | 13B00401<br>03/31/95<br>6 | 13B00501<br>02/26/95<br>1 | 13B00701<br>04/03/95<br>16 | 13B00801<br>03/30/95<br>4 | 13B00802<br>03/30/95<br>62 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Inorganics (mg/kg) (Cont.)** | | | | | | | | | | |
| Cadmium | --/0.98 | 37 | 39 n | 1,000 n | -- | -- | -- | -- | -- | 0.38 B |
| Calcium | 115/25,295 | ND | 1,000,000 | 1,000,000 | 72.4 J | 110 B | 346 J | 1,680 | 132 B | 3,120 |
| Chromium | 3.7/4.6 | 290 | 390 n | 10,000 n | 0.97 B | 1.1 B | 8.6 | 2.5 J | 1.6 B | 4.9 |
| Copper | --/4.1 | ND | 3,100 n | 82,000 n | -- | -- | 3.4 J | 1.6 B | -- | -- |
| Iron | 264/712 | ND | 23,000 n | 610,000 n | 17.9 J | 96.8 | 36 J | 91.7 | 280 | 1,480 |
| Lead | 3.9/14.5 | 500 | 400 | 400 | 0.43 J | 0.35 B | 8.4 J | 2.2 | 0.7 | 1.8 |
| Magnesium | 32.8/328 | ND | 460,468 | 460,468 | -- | 13.4 B | 15.7 B | 22.6 B | 38.6 B | 79.2 B |
| Manganese | 2.1/8.1 | 370 | 1,800 n | 47,000 n | -- | 0.78 B | 1.6 B | 1.9 J | 0.8 B | 4.1 |
| Mercury | --/0.07 | 23 | 23 n | 610 n | 0.04 B | -- | 0.07 | -- | -- | -- |
| Nickel | --/4.4 | 1,500 | 1,600 n | 41,000 n | -- | -- | 3.1 B | -- | -- | 2.5 B |
| Selenium | 1.3/0.9 | 390 | 390 n | 10,000 n | -- | -- | -- | -- | -- | 0.42 B |
| Sodium | --/91.4 | ND | 1,000,000 | 1,000,000 | -- | 96.8 B | -- | 136 B | 163 B | 156 B |
| Thallium | --/2.0 | ND | 63 n | 160 n | -- | -- | -- | -- | -- | 0.22 B |
| Vanadium | 3.4/3.1 | 490 | 550 n | 14,000 n | -- | 0.53 B | 1.3 J | 1.4 B | 1.6 B | 4.1 B |
| Zinc | 5.6/17.2 | 23,000 | 23,000 n | 610,000 n | 0.34 B | -- | 0.36 B | -- | -- | 4 |

See notes at end of table.

# Table A-5 (Continued)
## Summary of Detections in Soil
## Analytical Results, Study Area 13

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Lab Identifier<br>Collection Date<br>Feet bls | Background [1] | SCG [2] | RBC [3] for Residential Soil | RBC [3] for Industrial Soil | 13B00901<br>02/25/95<br>6 | 13B01001<br>02/25/95<br>6 | 13B01101<br>02/25/95<br>4 | 13B01201<br>02/25/95<br>6 | 13B01301<br>02/25/95<br>6 |
|---|---|---|---|---|---|---|---|---|---|
| **Volatiles (μg/kg)** | | | | | | | | | |
| Acetone | -- | 260,000 | 7,800,000 n | 200,000,000 n | -- | 68 | -- | -- | 8 J |
| 2-Butanone | -- | 2,200,000 | 47,000,000 n | 1,000,000,000 n | -- | -- | 4 J | -- | -- |
| **Pesticides/PCB (μg/kg)** | | | | | | | | | |
| 4,4'-DDD | -- | 4,500 | 2,700 c | 24,000 c | -- | -- | 2.6 J | -- | -- |
| 4,4'-DDE | -- | 3,000 | 1,900 c | 17,000 c | -- | -- | 2.8 J | -- | -- |
| **Total Petroleum Hydrocarbons (mg/kg)** | | | | | | | | | |
| Total Petroleum Hydrocarbons | -- | ND | ND | ND | -- | -- | 11.6 | 5.7 | 23.4 |
| **Inorganics (mg/kg)** | | | | | | | | | |
| Aluminum | 2,119 | 75,000 | 78,000 n | 1,000,000 n | 339 | 290 | 455 | 703 | 1,030 |
| Arsenic | 1.1 | 0.8 | 0.43 c/23 n | 3.8 c/610 n | 1.2 B | 0.48 B | 0.62 B | 0.75 B | 1.3 J |
| Barium | 3.6 | 5,200 | 5,500 n | 140,000 n | 0.73 B | 0.71 B | 2.7 B | 1.8 B | 2.7 B |
| Calcium | 115 | ND | 1,000,000 | 1,000,000 | 591 B | 162 B | 288 B | 1070 B | 394 B |
| Chromium | 3.7 | 290 | 390 n | 10,000 n | 1.3 B | 1.8 B | 4.1 | 1.3 B | 3.3 |
| Copper | -- | ND | 2,900 n | 76,000 n | -- | -- | 2.8 B | 0.75 B | 1.3 B |
| Iron | 264 | ND | 23,000 n | 610,000 n | 58.9 | 53.7 | 183 | 68.4 | 118 |
| Lead | 3.9 | 500 | 400 | 400 | 0.64 B | 0.44 B | 1.7 | 1.5 | 2.4 |
| Magnesium | 32.8 | ND | 460,468 | 460,468 | 18.7 B | 16.4 B | 31.9 B | 27.4 B | 33.8 B |

See notes at end of table.

# Table A-5 (Continued)
## Summary of Detections in Soil
## Analytical Results, Study Area 13

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Lab Identifier<br>Collection Date<br>Feet bls | Background [1] | SCG [2] | RBC [3] for Residential Soil | RBC [3] for Industrial Soil | 13B00901<br>02/25/95<br>6 | 13B01001<br>02/25/95<br>6 | 13B01101<br>02/25/95<br>4 | 13B01201<br>02/25/95<br>6 | 13B01301<br>02/25/95<br>6 |
|---|---|---|---|---|---|---|---|---|---|
| **Inorganics (mg/kg) (Cont.)** | | | | | | | | | |
| Manganese | 2.1 | 370 | 1,800 n | 43,000 n | 0.42 B | 0.38 B | 0.92 B | 1.1 B | 1.3 B |
| Vanadium | 3.4 | 490 | 550 n | 14,000 n | -- | -- | 0.5 B | 0.79 B | 0.96 B |
| Zinc | 5.6 | 23,000 | 23,000 n | 610,000 n | 1 B | -- | 4.5 B | 1.3 B | 2.6 B |

[1] Background values are for subsurface soils and surface soils, respectively. The background screening value is twice the average of detected background concentrations for inorganic analytes.
[2] "Soil Cleanup Goals for Florida" (Florida Department of Environmental Protection [FDEP] memorandum, September 29, 1995). Arsenic value is as revised in "Applicability of Soil Cleanup Goals for Florida" (FDEP memorandum, January 19, 1996). Values indicated are from a residential scenario, and apply only to surface soil sample 13B00501. Chromium values are for chromium VI.
[3] "Risk-Based Concentration Table", USEPA Region III, May, 1996, R.L. Smith. RBC indicated for arsenic is based on noncarcinogenic effects. RBC for chromium is based on chromium VI. RBC for lead is not available, value is Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites (OSWER directive 9355-4-12). RBC for thallium is based on thallium chloride. For essential nutrients (calcium, iron, magnesium, potassium, and sodium) screening values were derived based on recommended daily allowances.
[4] Residential/leaching SCGs.

Notes: All inorganic results expressed in mg/kg soil dry weight; organics in $\mu$g/kg soil dry weight.
Bolded/shaded value indicates exceedance of regulatory guidance and background.

RI/FS = Remedial Investigation and Feasibility Study.
n = noncarcinogenic effects.
c = carcinogenic effects.
mg/kg = milligrams per kilogram.
$\mu$g/kg = micrograms per kilogram.
-- = analyte/compound not detected at reporting limit.
ND = Not determined.
J = Estimated value.
B = Reported concentration is between the instrument detection limit (IDL) and the Contract Required Detection Limit (CRDL).

NA = Not analyzed.
bls = below land surface.
PCB = polychlorinated biphenyl.
DDE = dichlorodiphenyldichloroethene.
DDD = dichlorodiphenyldichloroethane.
USEPA = U.S. Environmental Protection Agency.
OSWER = Office of Solid Waste and Emergency Response.
SCG = soil cleanup goals.
RBC = risk-based concentration.

# Table A-6
## Summary of Detections in Shallow Groundwater Analytical Results, Study Area 13

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Well ID: / Lab Identifier: / Collection Date: | Background [1] Screening | FDEPG | FEDMCL | RBC[2] for Tap Water | OLD-13-01A / 13G00101 / 03/09/95 | OLD-13-01A / 13G00101D / 03/09/95 | OLD-13-03A / 13G00301 / 04/06/95 | OLD-13-05A / 13G00501 / 03/09/95 | OLD-13-07A / 13G00701 / 04/06/95 |
|---|---|---|---|---|---|---|---|---|---|
| **Volatile Organics (μg/ℓ)** | | | | | | | | | |
| cis-1,2-Dichloroethene | -- | 70 [5] | 70 | 61 n | 29 J | 30 J | 5.6 | 6 | 38 J |
| Trichloroethene | -- | 3 [5] | 5 | 1.6 c | 16 J | 17 J | 3 J | 3 | 52 |
| Tetrachloroethene | -- | 3 [5] | 5 | 1.1 c | 250 | 270 | 16 | 7 | 680 |
| **General Chemistry (mg/ℓ)** | | | | | | | | | |
| Total Suspended Solids | ND | ND | ND | ND | NA | NA | -- | NA | -- |
| **Inorganics (μg/ℓ)** | | | | | | | | | |
| Aluminum | 4,067 | 200 [3] | ND | 37,000 n | -- | -- | 51 B | 1,040 | 89.9 B |
| Arsenic | 5.0 | 50 [5] | 50 | 0.045 c/11 n | -- | -- | 3.7 J | -- | 2.6 B |
| Barium | 31.4 | 2,000 [5] | 2,000 | 2,600 n | 2.6 B | 3.2 B | 2.6 B | 10.2 B | 3.4 B |
| Calcium | 36,830 | ND | ND | 1,000,000 | 60,600 | 61,100 | 64,000 | 36,500 | 42,300 |
| Copper | 5.4 | 1,000 [3] | ND | 1,500 n | -- | -- | -- | -- | 47.9 |
| Iron | 1,227 | 300 [3] | ND | 11,000 n | 34.3 B | 33.3 B | 78 B | 95.2 B | 44.7 B |
| Magnesium | 4,560 | ND | ND | 118,807 | 1,390 B | 1,430 B | 1,220 B | 1,710 B | 2,340 B |
| Manganese | 17.0 | 50 [3] | ND | 840 n | 6 B | 5.4 B | 1.7 B | 2.6 B | 3.1 B |
| Mercury | 0.12 | 2 [5] | 2 | 11 n | -- | 0.14 B | -- | -- | -- |
| Potassium | 5,400 | ND | ND | 297,016 | 1,140 B | 841 B | 873 B | 627 B | 2,570 B |
| Sodium | 18,222 | 160,000 [5] | ND | 396,022 | 7,300 | 7,060 | 2,320 B | 2,060 B | 14,700 |
| Vanadium | 20.6 | 49 [4] | -- | 260 n | -- | -- | -- | -- | 6.8 B |
| Zinc | 4.0 | 5,000 [3] | ND | 11,000 n | 1.7 B | -- | -- | -- | -- |

See notes at end of table.

**Table A-6 (Continued)**
**Summary of Detections in Shallow Groundwater**
**Analytical Results, Study Area 13**

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Well ID:<br>Lab Identifier:<br>Collection Date: | Background [1] Screening | FDEPG | FEDMCL | RBC[2] for Tap Water | OLD-13-01<br>13G00101<br>03/09/95 | OLD-13-01<br>13G00101D<br>03/09/95 | OLD-13-03<br>13G00301<br>04/06/95 | OLD-13-05<br>13G00501<br>03/09/95 | OLD-13-07<br>13G00701<br>04/06/95 |
|---|---|---|---|---|---|---|---|---|---|

[1] Groundwater background screening value is twice the average of detected concentrations for inorganic analytes. For organic compounds, values are the mean of detected concentration, presented for comparison purposes only.
[2] "Risk-Based Concentration Table", USEPA Region III, May 1996, R.L. Smith. RBC for chromium is based on chromium VI. RBC for lead is not available, value is treatment technology action limit for lead in drinking water distribution system identified in "Drinking Water Standards and Health Advisories" (USEPA, 1995). For essential nutrients (calcium, magnesium, potassium, and sodium) screening values were derived based on recommended daily allowances.
[3] Secondary Standard.
[4] Systemic Toxicant.
[5] Primary Standard.

Notes: RI/FS = Remedial Investigation and Feasibility Study.
mg/ℓ = milligrams per liter.
μg/ℓ = micrograms per liter.
NA = not analyzed.
ND = not determined.
c = carcinogenic effects.
n = noncarcinogenic effects.
J = estimated value.
-- = analyte/compound was not detected at reporting limit.
MCL = Maximum Contaminant Level.
FDEPG = Florida Department of Environmental Protection, Groundwater Guidance Concentrations, June 1994.
FEDMCL = Federal Maximum Contaminant Levels, Primary Drinking Water Regulations and Health Advisories, February 1996.
B = Reported concentration is between the instrument detection limit and the contract required detection limit.
USEPA = U.S. Environmental Protection Agency.
ID = identifier.
RBC = risk-based concentration.

Bolded/shaded value indicates exceedance of regulatory guidance and background.

# Table A-7
## Summary of Detections in Deep Groundwater Analytical Results, Study Area 13

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Well ID: / Lab Identifier: / Collection Date: | Background[1] Screening | FDEPG | FEDMCL | RBC[2] for Tap Water | OLD-13-02C 13G00201 04/06/95 | OLD-13-04C 13G00401 04/06/95 | OLD-13-06C 13G00601 04/06/95 | OLD-13-08C 13G00801 04/06/95 |
|---|---|---|---|---|---|---|---|---|
| **Volatile Organics (μg/ℓ)** | | | | | | | | |
| Chloroform | 2.4 | 100[5]/6[6] | 100 | 0.15 c | 0.06 J | -- | -- | 0.1 J |
| Trichloroethene | -- | 3[5] | 5 | 1.6 c | -- | -- | -- | 0.04 J |
| Tetrachloroethene | -- | 3[5] | 5 | 1.1 c | 0.4 | -- | -- | 0.2 |
| Xylenes (total) | -- | 10,000[3][5]/20 | 10,000 | 12,000 n | 0.06 J | -- | -- | -- |
| **Semivolatile Organics (μg/ℓ)** | | | | | | | | |
| bis(2-Ethylhexyl)phthalate | 1 | 6[5] | ND | 4.8 c | -- | -- | 1 | 1 |
| **General Chemistry (mg/ℓ)** | | | | | | | | |
| Total Suspended Solids | ND | ND | ND | ND | 4 | -- | -- | 108 |
| **Inorganics (μg/ℓ)** | | | | | | | | |
| Aluminum | 4,067 | 200[3] | ND | 37,000 n | 4,380 | 320 | 588 | 17,300 |
| Arsenic | 5.0 | 50[5] | 50 | 0.045 c/11 n | 27.6 | 10.3 | 22.3 | 18.3 |
| Barium | 31.4 | 2,000[5] | 2,000 | 2,600 n | 56.6 B | 16.5 B | 17.3 B | 145 B |
| Beryllium | -- | 4[5] | 4 | 0.016 c | 0.32 B | -- | 0.11 B | 0.41 B |
| Calcium | 36,830 | ND | ND | 1,000,000 | 7,360 | 4,970 B | 8,530 | 9,850 |
| Chromium | 7.8 | 100[5] | 100 | 180 n | 7 B | -- | -- | 20.8 |
| Iron | 1,227 | 300[3] | ND | 11,000 n | 2,010 | 1,870 | 544 | 1,190 |
| Lead | 4.0 | 15[5] | 15 | 15 | -- | -- | -- | 2.1 B |
| Magnesium | 4,560 | ND | ND | 118,807 | 2,560 B | 2,550 B | 1,750 B | 3,160 B |
| Manganese | 17.0 | 50[3] | ND | 840 n | 9 B | 6.4 B | 6.5 B | 5.8 B |

See notes at end of table.

## Table A-7 (Continued)
## Summary of Detections in Deep Groundwater
## Analytical Results, Study Area 13

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Well ID:<br>Lab Identifier:<br>Collection Date: | Background [1] Screening | FDEPG | FEDMCL | RBC[2] for Tap Water | OLD-13-02C<br>13G00201<br>04/06/95 | OLD-13-04C<br>13G00401<br>04/06/95 | OLD-13-06C<br>13G00601<br>04/06/95 | OLD-13-08C<br>13G00801<br>04/06/95 |
|---|---|---|---|---|---|---|---|---|
| **Inorganics (μg/ℓ) (Cont.)** | | | | | | | | |
| Potassium | 5,400 | ND | ND | 297,016 | 3,600 B | 3,730 B | 675 B | 2,810 B |
| Sodium | 18,222 | 160,000 [5] | ND | 396,022 | 13,700 | 12,400 | 12,200 | 15,400 |
| Vanadium | 20.6 | 49 [4] | ND | 260 n | 6.4 B | 3 B | -- | 16.9 B |
| Zinc | 4.0 | 5,000 [3] | ND | 11,000 n | 6.8 B | 8.6 B | 4.7 B | 7.2 B |

[1] Groundwater background screening value is twice the average of detected concentrations for inorganic analytes. For organic compounds, values are the mean of detected concentration, presented for comparison purposes only.
[2] "Risk-Based Concentration Table", USEPA Region III, May, 1996, R.L. Smith. RBC for chromium is based on chromium VI. RBC for lead is not available, value is treatment technology action limit for lead in drinking water distribution system identified in Drinking Water Standards and Health Advisories (USEPA, 1995). For essential nutrients (calcium, magnesium, potassium, and sodium) screening values were derived based on recommended daily allowances.
[3] Secondary Standard.
[4] Systemic Toxicant.
[5] Primary Standard.
[6] Carcinogen.

Notes: RI/FS = Remedial Investigation and Feasibility Study.
μg/ℓ = micrograms per liter.
-- = analyte/compound was not detected at reporting limit.
c = carcinogenic effects.
n = noncarcinogenic effects.
J = estimated value.
MCL = maximum contaminant levels.
FDEPG = Florida Department of Environmental Protection, Groundwater Guidance Concentrations, June 1994.
FEDMCL = Federal Maximum Contaminant Levels, Primary Drinking Water Regulations and Health Advisories, February 1996.
B = Reported concentration is between the instrument detection limit and the contract required detection limit.
mg/ℓ = milligrams per liter.
ND = not detected.
USEPA = U.S. Environmental Protection Agency.
RBC = risk-based concentration.
ID = identifier.

Bolded/shaded value indicates exceedance of regulatory guidance and background.

## Table A-8
## Site Screening: Temporary Well and TerraProbe℠ Sampling Results

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Sample ID | Depth (feet bls) | PCE (µg/ℓ) | TCE (µg/ℓ) | 1,1-DCE (µg/ℓ) | 1,2-DCE (µg/ℓ) | Vinyl Chloride (µg/ℓ) |
|---|---|---|---|---|---|---|
| **TerraProbe℠ Samples** | | | | | | |
| 13Q00101FGC | 8 | 1.5 | -- | -- | -- | -- |
| 13Q00102FGC | 18 | -- | 59.3 | -- | -- | -- |
| 13Q00103FGC | 30 | 109.6 | 8.3 | -- | -- | -- |
| 13Q00201FGC | 8 | -- | -- | -- | -- | -- |
| 13Q00202FGC | 18 | -- | 45.8 | -- | -- | -- |
| 13Q00203FGC | 30 | 24.1 | 23.4 | -- | -- | -- |
| 13Q00301FGC | 8 | -- | -- | -- | -- | -- |
| 13Q00302FGC | 18 | 11.2 | -- | -- | -- | -- |
| 13Q00303FGC | 30 | 12.0 | 18.0 | -- | -- | -- |
| 13Q00401FGC | 8 | 1.7 | -- | -- | -- | -- |
| 13Q00402FGC | 18 | 8.8 | -- | -- | -- | -- |
| 13Q00403FGC | 30 | 167.9 | 277.6 | -- | -- | -- |
| 13Q00501FGC | 8 | 0.3 | -- | -- | -- | -- |
| 13Q00502FGC | 18 | 50.6 | -- | -- | -- | -- |
| 13Q00503FGC | 30 | 21.9 | 1059.7 | -- | -- | -- |
| 13Q00601FGC | 8 | 3.0 | -- | -- | -- | -- |
| 13Q00602FGC | 18 | 17.0 | 29.0 | -- | -- | -- |
| 13Q00603FGC | 30 | 821.1 | 852.5 | -- | -- | -- |
| 13Q00603 | 8 | 760 | 2100 | -- | 51 | -- |
| 13Q00701FGC | 8 | 250.8 | 129.9 | -- | -- | -- |
| 13Q00701 | 8 | 1600 | 240 | -- | 770 | 16 |
| 13Q00702FGC | 18 | 4325.8 | 391.1 | -- | -- | -- |
| 13Q00702 | 18 | 270 | 18 | -- | 7 | -- |
| 13Q00703FGC | 30 | 272.0 | 41.1 | -- | -- | -- |
| 13Q00801FGC | 8 | 136.3 | 5.1 | -- | -- | -- |
| 13Q00802FGC | 18 | 468.8 | 54.2 | -- | -- | -- |
| 13Q00803FGC | 30 | 23.4 | 7.6 | -- | -- | -- |
| 13Q00901FGC | 8 | 16.1 | 1.9 | -- | -- | -- |
| 13Q00902FGC | 18 | 0.8 | -- | -- | -- | -- |

See notes at end of table.

**Table A-8 (Continued)**
**Site Screening: Temporary Well and TerraProbe℠ Sampling Results**

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Sample ID | Depth (feet bls) | PCE (μg/ℓ) | TCE (μg/ℓ) | 1,1-DCE (μg/ℓ) | 1,2-DCE (μg/ℓ) | Vinyl Chloride (μg/ℓ) |
|---|---|---|---|---|---|---|
| **TerraProbe℠ Samples (Cont.)** | | | | | | |
| 13Q00903FGC | 30 | 3.0 | -- | -- | -- | -- |
| 13Q01001FGC | 8 | .3 | -- | -- | -- | -- |
| 13Q01002FGC | 18 | 1346.4 | 51.0 | -- | -- | -- |
| 13Q01002 | 18 | 2500 | 84 | -- | 25 | -- |
| 13Q01003FGC | 30 | 1333.4 | 604.5 | -- | -- | -- |
| 13Q01003 | 30 | 2000 | 2200 | -- | 39 | -- |
| 13Q01101FGC | 8 | -- | -- | -- | -- | -- |
| 13Q01102FGC | 18 | 863.5 | 8.6 | -- | -- | -- |
| 13Q01103FGC | 30 | 952.0 | 98.7 | -- | -- | -- |
| 13Q01103 | 30 | 6400 | 400 | -- | 270 | -- |
| 13Q01201FGC | 8 | 4.3 | -- | -- | -- | -- |
| 13Q01202FGC | 18 | 3.1 | -- | -- | -- | -- |
| 13Q01203FGC | 30 | 43.2 | -- | -- | -- | -- |
| 13Q01301FGC | 8 | 37.0 | -- | -- | -- | -- |
| 13Q01302FGC | 18 | 0.1 | 0.1 | -- | -- | -- |
| 13Q01303FGC | 30 | 1.5 | -- | -- | -- | -- |
| 13Q01401FGC | 8 | 1321.7 | 10.3 | -- | -- | -- |
| 13Q01402FGC | 18 | 1244.5 | 379.3 | -- | -- | -- |
| 13Q01403FGC | 30 | 73.6 | 7.2 | -- | -- | -- |
| 13Q01501FGC | 8 | 0.8 | -- | -- | -- | -- |
| 13Q01502FGC | 18 | 4.9 | -- | -- | -- | -- |
| 13Q01503FGC | 30 | 71.1 | 5.6 | -- | -- | -- |
| 13Q01601FGC | 8 | 1.11 | 0.3 | -- | -- | -- |
| 13Q01602FGC | 18 | -- | -- | -- | -- | -- |
| 13Q01603FGC | 30 | -- | -- | -- | -- | -- |
| 13Q01701FGC | 8 | -- | -- | -- | -- | -- |
| 13Q01702FGC | 18 | -- | -- | -- | -- | -- |
| 13Q01703FGC | 30 | -- | -- | -- | -- | -- |

See notes at end of table

## Table A-8 (Continued)
## Site Screening: Temporary Well and TerraProbe[SM] Sampling Results

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Sample ID | Depth (feet bls) | PCE (μg/ℓ) | TCE (μg/ℓ) | 1,1-DCE (μg/ℓ) | 1,2-DCE (μg/ℓ) | Vinyl Chloride (μg/ℓ) |
|---|---|---|---|---|---|---|
| **<u>TerraProbe[SM] Samples</u> (Cont.)** | | | | | | |
| 13Q01801FGC | 8 | 1.4 | -- | -- | -- | -- |
| 13Q01802FGC | 18 | -- | -- | -- | -- | -- |
| 13Q01803FGC | 30 | -- | -- | -- | -- | -- |
| 13Q01901FGC | 8 | -- | -- | -- | -- | -- |
| 13Q01902FGC | 18 | -- | -- | -- | -- | -- |
| 13Q01903FGC | 30 | -- | -- | -- | -- | -- |
| 13Q02001FGC | 8 | -- | -- | -- | -- | -- |
| 13Q02002FGC | 18 | -- | -- | -- | -- | -- |
| 13Q02101FGC | 8 | -- | -- | -- | -- | -- |
| 13Q02102FGC | 18 | -- | -- | -- | -- | -- |
| **<u>Temporary Well Samples</u>** | | | | | | |
| 13G00901FGC | | -- | -- | -- | -- | -- |
| 13G00901 | | -- | -- | -- | -- | -- |
| 13G01001FGC | | -- | -- | -- | -- | -- |
| 13G01001 | | -- | -- | -- | -- | -- |
| 13G01101FGC | | -- | -- | -- | -- | -- |
| 13G01101 | | -- | -- | -- | -- | -- |
| 13G01201FGC | | -- | -- | -- | -- | -- |
| 13G01201 | | -- | -- | -- | -- | -- |
| 13G01301FGC | | -- | -- | -- | -- | -- |
| 13G01301 | | -- | -- | -- | -- | -- |
| 13G01401FGC | | -- | -- | -- | -- | -- |
| 13G01401 | | -- | -- | -- | -- | -- |
| 13G01501FGC | | -- | -- | -- | -- | -- |
| 13G01501 | | -- | -- | -- | -- | -- |
| 13G01601FGC | | -- | -- | -- | -- | -- |
| 13G01601 | | -- | -- | -- | -- | -- |

See notes at end of table.

## Table A-8 (Continued)
## Site Screening: Temporary Well and TerraProbe℠ Sampling Results

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Sample ID | PCE (µg ℓ) | TCE (µg ℓ) | 1,1-DCE (µg ℓ) | 1,2-DCE (µg ℓ) | Vinyl Chloride (µg ℓ) |
|---|---|---|---|---|---|
| **Temporary Well Samples (Cont.)** | | | | | |
| 13G01701FGC | 99.8 | 107.7 | -- | -- | -- |
| 13G01701 | 120 | 170 | -- | 320 | 2 |
| 13G01801FGC | 6.5 | 4.8 | -- | -- | -- |
| 13G01801 | 23 | 14 | -- | 34 | -- |
| 13G01901FGC | -- | -- | -- | -- | -- |
| 13G01901 | -- | -- | -- | -- | -- |
| 13G01901FGCD | -- | -- | -- | -- | -- |
| 13G02001FGC | -- | -- | -- | -- | -- |
| 13G02001 | -- | -- | -- | -- | -- |
| 13G02101FGC | -- | -- | -- | -- | -- |
| 13G02101 | -- | -- | -- | -- | -- |

Notes: "-" = compound not detected above reporting limits.
SM = service mark.
ID = identification.
bls = below land surface.
PCE = perchloroethylene.
µg/ℓ = micrograms per liter.
TCE = trichloroethene.
DCE = dichloroethene.

The suffix "D" denotes a duplicate sample.
The suffix "FGC" denotes a field gas chromatograph (GC) analysis.
The field GC only analyzed for PCE, 1,2-DCE, and TCE.

