INTERIM MEASURE WORK PLAN PHASE 1 SOURCE DELINEATION SOLID WASTE MANAGEMENT UNIT 196 (SWMU 196) ZONE H WITH TRANSMITTAL CNC CHARLESTON SC

11/1/2001

CH2MHILL

INTERIM MEASURE WORK PLAN

Phase 1 - Source Area Delineation

Solid Waste Management Unit 196, Zone H

Charleston Naval Complex
North Charleston, South Carolina

SUBMITTED TO
U.S. Navy Southern Division
Naval Facilities Engineering Command

PREPARED BY
CH2M-Jones

November 2000

Revision 1
Contract N62467-99-C-0960

DEPARTMENT OF THE NAVY
SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
P.O. BOX 190010
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NORTH CHARLESTON, S.C. 29419-9010

5090/11
Code 18B1
27 November, 2000

Mr. John Litton, P.E.
Director, Division of Hazardous and Infectious Waste Management
Bureau of Land and Waste Management
South Carolina Department of Health and Environmental Control
2600 Bull Street
Columbia, SC 29201

Subj: SUBMITTAL OF PHASE I SOURCE AREA DELINEATION FOR SOLID WASTE MANAGEMENT UNIT 196 INTERIM MEASURE WORK PLAN, REVISION 1

Dear Mr. Litton,

The purpose of this letter is to submit an Interim Measure Work Plan for Solid Waste Management Unit (SMWU) 196 located at the Charleston Naval Complex. The work plan is submitted to fulfill the requirements of condition IV.E.2 of the RCRA Part B permit issued to the Navy by the South Carolina Department of Health and Environmental Control and the U.S. Environmental Protection Agency.

This document has been prepared pursuant to agreements by the CNC BRAC Cleanup Team for completing the RCRA Corrective Action process and has been distributed under separate cover letter by CH2M Hill. Appropriate certification is provided under that correspondence. We request that the Department and the EPA review this document and provide comments or approval whichever is appropriate. If you should have any questions, please contact Matthew Humphrey or myself at (843) 743-9985 and (843) 820-5525 respectively.

Sincerely,

Matthew A Hunt

Matthew A.Hunt, P.E.
Environmental Engineer
BRAC Division

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CH2MHILL

November 21, 2000

John Litton, P.E.
Director
Division of Hazardous and Infectious Wastes
South Carolina Department of Health and
Environmental Control
Bureau of Land and Waste Management
2600 Bull Street
Columbia, SC 29201

Dear Mr. Litton:

Enclosed please find four copies of Revision 1 of the Phase 1 Interim Measure Work Plan – Source Delineation for SWMU 196, at the Charleston Naval Complex (CNC). This report has been prepared pursuant to agreements by the CNC BRAC Cleanup Team for completing the RCRA Corrective Action process.

Please contact me if you have any questions or comments.

Sincerely,

Dean Williamson, P.E.

xc: Tony Hunt/Navy, w/att
Mihir Mehta/SCDHEC
Gary Foster/CH2M HILL w/att

INTERIM MEASURE WORK PLAN

Phase 1 - Source Area Delineation

Solid Waste Management Unit 196, Zone H

Charleston Naval Complex
North Charleston, South Carolina

SUBMITTED TO
U.S. Navy Southern Division
Naval Facilities Engineering Command

PREPARED BY
CH2M-Jones

November 2000
158814.ZH.PR.00

Revision 1
Contract N62467-99-C-0960

Certification Page for Interim Measure Work Plan for SWMU 196, Zone H

Phase I Source Area Delineation

I, Dean Williamson, certify that this report has been prepared under my direct supervision. The data and information are, to the best of my knowledge, accurate and correct, and the report has been prepared in accordance with current standards of practice for engineering.

South Carolina

Temporary Permit No. T2000342

Dean Williamson, P.E.