**Table A-9**
**Summary of Positive Detections in Surface Soil**
**Analytical Results, Study Area 14**

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Lab Identifier: / Collection Date: / Feet bls: | Background [1] Screening | SCG [2] | RBC [3] for Residential Soil | RBC [3] for Industrial Soil | 14B00101 02/25/95 1 | 14B00201 02/25/95 2 | 14B00301 02/25/95 2 | 14B00401 02/25/95 2 |
|---|---|---|---|---|---|---|---|---|
| **Volatile Organics (μg/kg)** | | | | | | | | |
| Tetrachloroethene | -- | 12,000/30 [4] | 12,000 c | 110,000 c | -- | 11 | -- | 1 J |
| **General Chemistry (mg/kg)** | | | | | | | | |
| Total Petroleum Hydrocarbons | -- | ND | ND | ND | 40.2 | 9.1 | 5.5 | 11.2 |
| **Semivolatile Organics (μg/kg)** | | | | | | | | |
| Pyrene | -- | 2,200,000 | 2,300,000 n | 61,000,000 n | 230 J | -- | -- | -- |
| Chrysene | -- | 140,000 | 88,000 c | 780,000 c | 200 J | -- | -- | -- |
| Benzo(b)fluoranthene | -- | 1,400 | 880 c | 7,800 c | 220 J | -- | -- | -- |
| Benzo(k)fluoranthene | -- | 14,000 | 8,800 c | 78,000 c | 180 J | -- | -- | -- |
| Benzo(a)anthracene | -- | 1,400 | 880 c | 7,800 c | 110 J | -- | -- | -- |
| Indeno(1,2,3-cd)pyrene | -- | 1,400 | 880 c | 7,800 c | 140 J | -- | -- | -- |
| Benzo(g,h,i)perylene | -- | 14,000 | 2,300,000 n | 61,000,000 n | 180 J | -- | -- | -- |
| **Pesticides/PCBs (μg/kg)** | | | | | | | | |
| 4,4'-DDE | 130/39.2 | 3,000 | 1,900 c | 17,000 c | 6.2 J | -- | -- | 5.8 |
| 4,4'-DDT | -- | 3,100 | 1,900 c | 17,000 c | 17 | -- | 6.4 | 16 |
| alpha-Chlordane | -- | 800 | 490 c | 4,400 c | 1.8 J | -- | -- | -- |
| gamma-Chlordane | -- | 800 | 490 c | 4,400 c | 1.6 NJ | -- | -- | -- |
| **Inorganics (mg/kg)** | | | | | | | | |
| Aluminum | 2,088 | 75,000 | 78,000 n | 1,000,000 n | 1,730 | 945 | 13.1 B | 844 |
| Arsenic | 1.0 | 0.8 | 0.43 c/23 n | 3.8 c/610 n | 0.62 B | -- | -- | 0.84 B |

See notes at end of table.

## Table A-9 (Continued)
## Summary of Positive Detections in Surface Soil
## Analytical Results, Study Area 14

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Lab Identifier:<br>Collection Date:<br>Feet bls: | Background [1] Screening | SCG [2] | RBC [3] for Residential Soil | RBC [3] for Industrial Soil | 14B00101<br>02/25/95<br>1 | 14B00201<br>02/25/95<br>2 | 14B00301<br>02/25/95<br>2 | 14B00401<br>02/25/95<br>2 |
|---|---|---|---|---|---|---|---|---|
| **Inorganics (mg/kg) (Continued)** | | | | | | | | |
| Barium | 8.7 | 5,200 | 5,500 n | 140,000 n | 5.8 B | 1.8 B | 0.28 B | 2 B |
| Beryllium | 0.09 | 0.2 | 0.15 c | 1.3 c | 0.07 B | -- | -- | -- |
| Cadmium | 0.98 | 37 | 39 n | 1,000 n | 1.7 | -- | -- | -- |
| Calcium | 25,295 | ND | 1,000,000 | 1,000,000 | 12,400 | 2,460 | 458 B | 1,710 |
| Chromium | 4.6 | 290 | 390 n | 10,000 n | 16.4 | 1.3 B | 0.63 B | 1 B |
| Copper | 4.1 | ND | 3,100 n | 82,000 n | 30.2 | -- | -- | -- |
| Iron | 712 | ND | 23,000 n | 610,000 n | 660 | 259 | -- | 279 |
| Lead | 14.5 | 500 | 400 | 400 | 40.9 | 1.1 | -- | 1.1 |
| Magnesium | 328 | ND | 460,468 | 460,468 | 175 B | 41.6 B | 17.1 B | 50.7 B |
| Manganese | 8.1 | 370 | 1,800 n | 47,000 n | 14.7 | 1.3 B | -- | 1 B |
| Nickel | 4.4 | 1,500 | 1,600 n | 41,000 n | 9.2 | -- | -- | -- |
| Vanadium | 3.1 | 490 | 550 n | 14,000 n | 2.5 B | 0.58 B | -- | 0.68 B |
| Zinc | 17.2 | 23,000 | 23,000 n | 610,000 n | 52.9 | -- | -- | 5.3 |

See notes at end of table.

## Table A-9 (Continued)
## Summary of Positive Detections in Surface Soil
## Analytical Results, Study Area 14

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Lab Identifier:<br>Collection Date:<br>Feet bls: | Background [1] Screening | SCG [2] | RBC [3] for Residential Soil | RBC [3] for Industrial Soil | 14B00101<br>02/25/95<br>1 | 14B00201<br>02/25/95<br>2 | 14B00301<br>02/25/95<br>2 | 14B00401<br>02/25/95<br>2 |
|---|---|---|---|---|---|---|---|---|

[1] The background screening value is twice the average of detected background concentrations for inorganic analytes. For organic compounds, values are the mean of detected background concentrations, presented for comparison purposes only.
[2] "Soil Cleanup Goals for Florida" (Florida Department of Environmental Protection memorandum, September 29, 1995). Arsenic value is as revised in Applicability of Soil Cleanup Goals for Florida (FDEP memorandum, January 19, 1996). Values indicated are from a residential scenario. Chromium values are for chromium VI.
[3] "Risk-Based Concentration Table", "USEPA Region III, May 1996, R.L. Smith. RBC for chromium is based on chromium VI. RBC for lead is not available, value is Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites (OSWER directive 9355-4-12). For essential nutrients (calcium, magnesium, potassium, and sodium), screening values were derived based on recommended daily allowances.
[4] Residential/Leaching SCGs.

Notes: RI/FS = Remedial Investigation and Feasibility Study.
n = noncarcinogenic effects.
c = carcinogenic effects.
μg/kg = micrograms per kilogram.
mg/kg = milligrams per kilogram.
ND = not determined.
N = Indicates presumptive evidence of the compound.
J = estimated value.
bls = below land surface.
DDE = dichlorodiphenyldichloroethene.
DDT = dichlorodiphenyltrichloroethane.
USEPA = U.S. Environmental Protection Agency.
OSWER = Office of Solid Waste and Emergency Response.
B = reported concentration is between the instrument detection limit and the contract required detection limit.
-- = analyte/compound was not detected at reporting limit.
SCG = soil cleanup goals.
RBC = risk-based concentration.

All inorganic results expressed in mg/kg soil dry weight; organics in μg/kg soil dry weight.
Bolded/shaded values indicate exceedance of regulatory guidance and background.

# Table A-10
## Summary of Positive Detections in Subsurface Soil Analytical Results, Study Area 14

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Lab Identifier: / Collection Date: / Feet bls: | Background [1] Screening | SCG [2] | RBC [3] for Residential Soil | RBC [3] for Industrial Soil | 14B00102 02/25/95 10 | 14B00102D 02/25/95 10 | 14B00202 03/27/95 10 | 14B00302 02/28/95 6 | 14B00402 03/27/95 10 |
|---|---|---|---|---|---|---|---|---|---|
| **Volatile Organics (μg/kg)** | | | | | | | | | |
| Acetone | -- | NA | 7,800,000 n | 200,000,000 n | -- | -- | 6 J | 33 | 5 J |
| Tetrachloroethene | -- | 30 | 12,000 c | 110,000 c | -- | -- | -- | -- | 2 J |
| **General Chemistry (mg/kg)** | | | | | | | | | |
| Total Petroleum Hydrocarbons | -- | NA | ND | ND | 594 | 558 | -- | -- | -- |
| **Semivolatile Organics (μg/kg)** | | | | | | | | | |
| Fluoranthene | -- | NA | 31,000,000 n | 82,000,000 n | -- | -- | -- | 140 J | -- |
| Pyrene | -- | NA | 2,300,000 n | 61,000,000 n | -- | -- | -- | 170 J | -- |
| Chrysene | -- | NA | 88,000 c | 780,000 c | -- | -- | -- | 150 J | -- |
| Benzo(b)fluoranthene | -- | NA | 880 c | 7,800 c | -- | -- | -- | 170 J | -- |
| Benzo(k)fluoranthene | -- | NA | 8,800 c | 78,000 c | -- | -- | -- | -- | -- |
| Benzo(a)anthracene | -- | NA | 880 c | 7,800 c | -- | -- | -- | 100 J | -- |
| Benzo(g,h,i)perylene | -- | NA | 2,300,000 n | 61,000,000 n | -- | -- | -- | 110 J | -- |
| **Pesticides/PCBs (μg/kg)** | | | | | | | | | |
| 4,4'-DDD | -- | NA | 2,700 c | 24,000 c | 9.9 J | 9.4 J | -- | -- | -- |
| 4,4'-DDE | 39.2 | NA | 1,900 c | 17,000 c | 5 J | 5.1 | -- | 32 | -- |
| 4,4'-DDT | -- | NA | 1,900 c | 17,000 c | -- | -- | -- | 100 | -- |
| alpha-BHC | -- | NA | 100 c | 910 c | -- | -- | -- | 6.1 | -- |
| alpha-Chlordane | -- | NA | 490 c | 4,400 c | -- | -- | -- | 4.6 | -- |
| gamma-Chlordane | -- | NA | 490 c | 4,400 c | -- | -- | -- | 4.4 J | -- |
| **General Chemistry (mg/kg)** | | | | | | | | | |
| Total Petroleum Hydrocarbons | NA | NA | ND | ND | NA | NA | 79.4 | 48.4 | 24.2 |

See notes at end of table.

## Table A-10 (Continued)
## Summary of Positive Detections in Subsurface Soil
## Analytical Results, Study Area 14

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Lab Identifier: / Collection Date: / Feet bls: | Background [1] Screening | SCG [2] | RBC [3] for Residential Soil | RBC [3] for Industrial Soil | 14B00102 02/25/95 10 | 14B00102D 02/25/95 10 | 14B00202 03/27/95 10 | 14B00302 02/28/95 6 | 14B00402 03/27/95 10 |
|---|---|---|---|---|---|---|---|---|---|
| **Inorganics (mg/kg)** | | | | | | | | | |
| Aluminum | 2,119 | NA | 78,000 n | 1,000,000 n | 1,880 | 2,090 | 323 | 741 | 1,580 |
| Arsenic | 1.1 | NA | 0.43 c/23 n | 3.8 c/610 n | 2.6 B | 1.8 B | -- | -- | 0.17 B |
| Barium | 3.6 | NA | 5,500 | 140,000 n | 18.6 B | 19.9 B | 0.49 B | 3.9 B | 10.1 B |
| Beryllium | -- | NA | 0.15 c | 1.3 c | 0.36 B | 0.49 B | -- | 0.06 B | 0.08 B |
| Calcium | 115 | NA | 1,000,000 | 1,000,000 | 2,310 | 2,440 | 3,340 | 25,400 J | 566 B |
| Chromium | 3.7 | NA | 390 n | 10,000 n | 33 | 27.2 | 1.8 B | 1.8 B | 4.7 |
| Cobalt | 1.6 | NA | 4,700,000 n | 120,000,000 n | 1 B | 0.87 B | -- | -- | -- |
| Copper | -- | NA | 3,100 n | 82,000 n | 39.2 | 48.4 | 2.6 B | 0.87 J | 3.6 B |
| Iron | 264 | NA | 23,000 n | 610,000 n | 5,500 | 7,260 | 72 | 216 J | 130 |
| Lead | 3.9 | NA | 400 | 400 | 6 | 6.2 | 0.56 B | 5.2 J | 4.4 |
| Magnesium | 32.8 | NA | 460,468 | 460,468 | 818 B | 949 B | 31.7 B | 183 B | 28.3 B |
| Manganese | 2.1 | NA | 1,800 n | 47,000 n | 5.2 | 6.6 | 1.8 B | 5.3 | 1.8 B |
| Mercury | -- | NA | 23 n | 610 n | -- | -- | -- | 0.03 B | -- |
| Nickel | -- | NA | 1,600 n | 41,000 n | 3.1 B | 4 B | -- | -- | -- |
| Potassium | 185 | NA | 297,016 | 297,016 | 1,440 | 1,660 | -- | -- | -- |
| Sodium | -- | NA | 1,000,000 | 1,000,000 | -- | -- | 116 B | -- | 159 B |
| Thallium | -- | NA | 6.3 n | 160 n | -- | -- | -- | -- | 0.15 B |
| Vanadium | 3.4 | NA | 550 n | 14,000 n | 6.9 B | 8.1 B | 0.68 B | 0.56 J | 2.6 B |
| Zinc | 5.6 | NA | 23,000 n | 610,000 n | 48.4 | 56.7 | -- | 7.3 | -- |

See notes at end of table.

**Table A-10 (Continued)**
**Summary of Positive Detections in Subsurface Soil**
**Analytical Results, Study Area 14**

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

1 Background values are for subsurface soils and surface soils, respectively. The background screening value is twice the average of detected background concentrations for inorganic analytes. For organic compounds, values are the mean of detected background concentrations, presented for comparison purposes only.

2 "Soil Cleanup Goals for Florida" (Florida Department of Environmental Protection [FDEP] memorandum, September 29, 1995). Arsenic value is as revised in Applicability of Soil Cleanup Goals for Florida (FDEP memorandum, January 19, 1996). Values indicated are for a leaching scenario, and only apply to tetrachloroethene (PCE). PCE is the only organic constituent present in subsurface soil and also present in groundwater above Florida Groundwater Guidance Concentrations.

3 "Risk-Based Concentration Table", USEPA Region III, May 1996, R.L. Smith. RBC for chromium is based on chromium VI. RBC for lead is not available, value is Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites (OSWER directive 9355-4-12). For essential nutrients (calcium, magnesium, potassium, and sodium) screening values were derived based on recommended daily allowances.

Notes: RI/FS = Remedial Investigation and Feasibility Study.
μg/kg micrograms per kilogram.
mg/kg = milligrams per kilogram.
-- = analyte/compound was not detected at reporting limit.
ND = not determined.
NA = not analyzed.
n = noncarcinogenic effects.
c = carcinogenic effects.
J = estimated value.
B = reported concentration is between the instrument detection limit and the contract required detection limit.
bls = below land surface.
PCB = polychlorinated biphenyl.
DDD = dichlorodiphenyldichloroethane.
DDE = dichlorodiphenyldichloroethene.
DDT = dichlorodiphenyltrichloroethane.
BHC = benzene hexachloride.
USEPA = U.S. Environmental Protection Agency.
OSWER = Office of Solid Waste and Emergency Response.
SCG = soil cleanup goals.
RBC = risk-based concentration.

All inorganic results expressed in mg/kg soil dry weight; organics in μg/kg soil dry weight.
Bolded/shaded values indicate exceedance of regulatory guidance and background.

# Table A-11
## Summary of Detections in Groundwater
## Analytical Results, Study Area 14

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Lab Identifier:<br>Collection Data:<br>Feet bls: | Background [1] Screening | FDEPG | FEDMCL | RBC [2] for Tap Water | OLD-14-01A<br>14G00101<br>04/06/95 | OLD-14-02A<br>14G00201<br>04/06/95 | OLD-14-03A<br>14G00301<br>03/10/95 | OLD-14-03A<br>14G00302<br>06/08/95 | OLD-14-04A<br>14G00401<br>04/06/95 | OLD-14-04A<br>14G00401D<br>04/06/95 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Volatile organics (μg/ℓ)** | | | | | | | | | | |
| Methylene chloride | -- | 5 [5] | 5 | 0.15 c | -- | 2 J | -- | NA | -- | -- |
| Chloroform | 2.4 | 6 [6] | 100 | 0.15 c | -- | 0.2 J | -- | NA | -- | -- |
| Trichloroethene | -- | 3 [5] | 5 | 1.6 c | -- | -- | -- | NA | 20 J | 19 J |
| Tetrachloroethene | -- | 3 [5] | 6 | 1.1 c | -- | 1.37 J | -- | NA | 46 | 46 |
| **Semivolatile organics (μg/ℓ)** | | | | | | | | | | |
| bis(2-Ethylhexyl)-phthalate | -- | 6 [5] | 6 | 4.8 c | -- | -- | 33 D | -- | -- | -- |
| Dimethylphthalate | -- | 70,000 [4] | ND | 370,000 n | -- | -- | -- | -- | -- | 1 J |
| Phenol | -- | -- | -- | 22,000 n | -- | -- | -- | 1 J | -- | -- |
| **Inorganics (μg/ℓ)** | | | | | | | | | | |
| Aluminum | 4,067 | 200 [3] | 200 | 37,000 n | 105 B | 81.6 B | -- | NA | 143 B | 121 B |
| Antimony | 4.1 | 6 [5] | 6 | 15 n | -- | 10.1 B | 17.6 | NA | 10.6 B | 10.4 B |
| Arsenic | 5.0 | 50 [5] | 50 | 0.045 c/11 n | 1.9 B | 2 B | -- | NA | -- | -- |
| Barium | 31.4 | 2,000 [5] | 2,000 | 2,600 n | 11.6 B | 4.5 B | 5.7 B | NA | 5.8 B | 5.3 B |
| Beryllium | -- | 4 [5] | 4 | 0.016 c | 0.1 B | -- | -- | NA | 0.15 B | -- |
| Calcium | 36,830 | ND | ND | 1,000,000 | 37,200 | 28,100 | 95,500 | NA | 31,600 | 31,600 |
| Iron | 1,227 | 300 [3] | ND | 11,000 n | 191 | 8 B | 32.6 B | NA | 142 | 145 |
| Magnesium | 4,560 | ND | ND | 118,807 | 1,280 B | 2,320 B | 6,740 | NA | 2,000 B | 2,020 B |
| Manganese | 17.0 | 50 [3] | ND | 840 n | 7.4 B | 3.5 B | 9.4 B | NA | 6.6 B | 6.2 B |
| Potassium | 5,400 | ND | -- | 297,016 | 1,900 B | 922 B | 884 B | NA | 2,720 B | 2,760 B |
| Selenium | 9.7 | 50 [5] | 50 | 180 n | -- | -- | 3.2 B | NA | -- | -- |

See notes at end of table.

## Table A-11 (Continued)
## Summary of Detections in Groundwater
## Analytical Results, Study Area 14

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Lab Identifier: / Collection Date: / Feet bls: | Background [1] Screening | FDEPG | FEDMCL | RBC [2] for Tap Water | OLD-14-01A 14G00101 04/06/95 | OLD-14-02A 14G00201 04/06/95 | OLD-14-03A 14G00301 03/10/95 | OLD-14-03A 14G00302 06/08/95 | OLD-14-04A 14G00401 04/06/95 | OLD-14-04A 14G00401D 04/06/95 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Inorganics (µg/ℓ) (Cont.)** | | | | | | | | | | |
| Silver | -- | 100 [3] | ND | 180 n | 3.6 B | -- | -- | NA | -- | 3.6 B |
| Sodium | 18,222 | 160,000 [5] | ND | 396,022 | 1,340 B | 7,370 | 8,300 | NA | 40,500 | 41,600 |
| Vanadium | 20.6 | 49 [4] | ND | 260 n | 2.8 B | 11.6 B | -- | NA | 7.4 B | 5.7 B |
| Zinc | 4 | 5,000 [3] | ND | 11,000 n | 1.7 B | 24.4 | 1.9 B | NA | 2.3 B | 1.4 B |

[1] Groundwater background screening value is twice the average of detected concentrations for inorganic analytes. For organic compounds, values are the mean of detected concentration, presented for comparison purposes only.
[2] "Risk-Based Concentration Table", USEPA Region III, May 1996, R.L. Smith. RBC for chromium is based on chromium VI. RBC for lead is not available, value is treatment technology action limit for lead in drinking water distribution system identified in Drinking Water Standards and Health Advisories (USEPA, 1995). For essential nutrients (calcium, magnesium, potassium, and sodium) screening values were derived based on recommended daily allowances.
[3] Secondary Standard.
[4] Systemic Toxicant.
[5] Primary Standard.
[6] Carcinogen.

Notes: RI/FS = Remedial Investigation and Feasibility Study.
ND = not determined.
n = noncarcinogenic effects.
NA = not analyzed.
c = carcinogenic effects.
J = estimated value.
µg/ℓ = micrograms per liter.
-- = analyte/compound was not detected at reporting limit.
D = indicates value was determined during a diluted reanalysis.
B = reported concentration is between the instrument detection limit and the contract required detection limit.
MCL = maximum contaminant level.
FDEPG = Florida Department of Environmental Protection, Groundwater Guidance Concentrations, June 1994.
FEDMCL = Federal Maximum Contaminant Levels, Primary Drinking Water Regulations and Health Advisories, February 1996.
RBC = risk-based concentration.

Bolded/shaded value indicates exceedance of regulatory guidance and background.

FOCUSED FIELD INVESTIGATION, OU4
SUMMARY TABLE FOR FIELD LABORATORY AND OFFSITE ANALYTICAL RESULTS

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Sample No. | EASTING | NORTHING | Date sampled | medium | depth(u) | depth(l) | PCE | TCE | C-1,2-DCE | T-1,2-DCE | 1,1-DCE | VC | T. CHLOR. | BENZENE | TOLUENE | ETHYLB. | m/p XYL. | O XYL. | BTEX | TOT VOCs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| U4D00101F | 544389.00 | 1536611.00 | May-96 | D | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4D00201F | 544580.00 | 1536844.00 | May-96 | D | | | 92.0 | 220.0 | 110.0 | 2.1 | N/D | 0.4 | 424.5 | N/D | N/D | N/D | N/D | N/D | 0.0 | 424.5 |
| U4D00301F | 544608.00 | 1536833.00 | May-96 | D | | | 1.6 | 150.0 | 92.0 | 1.0 | N/D | N/D | 244.6 | N/D | N/D | N/D | N/D | N/D | 0.0 | 244.6 |
| U4D00401F | 544629.00 | 1536844.00 | May-96 | D | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4D00402F | 544629.00 | 1536844.00 | May-96 | D | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4D00501F | 544649.00 | 1536846.00 | May-96 | D | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4D00502F | 544649.00 | 1536846.00 | May-96 | D | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4D00601F | 544568.00 | 1536873.00 | May-96 | D | | | N/D | 27.0 | 750.0 | 5.6 | N/D | 95.0 | 877.6 | N/D | N/D | N/D | N/D | N/D | 0.0 | 877.6 |
| U4D00701F | 544532.00 | 1536892.00 | May-96 | D | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | 11.0 | N/D | N/D | N/D | 11.0 | 11.0 |
| U4D00702F | 544532.00 | 1536892.00 | May-96 | D | | | N/D | 3.7 | N/D | N/D | N/D | N/D | 3.7 | N/D | N/D | N/D | N/D | N/D | 0.0 | 3.7 |
| U4D00801F | 544529.00 | 1536921.00 | May-96 | D | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4D00802F | 544529.00 | 1536921.00 | May-96 | D | | | N/D | 1.1 | N/D | N/D | N/D | N/D | 1.1 | N/D | N/D | N/D | N/D | N/D | 0.0 | 1.1 |
| U4D00901F | 544544.00 | 1536944.00 | May-96 | D | | | N/D | N/D | 2.2 | N/D | N/D | N/D | 2.2 | N/D | 1.6 | N/D | N/D | N/D | 1.6 | 3.8 |
| U4D00901FD | 544544.00 | 1536944.00 | May-96 | D | | | N/D | 0.6 | N/D | N/D | N/D | N/D | 0.6 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.6 |
| U4D01001F | 544558.00 | 1536844.00 | May-96 | D | | | 94000.0 | 53000.0 | 500.0 | 35.0 | N/D | 13.0 | 147548.0 | N/D | 3.3 | N/D | N/D | 1.9 | 5.2 | 147553.2 |
| U4D01101F | 544565.00 | 1536806.00 | May-96 | D | | | N//D | 3.6 | 38.0 | N/D | N/D | 1.3 | 42.9 | N/D | N/D | N/D | N/D | 1.3 | 1.3 | 44.2 |
| U4D01102F | 544565.00 | 1536806.00 | May-96 | D | | | N//D | 3.8 | 22.0 | N/D | N/D | N/D | 25.8 | N/D | N/D | N/D | N/D | 10.0 | 10.0 | 35.8 |
| U4D01201F | 544526.00 | 1536790.00 | May-96 | D | | | 43.0 | 1400.0 | 3000.0 | 28.0 | N/D | 53.0 | 4524.0 | N/D | 2.3 | N/D | N/D | N/D | 2.3 | 4526.3 |
| U4D01301F | 544510.00 | 1536753.00 | May-96 | D | | | 22.0 | 360.0 | 700.0 | 6.8 | N/D | N/D | 1088.8 | N/D | N/D | N/D | N/D | N/D | 0.0 | 1088.8 |
| U4D01302F | 544510.00 | 1536753.00 | May-96 | D | | | 0.9 | 79.0 | 220.0 | 1.7 | N/D | N/D | 301.6 | N/D | N/D | N/D | N/D | N/D | 0.0 | 301.6 |
| U4D01401F | 544475.00 | 1536728.00 | May-96 | D | | | 1.8 | 72.0 | 53.0 | N/D | N/D | N/D | 126.8 | N/D | N/D | N/D | N/D | N/D | 0.0 | 126.8 |
| U4D01402F | 544475.00 | 1536728.00 | May-96 | D | | | N/D | 7.8 | 6.1 | N/D | N/D | N/D | 13.9 | N/D | N/D | N/D | N/D | N/D | 0.0 | 13.9 |
| U4D01501F | 544470.00 | 1536698.00 | May-96 | D | | | 1.4 | 56.0 | 38.0 | N/D | N/D | N/D | 95.4 | N/D | 1.4 | N/D | N/D | N/D | 1.4 | 96.8 |
| U4D01502F | 544470.00 | 1536698.00 | May-96 | D | | | N/D | 13.0 | 10.0 | N/D | N/D | N/D | 23.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 23.0 |
| U4D01601F | 544457.00 | 1536689.00 | May-96 | D | | | 1.0 | 0.7 | N/D | N/D | N/D | N/D | 1.7 | N/D | N/D | N/D | N/D | N/D | 0.0 | 1.7 |
| U4D01602F | 544457.00 | 1536689.00 | May-96 | D | | | 0.7 | N/D | N/D | N/D | N/D | N/D | 0.7 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.7 |
| U4D01701F | 544446.00 | 1536656.00 | May-96 | D | | | N/D | N/D | N/D | N/D | N/D | 0.5 | 0.5 | N/D | 150.0 | N/D | N/D | N/D | 150.0 | 150.5 |
| U4D01702F | 544446.00 | 1536656.00 | May-96 | D | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4D01801F | 544428.00 | 1536627.00 | May-96 | D | | | 20.0 | 10.0 | 7.9 | N/D | N/D | N/D | 37.9 | N/D | 550.0 | N/D | N/D | N/D | 550.0 | 587.9 |
| U4D01802F | 544428.00 | 1536627.00 | May-96 | D | | | N/D | 1.3 | N/D | N/D | N/D | 0.2 | 1.5 | N/D | N/D | N/D | N/D | N/D | 0.0 | 1.5 |
| U4D01802FD | 544428.00 | 1536627.00 | May-96 | D | | | 0.8 | 1.2 | N/D | N/D | N/D | N/D | 2.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 2.0 |
| U4D01901F | 544528.00 | 1536841.00 | May-96 | D | | | 78.0 | 800.0 | 160.0 | 2.4 | N/D | 1.5 | 1041.9 | N/D | N/D | N/D | N/D | N/D | 0.0 | 1041.9 |
| U4D02001F | 544541.00 | 1536868.00 | May-96 | D | | | N/D | 9.0 | 3.0 | N/D | N/D | N/D | 12.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 12.0 |
| U4D02101F | 544513.00 | 1536821.00 | May-96 | D | | | 18.0 | 410.0 | 36.0 | N/D | 1.2 | N/D | 465.2 | N/D | N/D | N/D | N/D | N/D | 0.0 | 465.2 |
| U4D02201F | 544499.00 | 1536794.00 | May-96 | D | | | 200.0 | 6.6 | N/D | N/D | N/D | N/D | 206.6 | N/D | N/D | N/D | N/D | N/D | 0.0 | 206.6 |
| U4D02301F | 544517.00 | 1536872.00 | May-96 | D | | | N/D | 3.9 | 31.0 | N/D | N/D | N/D | 34.9 | N/D | N/D | N/D | N/D | N/D | 0.0 | 34.9 |
| U4D02401F | 544478.00 | 1536772.00 | May-96 | D | | | 1400.0 | 100.0 | 41.0 | N/D | N/D | N/D | 1541.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 1541.0 |
| U4D02501F | 544463.00 | 1536747.00 | May-96 | D | | | 4.4 | 42.0 | 20.0 | N/D | N/D | N/D | 66.4 | N/D | N/D | N/D | N/D | N/D | 0.0 | 66.4 |
| U4D02601F | 544444.00 | 1536723.00 | May-96 | D | | | N/D | 130.0 | 80.0 | N/D | N/D | N/D | 210.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 210.0 |
| U4D02601FD | 544444.00 | 1536723.00 | May-96 | D | | | N/D | 42.0 | 25.0 | N/D | N/D | N/D | 67.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 67.0 |
| U4D02701F | 544433.00 | 1536700.00 | May-96 | D | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4D02801F | 544422.00 | 1536677.00 | May-96 | D | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4D02901F | 544413.00 | 1536654.00 | May-96 | D | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |

# FOCUSED FIELD INVESTIGATION, OU4
## SUMMARY TABLE FOR FIELD LABORATORY AND OFFSITE ANALYTICAL RESULTS

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Sample No. | EASTING | NORTHING | Date sampled | medium | depth(u) | depth(l) | PCE | TCE | C-1,2-DCE | T-1,2-DCE | 1,1-DCE | VC | T. CHLOR. | BENZENE | TOLUENE | ETHYLB. | m/p XYL. | O XYL. | BTEX | TOT VOCs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| U4D03001F | 544491.00 | 1536897.00 | May-96 | D | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4D03101F | 544505.00 | 1536849.00 | May-96 | D | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4D03201F | 544492.00 | 1536822.00 | May-96 | D | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4D03301F | 544428.00 | 1536844.00 | May-96 | D | | | 2.0 | N/D | N/D | N/D | N/D | N/D | 2.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 2.0 |
| U4D03401F | 544409.00 | 1536799.00 | May-96 | D | | | 8.1 | N/D | N/D | N/D | N/D | N/D | 8.1 | N/D | N/D | N/D | N/D | N/D | 0.0 | 8.1 |
| U4D03501F | 544393.00 | 1536758.00 | May-96 | D | | | N/D | 15.0 | 5.7 | N/D | N/D | N/D | 20.7 | N/D | N/D | N/D | N/D | N/D | 0.0 | 20.7 |
| U4D03601F | 544380.00 | 1536705.00 | May-96 | D | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4D03701F | 544358.00 | 1536664.00 | May-96 | D | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4D03801F | 544361.00 | 1536841.00 | May-96 | D | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4D03901F | 544338.00 | 1536795.00 | May-96 | D | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4D04001F | 544441.00 | 1536888.00 | May-96 | D | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4D04101F | 544337.00 | 1536745.00 | May-96 | D | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4D04201F | 544382.00 | 1536632.00 | May-96 | D | | | N/D | 0.7 | N/D | N/D | N/D | N/D | 0.7 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.7 |
| U4D04201FD | 544382.00 | 1536632.00 | May-96 | D | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4D04301F | 543989.00 | 1536792.00 | May-96 | D | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4D04401F | 544384.00 | 1536877.00 | May-96 | D | | | 28.0 | 18.0 | N/D | N/D | N/D | N/D | 46.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 46.0 |
| U4D04501F | 544451.00 | 1536627.00 | May-96 | D | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4D04601F | 544178.00 | 1536756.00 | May-96 | D | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4D04701F | 544347.00 | 1536909.00 | May-96 | D | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4D04801F | 544310.00 | 1536866.00 | May-96 | D | | | N/D | N/D | 160.0 | 1.2 | N/D | N/D | 161.2 | N/D | N/D | N/D | N/D | N/D | 0.0 | 161.2 |
| U4G00101F | 544607.72 | 1536833.15 | May-96 | G | | | 6.4 | 3000.0 | 1600.0 | 25.0 | N/D | N/D | 4631.4 | N/D | N/D | N/D | N/D | N/D | 0.0 | 4631.4 |
| U4G00102F | 544607.72 | 1536833.15 | May-96 | G | | | 1.5 | 450.0 | 880.0 | 32.0 | N/D | 1.0 | 1364.5 | N/D | N/D | N/D | N/D | N/D | 0.0 | 1364.5 |
| U4G00201F | 544552.55 | 1536846.70 | May-96 | G | | | 590.0 | 5800.0 | 530.0 | 5.0 | N/D | N/D | 6925.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 6925.0 |
| U4G00202F | 544552.55 | 1536846.70 | May-96 | G | | | 120.0 | 1300.0 | 840.0 | 25.0 | 1.1 | 0.4 | 2286.5 | N/D | N/D | N/D | N/D | N/D | 0.0 | 2286.5 |
| U4G00301F | 544560.09 | 1536800.29 | May-96 | G | | | 22.0 | 1400.0 | 710.0 | 19.0 | N/D | N/D | 2151.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 2151.0 |
| U4G00401F | 544531.80 | 1536885.31 | May-96 | G | | | 3.4 | 3.3 | 2.2 | N/D | N/D | N/D | 8.9 | N/D | N/D | N/D | N/D | N/D | 0.0 | 8.9 |
| U4G00501F | 544507.63 | 1536747.31 | May-96 | G | | | 8.4 | 330.0 | 570.0 | 11.0 | N/D | N/D | 919.4 | N/D | N/D | N/D | N/D | N/D | 0.0 | 919.4 |
| U4G00601F | 544464.00 | 1536834.00 | May-96 | G | | | 22.0 | 27.0 | 2.2 | N/D | N/D | N/D | 51.2 | N/D | N/D | N/D | N/D | N/D | 0.0 | 51.2 |
| U4G00901 | 544605.89 | 1536845.69 | Jun-96 | G | 1 | 11 | N/D | 500.0 | 830.0 | N/D | N/D | N/D | 1330.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 1330.0 |
| U4G00901D | 544605.89 | 1536845.69 | Jun-96 | G | 1 | 11 | N/D | 680.0 | 850.0 | N/D | N/D | N/D | 1530.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 1530.0 |
| U4G01001 | 544607.95 | 1536857.37 | Jun-96 | G | 16 | 21 | N/D | 76.0 | 140.0 | N/D | N/D | N/D | 216.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 216.0 |
| U4G01101 | 544600.52 | 1536850.67 | Jun-96 | G | 57 | 62 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4G01201 | 544687.41 | 1536803.34 | Jun-96 | G | 1.5 | 11.5 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4G01301 | 544693.11 | 1536799.83 | Jun-96 | G | 16 | 21 | N/D | 35.0 | 130.0 | N/D | N/D | N/D | 165.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 165.0 |
| U4G01401 | 544695.82 | 1536807.66 | Jun-96 | G | 57 | 62 | 91.0 | N/D | N/D | N/D | N/D | N/D | 91.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 91.0 |
| U4Q00101F | 544606.00 | 1536854.00 | May-96 | Q | 2 | 4 | 1.6 | 420.0 | 230.0 | 0.4 | 1.0 | N/D | 653.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 653.0 |
| U4Q00102F | 544606.00 | 1536854.00 | May-96 | Q | 4 | 6 | 75.0 | 990.0 | 570.0 | 2.5 | N/D | N/D | 1637.5 | N/D | N/D | N/D | N/D | N/D | 0.0 | 1637.5 |
| U4Q00103F | 544606.00 | 1536854.00 | May-96 | Q | 6 | 8 | N/D | 110.0 | 410.0 | N/D | N/D | N/D | 520.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 520.0 |
| U4Q00104F | 544606.00 | 1536854.00 | May-96 | Q | 8 | 10 | N/D | 93.0 | 370.0 | N/D | N/D | N/D | 463.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 463.0 |
| U4Q00105F | 544606.00 | 1536854.00 | May-96 | Q | 10 | 12 | N/D | 110.0 | 830.0 | N/D | N/D | N/D | 940.0 | N/D | N/D | N/D | 110.0 | 16.0 | 126.0 | 1066.0 |
| U4Q00106F | 544606.00 | 1536854.00 | May-96 | Q | 24 | 26 | 12.0 | 18.0 | N/D | N/D | N/D | N/D | 30.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 30.0 |
| U4Q00107F | 544606.00 | 1536854.00 | May-96 | Q | 26 | 28 | 8.8 | 11.0 | N/D | N/D | N/D | N/D | 19.8 | N/D | N/D | N/D | N/D | N/D | 0.0 | 19.8 |
| U4Q00108F | 544606.00 | 1536854.00 | May-96 | Q | 28 | 30 | 9.4 | 3.1 | N/D | N/D | N/D | N/D | 12.5 | N/D | N/D | N/D | N/D | N/D | 0.0 | 12.5 |

FOCUSED FIELD INVESTIGATION, OU4
SUMMARY TABLE FOR FIELD LABORATORY AND OFFSITE ANALYTICAL RESULTS

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Sample No. | EASTING | NORTHING | Date sampled | medium | depth(u) | depth(l) | PCE | TCE | C-1,2-DCE | T-1,2-DCE | 1,1-DCE | VC | T. CHLOR. | BENZENE | TOLUENE | ETHYLB. | m/p XYL. | O XYL. | BTEX | TOT VOCs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| U4Q00109F | 544606.00 | 1536854.00 | May-96 | Q | 30 | 32 | 3.5 | 1.2 | N/D | N/D | N/D | N/D | 4.7 | N/D | N/D | N/D | N/D | N/D | 0.0 | 4.7 |
| U4Q00110F | 544606.00 | 1536854.00 | May-96 | Q | 32 | 34 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00111F | 544606.00 | 1536854.00 | May-96 | Q | 34 | 36 | 1.5 | 0.5 | N/D | N/D | N/D | N/D | 2.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 2.0 |
| U4Q00112F | 544606.00 | 1536854.00 | May-96 | Q | 36 | 38 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00113F | 544606.00 | 1536854.00 | May-96 | Q | 38 | 40 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00113FD | 544606.00 | 1536854.00 | May-96 | Q | 38 | 40 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00114F | 544606.00 | 1536854.00 | May-96 | Q | 40 | 42 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00115F | 544606.00 | 1536854.00 | May-96 | Q | 42 | 44 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00116F | 544606.00 | 1536854.00 | May-96 | Q | 44 | 46 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00117F | 544606.00 | 1536854.00 | May-96 | Q | 46 | 48 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00118F | 544606.00 | 1536854.00 | May-96 | Q | 48 | 50 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00119F | 544606.00 | 1536854.00 | May-96 | Q | 50 | 52 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00120F | 544606.00 | 1536854.00 | May-96 | Q | 52 | 54 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00121F | 544606.00 | 1536854.00 | May-96 | Q | 59 | 61 | N/D | 0.9 | 2.5 | N/D | N/D | N/D | 3.4 | N/D | N/D | N/D | N/D | N/D | 0.0 | 3.4 |
| U4Q00122F | 544606.00 | 1536854.00 | May-96 | Q | 65 | 67 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00201F | 544613.00 | 1536897.00 | May-96 | Q | 3 | 5 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00202F | 544613.00 | 1536897.00 | May-96 | Q | 6 | 8 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00203F | 544613.00 | 1536897.00 | May-96 | Q | 9 | 11 | 2.4 | 1.4 | 3.2 | N/D | N/D | N/D | 7.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 7.0 |
| U4Q00204F | 544613.00 | 1536897.00 | May-96 | Q | 22 | 24 | 0.8 | N/D | N/D | N/D | N/D | N/D | 0.8 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.8 |
| U4Q00205F | 544613.00 | 1536897.00 | May-96 | Q | 24 | 26 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00206F | 544613.00 | 1536897.00 | May-96 | Q | 28 | 30 | 0.6 | N/D | N/D | N/D | N/D | N/D | 0.6 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.6 |
| U4Q00207F | 544613.00 | 1536897.00 | May-96 | Q | 32 | 34 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00208F | 544613.00 | 1536897.00 | May-96 | Q | 40 | 42 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00209F | 544613.00 | 1536897.00 | May-96 | Q | 48 | 50 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00210F | 544613.00 | 1536897.00 | May-96 | Q | 56 | 58 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00211F | 544613.00 | 1536897.00 | May-96 | Q | 60 | 62 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00301F | 544610.00 | 1536936.00 | May-96 | Q | 4 | 6 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00302F | 544610.00 | 1536936.00 | May-96 | Q | 6 | 8 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00303F | 544610.00 | 1536936.00 | May-96 | Q | 8 | 10 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00304F | 544610.00 | 1536936.00 | May-96 | Q | 10 | 12 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00305F | 544610.00 | 1536936.00 | May-96 | Q | 12 | 14 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00305FD | 544610.00 | 1536936.00 | May-96 | Q | 12 | 14 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00306F | 544610.00 | 1536936.00 | May-96 | Q | 16 | 18 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00307F | 544610.00 | 1536936.00 | May-96 | Q | 22 | 24 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00308F | 544610.00 | 1536936.00 | May-96 | Q | 34 | 36 | 10.0 | N/D | N/D | N/D | N/D | N/D | 10.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 10.0 |
| U4Q00309F | 544610.00 | 1536936.00 | May-96 | Q | 42 | 44 | 0.8 | N/D | N/D | N/D | N/D | N/D | 0.8 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.8 |
| U4Q00309FD | 544610.00 | 1536936.00 | May-96 | Q | 42 | 44 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00310F | 544610.00 | 1536936.00 | May-96 | Q | 52 | 54 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00311F | 544610.00 | 1536936.00 | May-96 | Q | 60 | 62 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00401F | 544567.00 | 1536795.00 | May-96 | Q | 2 | 4 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00402F | 544567.00 | 1536795.00 | May-96 | Q | 4 | 6 | N/D | N/D | 5.8 | N/D | N/D | N/D | 5.8 | N/D | N/D | N/D | N/D | N/D | 0.0 | 5.8 |
| U4Q00403F | 544567.00 | 1536795.00 | May-96 | Q | 6 | 8 | 1.7 | 270.0 | 1100.0 | 100.0 | 1.6 | 3.0 | 1476.3 | N/D | N/D | N/D | N/D | N/D | 0.0 | 1476.3 |
| U4Q00404F | 544567.00 | 1536795.00 | May-96 | Q | 8.5 | 10.5 | 8.1 | 680.0 | 640.0 | 19.0 | N/D | N/D | 1347.1 | N/D | N/D | N/D | N/D | N/D | 0.0 | 1347.1 |

# FOCUSED FIELD INVESTIGATION, OU4
## SUMMARY TABLE FOR FIELD LABORATORY AND OFFSITE ANALYTICAL RESULTS

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Sample No. | EASTING | NORTHING | Date sampled | medium | depth(u) | depth(l) | PCE | TCE | C-1,2-DCE | T-1,2-DCE | 1,1-DCE | VC | T. CHLOR. | BENZENE | TOLUENE | ETHYLB. | m/p XYL. | O XYL. | BTEX | TOT VOCs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| U4Q00405F | 544567.00 | 1536795.00 | May-96 | Q | 15 | 17 | 64.0 | 190.0 | 4.4 | N/D | N/D | N/D | 258.4 | N/D | N/D | N/D | N/D | N/D | 0.0 | 258.4 |
| U4Q00406F | 544567.00 | 1536795.00 | May-96 | Q | 17 | 19 | 97.0 | 270.0 | 4.8 | N/D | N/D | N/D | 371.8 | N/D | N/D | N/D | N/D | N/D | 0.0 | 371.8 |
| U4Q00407F | 544567.00 | 1536795.00 | May-96 | Q | 19 | 21 | 19.0 | 160.0 | 2.2 | N/D | N/D | 0.1 | 181.3 | N/D | N/D | N/D | N/D | N/D | 0.0 | 181.3 |
| U4Q00407FD | 544567.00 | 1536795.00 | May-96 | Q | 19 | 21 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00408F | 544567.00 | 1536795.00 | May-96 | Q | 21 | 23 | 44.0 | 310.0 | 5.0 | 0.4 | N/D | N/D | 359.4 | 0.4 | 0.4 | 3.8 | N/D | 0.7 | 5.3 | 364.7 |
| U4Q00409F | 544567.00 | 1536795.00 | May-96 | Q | 23 | 25 | 170.0 | 130.0 | 3.0 | N/D | N/D | N/D | 303.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 303.0 |
| U4Q00410F | 544567.00 | 1536795.00 | May-96 | Q | 25 | 27 | 180.0 | 180.0 | 4.7 | N/D | N/D | N/D | 364.7 | N/D | N/D | N/D | N/D | N/D | 0.0 | 364.7 |
| U4Q00411F | 544567.00 | 1536795.00 | May-96 | Q | 27 | 29 | 130.0 | 56.0 | 4.2 | N/D | N/D | N/D | 190.2 | N/D | N/D | N/D | N/D | N/D | 0.0 | 190.2 |
| U4Q00412F | 544567.00 | 1536795.00 | May-96 | Q | 29 | 31 | 120.0 | 11.0 | N/D | N/D | N/D | N/D | 131.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 131.0 |
| U4Q00413F | 544567.00 | 1536795.00 | May-96 | Q | 31 | 33 | 120.0 | 12.0 | N/D | N/D | N/D | N/D | 132.0 | N/D | N/D | N/D | N/D | 3.1 | 3.1 | 135.1 |
| U4Q00414F | 544567.00 | 1536795.00 | May-96 | Q | 33 | 35 | 99.0 | 1.7 | N/D | N/D | N/D | N/D | 100.7 | N/D | N/D | N/D | N/D | N/D | 0.0 | 100.7 |
| U4Q00415F | 544567.00 | 1536795.00 | May-96 | Q | 35 | 37 | 13.0 | 0.4 | N/D | N/D | N/D | N/D | 13.4 | N/D | N/D | N/D | N/D | N/D | 0.0 | 13.4 |
| U4Q00416F | 544567.00 | 1536795.00 | May-96 | Q | 37 | 39 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00417F | 544567.00 | 1536795.00 | May-96 | Q | 39 | 41 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00418F | 544567.00 | 1536795.00 | May-96 | Q | 41 | 43 | 0.8 | 0.8 | N/D | N/D | N/D | N/D | 1.6 | N/D | N/D | N/D | N/D | N/D | 0.0 | 1.6 |
| U4Q00419F | 544567.00 | 1536795.00 | May-96 | Q | 43 | 45 | 2.8 | 0.9 | N/D | N/D | N/D | N/D | 3.7 | N/D | N/D | N/D | N/D | N/D | 0.0 | 3.7 |
| U4Q00420F | 544567.00 | 1536795.00 | May-96 | Q | 45 | 47 | 4.9 | 1.0 | N/D | N/D | N/D | N/D | 5.9 | N/D | N/D | N/D | N/D | N/D | 0.0 | 5.9 |
| U4Q00421F | 544567.00 | 1536795.00 | May-96 | Q | 47 | 49 | 1.0 | N/D | N/D | N/D | N/D | N/D | 1.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 1.0 |
| U4Q00422F | 544567.00 | 1536795.00 | May-96 | Q | 49 | 51 | 0.9 | N/D | N/D | N/D | N/D | N/D | 0.9 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.9 |
| U4Q00423F | 544567.00 | 1536795.00 | May-96 | Q | 51 | 53 | 0.8 | N/D | N/D | N/D | N/D | N/D | 0.8 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.8 |
| U4Q00424F | 544567.00 | 1536795.00 | May-96 | Q | 53 | 55 | 4.4 | N/D | N/D | N/D | N/D | N/D | 4.4 | N/D | N/D | N/D | N/D | N/D | 0.0 | 4.4 |
| U4Q00425F | 544567.00 | 1536795.00 | May-96 | Q | 55 | 57 | 220.0 | 9.9 | N/D | N/D | N/D | N/D | 229.9 | N/D | N/D | N/D | N/D | N/D | 0.0 | 229.9 |
| U4Q00426F | 544567.00 | 1536795.00 | May-96 | Q | 57 | 59 | 4.3 | 1.0 | N/D | N/D | N/D | N/D | 5.3 | N/D | N/D | N/D | N/D | N/D | 0.0 | 5.3 |
| U4Q00501F | 544570.00 | 1536750.00 | May-96 | Q | 4 | 6 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00502F | 544570.00 | 1536750.00 | May-96 | Q | 6 | 8 | N/D | 7.1 | 3.5 | N/D | N/D | N/D | 10.6 | N/D | N/D | N/D | N/D | N/D | 0.0 | 10.6 |
| U4Q00503F | 544570.00 | 1536750.00 | May-96 | Q | 20 | 22 | 950.0 | 23.0 | 6.7 | N/D | N/D | N/D | 979.7 | N/D | N/D | N/D | N/D | N/D | 0.0 | 979.7 |
| U4Q00504F | 544570.00 | 1536750.00 | May-96 | Q | 24 | 26 | 300.0 | 5.0 | 1.6 | N/D | N/D | N/D | 306.6 | N/D | N/D | N/D | N/D | N/D | 0.0 | 306.6 |
| U4Q00505F | 544570.00 | 1536750.00 | May-96 | Q | 28 | 30 | 300.0 | 3.0 | 1.2 | N/D | N/D | N/D | 304.2 | N/D | N/D | N/D | N/D | N/D | 0.0 | 304.2 |
| U4Q00506F | 544570.00 | 1536750.00 | May-96 | Q | 32 | 34 | 48.0 | 3.1 | N/D | N/D | N/D | N/D | 51.1 | N/D | N/D | N/D | N/D | N/D | 0.0 | 51.1 |
| U4Q00506FD | 544570.00 | 1536750.00 | May-96 | Q | 32 | 34 | 50.0 | 2.5 | N/D | N/D | N/D | 0.1 | 52.6 | N/D | N/D | N/D | N/D | N/D | 0.0 | 52.6 |
| U4Q00507F | 544570.00 | 1536750.00 | May-96 | Q | 36 | 38 | 0.4 | N/D | N/D | N/D | N/D | N/D | 0.4 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.4 |
| U4Q00508F | 544570.00 | 1536750.00 | May-96 | Q | 42 | 44 | 0.4 | N/D | N/D | N/D | N/D | N/D | 0.4 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.4 |
| U4Q00509F | 544570.00 | 1536750.00 | May-96 | Q | 48 | 50 | 1.7 | 1.2 | N/D | N/D | N/D | N/D | 2.9 | N/D | N/D | N/D | N/D | N/D | 0.0 | 2.9 |
| U4Q00510F | 544570.00 | 1536750.00 | May-96 | Q | 58 | 60 | 0.5 | N/D | N/D | N/D | N/D | N/D | 0.5 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.5 |
| U4Q00601F | 544562.00 | 1536704.00 | May-96 | Q | 4 | 6 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00602F | 544562.00 | 1536704.00 | May-96 | Q | 6 | 8 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00603F | 544562.00 | 1536704.00 | May-96 | Q | 9 | 11 | 1.5 | 9.0 | 5.4 | N/D | N/D | N/D | 15.9 | N/D | N/D | N/D | N/D | N/D | 0.0 | 15.9 |
| U4Q00604F | 544562.00 | 1536704.00 | May-96 | Q | 11 | 13 | 2.4 | 71.0 | 54.0 | 1.2 | N/D | N/D | 128.6 | N/D | N/D | N/D | N/D | N/D | 0.0 | 128.6 |
| U4Q00605F | 544562.00 | 1536704.00 | May-96 | Q | 22 | 24 | 2.0 | 10.0 | 1.9 | N/D | N/D | N/D | 13.9 | N/D | N/D | N/D | N/D | N/D | 0.0 | 13.9 |
| U4Q00606F | 544562.00 | 1536704.00 | May-96 | Q | 26 | 28 | 3.7 | 13.0 | 3.0 | N/D | N/D | N/D | 19.7 | N/D | N/D | N/D | N/D | N/D | 0.0 | 19.7 |
| U4Q00607F | 544562.00 | 1536704.00 | May-96 | Q | 30 | 32 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00701F | 544524.00 | 1536677.00 | May-96 | Q | 4 | 6 | 3.2 | 26.0 | 3.8 | N/D | N/D | N/D | 33.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 33.0 |
| U4Q00702F | 544524.00 | 1536677.00 | May-96 | Q | 6 | 8 | 12.0 | 14.0 | 2.0 | N/D | N/D | N/D | 28.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 28.0 |

## FOCUSED FIELD INVESTIGATION, OU4
## SUMMARY TABLE FOR FIELD LABORATORY AND OFFSITE ANALYTICAL RESULTS

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Sample No. | EASTING | NORTHING | Date sampled | medium | depth(u) | depth(l) | PCE | TCE | C-1,2-DCE | T-1,2-DCE | 1,1-DCE | VC | T. CHLOR. | BENZENE | TOLUENE | ETHYLB. | m/p XYL. | O XYL. | BTEX | TOT VOCs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| U4Q00703F | 544524.00 | 1536677.00 | May-96 | Q | 18 | 20 | 24.0 | 28.0 | 14.0 | N/D | N/D | N/D | 66.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 66.0 |
| U4Q00801F | 544506.00 | 1536617.00 | May-96 | Q | 4 | 6 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00802F | 544506.00 | 1536617.00 | May-96 | Q | 6 | 8 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00803F | 544506.00 | 1536617.00 | May-96 | Q | 18 | 20 | 15.0 | 7.0 | 3.2 | N/D | N/D | N/D | 25.2 | N/D | N/D | N/D | N/D | N/D | 0.0 | 25.2 |
| U4Q00804F | 544506.00 | 1536617.00 | May-96 | Q | 24 | 26 | 7.0 | 13.0 | 2.7 | N/D | N/D | N/D | 22.7 | N/D | N/D | N/D | N/D | N/D | 0.0 | 22.7 |
| U4Q00805F | 544506.00 | 1536617.00 | May-96 | Q | 30 | 32 | N/D | 16.0 | N/D | N/D | N/D | N/D | 16.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 16.0 |
| U4Q00806F | 544506.00 | 1536617.00 | May-96 | Q | 38 | 40 | 11.0 | 15.0 | N/D | N/D | N/D | N/D | 26.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 26.0 |
| U4Q00807F | 544506.00 | 1536617.00 | May-96 | Q | 46 | 48 | N/D | 0.6 | N/D | N/D | N/D | N/D | 0.6 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.6 |
| U4Q00808F | 544506.00 | 1536617.00 | May-96 | Q | 50 | 52 | 5.2 | 18.0 | N/D | N/D | N/D | 0.3 | 23.5 | N/D | N/D | N/D | N/D | N/D | 0.0 | 23.5 |
| U4Q00809F | 544506.00 | 1536617.00 | May-96 | Q | 54 | 56 | 0.5 | 0.5 | N/D | N/D | N/D | N/D | 1.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 1.0 |
| U4Q00901F | 544480.00 | 1536573.00 | May-96 | Q | 4 | 6 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00902F | 544480.00 | 1536573.00 | May-96 | Q | 7 | 9 | 2.8 | 3.4 | 1.5 | N/D | N/D | N/D | 7.7 | N/D | N/D | N/D | N/D | N/D | 0.0 | 7.7 |
| U4Q00903F | 544506.00 | 1536567.00 | May-96 | Q | 16 | 18 | 9.6 | 12.0 | N/D | N/D | N/D | N/D | 21.6 | N/D | N/D | N/D | N/D | N/D | 0.0 | 21.6 |
| U4Q00903FD | 544506.00 | 1536567.00 | May-96 | Q | 16 | 18 | 8.3 | 8.9 | N/D | N/D | N/D | N/D | 17.2 | N/D | N/D | N/D | N/D | N/D | 0.0 | 17.2 |
| U4Q00904F | 544506.00 | 1536567.00 | May-96 | Q | 20 | 22 | 10.0 | 2.4 | N/D | N/D | N/D | N/D | 12.4 | N/D | N/D | N/D | N/D | N/D | 0.0 | 12.4 |
| U4Q00904FD | 544506.00 | 1536567.00 | May-96 | Q | 20 | 22 | 10.0 | 4.4 | N/D | N/D | N/D | N/D | 14.4 | N/D | N/D | N/D | N/D | N/D | 0.0 | 14.4 |
| U4Q00905F | 544506.00 | 1536567.00 | May-96 | Q | 24 | 26 | N/D | 5.5 | N/D | N/D | N/D | 0.3 | 5.8 | N/D | N/D | N/D | N/D | N/D | 0.0 | 5.8 |
| U4Q00905FD | 544506.00 | 1536567.00 | May-96 | Q | 24 | 26 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00906F | 544506.00 | 1536567.00 | May-96 | Q | 28 | 30 | 7.8 | 10.0 | N/D | N/D | N/D | N/D | 17.8 | N/D | N/D | N/D | N/D | N/D | 0.0 | 17.8 |
| U4Q00906FD | 544506.00 | 1536567.00 | May-96 | Q | 28 | 30 | 1.9 | 2.6 | N/D | N/D | N/D | N/D | 4.5 | N/D | N/D | N/D | N/D | N/D | 0.0 | 4.5 |
| U4Q00907F | 544506.00 | 1536567.00 | May-96 | Q | 34 | 36 | N/D | 1.0 | N/D | N/D | N/D | N/D | 1.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 1.0 |
| U4Q00908F | 544506.00 | 1536567.00 | May-96 | Q | 42 | 44 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00909F | 544506.00 | 1536567.00 | May-96 | Q | 48 | 50 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q00910F | 544506.00 | 1536567.00 | May-96 | Q | 52 | 54 | 0.5 | 0.8 | N/D | N/D | N/D | N/D | 1.3 | N/D | N/D | N/D | N/D | N/D | 0.0 | 1.3 |
| U4Q01001F | 544689.00 | 1536820.00 | May-96 | Q | 4 | 6 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q01002F | 544689.00 | 1536820.00 | May-96 | Q | 6 | 8 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q01003F | 544689.00 | 1536820.00 | May-96 | Q | 8 | 10 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q01004F | 544689.00 | 1536820.00 | May-96 | Q | 10 | 12 | N/D | 4.8 | 12.0 | N/D | N/D | N/D | 16.8 | N/D | N/D | N/D | N/D | N/D | 0.0 | 16.8 |
| U4Q01005F | 544689.00 | 1536820.00 | May-96 | Q | 12 | 14 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q01006F | 544689.00 | 1536820.00 | May-96 | Q | 14 | 16 | N/D | 84.0 | 800.0 | 69.0 | 0.9 | 5.0 | 958.9 | N/D | N/D | N/D | N/D | N/D | 0.0 | 958.9 |
| U4Q01007F | 544689.00 | 1536820.00 | May-96 | Q | 22 | 24 | 17.0 | 780.0 | 800.0 | 20.0 | N/D | 8.3 | 1625.3 | N/D | N/D | N/D | N/D | N/D | 0.0 | 1625.3 |
| U4Q01008F | 544689.00 | 1536820.00 | May-96 | Q | 24 | 26 | 21.0 | 960.0 | 790.0 | 20.0 | N/D | 3.0 | 1794.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 1794.0 |
| U4Q01009F | 544689.00 | 1536820.00 | May-96 | Q | 26 | 28 | 1500.0 | 41.0 | 550.0 | 16.0 | N/D | 0.9 | 2107.9 | N/D | N/D | N/D | N/D | N/D | 0.0 | 2107.9 |
| U4Q01010F | 544689.00 | 1536820.00 | May-96 | Q | 28 | 30 | 43.0 | 2000.0 | 100.0 | 14.0 | 1.0 | 2.1 | 2160.1 | N/D | N/D | N/D | N/D | N/D | 0.0 | 2160.1 |
| U4Q01011F | 544689.00 | 1536820.00 | May-96 | Q | 30 | 32 | 2600.0 | 3800.0 | 65.0 | 10.0 | 4.0 | N/D | 6479.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 6479.0 |
| U4Q01012F | 544689.00 | 1536820.00 | May-96 | Q | 32 | 34 | 290.0 | 3200.0 | 150.0 | 16.0 | 7.2 | 2.7 | 3665.9 | N/D | N/D | N/D | N/D | N/D | 0.0 | 3665.9 |
| U4Q01013F | 544689.00 | 1536820.00 | May-96 | Q | 34 | 36 | 240.0 | 1500.0 | 54.0 | 3.8 | N/D | 0.9 | 1798.7 | N/D | N/D | N/D | N/D | N/D | 0.0 | 1798.7 |
| U4Q01014F | 544689.00 | 1536820.00 | May-96 | Q | 38 | 40 | 45.0 | 190.0 | 3.9 | N/D | N/D | N/D | 238.9 | N/D | N/D | N/D | N/D | N/D | 0.0 | 238.9 |
| U4Q01015F | 544689.00 | 1536820.00 | May-96 | Q | 42 | 44 | 3.4 | 15.0 | N/D | N/D | N/D | N/D | 18.4 | N/D | N/D | N/D | N/D | N/D | 0.0 | 18.4 |
| U4Q01016F | 544689.00 | 1536820.00 | May-96 | Q | 46 | 48 | 3.4 | 14.0 | 1.8 | N/D | N/D | N/D | 19.2 | N/D | N/D | N/D | N/D | N/D | 0.0 | 19.2 |
| U4Q01017F | 544689.00 | 1536820.00 | May-96 | Q | 48 | 50 | 1.2 | 32.0 | 1.8 | N/D | N/D | N/D | 35.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 35.0 |
| U4Q01018F | 544689.00 | 1536820.00 | May-96 | Q | 50 | 52 | 17.0 | 39.0 | N/D | N/D | N/D | N/D | 56.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 56.0 |
| U4Q01019F | 544689.00 | 1536820.00 | May-96 | Q | 52 | 54 | 4.0 | 33.0 | N/D | N/D | N/D | N/D | 37.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 37.0 |