11/21/2000

Date

SOUTH CAROLINA CERTIFICATE OF AUTHORIZATION

CH2M HILL, INC. No. C00201

Contents

Acronyms and Abbreviations

1,2-DCB	1,2-dichlorobenzene
bls	below land surface
BMP	Best Management Practice
BRAC	Base Realignment and Closure Act
CA	Corrective Action
CB	chlorobenzene
CMS	Corrective Measures Study
CNC	Charleston Naval Complex
CSAP	Comprehensive Sampling and Analysis Plan
DCB	dichlorobenzene
DMP	Data Management Plan
DNAPL	dense non-aqueous phase liquid
DPT	Direct-Push Technology
DQO	Data Quality Objectives
EnSafe	EnSafe Inc.
EPA	U.S. Environmental Protection Agency
ESDSOPQAM	Environmental Services Division Standard Operating Procedures and Quality Assurance Manual
ft	feet
ft bls	feet below land surface
GIS	geographic information systems
IDW	investigative-derived waste
IM	Interim Measure
IM WP	IM Work Plan
µg/L	micrograms per liter
mg/L	milligrams per liter
mL	milliliter

msl	mean sea level
NAVBASE	Naval Base
NWP	Nationwide Permit
PCB	polychlorinated biphenyl
QAP	Quality Assurance Plan
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SCDHEC	South Carolina Department of Health and Environmental Control
SOP	standard operating procedure
SSL	Soil Screening Level
SWMU	solid waste management unit
SVOC	semi-volatile organic compound
USACE	U.S. Army Corps of Engineers
VOC	volatile organic compound

Introduction

1.0 Introduction

In 1993, Naval Base (NAVBASE) Charleston was added to the list of bases scheduled for closure as part of the Defense Base Realignment and Closure Act (BRAC), which regulates closure and transition of property to the community. The Charleston Naval Complex (CNC) was formed as a result of the dis-establishment of the Charleston Naval Shipyard and NAVBASE on April 1, 1996.

CNC Corrective Action (CA) activities are being conducted under the Resource Conservation and Recovery Act (RCRA); the South Carolina Department of Health and Environmental Control (SCDHEC) is the lead agency for CA activities at the site. All RCRA CA activities are performed in accordance with the Final Permit (Permit No. SC0 170 022 560).

In April 2000, CH2M-Jones was awarded a contract to provide environmental investigation and remediation services at CNC. This submittal has been prepared by CH2M-Jones to document the basis for an Interim Measure Work Plan (IM WP) at Solid Waste Management Unit (SWMU) 196 in Zone H of the CNC.

This submittal is a revision to the September 2000 (Revision 0) submittal, which has been updated to incorporate responses to SCDHEC comments. Responses to SCDHEC comments are presented in Appendix C.

1.1 Purpose and Objectives of Phase I Interim Measure Work Plan

1.1.1 Phase I Interim Measure Work Plan Purpose

Previous soil and groundwater investigations at SWMU 196 at the CNC have revealed the presence of significant concentrations of chlorobenzene (CB) and dichlorobenzenes (DCBs) in shallow groundwater. Concentrations in several monitor wells containing up to 15 milligrams per liter (mg/L) of CB and 13 mg/L of DCB have been detected. These values are approximately 0.3 and 8 percent, respectively, of the maximum solubility of CB and 1,2-dichlorbenzene (1,2-DCB) in water, suggesting the possibility that CB or DCB may be present in the shallow aquifer in the form of a dense non-aqueous phase liquid (DNAPL).

In addition, surface water sampling, through the use of a diffusion sampler, has detected low concentrations of DCB in surface water in Shipyard Creek, near SWMU 196, indicating that a complete migration pathway into Shipyard Creek from this SWMU is present. The location of SWMU 196 within the CNC is presented in Figure 1-1.

The RCRA CA process allows for the implementation of an IM to control or minimize ongoing threats to human health or the environment (61 FR 19432 [1996]). The Phase I IM will define the extent of CB/DCB contamination at SWMU 196. The Phase II IM, which will involve remediation of the CB/DCB source area at SWMU 196, will meet the overall objectives of an IM as specified by the U.S. Environmental Protection Agency (EPA).