# FOCUSED FIELD INVESTIGATION, OU4
## SUMMARY TABLE FOR FIELD LABORATORY AND OFFSITE ANALYTICAL RESULTS

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Sample No. | EASTING | NORTHING | Date sampled | medium | depth(u) | depth(l) | PCE | TCE | C-1,2-DCE | T-1,2-DCE | 1,1-DCE | VC | T. CHLOR. | BENZENE | TOLUENE | ETHYLB. | m/p XYL. | O XYL. | BTEX | TOT VOCs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| U4Q01020F | 544689.00 | 1536820.00 | May-96 | Q | 54 | 56 | 4.9 | 45.0 | 2.7 | N/D | N/D | N/D | 52.6 | N/D | N/D | N/D | N/D | N/D | 0.0 | 52.6 |
| U4Q01021F | 544689.00 | 1536820.00 | May-96 | Q | 56 | 58 | 7.2 | 60.0 | 71.0 | 1.0 | N/D | N/D | 139.2 | N/D | N/D | N/D | N/D | N/D | 0.0 | 139.2 |
| U4Q01022F | 544689.00 | 1536820.00 | May-96 | Q | 58 | 60 | 9.1 | 18.0 | N/D | N/D | N/D | N/D | 27.1 | N/D | N/D | N/D | N/D | N/D | 0.0 | 27.1 |
| U4Q01023F | 544689.00 | 1536820.00 | May-96 | Q | 60 | 62 | 1.3 | 8.4 | N/D | N/D | N/D | N/D | 9.7 | N/D | N/D | N/D | N/D | N/D | 0.0 | 9.7 |
| U4Q01024F | 544689.00 | 1536820.00 | May-96 | Q | 64 | 66 | 4.6 | 24.0 | 3.0 | N/D | N/D | N/D | 31.6 | N/D | N/D | N/D | N/D | N/D | 0.0 | 31.6 |
| U4Q01101F | 544698.00 | 1536885.00 | May-96 | Q | 4 | 6 | 65.0 | 12.0 | 75.0 | 0.5 | N/D | N/D | 152.5 | N/D | N/D | N/D | N/D | N/D | 0.0 | 152.5 |
| U4Q01102F | 544842.00 | 1536861.00 | May-96 | Q | 6 | 8 | 7.7 | 5.4 | 110.0 | 0.5 | N/D | N/D | 123.6 | N/D | N/D | N/D | N/D | N/D | 0.0 | 123.6 |
| U4Q01103F | 544842.00 | 1536861.00 | May-96 | Q | 8 | 10 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q01104F | 544842.00 | 1536861.00 | May-96 | Q | 10 | 12 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q01105F | 544842.00 | 1536861.00 | May-96 | Q | 12 | 14 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q01106F | 544842.00 | 1536861.00 | May-96 | Q | 14 | 16 | N/D | N/D | 3.4 | N/D | N/D | N/D | 3.4 | N/D | N/D | N/D | N/D | N/D | 0.0 | 3.4 |
| U4Q01107F | 544842.00 | 1536861.00 | May-96 | Q | 22 | 24 | 1.0 | 9.8 | 69.0 | N/D | N/D | N/D | 79.8 | N/D | N/D | N/D | N/D | N/D | 0.0 | 79.8 |
| U4Q01108F | 544842.00 | 1536861.00 | May-96 | Q | 26 | 28 | N/D | 1.9 | N/D | N/D | N/D | N/D | 1.9 | N/D | N/D | N/D | N/D | N/D | 0.0 | 1.9 |
| U4Q01109F | 544842.00 | 1536861.00 | May-96 | Q | 30 | 32 | 6.4 | 4.6 | 1.8 | N/D | N/D | N/D | 12.8 | N/D | N/D | N/D | N/D | N/D | 0.0 | 12.8 |
| U4Q01110F | 544842.00 | 1536861.00 | May-96 | Q | 34 | 36 | 1.6 | N/D | N/D | N/D | N/D | N/D | 1.6 | N/D | N/D | N/D | N/D | N/D | 0.0 | 1.6 |
| U4Q01111F | 544842.00 | 1536861.00 | May-96 | Q | 38 | 40 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q01112F | 544842.00 | 1536861.00 | May-96 | Q | 44 | 46 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q01113F | 544842.00 | 1536861.00 | May-96 | Q | 50 | 52 | 1.4 | N/D | N/D | N/D | N/D | N/D | 1.4 | N/D | N/D | N/D | N/D | N/D | 0.0 | 1.4 |
| U4Q01114F | 544842.00 | 1536861.00 | May-96 | Q | 54 | 56 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q01115F | 544842.00 | 1536861.00 | May-96 | Q | 58 | 60 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q01115FD | 544842.00 | 1536861.00 | May-96 | Q | 58 | 60 | 0.6 | N/D | N/D | N/D | N/D | N/D | 0.6 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.6 |
| U4Q01116F | 544842.00 | 1536861.00 | May-96 | Q | 62 | 64 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q01201F | 544499.00 | 1536511.00 | May-96 | Q | 4 | 6 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q01201FD | 544499.00 | 1536511.00 | May-96 | Q | 4 | 6 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q01202F | 544499.00 | 1536511.00 | May-96 | Q | 6 | 8 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q01202FD | 544499.00 | 1536511.00 | May-96 | Q | 6 | 8 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q01203F | 544499.00 | 1536511.00 | May-96 | Q | 8 | 10 | N/D | 0.4 | N/D | N/D | N/D | N/D | 0.4 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.4 |
| U4Q01204F | 544499.00 | 1536511.00 | May-96 | Q | 18 | 20 | 0.8 | 0.5 | N/D | N/D | N/D | N/D | 1.3 | N/D | N/D | N/D | N/D | N/D | 0.0 | 1.3 |
| U4Q01205F | 544499.00 | 1536511.00 | May-96 | Q | 22 | 24 | 6.2 | 1.3 | N/D | N/D | N/D | N/D | 7.5 | N/D | N/D | N/D | N/D | N/D | 0.0 | 7.5 |
| U4Q01205FD | 544499.00 | 1536511.00 | May-96 | Q | 22 | 24 | 6.2 | 5.7 | N/D | N/D | N/D | N/D | 11.9 | N/D | N/D | N/D | N/D | N/D | 0.0 | 11.9 |
| U4Q01206F | 544499.00 | 1536511.00 | May-96 | Q | 26 | 28 | N/D | 4.2 | N/D | N/D | N/D | 0.3 | 4.5 | N/D | N/D | N/D | N/D | N/D | 0.0 | 4.5 |
| U4Q01206FD | 544499.00 | 1536511.00 | May-96 | Q | 26 | 28 | 0.4 | 2.4 | N/D | N/D | N/D | N/D | 2.8 | N/D | N/D | N/D | N/D | N/D | 0.0 | 2.8 |
| U4Q01207F | 544499.00 | 1536511.00 | May-96 | Q | 32 | 34 | N/D | 5.5 | N/D | N/D | N/D | N/D | 5.5 | N/D | N/D | N/D | N/D | N/D | 0.0 | 5.5 |
| U4Q01207FD | 544499.00 | 1536511.00 | May-96 | Q | 32 | 34 | 7.3 | 8.5 | N/D | N/D | N/D | N/D | 15.8 | N/D | N/D | N/D | N/D | N/D | 0.0 | 15.8 |
| U4Q01208F | 544499.00 | 1536511.00 | May-96 | Q | 38 | 40 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q01209F | 544499.00 | 1536511.00 | May-96 | Q | 46 | 48 | N/D | 0.7 | N/D | N/D | N/D | N/D | 0.7 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.7 |
| U4Q01210F | 544499.00 | 1536511.00 | May-96 | Q | 50 | 52 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q01211F | 544499.00 | 1536511.00 | May-96 | Q | 54 | 56 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q01212F | 544499.00 | 1536511.00 | May-96 | Q | 58 | 60 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q01301F | 544564.00 | 1536666.00 | May-96 | Q | 24 | 26 | 1.0 | 1.2 | N/D | N/D | N/D | N/D | 2.2 | N/D | N/D | N/D | N/D | N/D | 0.0 | 2.2 |
| U4Q01302F | 544564.00 | 1536666.00 | May-96 | Q | 30 | 32 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q01303F | 544564.00 | 1536666.00 | May-96 | Q | 36 | 38 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q01304F | 544564.00 | 1536666.00 | May-96 | Q | 42 | 44 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |

FOCUSED FIELD INVESTIGATION, OU4
SUMMARY TABLE FOR FIELD LABORATORY AND OFFSITE ANALYTICAL RESULTS

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Sample No. | EASTING | NORTHING | Date sampled | medium | depth(u) | depth(l) | PCE | TCE | C-1,2-DCE | T-1,2-DCE | 1,1-DCE | VC | T. CHLOR. | BENZENE | TOLUENE | ETHYLB. | m/p XYL. | O XYL. | BTEX | TOT VOCs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| U4Q01305F | 544564.00 | 1536666.00 | May-96 | Q | 48 | 50 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4Q01306F | 544564.00 | 1536666.00 | May-96 | Q | 54 | 56 | 0.4 | 0.5 | N/D | N/D | N/D | N/D | 0.9 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.9 |
| U4Q01307F | 544564.00 | 1536666.00 | May-96 | Q | 58 | 60 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4S00101F | 544807.00 | 1536940.00 | May-96 | S | 0 | 1 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4S00201F | 544781.00 | 1536823.00 | May-96 | S | 0 | 1 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4S00301F | 544520.00 | 1536668.00 | May-96 | S | 0 | 1 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4S00401F | 544566.00 | 1536719.00 | May-96 | S | 0 | 1 | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4W00101F | 544389.00 | 1536611.00 | May-96 | W | | | N/D | N/D | N/D | N/D | N/D | 0.1 | 0.1 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.1 |
| U4W00201F | 544580.00 | 1536844.00 | May-96 | W | | | 63.0 | 150.0 | 230.0 | 13.0 | 1.1 | 12.0 | 469.1 | N/D | N/D | N/D | N/D | N/D | 0.0 | 469.1 |
| U4W00301F | 544608.00 | 1536833.00 | May-96 | W | | | N/D | 76.0 | 180.0 | 10.0 | 1.1 | 62.0 | 329.1 | N/D | N/D | N/D | N/D | N/D | 0.0 | 329.1 |
| U4W00601F | 544568.00 | 1536873.00 | May-96 | W | | | N/D | 23.0 | 100.0 | 0.7 | N/D | 65.0 | 188.7 | N/D | N/D | N/D | N/D | N/D | 0.0 | 188.7 |
| U4W00701F | 544532.00 | 1536892.00 | May-96 | W | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | 0.6 | N/D | N/D | N/D | 0.6 | 0.6 |
| U4W00801F | 544529.00 | 1536921.00 | May-96 | W | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4W00901F | 544544.00 | 1536944.00 | May-96 | W | | | N/D | N/D | 2.3 | N/D | N/D | 0.5 | 2.8 | N/D | N/D | N/D | N/D | N/D | 0.0 | 2.8 |
| U4W00901FD | 544544.00 | 1536944.00 | May-96 | W | | | N/D | N/D | 2.3 | N/D | N/D | 0.6 | 2.9 | N/D | N/D | N/D | N/D | N/D | 0.0 | 2.9 |
| U4W01001F | 544558.00 | 1536844.00 | May-96 | W | | | 150.0 | 920.0 | 1200.0 | 46.0 | 6.4 | 280.0 | 2602.4 | N/D | 0.5 | N/D | N/D | N/D | 0.5 | 2602.9 |
| U4W01101F | 544565.00 | 1536806.00 | May-96 | W | | | N/D | 25.0 | 94.0 | 1.2 | 1.0 | 12.0 | 133.2 | N/D | 1.0 | N/D | N/D | N/D | 1.0 | 134.2 |
| U4W01201F | 544526.00 | 1536790.00 | May-96 | W | | | N/D | 5.6 | 180.0 | 0.7 | 0.9 | 83.0 | 270.2 | N/D | 7.2 | N/D | N/D | N/D | 7.2 | 277.4 |
| U4W01301F | 544510.00 | 1536753.00 | May-96 | W | | | 0.6 | 97.0 | 500.0 | 6.8 | 1.0 | 23.0 | 628.4 | N/D | N/D | N/D | N/D | N/D | 0.0 | 628.4 |
| U4W01401F | 544475.00 | 1536728.00 | May-96 | W | | | 2.8 | 33.0 | 42.0 | N/D | N/D | 5.8 | 83.6 | N/D | N/D | N/D | N/D | N/D | 0.0 | 83.6 |
| U4W01501F | 544470.00 | 1536698.00 | May-96 | W | | | N/D | 26.0 | 74.0 | 0.7 | N/D | 0.6 | 101.3 | N/D | N/D | N/D | N/D | N/D | 0.0 | 101.3 |
| U4W01601F | 544457.00 | 1536689.00 | May-96 | W | | | 1.6 | 5.1 | N/D | N/D | N/D | N/D | 6.7 | N/D | N/D | N/D | N/D | N/D | 0.0 | 6.7 |
| U4W01701F | 544446.00 | 1536656.00 | May-96 | W | | | N/D | 0.9 | N/D | N/D | N/D | N/D | 0.9 | N/D | 6.0 | N/D | N/D | N/D | 6.0 | 6.9 |
| U4W01801F | 544428.00 | 1536627.00 | May-96 | W | | | N/D | 0.5 | N/D | N/D | N/D | N/D | 0.5 | N/D | 17.0 | N/D | N/D | N/D | 17.0 | 17.5 |
| U4W01801FD | 544428.00 | 1536627.00 | May-96 | W | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | 30.0 | N/D | N/D | N/D | 30.0 | 30.0 |
| U4W01901F | 544528.00 | 1536841.00 | May-96 | W | | | N/D | N/D | 34.0 | N/D | N/D | 13.0 | 47.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 47.0 |
| U4W02001F | 544541.00 | 1536868.00 | May-96 | W | | | N/D | N/D | 15.0 | N/D | N/D | 7.6 | 22.6 | N/D | N/D | N/D | N/D | N/D | 0.0 | 22.6 |
| U4W02101F | 544513.00 | 1536821.00 | May-96 | W | | | 0.6 | 3.7 | 29.0 | N/D | N/D | 6.8 | 40.1 | N/D | N/D | N/D | N/D | N/D | 0.0 | 40.1 |
| U4W02201F | 544499.00 | 1536794.00 | May-96 | W | | | 0.9 | 2.1 | 6.1 | N/D | N/D | N/D | 9.1 | N/D | N/D | N/D | N/D | N/D | 0.0 | 9.1 |
| U4W02301F | 544517.00 | 1536872.00 | May-96 | W | | | N/D | N/D | 27.0 | N/D | N/D | 8.6 | 35.6 | N/D | N/D | N/D | N/D | N/D | 0.0 | 35.6 |
| U4W02401F | 544478.00 | 1536772.00 | May-96 | W | | | 4.7 | 2.0 | 4.3 | N/D | N/D | N/D | 11.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 11.0 |
| U4W02501F | 544463.00 | 1536747.00 | May-96 | W | | | N/D | 16.0 | 26.0 | N/D | N/D | N/D | 42.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 42.0 |
| U4W02601F | 544444.00 | 1536723.00 | May-96 | W | | | N/D | 9.9 | 23.0 | N/D | N/D | N/D | 32.9 | N/D | N/D | N/D | N/D | N/D | 0.0 | 32.9 |
| U4W02601FD | 544444.00 | 1536723.00 | May-96 | W | | | N/D | 9.8 | 23.0 | N/D | N/D | N/D | 32.8 | N/D | N/D | N/D | N/D | N/D | 0.0 | 32.8 |
| U4W02701F | 544433.00 | 1536700.00 | May-96 | W | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4W02801F | 544422.00 | 1536677.00 | May-96 | W | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4W02901F | 544413.00 | 1536654.00 | May-96 | W | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4W03001F | 544491.00 | 1536897.00 | May-96 | W | | | N/D | N/D | 2.8 | N/D | N/D | 0.3 | 3.1 | N/D | N/D | N/D | N/D | N/D | 0.0 | 3.1 |
| U4W03101F | 544505.00 | 1536849.00 | May-96 | W | | | 0.4 | N/D | N/D | N/D | N/D | 1.5 | 1.9 | N/D | N/D | N/D | N/D | N/D | 0.0 | 1.9 |
| U4W03201F | 544492.00 | 1536822.00 | May-96 | W | | | N/D | 1.0 | 13.0 | N/D | N/D | 8.5 | 22.5 | N/D | N/D | N/D | N/D | N/D | 0.0 | 22.5 |
| U4W03301F | 544428.00 | 1536844.00 | May-96 | W | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4W03301FD | 544428.00 | 1536844.00 | May-96 | W | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4W03401F | 544409.00 | 1536799.00 | May-96 | W | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |

# FOCUSED FIELD INVESTIGATION, OU4
## SUMMARY TABLE FOR FIELD LABORATORY AND OFFSITE ANALYTICAL RESULTS

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Sample No. | EASTING | NORTHING | Date sampled | medium | depth(u) | depth(l) | PCE | TCE | C-1,2-DCE | T-1,2-DCE | 1,1-DCE | VC | T. CHLOR. | BENZENE | TOLUENE | ETHYLB. | m/p XYL. | O XYL. | BTEX | TOT VOCs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| U4W03501F | 544393.00 | 1536758.00 | May-96 | W | | | N/D | 0.7 | N/D | N/D | N/D | N/D | 0.7 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.7 |
| U4W03502F | 544393.00 | 1536758.00 | May-96 | W | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4W03601F | 544380.00 | 1536705.00 | May-96 | W | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4W03602F | 544380.00 | 1536705.00 | May-96 | W | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4W03701F | 544358.00 | 1536664.00 | May-96 | W | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4W03702F | 544358.00 | 1536664.00 | May-96 | W | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | 0.4 | N/D | N/D | N/D | 0.4 | 0.4 |
| U4W03801F | 544361.00 | 1536841.00 | May-96 | W | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4W03802F | 544361.00 | 1536841.00 | May-96 | W | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4W03901F | 544338.00 | 1536795.00 | May-96 | W | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4W03902F | 544338.00 | 1536795.00 | May-96 | W | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4W04001F | 544441.00 | 1536888.00 | May-96 | W | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4W04002F | 544441.00 | 1536888.00 | May-96 | W | | | N/D | N/D | 7.8 | N/D | N/D | 3.5 | 11.3 | N/D | 0.9 | N/D | N/D | N/D | 0.9 | 12.2 |
| U4W04101F | 544337.00 | 1536745.00 | May-96 | W | | | N/D | 0.5 | 3.1 | N/D | N/D | 0.8 | 4.4 | N/D | N/D | N/D | N/D | N/D | 0.0 | 4.4 |
| U4W04102F | 544337.00 | 1536745.00 | May-96 | W | | | N/D | N/D | 2.7 | N/D | N/D | 0.4 | 3.1 | N/D | N/D | N/D | N/D | N/D | 0.0 | 3.1 |
| U4W04102FD | 544337.00 | 1536745.00 | May-96 | W | | | N/D | 0.5 | 3.0 | N/D | N/D | 0.5 | 4.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 4.0 |
| U4W04201F | 544382.00 | 1536632.00 | May-96 | W | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4W04301F | 543989.00 | 1536792.00 | May-96 | W | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4W04302F | 543989.00 | 1536792.00 | May-96 | W | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4W04401F | 544384.00 | 1536877.00 | May-96 | W | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4W04402F | 544384.00 | 1536877.00 | May-96 | W | | | N/D | N/D | 4.7 | N/D | N/D | 1.3 | 6.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 6.0 |
| U4W04501F | 544451.00 | 1536627.00 | May-96 | W | | | 1.1 | N/D | N/D | N/D | N/D | N/D | 1.1 | N/D | N/D | N/D | N/D | N/D | 0.0 | 1.1 |
| U4W04502F | 544451.00 | 1536627.00 | May-96 | W | | | N/D | N/D | 1.6 | N/D | N/D | 0.3 | 1.9 | N/D | N/D | N/D | N/D | N/D | 0.0 | 1.9 |
| U4W04601F | 544178.00 | 1536756.00 | May-96 | W | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4W04602F | 544178.00 | 1536756.00 | May-96 | W | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4W04701F | 544347.00 | 1536909.00 | May-96 | W | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4W04702F | 544347.00 | 1536909.00 | May-96 | W | | | N/D | N/D | 3.3 | N/D | N/D | 0.6 | 3.9 | N/D | N/D | N/D | N/D | N/D | 0.0 | 3.9 |
| U4W04801F | 544310.00 | 1536866.00 | May-96 | W | | | N/D | N/D | N/D | N/D | N/D | N/D | 0.0 | N/D | N/D | N/D | N/D | N/D | 0.0 | 0.0 |
| U4W04802F | 544310.00 | 1536866.00 | May-96 | W | | | N/D | N/D | 5.6 | N/D | N/D | 1.3 | 6.9 | N/D | N/D | N/D | N/D | N/D | 0.0 | 6.9 |

Notes:
D = duplicate sample.
N/D = Non-detect.
N/A = Not analyzed.

## Table A-13
## Summary of Subsurface Soil Results for Onsite Analysis

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Sample ID | Depth (feet) | Zone | PCE | TCE | m/p-Xylene | o-Xylene | Sample ID | Depth (feet) | Zone | PCE | TCE | m/p-Xylene | o-Xylene |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| U4P01401F | 0-4 | V | 82 | <2 | <4 | <2 | U4P01702F | 4-8 | V | 10 | <2 | <4 | <2 |
| U4P01401FD | 0-4 | V | 133 | <2 | <4 | <2 | U4P01703F | 8-12 | V | 6 | <2 | <4 | <2 |
| U4P01402F | 4-8 | V | 12 | <2 | <4 | <2 | U4P01704F | 12-16 | S | <2 | <2 | <4 | <2 |
| U4P01402FD | 4-8 | V | 15 | <2 | <4 | <2 | U4P01705F | 16-20 | S | <2 | <2 | <4 | <2 |
| U4P01403F | 10-12 | V | 4 | <2 | <4 | <2 | U4P01706F | 20-24 | S | <2 | <2 | <4 | <2 |
| U4P01404F | 14-16 | S | <2 | <2 | <4 | <2 | U4P01707F | 26-28 | S | <2 | <2 | <4 | <4 |
| U4P01405F | 18-20 | S | <2 | <2 | <4 | <2 | U4P01801F | 0-4 | V | 4 | <2 | <4 | <2 |
| U4P01406F | 21-23 | S | <2 | 2 | <4 | <2 | U4P01802F | 4-8 | V | <2 | <2 | <4 | <2 |
| U4P01501F | 0-4 | V | 52 | <2 | <4 | <2 | U4P01803 | 8-12 | V | <2 | <2 | <4 | <2 |
| U4P01502F | 4-8 | V | 15 | <2 | <4 | <2 | U4P02001F | 0-4 | V | 250E | <2 | <4 | <2 |
| U4P01503F | 8-12 | V | 12 | <2 | <4 | <2 | U4P02001FD | 0-4 | V | 260E | <2 | <4 | <2 |
| U4P01504F | 14-16 | S | 15 | <2 | <4 | <2 | U4P02002F | 4-8 | V | 40 | <2 | <4 | <2 |
| U4P01505F | 18-20 | S | <2 | 3 | <4 | <2 | U4P02003F | 8-12 | V | 20 | <2 | <4 | <2 |
| U4P01601F | 0-4 | V | 158E | 3 | <4 | <2 | U4P02004F | 14-16 | S | <2 | <2 | <4 | <2 |
| U4P01602F | 4-8 | V | 8 | <2 | <4 | <2 | U4P02005F | 18-20 | S | 4 | <2 | <4 | <2 |
| U4P01603F | 8-12 | V | 5 | <2 | <4 | <2 | U4P02006F | 22-24 | S | 5 | <2 | <4 | <2 |
| U4P01604F | 12-16 | S | <2 | <2 | <4 | <2 | U4P02007F | 26-28 | S | <2 | <2 | <4 | <2 |
| U4P01605F | 16-20 | S | <2 | <2 | <4 | <2 | U4P02301F | 0-4 | V | <2 | <2 | <4 | <2 |
| U4P01606F | 20-24 | S | <2 | <2 | <4 | <2 | U4P02302F | 4-8 | V | <2 | <2 | <4 | <2 |
| U4P01607F | 24-28 | S | <2 | <2 | <4 | <2 | U4P02303F | 8-12 | S | <2 | <2 | <4 | <2 |
| U4P01701F | 0-4 | V | 100 | <2 | <4 | <2 | U4P02304F | 14-16 | S | <2 | <2 | <4 | <2 |

See notes at end of table.

**Table A-13 (Continued)**
**Summary of Subsurface Soil Results for Onsite Analysis**

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Sample ID | Depth (feet) | Zone | PCE | TCE | m/p-Xylene | o-Xylene | Sample ID | Depth (feet) | Zone | PCE | TCE | m/p-Xylene | o-Xylene |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| U4P02305F | 18-20 | S | <2 | <2 | <4 | <2 | U4P02502F | 4-8 | V | 6 | <2 | <4 | <2 |
| U4P02306F | 22-24 | S | <2 | <2 | <4 | <2 | U4P02503F | 8-12 | S | <2 | <2 | <4 | <2 |
| U4P02401F | 0-4 | V | 15 | <2 | <4 | <2 | U4P02504F | 14-16 | S | <2 | <2 | <4 | <2 |
| U4P02401FD | 0-4 | V | 15 | <2 | <4 | <2 | U4P02505F | 18-20 | S | <2 | <2 | <4 | <2 |
| U4P02402F | 4-8 | V | <2 | <2 | <4 | <2 | U4P02506F | 22-24 | S | <2 | <2 | <4 | <2 |
| U4P02403F | 8-12 | S | <2 | <2 | <4 | <2 | U4P02507F | 26-28 | S | <2 | <2 | <4 | <2 |
| U4P02404F | 14-16 | S | <2 | <2 | <4 | <2 | U4P02601F | 0-4 | V | <2 | <2 | 9 | <2 |
| U4P02405F | 18-20 | S | <2 | <2 | <4 | <2 | U4P02602F | 4-8 | V | <2 | <2 | <4 | <2 |
| U4P02406F | 22-24 | S | <2 | <2 | <4 | <2 | U4P02603F | 8-12 | S | <2 | <2 | <4 | 4 |
| U4P02407F | 26-28 | S | <2 | <2 | <4 | <2 | U4P02604F | 22-24 | S | <2 | <2 | <4 | <2 |
| U4P02501F | 0-4 | V | 60 | <2 | <4 | <2 | U4P02605F | 26-28 | S | <2 | <2 | <4 | <2 |

Notes: All results reported as micrograms per kilogram soil dry weight.

RI/FS = Remedial Investigation and Feasibility Study.
ID = identification.
PCE = tetrachloroethene.
TCE = trichloroethene.
F = field.
D = duplicate sample.
V = vadose.
S = saturated.
E = estimated

**Table A-14**
**Summary of Subsurface Soil Results for Off-site Analysis**

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Sample ID | Depth (ft) | Zone | PCE | TCE |
|---|---|---|---|---|
| U4P01504 | 14-16 | S | 430 | 7.6 |
| U4P01505 | 18-20 | S | 7.6 | 27 |
| U4P01505D | 18-20 | S | 26 | 27 |
| U4P01604 | 12-16 | S | <6 | <6 |
| U4P01901 | 0-4 | V | 41 | <5.2 |
| U4P01902 | 4-8 | V | 22 | <5.1 |
| U4P01903 | 8-12 | V | <6.0 | <6.0 |
| U4P01904 | 14-16 | S | <6.2 | <6.2 |
| U4P01905 | 18-19 | S | <6.1 | <6.1 |
| U4P02004 | 14-16 | S | <6.1 | <6.1 |
| U4P02101 | 0-4 | V | 31 | <5.1 |
| U4P02102 | 4-8 | V | 20 | <5.2 |
| U4P02103 | 8-12 | V | <6.0 | <6.0 |
| U4P02104 | 15-17 | S | <6.4 | <6.4 |
| U4P02301 | 0-4 | V | <5.1 | <5.1 |
| U4P02301D | 0-4 | V | <5.1 | <5.1 |
| U4P02501 | 0-4 | V | 17 | <5.2 |
| U4P02501D | 0-4 | V | 21 | <5.4 |
| U4P02602 | 4-8 | V | <5.9 | <5.9 |

Notes: All results reported as micrograms per kilogram.