The remediation of the CB/DCB source area is not necessarily intended to be the final remedy for SWMU 196; however, the abatement of the source area is expected to be compatible with the final remedy selected for SWMU 196.

Currently, the RCRA Facility Investigation (RFI) for this site has not been completed. After completion of the RFI for this site, the RCRA Corrective Measures Study (CMS) process will be followed to identify appropriate final remedial measures for SWMU 196, should additional corrective action be necessary after the IM is complete.

1.1.2 Phase I Interim Measure Work Plan Objectives

The key objective of the Phase I IM for SWMU 196 is to more precisely determine the extent and spatial distribution of the high-concentration source areas of CB and DCB in the shallow groundwater at SWMU 196. Additional objectives are to obtain the data expeditiously and without causing an inadvertent mobilization of DNAPL materials that may be present in the shallow aquifer.

The primary data collection approach for the Phase I IM will be the collection and analysis of shallow groundwater samples. A groundwater profiling device, such as the Waterloo™ profiler or Geoprobe's Groundwater Profiler, will be the primary sampling device for collecting groundwater samples at vertically discrete intervals from borings installed in the suspected source area. Up to three discrete groundwater samples may be collected from each boring. The technical approach for this task is described in detail in Section 2.0. The groundwater samples will be analyzed for CB and DCB using an onsite laboratory or offsite laboratory that can provide rapid turnaround of results. The analytical results will then be interpreted and used to map out the source area targeted for the subsequent IM.

1.2 Site Background and Setting

SWMU 196 is in the southern portion of the CNC and in the southern section of the former public works storage yard that includes Building 1838 (see Figure 1-1). This area was formerly tidal marsh land and has been filled to its present elevation. The fill area drops off steeply to the southeast of (to the rear of) the building toward Shipyard Creek. In 1991, drums and cans containing solvents, paints, acid, and lubricant oil were found stored in the area. Also found were a potassium chromate tank and transformers. All contents were removed by 1993.

Soil and groundwater investigations were conducted through the mid to late 1990s, and both CB and DCBs were consistently found in the groundwater from several monitor wells. Figure 1-2 depicts the historical site sampling point locations. A discussion on the stratigraphy of the site is presented in Appendix A.

CB and DCBs have been detected on the other side of Shipyard Creek. However, the presence of these constituents is likely related to the SWMU 9 area. Hydrogeologic data at SWMU 196 show upward groundwater gradients near Shipyard Creek, indicating that shallow groundwater from the SWMU 196 area is likely discharging into Shipyard Creek.

Also, CB and DCBs have been detected in the SWMU 9 area at concentrations that are indicative of a separate source area. Figure 1-3 shows the location of monitor wells where CB and DCBs have been detected in the SWMU 9 vicinity. Table 1-1 presents the concentrations of CB and DCBs at the wells identified in Figure 1-3. The highest concentrations are reported at monitor well station H009GW010.

1.3 Organization of Phase I Interim Measure Work Plan

This groundwater work plan consists of the following four sections, including this introductory section:

1.0 Introduction — Presents the purpose of the report and background information relating to the proposed investigation.

2.0 Technical Approach — Provides a description of the technical approach for completing the characterization of CB and DCB of the site.

3.0 Investigative-Derived Waste — Describes the procedures to be implemented for management of investigative-derived waste (IDW).

4.0 References — Lists the references used in this document.

Appendix A — Presents subsurface soil conditions at the site.

Appendix B — Presents available profiler literature.

Appendix C— Presents responses to SCDHEC comments.

TABLE 1-1
CB and DCBs Detected in SWMU 9 Area Monitor Wells
Interim Measure Work Plan, Phase 1 Source Area Delineation

Sample	Chemical Name	Result (µg/L)	Qualifier	Station	Date Collected
009GW001C1	1,3-dichlorobenzene	1.0	J	H009GW001	10/19/1999
009GW001C1	1,4-dichlorobenzene	1.0	J	H009GW001	10/19/1999
009GW00701	chlorobenzene	63.0	J	H009GW007	11/10/1994
009GW00702	chlorobenzene	37.0	=	H009GW007	04/24/1995
009GW00703	chlorobenzene	39.0	=	H009GW007	09/14/1995
009GW00704	1,2-dichlorobenzene	16.0	J	H009GW007	03/20/1996
009GW00704	1,4-dichlorobenzene	8.0	J	H009GW007	03/20/1996
009GW00704	chlorobenzene	41.0	=	H009GW007	03/20/1996
009GW01001	1,2-dichlorobenzene	4.9	J	H009GW010	11/07/1994
009GW01001	1,4-dichlorobenzene	7.5	J	H009GW010	11/07/1994
009GW01001	chlorobenzene	1300.0	=	H009GW010	11/07/1994
009GW01002	1,2-dichlorobenzene	3.9	J	H009GW010	04/25/1995
009GW01002	1,4-dichlorobenzene	9.8	J	H009GW010	04/25/1995
009GW01002	chlorobenzene	480.0	=	H009GW010	04/25/1995
009GW01003	1,2-dichlorobenzene	5.3	J	H009GW010	09/29/1995
009GW01003	1,4-dichlorobenzene	8.1	J	H009GW010	09/29/1995
009GW01003	chlorobenzene	1200.0	=	H009GW010	09/29/1995
009GW01004	1,2-dichlorobenzene	3.0	J	H009GW010	04/10/1996
009GW01004	1,3-dichlorobenzene	2.0	J	H009GW010	04/10/1996
009GW01004	1,4-dichlorobenzene	8.0	J	H009GW010	04/10/1996
009GW01004	chlorobenzene	440.0	=	H009GW010	04/10/1996
009GW01201	chlorobenzene	14.0	=	H009GW012	11/22/1994
009GW01203	chlorobenzene	8.0	=	H009GW012	09/29/1995
009GW01301	1,4-dichlorobenzene	7.3	J	H009GW013	11/18/1994
009GW01301	chlorobenzene	31.0	J	H009GW013	11/18/1994
009GW01302	1,4-dichlorobenzene	5.6	J	H009GW013	04/17/1995
009GW01302	chlorobenzene	18.0	=	H009GW013	04/17/1995
009GW01303	1,4-dichlorobenzene	5.2	J	H009GW013	10/02/1995
009GW01303	chlorobenzene	30.0	=	H009GW013	10/02/1995
009GW01304	1,4-dichlorobenzene	4.0	J	H009GW013	04/12/1996
009GW01304	chlorobenzene	25.0	=	H009GW013	04/12/1996
009GW013C1	1,4-dichlorobenzene	2.0	J	H009GW013	10/20/1999
009GW01401	1,4-dichlorobenzene	3.3	J	H009GW014	11/29/1994
009GW01401	chlorobenzene	61.0	=	H009GW014	11/29/1994

TABLE 1-1 (CONTINUED)
CB and DCBs Detected in SWMU 9 Area Monitor Wells
Interim Measure Work Plan, Phase 1 Source Area Delineation