RI/FS = Remedial Investigation and Feasibility Study.
ID = identification.
ft = feet.
PCE = tetrachloroethene.
TCE = trichloroethene.
D = duplicate sample.
V = vadose.
S = saturated.
< = less than.

## Table A-15
## Summary of TerraProbe[SM] Groundwater Results for Onsite Analysis

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Sample No. | Depth (feet) | PCE | TCE | cis-DCE | trans-DCE | Sample No. | Depth (feet) | PCE | TCE | cis-DCE | trans-DCE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| U4Q01401F | 11-13 | 440E | 230E | 45 | <2 | U4Q02005F | 28-30 | 600E | 4 | 20 | <2 |
| U4Q01402F | 16-18 | 50 | 400E | 250E | 6 | U4Q02101F | 13-15 | 25 | <2 | 10 | <2 |
| U4Q01402FD | 16-18 | 20 | 440E | 240E | 5 | U4Q02102F | 16-18 | 8 | <2 | 6 | <2 |
| U4Q01403F | 20-22 | 45 | 500E | 200E | 7 | U4Q02102FD | 16-18 | 9 | <2 | 6 | <2 |
| U4Q01404F | 24-26 | 30 | 200E | 300E | 15 | U4Q02301F | 12-14 | <2 | <2 | <2 | <2 |
| U4Q01501F | 12-14 | 800E | 200E | 8 | <2 | U4Q02302F | 16-18 | <2 | <2 | <2 | <2 |
| U4Q01502F | 16-18 | 550E | 640E | 50 | 5 | U4Q02303F | 20-22 | 10 | <2 | <2 | <2 |
| U4Q01503F | 20-22 | 3362E | 1000E | 30 | 5 | U4Q02401F | 12-14 | <2 | <2 | 20 | <2 |
| U4Q01601F | 12-14 | 270E | 15 | 2 | <2 | U4Q02402F | 16-18 | 7 | 5 | 70 | 4 |
| U4Q01602F | 16-18 | 60 | 4 | <2 | <2 | U4Q02403F | 20-22 | 50 | 170E | 450E | 30 |
| U4Q01603F | 20-22 | 120E | <2 | 3 | <2 | U4Q02403FD | 20-22 | 40 | 90 | 700E | 30 |
| U4Q01604F | 24-26 | 50 | <2 | <2 | <2 | U4Q02404F | 24-26 | 150E | <2 | 200E | 8 |
| U4Q01605F | 28-30 | 600E | <2 | <2 | <2 | U4Q02405F | 28-30 | <2 | <2 | <2 | <2 |
| U4Q01701F | 12-14 | 5 | <2 | 7 | <2 | U4Q02501F | 12-14 | <2 | <2 | <2 | <2 |
| U4Q01702F | 16-18 | 10 | <2 | 4 | <2 | U4Q02502F | 16-18 | <2 | <2 | <2 | <2 |
| U4Q01703F | 20-22 | 12 | <2 | <2 | <2 | U4Q02503F | 20-22 | <2 | <2 | 3 | <2 |
| U4Q01704F | 24-26 | 11 | <2 | <2 | <2 | U4Q02504F | 24-26 | 98 | 13 | 112E | 6 |
| U4Q01705F | 28-30 | 17 | <2 | <2 | <2 | U4Q02505F | 28-30 | 6 | <2 | <2 | 3 |
| U4Q01705FD | 28-30 | 10 | <2 | <2 | <2 | U4Q02601F | 12-14 | 320E | <2 | <2 | <2 |
| U4Q01801F | 12-14 | 7 | <2 | 5 | <2 | U4Q02602F | 16-18 | 84 | <2 | 11 | <2 |
| U4Q02001F | 12-14 | 400E | 260E | 140E | 3 | U4Q02602FD | 16-18 | 66 | <2 | 11 | <2 |
| U4Q02002F | 16-18 | 1,00E | 25 | 60 | <2 | U4Q02603F | 20-22 | 110E | 2 | 14 | <2 |
| U4Q02003F | 20-22 | 2,350E | 100 | 65 | <2 | U4Q02604F | 24-26 | 2,100 | 30 | 40 | <2 |
| U4Q02003FD | 20-22 | 2,370E | 105E | 60 | <2 | U4Q02605F | 28-30 | 1,100E | 100 | 3 | <2 |
| U4Q02004F | 24-26 | 2000E | 20 | 30 | <2 | U4Q02701F | 12-14 | <2 | <2 | <2 | 6 |

See notes at end of table.

**Table A-15 (Continued)**
**Summary of TerraProbe℠ Groundwater Results for Onsite Analysis**

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Sample No. | Depth (feet) | PCE | TCE | cis-DCE | trans-DCE | Sample No. | Depth (feet) | PCE | TCE | cis-DCE | trans-DCE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| U4Q02702F | 16-18 | 5 | <2 | <2 | 2 | U4Q02801F | 12-14 | <2 | <2 | 11 | 2 |
| U4Q02703F | 20-22 | 4 | <2 | <2 | 5 | U4Q02802F | 18-20 | 3 | <2 | 12 | <2 |
| U4Q02704F | 24-26 | <2 | <2 | <2 | 3 | U4Q02803F | 24-26 | 3 | <2 | 3 | <2 |
| U4Q02705F | 28-30 | 2 | <2 | <2 | <2 | U4Q02804F | 30-32 | 5 | <2 | <2 | 2 |

Notes: All results reported as micrograms per liter.

RI/FS = Remedial Investigation and Feasibility Study.
PCE = tetrachloroethene.
TCE = trichloroethene.
cis-DCE = cis-dichloroethene.
trans-DCE = trans-dichloroethene.
< = less than.
℠ = service mark.

## Table A-16
## Summary of Groundwater Results for Off-Site Analysis

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Sample ID | Depth (ft) | PCE | TCE | cis-DCE |
|---|---|---|---|---|
| U4Q01501 | 12-14 | 14000 | 440 | <300 |
| U4Q01502 | 16-18 | 6100 | 11000 | <250 |
| U4Q01502D | 16-18 | 8600 | 15000 | <300 |
| U4Q01601 | 12-14 | 38 | 3.9 | 3 |
| U4Q01901 | 12-14 | 5.4 | 0.24 | <0.5 |
| U4Q01902 | 16-18 | 2.4 | 0.12 | <0.5 |
| U4Q02101 | 13-15 | 1.4 | 0.58 | 1.1 |
| U4Q02102 | 16-18 | 1.1 | 0.22 | 0.9 |
| U4Q02403 | 20-22 | 33 | 90 | 880 |
| U4Q02403D | 20-22 | 30 | 86 | 830 |
| U4Q02505 | 28-30 | <0.5 | <0.5 | 0.99 |
| U4Q02704 | 24-26 | <0.5 | <0.5 | 0.13 |

Notes: RI/FS = Remedial Investigation and Feasibility Study.
ft = feet.
ID = identification.
D = duplicate.
PCE = tetrachloroethene.
TCE = trichloroethene.
cis-DCE = cis-1,2-dichloroethene.
< = less than.

## Table A-17
## Summary of Groundwater Analysis from Monitoring Wells and Microwells

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Well ID | Date | Sample ID | PCE | TCE | cis-DCE |
|---|---|---|---|---|---|
| OLD-13-01A | 3/9/95 | 13G00101 | 250 | 16 J | 29 J |
| | 3/24/97 | 13G00102 | 46 | 14 | 30 |
| OLD-13-02C | 4/6/95 | 13G00201 | <.5 | <.5 | <.5 |
| | 3/24/97 | 13G00202 | 14 | <.5 | <.5 |
| OLD-13-03A | 4/6/95 | 13G00301 | 16 | 3 J | 5.6 |
| | 3/24/97 | 13G00302 | 9.3 | 5.2 | 7.3 |
| OLD-13-04C | 4/6/95 | 13G00401 | <.5 | <.5 | <.5 |
| | 3/24/97 | 13G00402 | .13 | <.5 | <.5 |
| OLD-13-05A | 3/9/95 | 13G00501 | 7 | 3 | 6 |
| | 3/24/97 | 13G00502 | 1.5 | .21 | <.5 |
| OLD-13-06C | 4/6/95 | 13G00601 | <.5 | <.5 | <.5 |
| | 3/24/97 | 13G00602 | <.5 | <.5 | <.5 |
| OLD-13-07A | 4/6/95 | 13G00701 | 680 | 52 | 38 J |
| | 3/25/97 | 13G00702 | 28,000 | <620 | <620 |
| OLD-13-08C | 4/6/95 | 13G00801 | .2 | <.5 | .1 J |
| | 3/25/97 | 13G00802 | .18 | <.5 | <.5 |
| OLD-13-18B | 3/25/97 | U4G01801 | 420 | 2.7 | 10 |
| OLD-13-19B | 3/25/97 | U4G01901 | 9.3 | 2.3 | .31 |
| OLD-13-20B | 3/25/97 | U4G02001 | 6,900 | 910 | <150 |

Notes: RI/FS = Remedial Investigation and Feasibility Study.
J = estimated value.
ID = identification.
PCE = tetrachloroethene.
TCE = trichloroethene.
cis-DCE = cis-dichloroethene.
< = less than.

All results reported as micrograms per liter.

## APPENDIX B

## PREVIOUS INVESTIGATION FIGURES

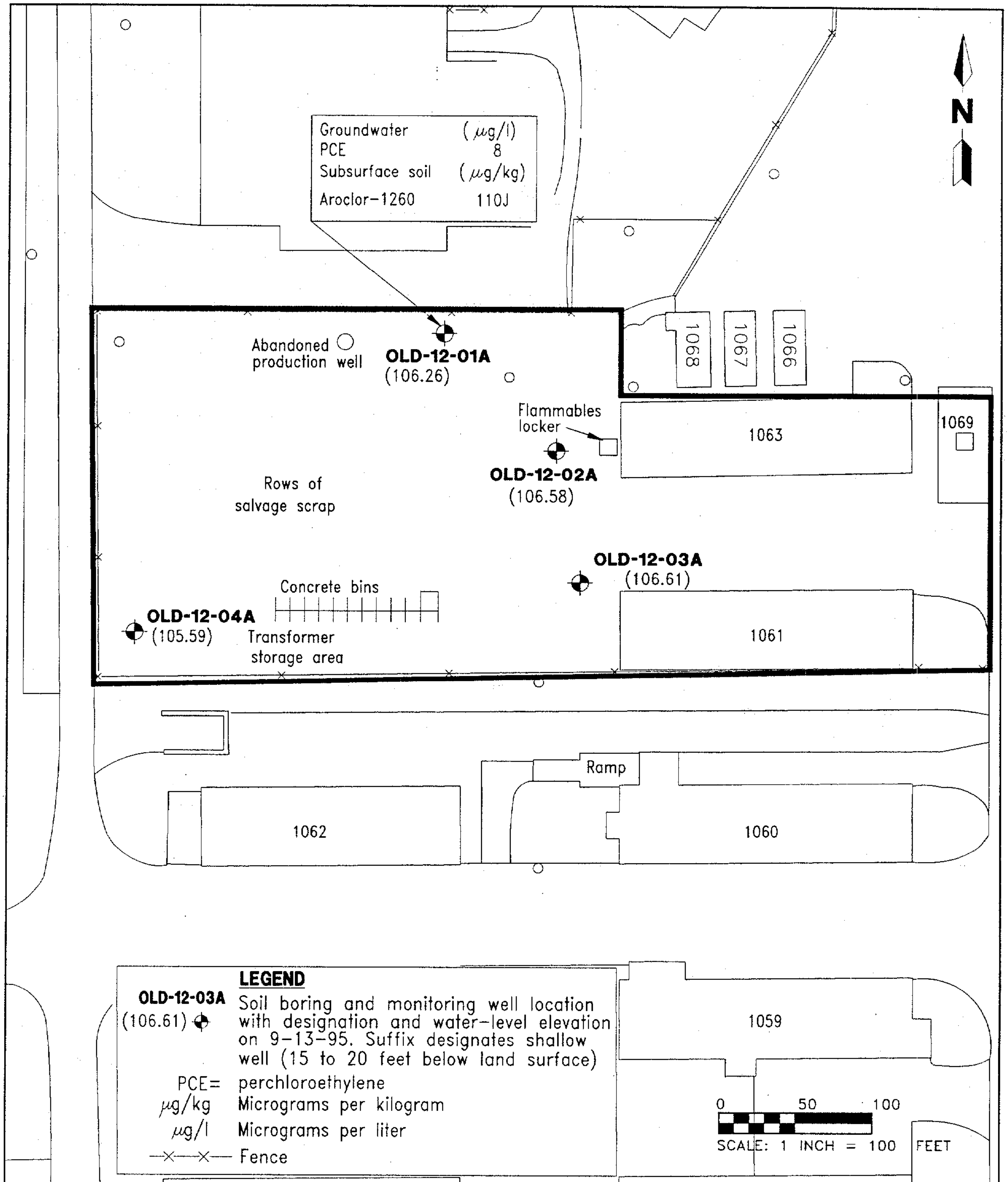
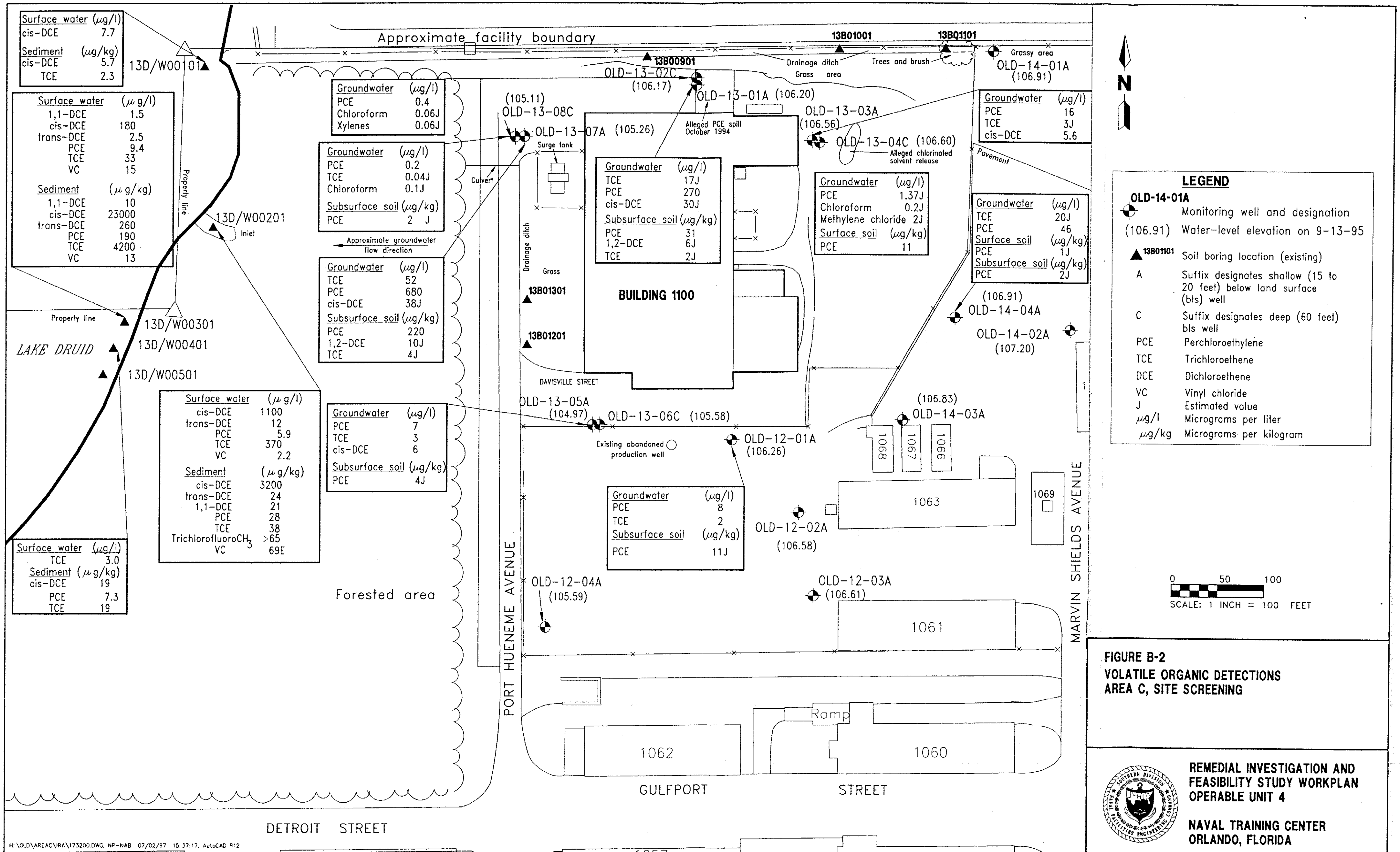


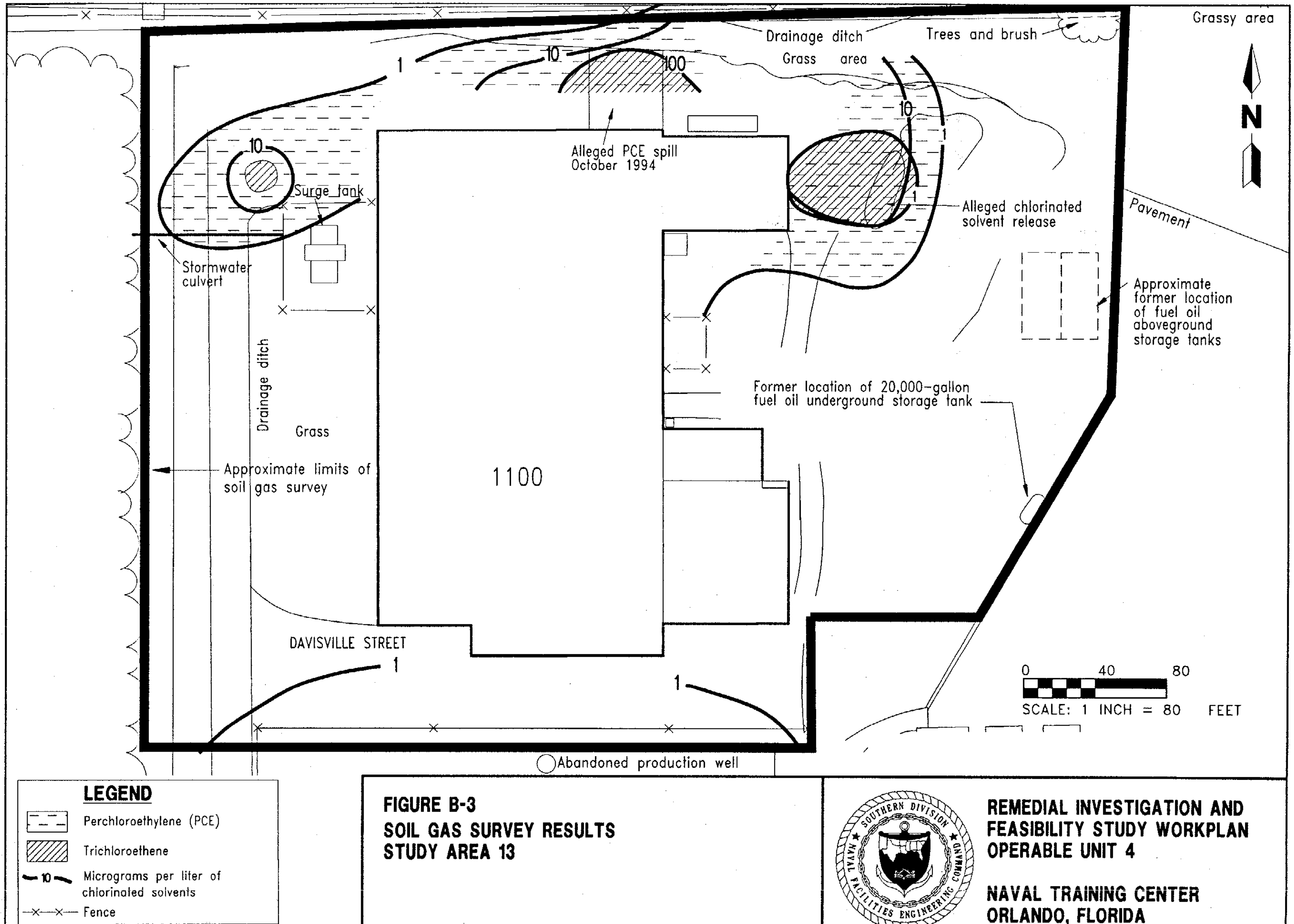

**FIGURE B-1**
**SOIL BORING AND MONITORING WELL LOCATIONS STUDY AREA 12**

173200.DWG, KHM-NAB 07/01/97 18:32:34, AutoCAD R12

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN OPERABLE UNIT 4**

**NAVAL TRAINING CENTER ORLANDO, FLORIDA**


Approximate facility boundary
Surface water (μg/l)
cis-DCE 7.7
Sediment (μg/kg)
cis-DCE 5.7
TCE 2.3
13D/W00101
Surface water (μ g/l)
1,1-DCE 1.5
cis-DCE 180
trans-DCE 2.5
PCE 9.4
TCE 33
VC 15
Sediment (μ g/kg)
1,1-DCE 10
cis-DCE 23000
trans-DCE 260
PCE 190
TCE 4200
VC 13
Property line
13D/W00201
Inlet
Property line
13D/W00301
13D/W00401
LAKE DRUID
13D/W00501
Surface water (μ g/l)
cis-DCE 1100
trans-DCE 12
PCE 5.9
TCE 370
VC 2.2
Sediment (μ g/kg)
cis-DCE 3200
trans-DCE 24
1,1-DCE 21
PCE 28
TCE 38
TrichlorofluoroCH3 >65
VC 69E
Surface water (μg/l)
TCE 3.0
Sediment (μ g/kg)
cis-DCE 19
PCE 7.3
TCE 19
Forested area
Groundwater (μg/l)
PCE 0.4
Chloroform 0.06J
Xylenes 0.06J
Groundwater (μg/l)
PCE 0.2
TCE 0.04J
Chloroform 0.1J
Subsurface soil (μg/kg)
PCE 2 J
Approximate groundwater flow direction
Groundwater (μg/l)
TCE 52
PCE 680
cis-DCE 38J
Subsurface soil (μg/kg)
PCE 220
1,2-DCE 10J
TCE 4J
Groundwater (μg/l)
PCE 7
TCE 3
cis-DCE 6
Subsurface soil (μg/kg)
PCE 4J
Culvert
(105.11)
OLD-13-08C
OLD-13-07A (105.26)
Surge tank
Drainage ditch
Grass
13B01301
13B01201
DAVISVILLE STREET
13B00901
OLD-13-02C
(106.17)
OLD-13-01A (106.20)
Alleged PCE spill October 1994
Groundwater (μg/l)
TCE 17J
PCE 270
cis-DCE 30J
Subsurface soil (μg/kg)
PCE 31
1,2-DCE 6J
TCE 2J
BUILDING 1100
13B01001
13B01101
Drainage ditch
Grass area
Trees and brush
Grassy area
OLD-14-01A
(106.91)
OLD-13-03A
(106.56)
OLD-13-04C (106.60)
Alleged chlorinated solvent release
Pavement
Groundwater (μg/l)
PCE 1.37J
Chloroform 0.2J
Methylene chloride 2J
Surface soil (μg/kg)
PCE 11
Groundwater (μg/l)
PCE 16
TCE 3J
cis-DCE 5.6
Groundwater (μg/l)
TCE 20J
PCE 46
Surface soil (μg/kg)
PCE 1J
Subsurface soil (μg/kg)
PCE 2J
(106.91)
OLD-14-04A
OLD-14-02A
(107.20)
OLD-13-05A
(104.97)
OLD-13-06C (105.58)
Existing abandoned production well
OLD-12-01A
(106.26)
(106.83)
OLD-14-03A
1068
1067
1066
Groundwater (μg/l)
PCE 8
TCE 2
Subsurface soil (μg/kg)
PCE 11J
OLD-12-02A
(106.58)
1063
1069
OLD-12-04A
(105.59)
OLD-12-03A
(106.61)
1061
PORT HUENEME AVENUE
MARVIN SHIELDS AVENUE
Ramp
1062
1060
GULFPORT STREET
DETROIT STREET
N
LEGEND
OLD-14-01A Monitoring well and designation
(106.91) Water-level elevation on 9-13-95
13B01101 Soil boring location (existing)
A Suffix designates shallow (15 to 20 feet) below land surface (bls) well
C Suffix designates deep (60 feet) bls well
PCE Perchloroethylene
TCE Trichloroethene
DCE Dichloroethene
VC Vinyl chloride
J Estimated value
μg/l Micrograms per liter
μg/kg Micrograms per kilogram
0 50 100
SCALE: 1 INCH = 100 FEET
FIGURE B-2
VOLATILE ORGANIC DETECTIONS
AREA C, SITE SCREENING
REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN OPERABLE UNIT 4
NAVAL TRAINING CENTER ORLANDO, FLORIDA
H:\OLD\AREAC\IRA\173200.DWG, NP-NAB 07/02/97 15:37:17, AutoCAD R12