Sample	Chemical Name	Result (µg/L)	Qualifier	Station	Date Collected
009GW01402	chlorobenzene	25.0	=	H009GW014	04/17/1995
009GW01403	chlorobenzene	26.0	=	H009GW014	09/29/1995
009GW01404	1,4-dichlorobenzene	1.0	J	H009GW014	04/12/1996
009GW01404	chlorobenzene	39.0	=	H009GW014	04/12/1996
009GW01901	chlorobenzene	28.0	=	H009GW019	04/20/1995
009GW01903	chlorobenzene	26.0	=	H009GW019	10/11/1995
009GW01904	chlorobenzene	29.0	J	H009GW019	04/15/1996
009GW02401	1,4-dichlorobenzene	2.0	J	H009GW024	08/10/1998
009GW02401	chlorobenzene	1.0	J	H009GW024	08/10/1998
009GW024C1	1,4-dichlorobenzene	3.0	J	H009GW024	10/19/1999
009GW02701	1,4-dichlorobenzene	1.0	J	H009GW027	08/12/1998
009GW02701	chlorobenzene	14.0	=	H009GW027	08/12/1998
009GW02801	1,4-dichlorobenzene	2.0	J	H009GW028	08/12/1998
009GW02801	chlorobenzene	20.0	=	H009GW028	08/12/1998
009GW02901	1,4-dichlorobenzene	3.0	J	H009GW029	08/13/1998
009GW02901	chlorobenzene	19.0	=	H009GW029	08/13/1998
009GW03001	1,2-dichlorobenzene	3.0	J	H009GW030	08/12/1998
009GW03001	1,4-dichlorobenzene	8.0	J	H009GW030	08/12/1998
009GW03001	chlorobenzene	80.0	=	H009GW030	08/12/1998
009GW12101	chlorobenzene	9.0	=	H009GW121	11/09/1994
009GW12D03	chlorobenzene	10.0	=	H009GW12D	09/29/1995
121GW00104	chlorobenzene	3.0	J	H121GW001	04/02/1996
FMWGW00404	1,4-dichlorobenzene	1.0	J	HFMWGW004	04/10/1996
FMWGW00404	chlorobenzene	19.0	=	HFMWGW004	04/10/1996

= Constituent detected above reporting limit.

J Constituent detected below reporting limit but above method detection limit.

µg/L micrograms per liter

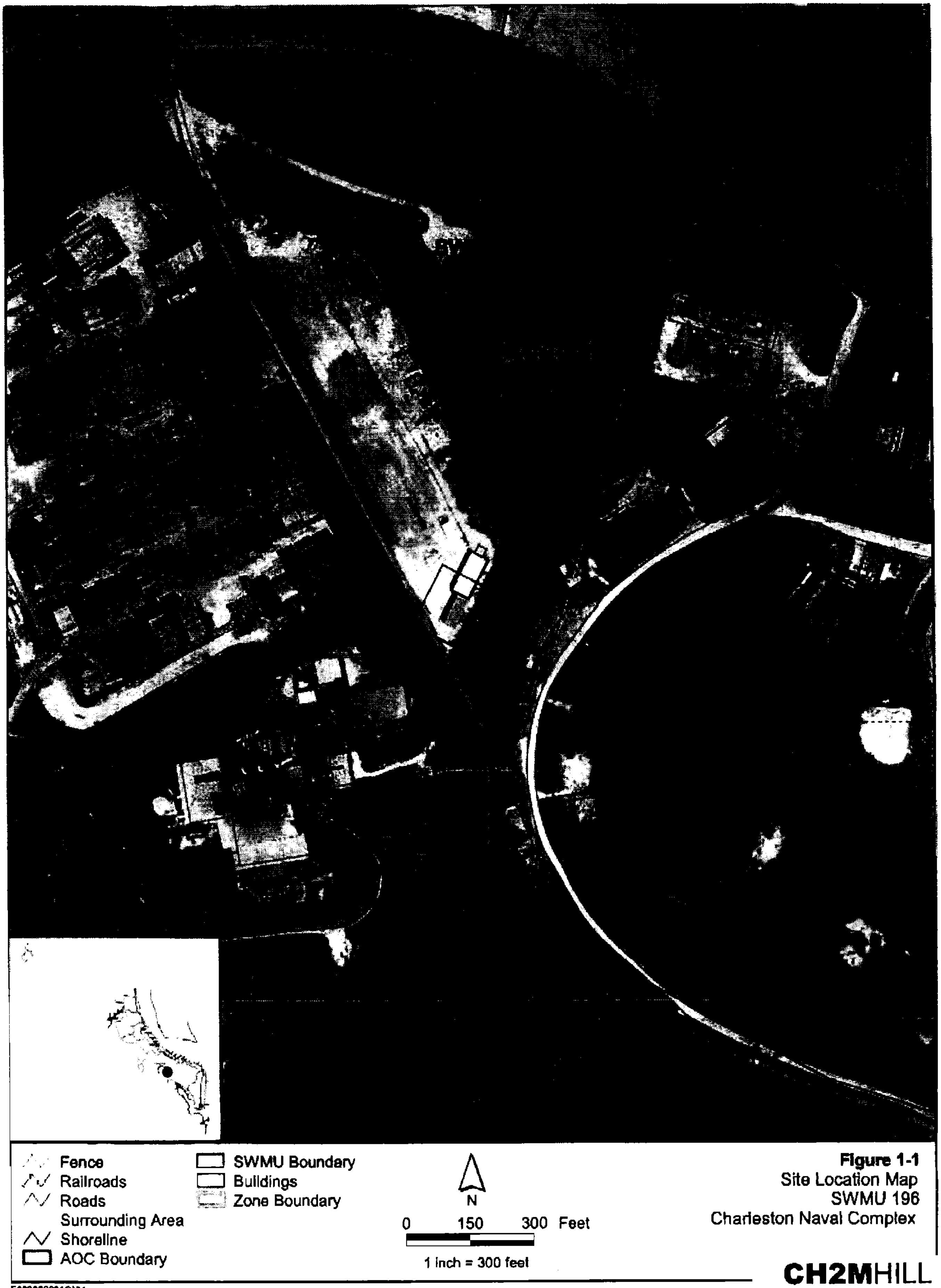

Figure 1-1
Site Location Map
SWMU 196
Charleston Naval Complex

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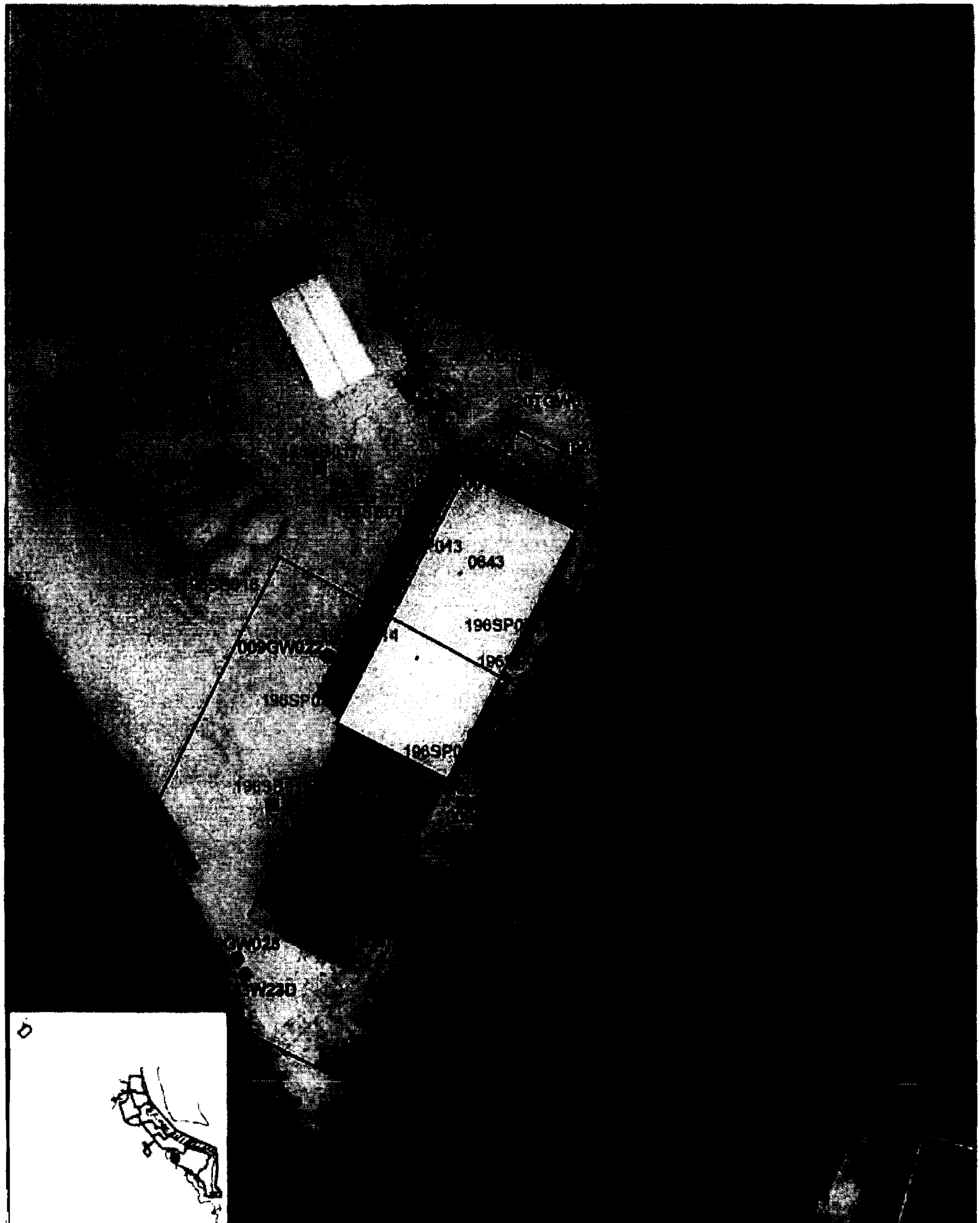