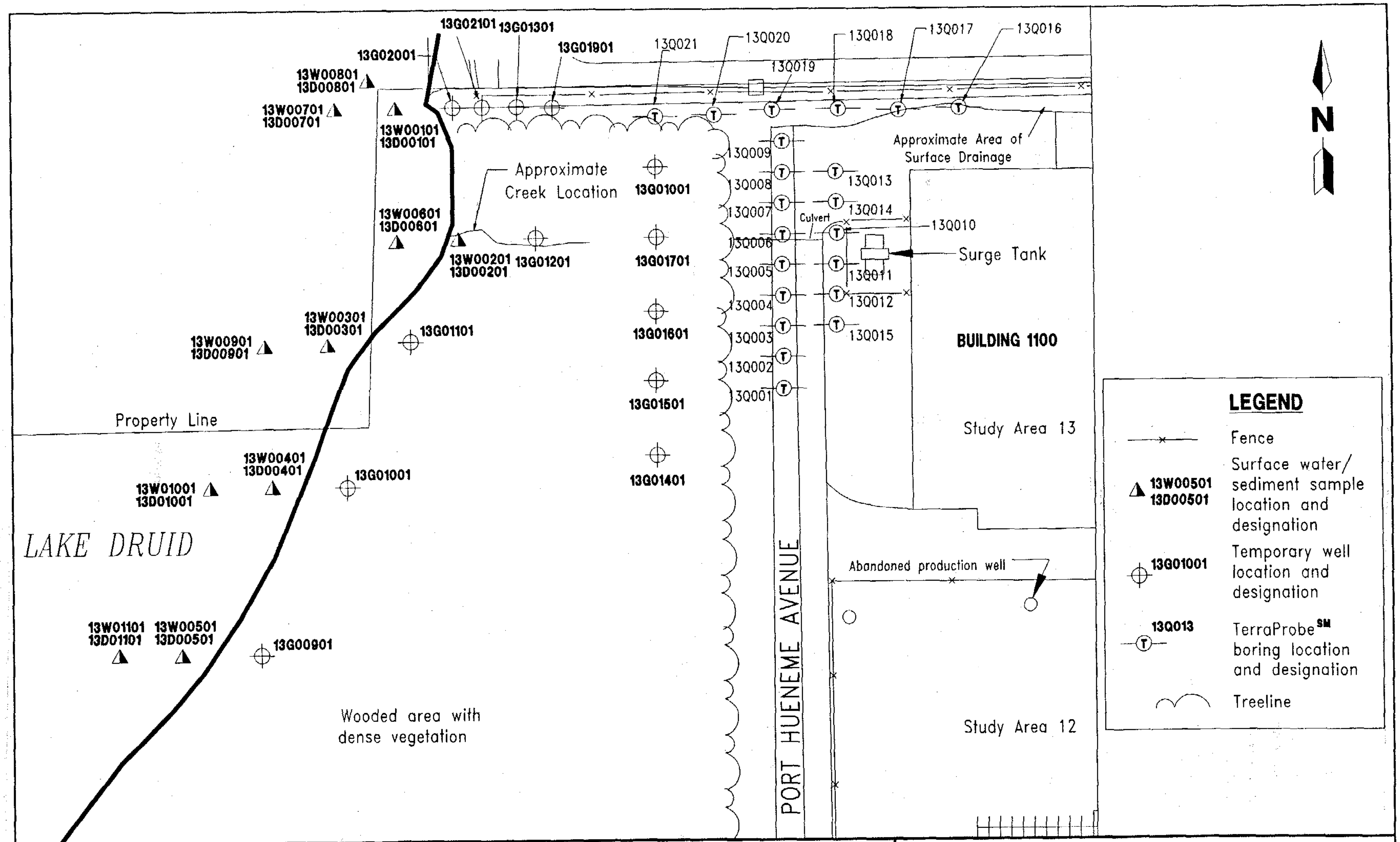



173200.DWG, BB-NAB 07/01/97 18:09:50, AutoCAD R12

**FIGURE B-3**
**SOIL GAS SURVEY RESULTS**
**STUDY AREA 13**

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN OPERABLE UNIT 4**

**NAVAL TRAINING CENTER ORLANDO, FLORIDA**




0 125 250

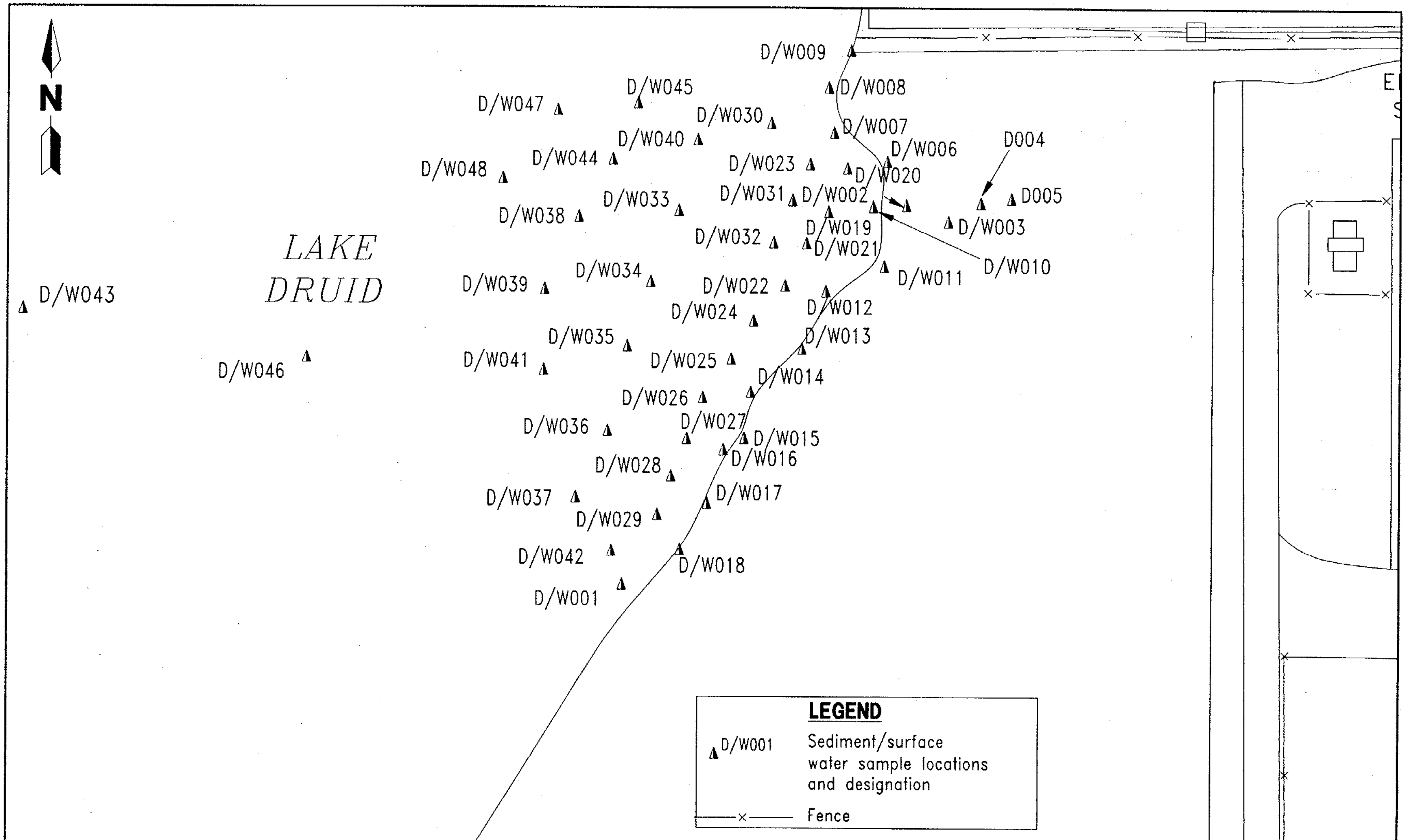
SCALE: 1 INCH = 250 FEET

H:\OLD\RIFS\SITSCREN.DWG, NP-NB 07/02/97 14:49:08, AutoCAD R12

**FIGURE B-4**
**SITE SCREENING SAMPLE LOCATIONS**

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN OPERABLE UNIT 4**

**NAVAL TRAINING CENTER ORLANDO, FLORIDA**




0 50 100

SCALE: 1 INCH = 100 FEET

**FIGURE B-5**
**SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS**

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN OPERABLE UNIT 4**

**NAVAL TRAINING CENTER ORLANDO, FLORIDA**

H:\OLD\AREAC\IRA\OU4MAP.DWG, NMM-BB 07/10/97 11:04:09, AutoCAD R12

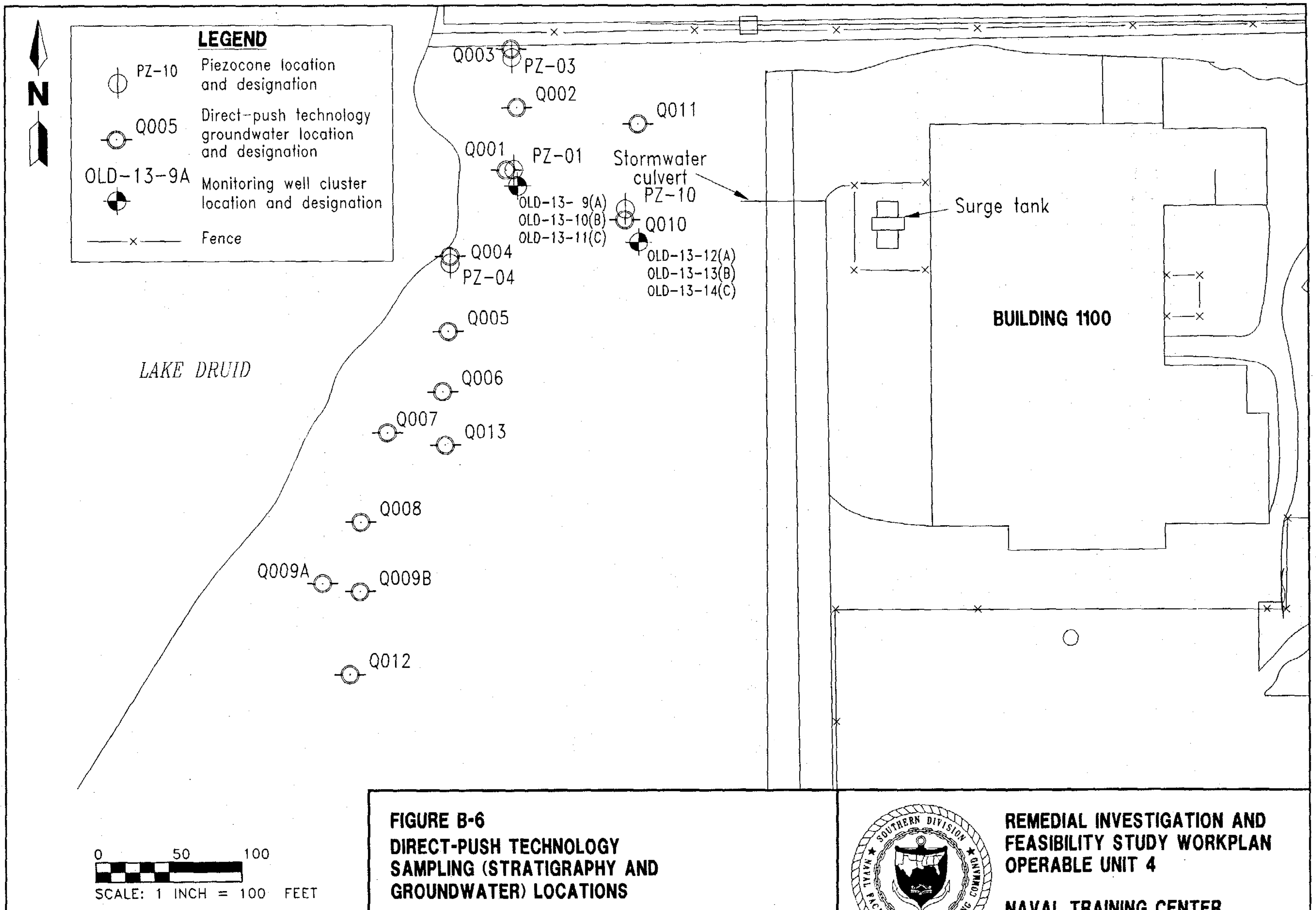



**FIGURE B-6**
**DIRECT-PUSH TECHNOLOGY SAMPLING (STRATIGRAPHY AND GROUNDWATER) LOCATIONS**

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN OPERABLE UNIT 4**

**NAVAL TRAINING CENTER ORLANDO, FLORIDA**

H:\OLD\RIFS\MISCDWGS.DWG, NAB-BB 07/10/97 11:08:21, AutoCAD R12

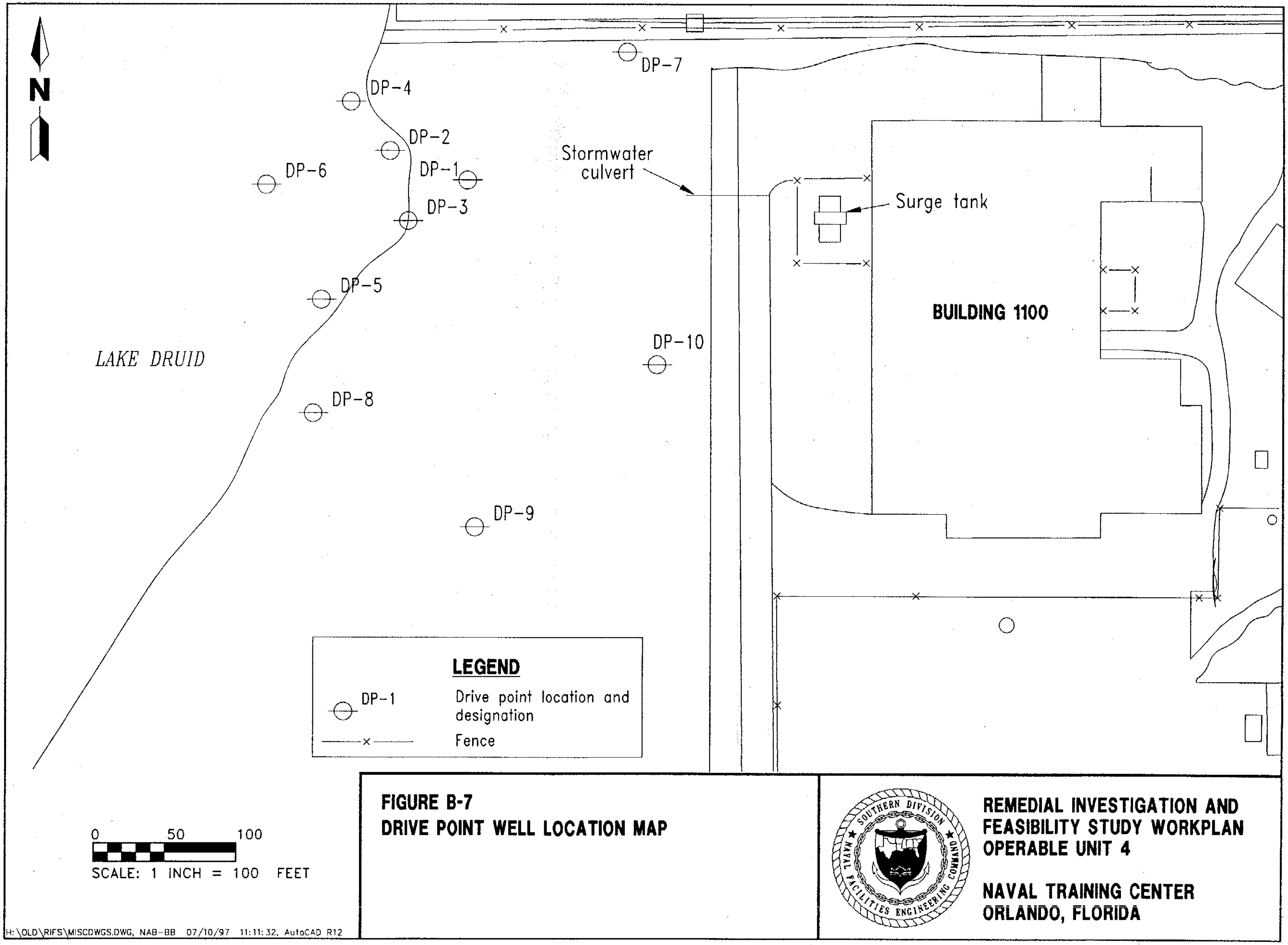



**FIGURE B-7**
**DRIVE POINT WELL LOCATION MAP**

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN OPERABLE UNIT 4**

**NAVAL TRAINING CENTER ORLANDO, FLORIDA**

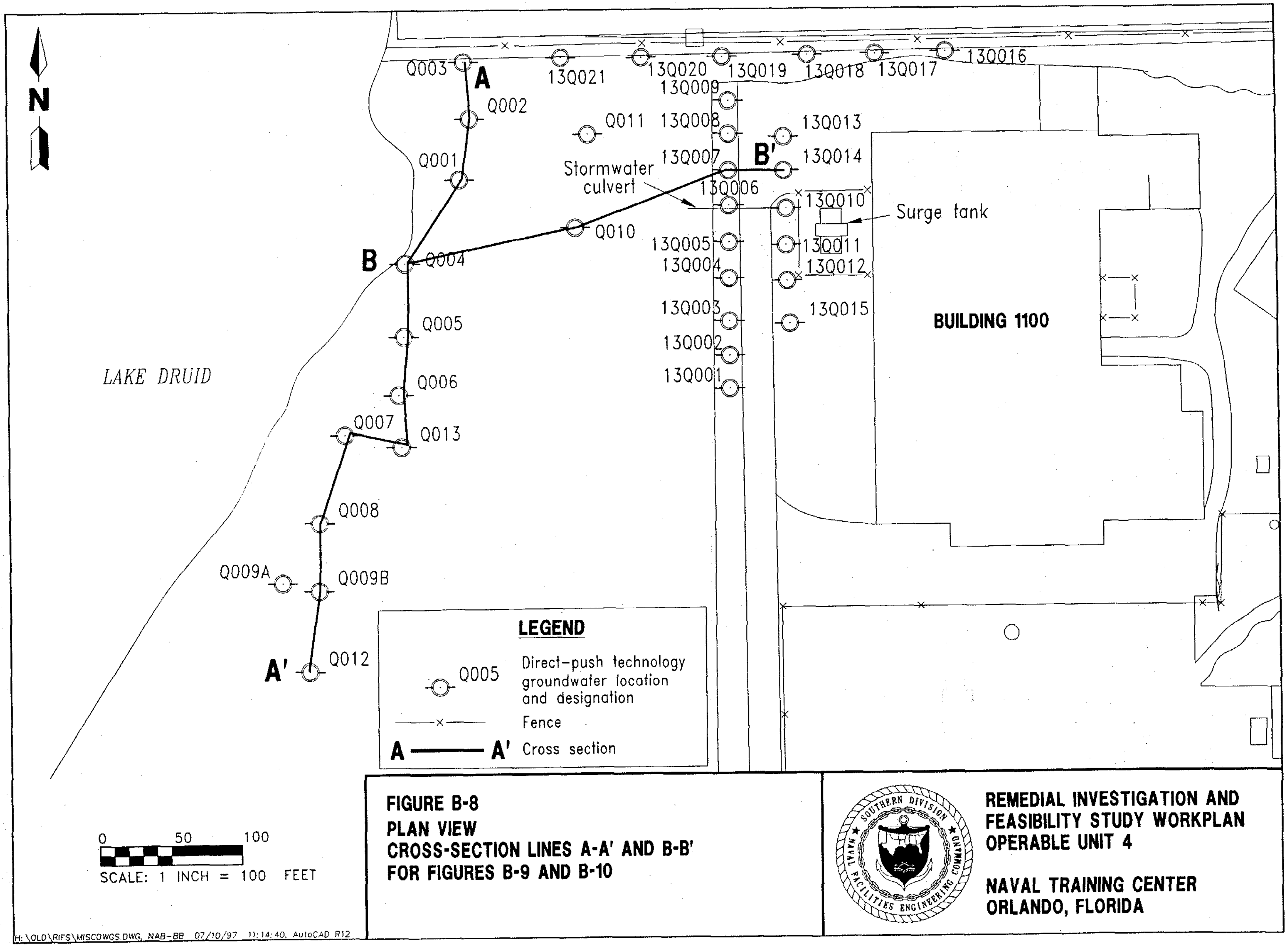
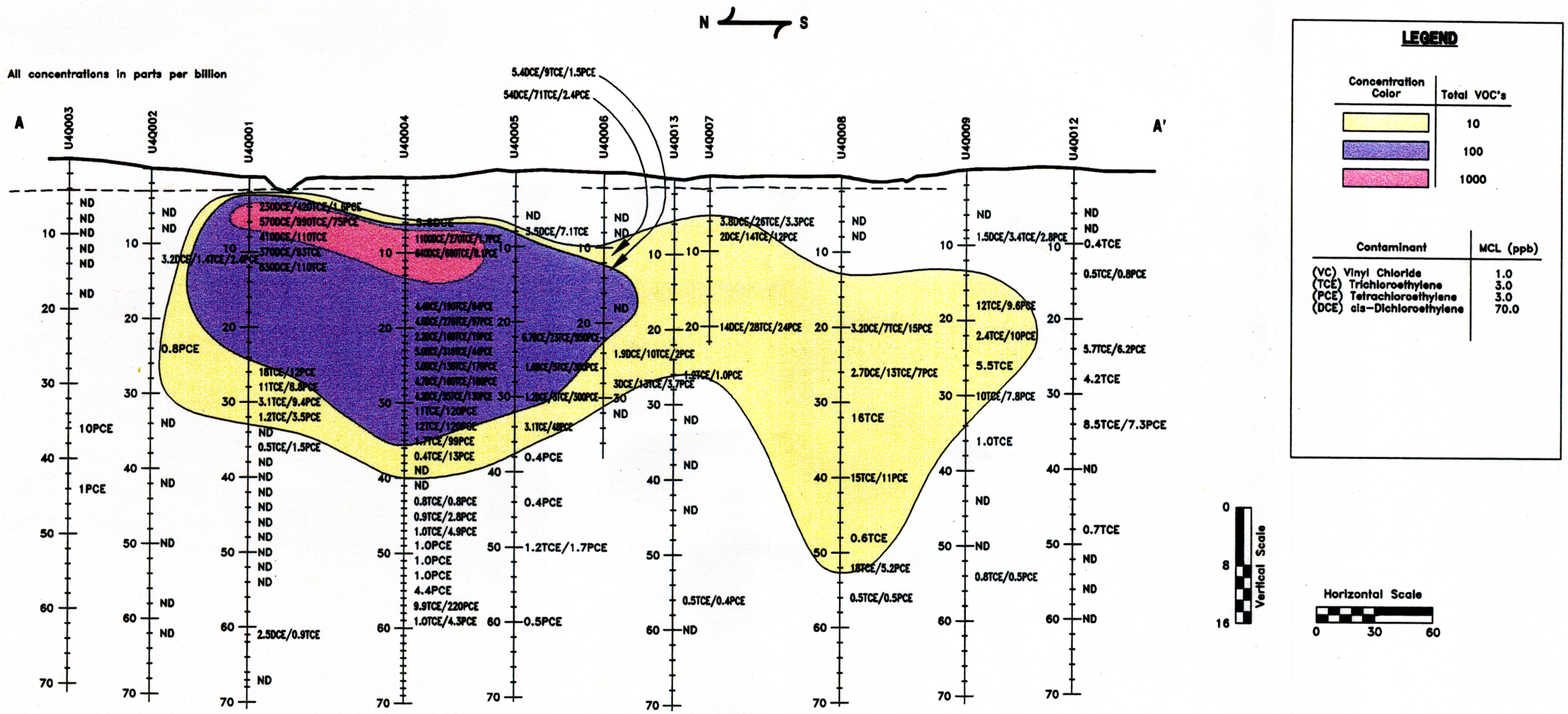



**FIGURE B-8**
**PLAN VIEW**
**CROSS-SECTION LINES A-A' AND B-B'**
**FOR FIGURES B-9 AND B-10**

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN**
**OPERABLE UNIT 4**

**NAVAL TRAINING CENTER**
**ORLANDO, FLORIDA**




NOTE:
VOC=volatile organic compound

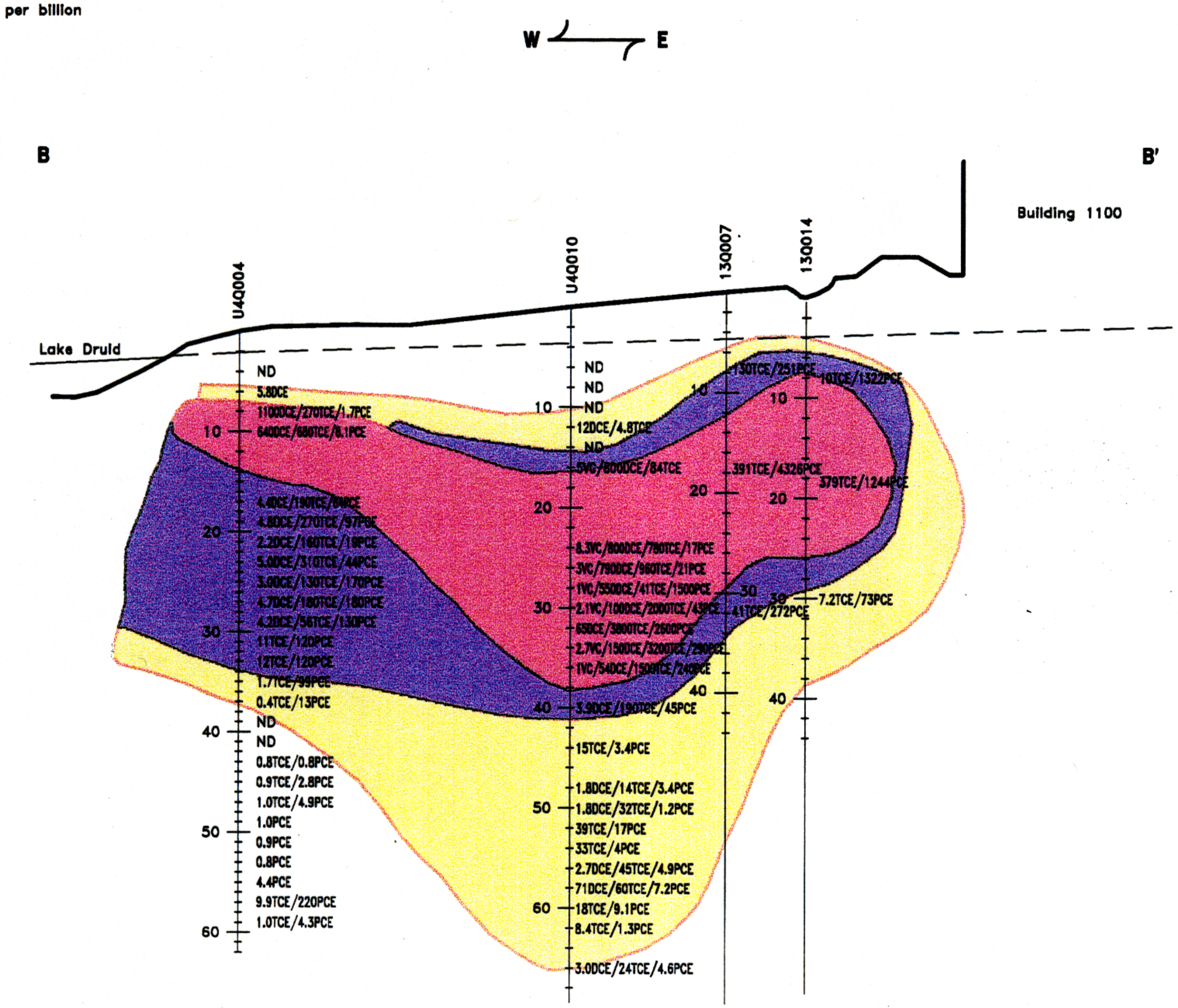
FIGURE B-9
NORTH-SOUTH CROSS SECTION A-A' SHOWING GROUNDWATER VOC CONCENTRATIONS

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN
OPERABLE UNIT 4

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

H:\ORLANDO\OU4\8556F003 AND T:\8556-07\8556F003\EJL\7-10-97

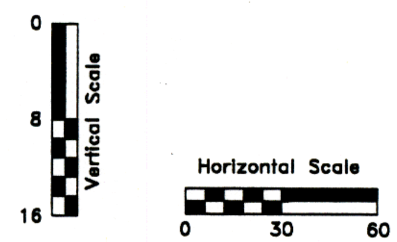
All concentrations in parts per billion




**LEGEND**

| Concentration Color | Total VOC's |
|---|---|
| (yellow) | 10 |
| (blue) | 100 |
| (pink) | 1000 |

| Contaminant | MCL (ppb) |
|---|---|
| (VC) Vinyl Chloride | 1.0 |
| (TCE) Trichloroethylene | 3.0 |
| (PCE) Tetrachloroethylene | 3.0 |
| (DCE) cis-Dichloroethylene | 70.0 |



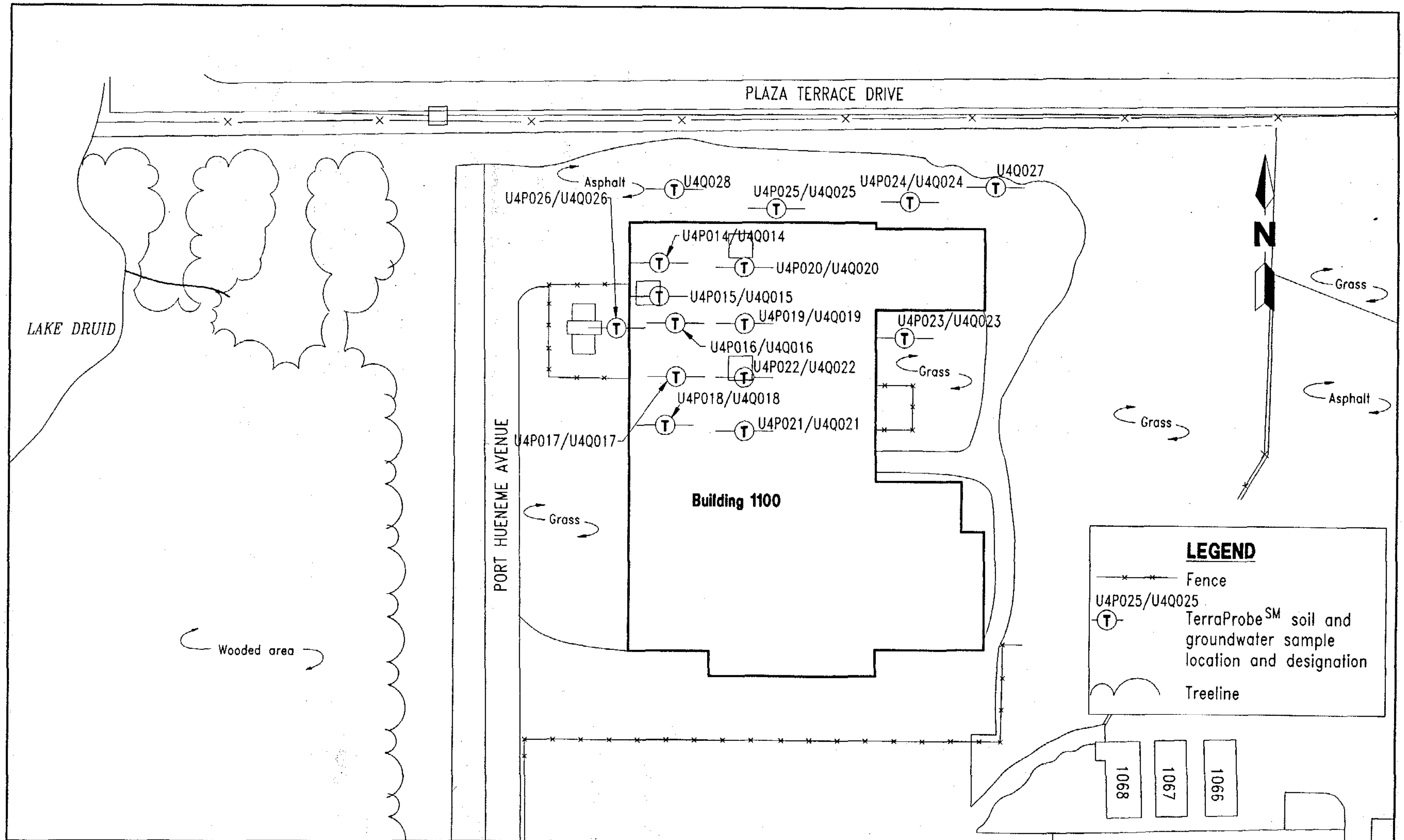

NOTE:
VOC=volatile organic compound

**FIGURE B-10**
**EAST-WEST CROSS SECTION B-B' SHOWING GROUNDWATER VOC CONCENTRATIONS**

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN OPERABLE UNIT 4**

**NAVAL TRAINING CENTER ORLANDO, FLORIDA**

H:\ORLANDO\OU4\8556F004 AND T:\8556-07\8556F004\EJL\7-10-97




0 50 100

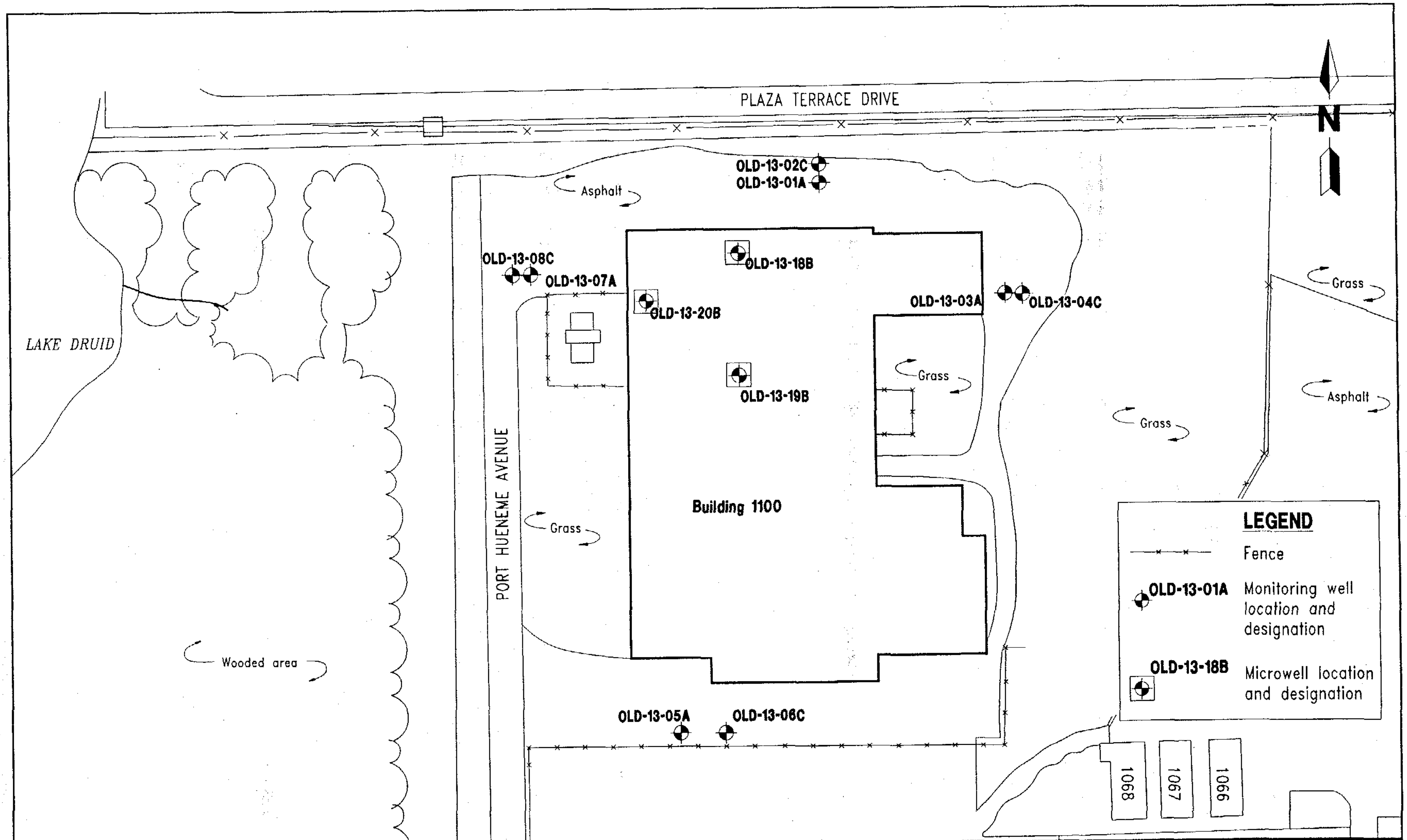
SCALE: 1 INCH = 100 FEET

**FIGURE B-11**
**TERRAPROBE SM SUBSURFACE SOIL AND GROUNDWATER SAMPLE LOCATIONS**
**OPERABLE UNIT 4**
**SOURCE INVESTIGATION**

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN**
**OPERABLE UNIT 4**

**NAVAL TRAINING CENTER**
**ORLANDO, FLORIDA**

H:\OLD\IRA-OU4\CONSTDWG\BLDG1100.DWG, PDP-BB 07/10/97 15:49:35, AutoCAD R12




0 50 100

SCALE: 1 INCH = 100 FEET

**FIGURE B-12**
**EXISTING MONITORING WELL AND NEW MICROWELL LOCATIONS, STUDY AREA 13**

SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN OPERABLE UNIT 4**

**NAVAL TRAINING CENTER ORLANDO, FLORIDA**

H:\OLD\IRA-OU4\CONSTDWG\BLDG1100.DWG, NAB-BB 07/10/97 15:52:37, AutoCAD R12

# APPENDIX C

## SYNOPSIS OF POTENTIAL FEDERAL AND STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)

## Table C-1
## Synopsis of Potential Federal ARARs

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Federal Standards and Requirements | Synopsis | ARAR Type | Consideration in the Remedial Response Process |
|---|---|---|---|
| Clean Air Act, National Ambient Air Quality Standards (NAAQS) (40 CFR Part 50) | Establishes primary (health-based) and secondary (welfare-based) air quality standards for carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, and sulfur oxides emitted from a major source of air emissions. | Action specific | Site remediation activities must comply with NAAQS. The principal application of these standards is during remedial activities resulting in exposures through dust and vapors. In general, emissions from remedial activities are not expected to qualify as a major source and are, therefore, not expected to be applicable requirements. However, the requirements may be determined to be relevant and appropriate for nonmajor sources with significantly similar emissions. |
| Clean Water Act (CWA), Ambient Water Quality Criteria (AWQC) (40 CFR Part 131) | Federal AWQC are nonenforceable, health-based criteria for surface water. AWQC provide levels of exposure from drinking the water and consuming aquatic life that are protective of public health. AWQC also provide acute and chronic concentrations for protection of freshwater and marine organisms. | Chemical specific | In the absence of any Florida Surface Water Quality Standard specific to the pollutant and water body of concern, AWQC may be ARARs for surface water bodies when protection of aquatic life is a concern or if human exposure from consumption of contaminated fish is a concern. |
| CWA, National Pollutant Discharge Elimination System (NPDES) (40 CFR Parts 122 and 125) | Requires permits specifying the permissible concentration or level of contaminants in the effluent for the discharge of pollutants from any point source into waters of the United States. | Action specific | Off-site discharge from a site to surface waters may require that an NPDES permit be obtained and that both the substantive and administrative NPDES requirements be met. |
| National Environmental Policy Act (NEPA) (40 CFR Part 6) | Requires an EIS or a "functional equivalent" for federal actions that may impact the human environment. Also requires that Federal agencies minimize the degradation, loss, or destruction of wetlands, and preserve and enhance natural and beneficial values of wetlands and floodplains under Executive Orders 11990 and 11988. | Location specific<br>Action specific | A federal action may be exempted from an EIS if a functionally equivalent study, such as an ecological risk assessment as performed under CERCLA, is completed. For remedies that may impact wetlands, (i.e., that degradation, loss, or destruction of wetlands should be minimized) the intent of NEPA is a potential ARAR. |
| Resource Conservation and Recovery Act (RCRA), Identification and Listing of Hazardous Waste (40 CFR Part 261) | Defines those solid wastes that are subject to regulation as hazardous wastes under 40 CFR Parts 262-265. | Action specific | These requirements define RCRA-regulated wastes, thereby delineating acceptable management approaches for listed and characteristically hazardous wastes that should be incorporated into the characterization and remediation elements of remedial response projects. |

See notes at end of table.

## Table C-1 (Continued)
## Synopsis of Potential Federal ARARs

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Federal Standards and Requirements | Synopsis | ARAR Type | Consideration in the Remedial Response Process |
|---|---|---|---|
| RCRA, Closure and Post-closure (40 CFR Part 264, Subpart G) | Details general requirements for closure and postclosure of hazardous waste facilities, including installation of a groundwater monitoring program. | Action specific | This requirement is a potential ARAR for remedial alternatives that involve the closure of a hazardous waste site. |
| RCRA, Use and Management of Containers (40 CFR Part 264, Subpart I) | Sets standards for the storage of containers of hazardous waste. | Action Specific | This requirement would apply if a remedial alternative involves the storage of containers of RCRA hazardous waste. Additionally, the staging of study-generated RCRA wastes should meet the intent of the regulation. |
| RCRA, Land Disposal Restrictions (LDRs) (40 CFR Part 268) | Establishes restrictions on land disposal of untreated hazardous wastes, and provides treatment standards for hazardous wastes. | Action Specific | Under the LDRs, treatment standards have been established for all "listed" wastes. If it is determined that hazardous wastes are considered subject to LDRs, the material must be handled and treated in compliance with these regulations. No excavation (as treatment), however, could apply to IDW disposal. |
| Safe Water Drinking Act (SDWA), National Primary Drinking Water Standards, Maximum Contaminant Levels (MCLs) (40 CFR Part 141) | Establishes standards for specific contaminants that have been determined to adversely affect human health. These standards, MCLs, are protective of human health for individual chemicals and are developed using MCLGs, available treatment technologies, and cost data. | Chemical specific | MCLs established by the SDWA are relevant and appropriate standards where the MCLGs are not. MCLs apply to ground or surface waters that are current or potential drinking water sources. |
| SDWA, National Secondary Drinking Water Standards (SMLCs) (40 CFR Part 143) | Establishes welfare-based standards for public water systems for specific contaminants or water characteristics that may affect the aesthetic qualities of drinking water. | Chemical specific | SMCLs are nonenforceable limits intended as guidelines for use by states in regulating water supplies. |

Notes: RI/FS = Remedial Investigation and Feasibility Study.
ARAR = applicable or relevant and appropriate requirements.
CFR = Code of Federal Regulations.
EIS = Environmental Impact Statement.
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act.
IDW = investigation-derived wastes.
MCLGs = maximum contaminant limit goal.

## Table C-2
## Synopsis of Potential Federal ARARs

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| State Citations | Synopsis | ARAR Type | Consideration in the Remedial Response Process |
|---|---|---|---|
| Florida Air Pollution Rules (Chapter 62-2, FAC) | Establishes permitting requirements for owners or operators of any source that emits any air pollutant. This rules also establishes ambient air quality standards for sulfur dioxide, $PM_{10}$, carbon monoxide, and ozone. | Action specific | Where remedial action could result in release of regulated contaminants to the atmosphere, such as may occur during air stripping, this regulation would be a potential ARAR. |
| Florida Rules on Permits (Chapter 62-4, FAC) | Establishes procedures for obtaining permits for sources of pollution. | Action specific | The substantive permitting requirements must be met during a CERCLA remediation. Both substantive and administrative requirements must be met for non-CERCLA activities. |
| Florida Surface Water Quality Standards (Chapter 62-302, FAC) | Defines classifications of surface waters and establishes water quality standards (WQS) for surface water within the classifications. The State's antidegradation policy is also established in this rule. | Chemical specific, Location specific | Remedial actions that potentially impact surface waters of the state will consider surface WQS. WQC may also be relevant and appropriate ARARs for groundwater if no MCL exists, groundwater discharges to surface water and contaminants are affecting aquatic organisms, or other health-based standards are not available. |
| Florida Groundwater Classes, Standards and Exemptions (Chapter 62-520, FAC) | Establishes the groundwater classification system for the State and provides qualitative minimum criteria for groundwater based on the classification. States that groundwater that is Class I or II must be treated to meet primary and secondary standards. | Chemical specific, Location specific | The classification system established in this rule defines potable water sources (F-I, G-I and G-II waters). Because groundwater at OU 3 is Class II, the primary and secondary standards in 62-550, FAC, may apply. |
| Groundwater Permitting and Monitoring Requirements (Chapter 62-522, FAC) | Establishes permitting and monitoring requirements for installations discharging to groundwater. | Action specific | This rule should be considered when discharge to groundwater is a possible remedial action. |
| Florida Drinking Water Standards (Chapter 62-550, FAC) | Established to implement the Federal Safe Drinking Water Act by adopting the national primary and secondary drinking water standards and by creating additional rules to fulfill State and Federal requirements. | Chemical specific, Location specific | MCLs are commonly considered applicable regulations for aquifers and related groundwater classified as a current or potential potable water supply source. MCLs should be considered ARARs during a cleanup of ground or surface waters that are current or potential sources of drinking water. |

See notes at end of table.

## Table C-2 (Continued)
## Synopsis of Potential Federal ARARs

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| State Citations | Synopsis | ARAR Type | Consideration in the Remedial Response Process |
|---|---|---|---|
| Florida Water Quality Based Effluent Limitations (Chapter 62-650, FAC) | States that all activities and discharges, except dredge and fill, must meet effluent limitations based on technology or water quality. | Chemical specific<br>Action specific | All activities and discharges, other than dredge and fill activities, are required to meet effluent limitations based on technology (technology-based effluent limit) and/or water quality (water-quality-based effluent limit), as defined in this rule. The substantive permitting requirement established in this rule may be potential relevant and appropriate ARARs for remedial actions where treated water is discharged to a surface water body. |
| Florida Hazardous Waste Rules (Chapter 62-730, FAC) | Adopts by reference appropriate sections of 40 CFR and establishes minor additions to these regulations concerning the generation, storage, treatment, transportation, and disposal of hazardous wastes. | Action specific | The substantive permitting requirements for hazardous waste must be met where applicable for remedial actions. |
| Florida Soil Thermal Treatment Facilities Regulations (Chapter 62-775, FAC) | Establishes criteria for the thermal treatment of petroleum or petroleum product contaminated soils. The rule further outlines procedures for excavating, receiving, handling, and stockpiling contaminated soils prior to thermal treatment in both stationary and mobile facilities. | Chemical specific<br>Action specific | The soil cleanup values established in this rule for TRPH, VOH, metals, and BTEX may be potential relevant and appropriate ARARs for contaminated soils. This requirement does not apply to soils classified as hazardous. Procedures for excavating, receiving, handling, and stockpiling contaminated soils prior to thermal treatment are ARARs for remedial alternatives involving thermal treatment of soils. |
| Groundwater Guidance Concentrations, Bureau of Groundwater Protection, June 1994. | The document establishes maximum concentration levels for groundwater contaminants in the State of Florida. Groundwater with concentrations less than the listed values are considered "free from" contamination. | TBC | The values in this guidance should be considered when determining cleanup levels for groundwater. |
| Approach to the Assessment of Sediment Quality in Florida Coastal Water, 1995. | These guidelines should be considered when evaluating potential biological harm posed by contaminated sediments in Florida coastal waters. | TBC | These guidelines may be used for analyzing the sediment quality after air sparging has begun. |
| Soil Cleanup Standards for Florida, September 1995. | This document provides guidance for soil cleanup levels, which can be developed on a site-by-site basis using the calculations found in Appendix B of the guidance. | TBC | These guidelines aid in determining risk-based and leachability-based cleanup goals for soils. |

See notes at end of table.

## Table C-2 (Continued)
## Synopsis of Potential Federal ARARs

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

Notes: RI/FS = Remedial Investigation and Feasibility Study.
ARAR = applicable or relevant and appropriate requirements.
FAC = Florida Administrative Code.
VOH = volatile organic halocarbons.
TRPH = total recoverable petroleum hydrocarbons.
BTEX = benzene, toluene, ethylbenzene, and xylenes.
TBC = to be considered.
$PM_{10}$ = particulate matter less than 10 microns.
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act.
MCL = maximum contaminant level.
OU = Operable Unit.
CFR = Code of Federal Regulations.

# APPENDIX D

# HASP ADDENDUM

## Preface

The following pages constitute the Health and Safety Plan (HASP) addendum for the Naval Training Center (NTC), Orlando Project Operations Plan for Site Investigations and Remedial Investigations. This addendum must be used in conjunction with the existing generic HASP for NTC, Orlando. The pages in this addendum should be inserted, where indicated, in the generic HASP. The generic HASP, with these pages correctly inserted, completes the update of the NTC, Orlando HASP for the interim remedial action focused field investigation at Operable Unit (OU) 4.

**2.3 SCOPE OF WORK (WORKPLAN).** This focused field investigation at OU 4, concentrating on Lake Druid, will consist of surface water and sediment sampling in Lake Druid, groundwater sample collection via cone penetrometer testing, advancement of soil borings and collection of subsurface soil samples via hollow-stem auger borings, and completion of these borings as monitoring wells for groundwater sampling.

Objective: Provide further delineation of the horizontal and vertical extent of the chlorinated solvent contamination in Lake Druid sediment and surface water.

Methods:
- surface water sampling
- sediment sampling
- drive point and seepage meter installation

Objective: Further characterize groundwater contamination adjacent to Lake Druid to determine the mechanism for contamination of the lake. Also to provide data necessary to remediate volatile organic compound contamination in the lake.

Methods:
- groundwater sampling using cone penetrometer testing
- monitoring well installation
- groundwater sampling

**2.4.5 Monitoring** The work environment will be monitored to ensure that Immediately Dangerous to Life and Health or other dangerous conditions are identified. At a minimum, monitoring will include evaluations for combustible atmospheres, oxygen-deficient environments, and hazardous concentrations of airborne contaminants. The combustible gas meter, set to alarm at 10 percent of the lower explosive limit (LEL), will be continuously used.

**2.4.6 Air Sampling** To the extent feasible, the presence of airborne contaminants will be evaluated through the use of direct reading instrumentation. Information gathered will be used to ensure the adequacy of the levels of protection being used at the site, and may be used as the basis for upgrading or downgrading the levels of protection in conformance with action levels provided in this HASP and at the direction of the site health and safety officer. Contaminants expected to be a concern at OU 4 are shown on Table 2-2.

The following sampling equipment will be used at the site:

1. PORTA-FID organic vapor analyzer (OVA),
2. Drager pump with vinyl chloride 0.5/a tubes, and
3. LEL/oxygen meter.

Refer to Appendix F for information on the calibration and maintenance of the equipment.

## Table 2-2
## Contaminants of Concern at Operable Unit 4

RI/FS Workplan, Operable Unit 4
Study Areas 12, 13, and 14 - Area C
Naval Training Center
Orlando, Florida

| Chemical | Approximate Odor Threshold (ppm) | Permissible Exposure Limits (ppm) | Threshold Limit Value (ppm) | Physical Characteristics | Dermal Toxicity | Remarks |
|---|---|---|---|---|---|---|
| 1,1-Dichloroethene (vinylidene chloride) | 190 | 1 | 10 | Colorless liquid, sweet odor. | Smarting of skin and 1st degree burns. | Vapor can cause dizziness and drunkenness; high levels cause anesthesia. |
| 1,2-Dichloroethene | 500 | 200 | 200 | Colorless liquid, sweet odor. | Moderate skin irritant. | Nausea, vomiting, weakness, tremor, cramps, CNS depression. |
| Tetrachloroethylene | 47 | 25 | 25 | Colorless liquid with an odor like chloroform. | Moderate skin irritant. | Inhalation may irritate eyes and nose and cause CNS damage. |
| Trichloroethene | 82 | 50 | 50 | Colorless liquid, sweet odor. | Can cause dermatitis. | Eye and nose irritation, blurred vision, nausea, CNS damage. |
| Vinyl Chloride | 20 | 1 | 5,A1 | Colorless gas, sweet odor. | May cause frostbite. | Dizziness, anesthesia, lung irritation. |

Notes: RI/FS = Remedial Investigation and Feasibility Study.
ppm = parts per million.
CNS = central nervous system.
A1 = Known Human Carcinogen.

Sources: American Industrial Hygienists Association, 1989.
U.S. Department of Transportation and U.S. Coast Guard, 1991.
National Institute of Occupational Safety and Health, 1990.
American Conference of Governmental and Industrial Hygienists.
Occupational Safety and Health Administration, 1989.

The vinyl chloride Drager tubes have a limited range of operating temperatures and humidities. Above certain temperature and humidity combinations, the tubes may not be accurate. Some typical limits are as follows:

| Temperature (°F) | Relative Humidity (Percent) |
|---|---|
| 86 | 66 |
| 80 | 79 |
| 75 | 93 |
| 73 | 100 |

Above 86 degrees Fahrenheit (°F), the tubes should not be used, regardless of humidity. Below 73 °F, temperature and humidity limits are not likely to be exceeded in Orlando.

If ambient conditions at OU 4 exceed the above limits, any OVA detections above background must be assumed to be vinyl chloride, as the Drager tubes cannot be relied upon to show otherwise. Under these conditions, a Level B PPE upgrade would be required.

If the OVA reads steadily above background in the breathing zone, begin monitoring with vinyl chloride Drager tubes. If vinyl chloride levels reach or exceed 0.5 parts per million (ppm) in the breathing zone, upgrade to Level B.

If vinyl chloride levels are below 0.5 ppm, continue working in modified Level D until the OVA reads 8 ppm above background in the breathing zone, at which time upgrade to Level C. If the OVA reads 116 ppm (or greater) above background, upgrade to Level B.

If the LEL meter reads 10 percent of the LEL or greater, use nonsparking tools. IF the LEL meter reads 20 percent of the LEL or greater, stop work and evacuate the site.

The above action limits are summarized below.

<u>Level B PPE required if</u>:

Vinyl chloride Drager tube ≥ 0.5 ppm, or
OVA ≥ 116 ppm, or
OVA above background and weather conditions are
outside the limits of the Drager tubes.

<u>Level C PPE required if</u>:

Vinyl chloride Drager tube < 0.5 ppm,
and OVA ≥ 8 ppm but < 116 ppm.

<u>Level D PPE required if</u>:

Vinyl chloride Drager tube < 0.5 ppm, and
OVA < 8 ppm.

Wherever feasible, engineering controls will be used to avoid the need to upgrade from Level D. An example is the use of industrial-sized fans to blow hazardous vapors from the breathing zone.

If air monitoring instrumentation indicates the need to upgrade to Level B along the northern property line, all work will be suspended to avoid the possibility of creating a dangerous condition outside Navy property.

## 3.0 CHEMICAL HAZARDS RESPONSE INFORMATION SYSTEM (CHRIS) DATA SHEETS

# VINYLIDENE CHLORIDE

VCI

**Common Synonyms**
1, 1-Dichloroethylene
unsym-Dichloroethylene

Watery liquid — Colorless — Sweet odor

Sinks in water. Flammable, irritating vapor is produced. Boiling point is 89°F.

Avoid contact with liquid and vapor. Keep people away.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).
Shut off ignition sources and call fire department.
Stop discharge if possible.
Stay upwind and use water spray to "knock down" vapor.
Evacuate area in case of large discharge.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

**Fire**

FLAMMABLE.
POISONOUS GAS IS PRODUCED IN FIRE.
Containers may explode in fire.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear self-contained breathing apparatus.
Combat fires from safe distance or protected location.
Extinguish with dry chemical, foam, or carbon dioxide.
Cool exposed containers with water.

**Exposure**

CALL FOR MEDICAL AID.

**VAPOR**
Irritating to eyes, nose, and throat.
If inhaled, will cause dizziness or difficult breathing.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

**LIQUID**
Will burn skin and eyes.
Harmful if swallowed.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.

**Water Pollution**

Effect of low concentrations on aquatic life is unknown.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

## 1. RESPONSE TO DISCHARGE

**(See Response Methods Handbook)**
Issue warning-high flammability
Evacuate area.

## 2. LABEL

2.1 **Category:** Flammable liquid
2.2 **Class:** 3

## 3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Vinyl halides
3.2 **Formula:** $CH_2=CCl_2$
3.3 **IMO/UN Designation:** 3.1/1303
3.4 **DOT ID No.:** 1303
3.5 **CAS Registry No.:** 75-35-4

## 4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless
4.3 **Odor:** Sweet; like carbon tetrachloride or chloroform

## 5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Approved canister or air-supplied mask; goggles or face shield; rubber gloves and boots.
5.2 **Symptoms Following Exposure:** Vapor can cause dizziness and drunkenness; high levels cause anesthesia. Liquid irritates eyes and skin.
5.3 **Treatment of Exposure:** INHALATION: if any illness develops, remove person to fresh air promptly, keep warm and quiet, and get medical attention; if breathing stops, start artificial respiration. INGESTION: not likely a problem; no known antidote; treat symptomically. EYES OR SKIN: flush with plenty of water for at least 15 min; get medical attention for eyes; remove contaminated clothing and wash before reuse.
5.4 **Threshold Limit Value:** 10 ppm
5.5 **Short Term Inhalation Limits:** Data not available
5.6 **Toxicity by Ingestion:** Grade 3; Oral $LD_{50}$ = 24 hr = 84 mg/kg (adrenalectomized rat)
5.7 **Late Toxicity:** Data not available
5.8 **Vapor (Gas) Irritant Characteristics:** Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect istemporary.
5.9 **Liquid or Solid Irritant Characteristics:** Causes smarting of the skin and first-degree burns on short exposure; may cause secondary burns on long exposure.
5.10 **Odor Threshold:** Data not available
5.11 **IDLH Value:** Data not available

## 6. FIRE HAZARDS

6.1 **Flash Point:** 0°F O.C.
6.2 **Flammable Limits in Air:** 7.3%-16.0%
6.3 **Fire Extinguishing Agents:** Foam, carbon dioxide, dry chemical
6.4 **Fire Extinguishing Agents Not to be Used:** Water may be ineffective.
6.5 **Special Hazards of Combustion Products:** Toxic hydrogen chloride and phosgene are generated in fires.
6.6 **Behavior in Fire:** May explode in fire due to polymerization. Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back.
6.7 **Ignition Temperature:** 955—1031°F
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** 2.7 mm/min.
6.10 **Adiabatic Flame Temperature:** Data not available

(Continued)

## 7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** Copper and aluminum can cause polymerization.
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Can occur if exposed to sunlight, air, copper, aluminum, heat.
7.6 **Inhibitor of Polymerization:** 200 ppm methyl ether of hydroquinone; 0.6-0.8% phenol
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 35

## 8. WATER POLLUTION

8.1 **Aquatic Toxicity:** Data not available
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** Data not available
8.4 **Food Chain Concentration Potential:** None

## 9. SHIPPING INFORMATION

9.1 **Grades of Purity:** 99%
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** Padded
9.4 **Venting:** Pressure-vacuum

## 10. HAZARD ASSESSMENT CODE

**(See Hazard Assessment Handbook)**
**A-X-Y-Z**

## 11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Flammable liquid
11.2 **NAS Hazard Rating for Bulk Water Transportation:**

| Category | Rating |
|---|---|
| Fire | 3 |
| Health | |
| Vapor Irritant | 2 |
| Liquid or Solid Irritant | 2 |
| Poisons | 3 |
| Water Pollution | |
| Human Toxicity | 0 |
| Aquatic Toxicity | 2 |
| Aesthetic Effect | 2 |
| Reactivity | |
| Other Chemicals | 2 |
| Water | 0 |
| Self Reaction | 3 |

11.3 **NFPA Hazard Classification:**

| Category | Classification |
|---|---|
| Health Hazard (Blue) | 1 |
| Flammability (Red) | 4 |
| Reactivity (Yellow) | 2 |

## 12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 96.95
12.3 **Boiling Point at 1 atm:** 88.9°F = 31.6°C = 304.8°K
12.4 **Freezing Point:** —187.6°F = 122.0°C = 151.2°K
12.5 **Critical Temperature:** Not pertinent
12.6 **Critical Pressure:** Not pertinent
12.7 **Specific Gravity:** 1.21 at 20°C (liquid)
12.8 **Liquid Surface Tension:** 24 dynes/cm = 0.024 N/m at 15°C
12.9 **Liquid Water Interfacial Tension:** 37 dynes/cm = 0.037 N/m at 22.7°C
12.10 **Vapor (Gas) Specific Gravity:** 3.3
12.11 **Ratio of Specific Heats of Vapor (Gas):** Data not available
12.12 **Latent Heat of Vaporization:** 130 Btu/lb = 72 cal/g = $3.0 \times 10^5$ J/kg
12.13 **Heat of Combustion:** —4860 Btu/lb = —2700 cal/g = $-113.0 \times 10^5$ J/kg
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** —333 Btu/lb = —185 cal/g = $-7.75 \times 10^5$ J/kg
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** 18.3 psia

## 6. FIRE HAZARDS (Continued)

6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

# VINYLIDENE CHLORIDE

| 12.17 SATURATED LIQUID DENSITY | | 12.18 LIQUID HEAT CAPACITY | | 12.19 LIQUID THERMAL CONDUCTIVITY | | 12.20 LIQUID VISCOSITY | |
|---|---|---|---|---|---|---|---|
| Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F | Temperature (degrees F) | British thermal unit-inch per hour-square foot-F | Temperature (degrees F) | Centipoise |
| —20 | 81.450 | 0 | .262 | | N | —20 | .478 |
| —15 | 81.129 | 10 | .268 | | O | —15 | .466 |
| —10 | 80.799 | 20 | .273 | | T | —10 | .455 |
| —5 | 80.469 | 30 | .279 | | | —5 | .443 |
| 0 | 80.139 | 40 | .284 | | P | 0 | .433 |
| 5 | 79.809 | 50 | .290 | | E | 5 | .423 |
| 10 | 79.480 | 60 | .295 | | R | 10 | .413 |
| 15 | 79.150 | 70 | .301 | | T | 15 | .404 |
| 20 | 78.820 | 80 | .307 | | I | 20 | .395 |
| 25 | 78.490 | | | | N | 25 | .387 |
| 30 | 78.160 | | | | E | 30 | .378 |
| 35 | 77.830 | | | | N | 35 | .371 |
| 40 | 77.500 | | | | T | 40 | .363 |
| 45 | 77.169 | | | | | 45 | .356 |
| 50 | 76.839 | | | | | 50 | .349 |
| 55 | 76.509 | | | | | 55 | .342 |
| 60 | 76.179 | | | | | 60 | .336 |
| 65 | 75.849 | | | | | 65 | .330 |
| 70 | 75.520 | | | | | 70 | .324 |
| 75 | 75.200 | | | | | 75 | .318 |
| 80 | 74.870 | | | | | 80 | .313 |
| 85 | 74.540 | | | | | 85 | .307 |

| 12.21 SOLUBILITY IN WATER | | 12.22 SATURATED VAPOR PRESSURE | | 12.23 SATURATED VAPOR DENSITY | | 12.24 IDEAL GAS HEAT CAPACITY | |
|---|---|---|---|---|---|---|---|
| Temperature (degrees F) | Pounds per 100 pounds of water | Temperature (degrees F) | Pounds per square inch | Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F (estimate) |
| 68.02 | .500 | 40 | 5.115 | 40 | .09246 | 100 | .169 |
| | | 50 | 6.473 | 50 | .11470 | 120 | .172 |
| | | 60 | 8.108 | 60 | .14090 | 140 | .175 |
| | | 70 | 10.060 | 70 | .17150 | 160 | .178 |
| | | 80 | 12.360 | 80 | .20690 | 180 | .181 |
| | | 90 | 15.070 | 90 | .24760 | 200 | .184 |
| | | 100 | 18.220 | 100 | .29410 | 220 | .186 |
| | | 110 | 21.870 | 110 | .34670 | 240 | .189 |
| | | 120 | 26.060 | 120 | .40600 | 260 | .192 |
| | | 130 | 30.850 | 130 | .47250 | 280 | .194 |
| | | 140 | 36.290 | 140 | .54650 | 300 | .197 |
| | | 150 | 42.430 | 150 | .62860 | 320 | .199 |
| | | 160 | 49.340 | 160 | .71920 | 340 | .202 |
| | | 170 | 57.070 | 170 | .81860 | 360 | .204 |
| | | 180 | 65.669 | 180 | .92720 | 380 | .206 |
| | | 190 | 75.209 | 190 | 1.04600 | 400 | .209 |
| | | 200 | 85.750 | 200 | 1.17400 | 420 | .211 |
| | | 210 | 97.339 | 210 | 1.31300 | 440 | .213 |
| | | | | | | 460 | .215 |
| | | | | | | 480 | .217 |
| | | | | | | 500 | .219 |
| | | | | | | 520 | .221 |
| | | | | | | 540 | .223 |
| | | | | | | 560 | .225 |
| | | | | | | 580 | .227 |
| | | | | | | 600 | .229 |