Groundwater Well
Sediment
Soil Boring
Soil Probe
Surface Water
Shoreline
AOC Boundary
SWMU Boundary
Buildings
Zone Boundary

N

0 30 60 Feet

1 inch = 50 feet

Figure 1-2
Historical Site Sample Locations
SWMU 196
Charleston Naval Complex

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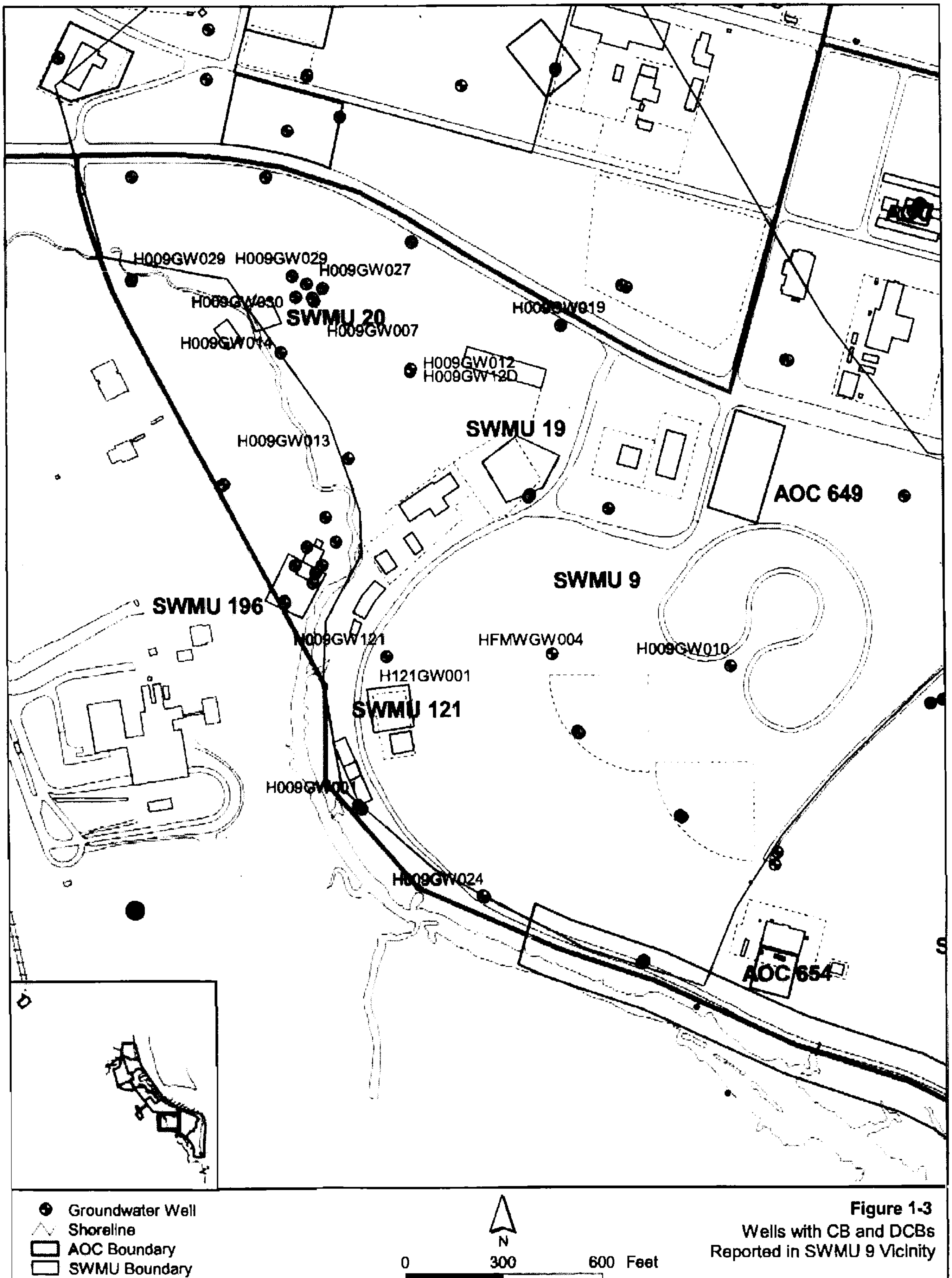