# TETRACHLOROETHYLENE

**TTE**

| Common Synonyms | Watery liquid · Colorless · Sweet odor |
|---|---|
| Tetracap<br>Perclene<br>Perchloroethylene<br>Perk | Sinks in water. Irritating vapor is produced. |

Stop discharge if possible.
Avoid contact with liquid and vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

| | |
|---|---|
| **Fire** | Not flammable.<br>Poisonous gases are produced when heated. |
| **Exposure** | CALL FOR MEDICAL AID.<br>**VAPOR**<br>Irritating to eyes, nose and throat.<br>If inhaled, will cause difficult breathing, or loss of consciousness.<br>Move to fresh air.<br>If breathing has stopped, give artificial respiration.<br>If breathing is difficult, give oxygen.<br>**LIQUID**<br>Irritating to skin and eyes.<br>Harmful if swallowed.<br>Remove contaminated clothing and shoes.<br>Flush affected areas with plenty of water.<br>IF IN EYES, hold eyelids open and flush with plenty of water.<br>IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. |
| **Water Pollution** | Effect of low concentrations on aquatic life is unknown.<br>May be dangerous if it enters water intakes.<br>Notify local health and wildlife officials.<br>Notify operators of nearby water intakes. |

### 1. RESPONSE TO DISCHARGE

**(See Response Methods Handbook)**

Should be removed
Chemical and physical treatment

### 2. LABEL

2.1 **Category:** None
2.2 **Class:** Not pertinent

### 3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Not listed
3.2 **Formula:** $Cl_2C{=}CCl_2$
3.3 **IMO/UN Designation:** 9.0/1897
3.4 **DOT ID No.:** 1897
3.5 **CAS Registry No.:** 127-18-4

### 4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless
4.3 **Odor:** Ethereal; like chloroform; mildly sweet

### 5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** For high vapor concentrations use approved canister or air-supplied mask; chemical goggles or face shield; plastic gloves.
5.2 **Symptoms Following Exposure:** Vapor can affect central nervous system and cause anesthesia. Liquid may irritate skin after prolonged contact. May irritate eyes but causes no injury.
5.3 **Treatment of Exposure:** INHALATION: if illness occurs, remove patient to fresh air, keep him warm and quiet, and get medical attention. INGESTION: induce vomiting only on physician's recommendation. EYES AND SKIN: flush with plenty of water and get medical attention if irritation or injury occurs.
5.4 **Threshold Limit Value:** 50 ppm
5.5 **Short Term Inhalation Limits:** 100 ppm for 60 min.
5.6 **Toxicity by Ingestion:** Grade 2; $LD_{50}$ = 0.5 to 5 g/kg
5.7 **Late Toxicity:** None
5.8 **Vapor (Gas) Irritant Characteristics:** Vapors cause a slight smarting of the eyes or throat if present in high concentrations. The effect is temporary.
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 **Odor Threshold:** 5 ppm
5.11 **IDLH Value:** 500 ppm

### 6. FIRE HAZARDS

6.1 **Flash Point:** Not flammable
6.2 **Flammable Limits in Air:** Not flammable
6.3 **Fire Extinguishing Agents:** Not pertinent
6.4 **Fire Extinguishing Agents Not to be Used:** Not pertinent
6.5 **Special Hazards of Combustion Products:** Toxic, irritating gases may be generated in fires.
6.6 **Behavior in Fire:** Not pertinent
6.7 **Ignition Temperature:** Not flammable
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** Not flammable
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

### 7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** Data not available

### 8. WATER POLLUTION

8.1 **Aquatic Toxicity:** Data not available
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** None
8.4 **Food Chain Concentration Potential:** None

### 9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Dry cleaning and industrial grades: 95+%
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Pressure-vacuum

### 10. HAZARD ASSESSMENT CODE

**(See Hazard Assessment Handbook)**

A-X

### 11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** ORM-A
11.2 **NAS Hazard Rating for Bulk Water Transportation:**

| Category | Rating |
|---|---|
| Fire | 0 |
| Health | |
| Vapor Irritant | 1 |
| Liquid or Solid Irritant | 1 |
| Poisons | 2 |
| Water Pollution | |
| Human Toxicity | 1 |
| Aquatic Toxicity | 3 |
| Aesthetic Effect | 2 |
| Reactivity | |
| Other Chemicals | 1 |
| Water | 0 |
| Self Reaction | 1 |

11.3 **NFPA Hazard Classification:** Not listed

### 12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 165.83
12.3 **Boiling Point at 1 atm:** 250°F = 121°C = 394°K
12.4 **Freezing Point:** −8.3°F = −22.4°C = 250.8°K
12.5 **Critical Temperature:** 657°F = 347°C = 620°K
12.6 **Critical Pressure:** Not pertinent
12.7 **Specific Gravity:** 1.63 at 20°C (liquid)
12.8 **Liquid Surface Tension:** 31.3 dynes/cm = 0.0313 N/m at 20°C
12.9 **Liquid Water Interfacial Tension:** 44.4 dynes/cm = 0.0444 N/m at 25°C
12.10 **Vapor (Gas) Specific Gravity:** Not pertinent
12.11 **Ratio of Specific Heats of Vapor (Gas):** 1.116
12.12 **Latent Heat of Vaporization:** 90.2 Btu/lb = 50.1 cal/g = $2.10 \times 10^5$ J/kg
12.13 **Heat of Combustion:** Not pertinent
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** Data not available

### NOTES

# TETRACHLOROETHYLENE

| 12.17 SATURATED LIQUID DENSITY | | 12.18 LIQUID HEAT CAPACITY | | 12.19 LIQUID THERMAL CONDUCTIVITY | | 12.20 LIQUID VISCOSITY | |
|---|---|---|---|---|---|---|---|
| Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F | Temperature (degrees F) | British thermal unit-inch per hour-square foot-F | Temperature (degrees F) | Centipoise |
| 35 | 103.400 | 0 | .198 | | N | 55 | .958 |
| 40 | 103.099 | 10 | .200 | | O | 60 | .929 |
| 45 | 102.900 | 20 | .201 | | T | 65 | .900 |
| 50 | 102.599 | 30 | .202 | | | 70 | .873 |
| 55 | 102.299 | 40 | .203 | | P | 75 | .848 |
| 60 | 102.000 | 50 | .204 | | E | 80 | .823 |
| 65 | 101.700 | 60 | .205 | | R | 85 | .800 |
| 70 | 101.400 | 70 | .206 | | T | 90 | .777 |
| 75 | 101.099 | 80 | .207 | | I | 95 | .756 |
| 80 | 100.799 | 90 | .208 | | N | 100 | .736 |
| 85 | 100.500 | 100 | .210 | | E | 105 | .716 |
| 90 | 100.200 | 110 | .211 | | N | 110 | .698 |
| 95 | 99.910 | 120 | .212 | | T | 115 | .680 |
| 100 | 99.610 | 130 | .213 | | | 120 | .663 |
| 105 | 99.320 | 140 | .214 | | | 125 | .647 |
| 110 | 99.020 | 150 | .215 | | | 130 | .631 |
| 115 | 98.730 | 160 | .216 | | | 135 | .616 |
| 120 | 98.429 | 170 | .217 | | | 140 | .601 |
| 125 | 98.139 | 180 | .218 | | | 145 | .588 |
| 130 | 97.839 | 190 | .220 | | | 150 | .574 |
| 135 | 97.549 | 200 | .221 | | | 155 | .561 |
| 140 | 97.250 | 210 | .222 | | | 160 | .549 |
| 145 | 96.959 | | | | | 165 | .537 |
| 150 | 96.669 | | | | | 170 | .526 |
| 155 | 96.370 | | | | | 175 | .515 |
| 160 | 96.080 | | | | | | |

| 12.21 SOLUBILITY IN WATER | | 12.22 SATURATED VAPOR PRESSURE | | 12.23 SATURATED VAPOR DENSITY | | 12.24 IDEAL GAS HEAT CAPACITY | |
|---|---|---|---|---|---|---|---|
| Temperature (degrees F) | Pounds per 100 pounds of water | Temperature (degrees F) | Pounds per square inch | Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F |
| 68.02 | .016 | 60 | .236 | 60 | .00702 | 0 | .108 |
| | | 70 | .318 | 70 | .00929 | 25 | .110 |
| | | 80 | .425 | 80 | .01216 | 50 | .113 |
| | | 90 | .561 | 90 | .01575 | 75 | .116 |
| | | 100 | .732 | 100 | .02022 | 100 | .118 |
| | | 110 | .948 | 110 | .02571 | 125 | .120 |
| | | 120 | 1.217 | 120 | .03242 | 150 | .122 |
| | | 130 | 1.548 | 130 | .04055 | 175 | .125 |
| | | 140 | 1.953 | 140 | .05032 | 200 | .127 |
| | | 150 | 2.446 | 150 | .06199 | 225 | .129 |
| | | 160 | 3.042 | 160 | .07583 | 250 | .131 |
| | | 170 | 3.756 | 170 | .09215 | 275 | .132 |
| | | 180 | 4.607 | 180 | .11130 | 300 | .134 |
| | | 190 | 5.616 | 190 | .13360 | 325 | .136 |
| | | 200 | 6.805 | 200 | .15940 | 350 | .138 |
| | | 210 | 8.199 | 210 | .18910 | 375 | .139 |
| | | 220 | 9.824 | 220 | .22330 | 400 | .141 |
| | | 230 | 11.710 | 230 | .26230 | 425 | .142 |
| | | 240 | 13.890 | 240 | .30660 | 450 | .143 |
| | | 250 | 16.390 | 250 | .35680 | 475 | .144 |
| | | 260 | 19.260 | 260 | .41330 | 500 | .146 |
| | | 270 | 22.520 | 270 | .47680 | 525 | .147 |
| | | 280 | 26.230 | 280 | .54790 | 550 | .148 |
| | | | | | | 575 | .148 |
| | | | | | | 600 | .149 |

# TRICHLOROETHANE

TCE

**Common Synonyms**
1,1,1-Trichloroethane
Methylchloroform
Aerothene
Chlorothene

Watery liquid | Colorless | Sweet odor

Sinks in water. Irritating vapor is produced.

Stop discharge if possible. Keep people away.
Avoid contact with liquid and vapor.
Call fire department.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

**Fire**

Combustible.
POISONOUS GASES ARE PRODUCED IN FIRE.
Wear goggles and self-contained breathing apparatus.
Extinguish with dry chemical, carbon dioxide, or foam.

**Exposure**

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause dizziness or difficult breathing.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Irritating to skin and eyes.
If swallowed, may produce nausea.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting.
IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.

**Water Pollution**

Effect of low concentrations on aquatic life is unknown.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

## 1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Should be removed
Chemical and physical treatment

## 2. LABEL

2.1 **Category:** None
2.2 **Class:** Not pertinent

## 3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Halogenated hydrocarbon
3.2 **Formula:** $CH_3CCl_3$
3.3 **IMO/UN Designation:** Not listed
3.4 **DOT ID No.:** 2831
3.5 **CAS Registry No.:** 71-55-6

## 4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless
4.3 **Odor:** Chloroform-like; sweetish

## 5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Organic vapor-acid gas canister; self-contained breathing apparatus for emergencies; neoprene or polyvinyl-alcohol-type gloves; chemical safety goggles and face shield; neoprene safety shoes (or leather safety shoes plus neoprene footwear); neoprene or polyvinyl alcohol suit or apron for splash protection.
5.2 **Symptoms Following Exposure:** INHALATION: symptoms range from loss of equilibrium and incoordination to loss of consciousness; high concentration can be fatal due to simple asphyxiation combined with loss of consciousness. INGESTION: produces effects similar to inhalation and may cause some feeling of nausea. EYES: slightly irritating and lachrymatory. SKIN: defatting action may cause dermatitis.
5.3 **Treatment of Exposure:** Get medical attention for all eye exposures and any other serious overexposures. Do NOT administer adrenalin or epinephrine; otherwise, treatment is symptomatic. INHALATION: remove victim to fresh air; if necessary, apply artificial respiration and/or administer oxygen. INGESTION: have victim drink water and induce vomiting. EYES: flush thoroughly with water. SKIN: remove contaminated clothing and wash exposed area thoroughly with soap and warm water.
5.4 **Threshold Limit Value:** 350 ppm
5.5 **Short Term Inhalation Limits:** 1,000 ppm for 60 min. in man
5.6 **Toxicity by Ingestion:** Grade 1; $LD_{50}$ = 5 to 15 g/kg (rat, mouse, rabbit, guinea pig)
5.7 **Late Toxicity:** Data not available
5.8 **Vapor (Gas) Irritant Characteristics:** Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 **Odor Threshold:** 100 ppm
5.11 **IDLH Value:** 1,000 ppm

## 6. FIRE HAZARDS

6.1 **Flash Point:** Data not available
6.2 **Flammable Limits in Air:** 7%-16%
6.3 **Fire Extinguishing Agents:** Dry chemical, foam, or carbon dioxide
6.4 **Fire Extinguishing Agents Not to be Used:** Not pertinent
6.5 **Special Hazards of Combustion Products:** Toxic and irritating gases are generated in fires.
6.6 **Behavior in Fire:** Not pertinent
6.7 **Ignition Temperature:** 932°F
6.8 **Electrical Hazard:** Not pertinent
6.9 **Burning Rate:** (est.) 2.9 mm/min.
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

## 7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** Reacts slowly, releasing corrosive hydrochloric acid.
7.2 **Reactivity with Common Materials:** Corrodes aluminum, but reaction is not hazardous.
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 36

## 8. WATER POLLUTION

8.1 **Aquatic Toxicity:** 75-150 ppm/*/pinfish/$TL_m$/salt water
*Time period not specified.
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** Data not available
8.4 **Food Chain Concentration Potential:** None

## 9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Uninhibited; inhibited; industrial inhibited; white room; cold cleaning
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Pressure-vacuum

## 10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
A-X-Y

## 11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** ORM-A
11.2 **NAS Hazard Rating for Bulk Water Transportation:**

| Category | Rating |
|---|---|
| Fire | 1 |
| Health | |
| Vapor Irritant | 1 |
| Liquid or Solid Irritant | 1 |
| Poisons | 2 |
| Water Pollution | |
| Human Toxicity | 1 |
| Aquatic Toxicity | 3 |
| Aesthetic Effect | 2 |
| Reactivity | |
| Other Chemicals | 1 |
| Water | 0 |
| Self Reaction | 0 |

11.3 **NFPA Hazard Classification:**

| Category | Classification |
|---|---|
| Health Hazard (Blue) | 2 |
| Flammability (Red) | 1 |
| Reactivity (Yellow) | 0 |

## 12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 133.41
12.3 **Boiling Point at 1 atm:** 165°F = 74°C = 347°K
12.4 **Freezing Point:** <−38°F = <−39°C = <234°K
12.5 **Critical Temperature:** Not pertinent
12.6 **Critical Pressure:** Not pertinent
12.7 **Specific Gravity:** 1.31 at 20°C (liquid)
12.8 **Liquid Surface Tension:** 25.4 dynes/cm = 0.0254 N/m at 20°C
12.9 **Liquid Water Interfacial Tension:** (est.) 45 dynes/cm = 0.045 N/m at 20°C
12.10 **Vapor (Gas) Specific Gravity:** 4.6
12.11 **Ratio of Specific Heats of Vapor (Gas):** 1.104
12.12 **Latent Heat of Vaporization:** 100 Btu/lb = 58 cal/g = $2.4 \times 10^5$ J/kg
12.13 **Heat of Combustion:** (est.) 4700 Btu/lb = 2600 cal/g = $110 \times 10^5$ J/kg
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** Data not available
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** 4.0 psia

NOTES

# TRICHLOROETHANE

| 12.17 SATURATED LIQUID DENSITY | | 12.18 LIQUID HEAT CAPACITY | | 12.19 LIQUID THERMAL CONDUCTIVITY | | 12.20 LIQUID VISCOSITY | |
|---|---|---|---|---|---|---|---|
| Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F | Temperature (degrees F) | British thermal unit-inch per hour-square foot-F | Temperature (degrees F) | Centipoise |
| 0 | 85.419 | 55 | .240 | | N | 15 | 1.363 |
| 10 | 84.870 | 60 | .242 | | O | 20 | 1.295 |
| 20 | 84.309 | 65 | .244 | | T | 25 | 1.231 |
| 30 | 83.759 | 70 | .246 | | | 30 | 1.172 |
| 40 | 83.200 | 75 | .248 | | P | 35 | 1.117 |
| 50 | 82.650 | 80 | .250 | | E | 40 | 1.065 |
| 60 | 82.089 | 85 | .252 | | R | 45 | 1.017 |
| 70 | 81.540 | 90 | .254 | | T | 50 | .972 |
| 80 | 80.981 | 95 | .256 | | I | 55 | .929 |
| 90 | 80.429 | 100 | .258 | | N | 60 | .889 |
| 100 | 79.870 | 105 | .260 | | E | 65 | .852 |
| 110 | 79.320 | 110 | .262 | | N | 70 | .817 |
| 120 | 78.759 | 115 | .264 | | T | 75 | .784 |
| 130 | 78.209 | 120 | .266 | | | 80 | .753 |
| 140 | 77.650 | 125 | .268 | | | 85 | .723 |
| 150 | 77.099 | 130 | .270 | | | | |
| 160 | 76.540 | 135 | .272 | | | | |
| | | 140 | .274 | | | | |

| 12.21 SOLUBILITY IN WATER | | 12.22 SATURATED VAPOR PRESSURE | | 12.23 SATURATED VAPOR DENSITY | | 12.24 IDEAL GAS HEAT CAPACITY | |
|---|---|---|---|---|---|---|---|
| Temperature (degrees F) | Pounds per 100 pounds of water | Temperature (degrees F) | Pounds per square inch | Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F |
| 68.02 | .070 | 70 | 2.099 | 70 | .04925 | 0 | .146 |
| | | 75 | 2.364 | 75 | .05495 | 25 | .150 |
| | | 80 | 2.657 | 80 | .06119 | 50 | .155 |
| | | 85 | 2.980 | 85 | .06799 | 75 | .159 |
| | | 90 | 3.335 | 90 | .07540 | 100 | .163 |
| | | 95 | 3.725 | 95 | .08346 | 125 | .167 |
| | | 100 | 4.152 | 100 | .09220 | 150 | .171 |
| | | 105 | 4.619 | 105 | .10170 | 175 | .175 |
| | | 110 | 5.130 | 110 | .11190 | 200 | .179 |
| | | 115 | 5.686 | 115 | .12300 | 225 | .183 |
| | | 120 | 6.292 | 120 | .13490 | 250 | .186 |
| | | 125 | 6.950 | 125 | .14770 | 275 | .190 |
| | | 130 | 7.663 | 130 | .16150 | 300 | .193 |
| | | 135 | 8.437 | 135 | .17630 | 325 | .196 |
| | | 140 | 9.273 | 140 | .19220 | 350 | .199 |
| | | 145 | 10.180 | 145 | .20920 | 375 | .202 |
| | | 150 | 11.150 | 150 | .22730 | 400 | .205 |
| | | 155 | 12.200 | 155 | .24670 | 425 | .208 |
| | | 160 | 13.330 | 160 | .26730 | 450 | .210 |
| | | 165 | 14.540 | 165 | .28930 | 475 | .213 |
| | | 170 | 15.840 | 170 | .31270 | 500 | .215 |
| | | 175 | 17.240 | 175 | .33760 | 525 | .217 |
| | | 180 | 18.730 | 180 | .36390 | 550 | .219 |
| | | 185 | 20.330 | 185 | .39180 | 575 | .222 |
| | | 190 | 22.030 | 190 | .42140 | 600 | .223 |

# VINYL CHLORIDE

VCM

| Common Synonyms | Gas | Colorless | Sweet odor |
|---|---|---|---|
| Chlorethylene<br>VCL<br>Vinyl C Monomer<br>VCM | Liquid floats and boils on water. Flammable, irritating visible vapor cloud is produced. | | |

Stop discharge if possible. Keep people away.
Shut off ignition sources and call fire department.
Stay upwind and use water spray to "knock down" vapor.
Evacuate area in case of large discharge.
Avoid contact with liquid and vapor.
Notify local health and pollution control agencies.

**Fire**

FLAMMABLE.
POISONOUS GAS IS PRODUCED IN FIRE.
Flashback along vapor trail may occur.
May explode if ignited in an enclosed area.
Wear self-contained breathing apparatus.
Cool exposed containers and protect men effecting shutoff with water.
Stop flow of gas if possible.
Let fire burn.
Extinguish small fires with dry chemical.

**Exposure**

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose, and throat.
If inhaled, will cause dizziness or difficult breathing.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.
LIQUID
Will cause frostbite.
Flush affected areas with plenty of water.
DO NOT RUB AFFECTED AREAS.

**Water Pollution**

Not harmful to aquatic life.

## 1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Issue warning-high flammability
Evacuate area

## 2. LABEL

2.1 **Category:** Flammable gas
2.2 **Class:** 2

## 3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Vinyl halides
3.2 **Formula:** $CH_2=CHCl$
3.3 **IMO/UN Designation:** 2.0/1086
3.4 **DOT ID No.:** 1086
3.5 **CAS Registry No.:** 75-01-4

## 4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquefied compressed gas
4.2 **Color:** Colorless
4.3 **Odor:** Pleasant, sweet

## 5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Rubber gloves and shoes; gas-tight goggles; organic vapor canister or self-contained breathing apparatus.
5.2 **Symptoms Following Exposure:** INHALATION: high concentrations cause dizziness, anesthesia, lung irritation. SKIN: may cause frostbite; phenol inhibitor may be absorbed through skin if large amounts of liquid evaporate.
5.3 **Treatment of Exposure:** INHALATION: remove patient to fresh air and keep him quiet and warm; call a doctor; give artificial respiration if breathing stops. EYES AND SKIN: flush with plenty of water for at least 15 min.; for eyes, get medical attention; remove contaminated clothing.
5.4 **Threshold Limit Value:** 5 ppm
5.5 **Short Term Inhalation Limits:** 500 ppm for 5 min.
5.6 **Toxicity by Ingestion:** Not pertinent
5.7 **Late Toxicity:** Chronic exposure may cause liver damage.
5.8 **Vapor (Gas) Irritant Characteristics:** Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary.
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of skin. May cause frostbite.
5.10 **Odor Threshold:** 260 ppm
5.11 **IDLH Value:** Data not available

## 6. FIRE HAZARDS

6.1 **Flash Point:** —110°F O.C.
6.2 **Flammable Limits in Air:** 4%-26%
6.3 **Fire Extinguishing Agents:** For small fires use dry chemical or carbon dioxide. For large fires stop flow of gas. Cool exposed containers with water.
6.4 **Fire Extinguishing Agents Not to be Used:** Not pertinent
6.5 **Special Hazards of Combustion Products:** Forms highly toxic combustion products such as hydrogen chloride, phosgenic, and carbon monoxide.
6.6 **Behavior in Fire:** Container may explode in fire. Gas is heavier than air and may travel considerable distance to a source of ignition and flash back.
6.7 **Ignition Temperature:** 882°F
6.8 **Electrical Hazard:** Class I, Group D
6.9 **Burning Rate:** 4.3 mm/min.

*(Continued)*

## 7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Polymerizes in presence of air, sunlight, or heat unless stabilized by inhibitors.
7.6 **Inhibitor of Polymerization:** Not normally used except when high temperatures are expected. Then 40-100 ppm of phenol used.
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 35

## 8. WATER POLLUTION

8.1 **Aquatic Toxicity:** None
8.2 **Waterfowl Toxicity:** None
8.3 **Biological Oxygen Demand (BOD):** None
8.4 **Food Chain Concentration Potential:** None

## 9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Commercial or technical 99+%
9.2 **Storage Temperature:** Under pressure; ambient At atm. pressure; low
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Under pressure; safety relief At atm. pressure; pressure-vacuum

## 10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-B-C-D-E-F-G-Z

## 11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Flammable gas
11.2 **NAS Hazard Rating for Bulk Water Transportation:**

| Category | Rating |
|---|---|
| Fire | 4 |
| Health | |
| Vapor Irritant | 2 |
| Liquid or Solid Irritant | 1 |
| Poisons | 2 |
| Water Pollution | |
| Human Toxicity | 0 |
| Aquatic Toxicity | 0 |
| Aesthetic Effect | 0 |
| Reactivity | |
| Other Chemicals | 2 |
| Water | 0 |
| Self Reaction | 2 |

11.3 **NFPA Hazard Classification:**

| Category | Classification |
|---|---|
| Health Hazard (Blue) | 2 |
| Flammability (Red) | 4 |
| Reactivity (Yellow) | 1 |

## 12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Gas
12.2 **Molecular Weight:** 62.50
12.3 **Boiling Point at 1 atm:** 7.2°F = 13.8°C = 259.4°K
12.4 **Freezing Point:** —244.8°F = —153.8°C = —119.4°K
12.5 **Critical Temperature:** 317.1°F = 158.4°C = 431.6°K
12.6 **Critical Pressure:** 775 psia = 52.7 atm = 5.34 MN/m²
12.7 **Specific Gravity:** 0.969 at —13°C (liquid)
12.8 **Liquid Surface Tension:** 16.0 dynes/cm = 0.0160 N/m at 25°C
12.9 **Liquid Water Interfacial Tension:** (est.) 30 dynes/cm = 0.03 N/m at 20°C
12.10 **Vapor (Gas) Specific Gravity:** 2.2
12.11 **Ratio of Specific Heats of Vapor (Gas):** 1.186
12.12 **Latent Heat of Vaporization:** 160 Btu/lb = 88 cal/g = 3.7 X $10^5$ J/kg
12.13 **Heat of Combustion:** —8136 Btu/lb = —4520 cal/g = —189.1 X $10^5$ J/kg
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** —729 Btu/lb = —405 cal/g = 16.9 X $10^5$ J/kg
12.25 **Heat of Fusion:** 18.14 cal/g
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** 75 psia

## 6. FIRE HAZARDS (Continued)

6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** 5.490 (Est.)
6.12 **Flame Temperature:** Data not available

# VINYL CHLORIDE

| 12.17 SATURATED LIQUID DENSITY | | 12.18 LIQUID HEAT CAPACITY | | 12.19 LIQUID THERMAL CONDUCTIVITY | | 12.20 LIQUID VISCOSITY | |
|---|---|---|---|---|---|---|---|
| Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F | Temperature (degrees F) | British thermal unit-inch per hour-square foot-F | Temperature (degrees F) | Centipoise |
| 0 | 61.000 | —30 | .259 | | NOT PERTINENT | —10 | .287 |
| 5 | 60.710 | —20 | .265 | | | —5 | .281 |
| | | —10 | .272 | | | 0 | .276 |
| | | 0 | .279 | | | 5 | .271 |

| 12.21 SOLUBILITY IN WATER | | 12.22 SATURATED VAPOR PRESSURE | | 12.23 SATURATED VAPOR DENSITY | | 12.24 IDEAL GAS HEAT CAPACITY | |
|---|---|---|---|---|---|---|---|
| Temperature (degrees F) | Pounds per 100 pounds of water | Temperature (degrees F) | Pounds per square inch | Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F |
| 68.02 | .600 | —50 | 3.384 | —50 | .04810 | 0 | .185 |
| | | —40 | 4.501 | —40 | .06245 | 25 | .192 |
| | | —30 | 5.908 | —30 | .08005 | 50 | .198 |
| | | —20 | 7.658 | —20 | .10140 | 75 | .205 |
| | | —10 | 9.814 | —10 | .12710 | 100 | .211 |
| | | 0 | 12.440 | 0 | .15760 | 125 | .217 |
| | | 10 | 15.610 | 10 | .19360 | 150 | .224 |
| | | 20 | 19.410 | 20 | .23560 | 175 | .230 |
| | | 30 | 23.920 | 30 | .28440 | 200 | .235 |
| | | 40 | 29.220 | 40 | .34050 | 225 | .241 |
| | | 50 | 35.430 | 50 | .40470 | 250 | .247 |
| | | 60 | 42.630 | 60 | .47760 | 275 | .252 |
| | | 70 | 50.940 | 70 | .56000 | 300 | .257 |
| | | 80 | 60.480 | 80 | .65250 | 325 | .263 |
| | | 90 | 71.349 | 90 | .75570 | 350 | .268 |
| | | 100 | 83.669 | 100 | .87050 | 375 | .273 |
| | | 110 | 97.580 | 110 | .99740 | 400 | .277 |
| | | 120 | 113.200 | 120 | 1.13700 | 425 | .282 |
| | | | | | | 450 | .286 |
| | | | | | | 475 | .291 |
| | | | | | | 500 | .295 |
| | | | | | | 525 | .299 |
| | | | | | | 550 | .303 |
| | | | | | | 575 | .307 |
| | | | | | | 600 | .311 |