Figure 1-3
Wells with CB and DCBs Reported in SWMU 9 Vicinity

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[illegible] Approach

2.0 Technical Approach

This section outlines the technical approach of the source area delineation for SWMU 196. The field investigation will consist of approximately 30 vertical profiler borings (see Figure 2-1) to delineate variations in the chemical concentrations in groundwater in an area of known groundwater contamination. Approximately seven of these locations are located in the marsh area.

The underground utilities in the area surrounding the proposed vertical profiler borings will be identified and the boring locations properly cleared prior to initiating the boring. The overall strategy will be to incrementally advance the profiler on a grid, starting in the vicinity of GEL015, stepping out until the extent is characterized. Discrete groundwater samples will be collected at various depths for each location, as described in the sections that follow. Samples will be analyzed by an onsite laboratory, or an offsite laboratory that can provide results in 24 hours.

2.1 Groundwater Profiling

Groundwater profiling uses a direct-push technology (DPT) groundwater sampling tool designed to collect depth-discrete groundwater samples. With a profiler, the site investigation can quickly delineate vertical profiles of contaminants in groundwater.

This investigation may involve two different groundwater sampling methods. One method employs a Waterloo Profiler, or similar, instrument for sample collection. The second method employs DPT to collect groundwater samples at discrete intervals. To determine the appropriate profiling technology, both methods will be evaluated in the field at two sampling locations.

Using the data from the two sampling locations, a CH2M-Jones representative will make a decision regarding which sampling method will be used at each sampling location. For example, if it is determined that a significant level of detail is needed at a specific location, the Waterloo Profiler or similar type of instrument may be used. If an area is determined to be either uncontaminated or have low levels of contamination, the DPT method may be used.

2.1.1 Waterloo Profiler (or similar instrument) Sampling Method

The Waterloo-type of profiler collects discrete groundwater samples from numerous depths during a single push (see Appendix B for technical information on one available profiler). A profiler typically has screened ports located behind the tip of the tool. The tip is attached to 3-foot lengths of heavy-duty threaded steel pipe that extend to the ground surface. The profiler is advanced by pushing, pounding, or vibrating the steel pipe into the ground. Three-foot lengths of pipe are continually added as the tool is advanced deeper into the ground to the first sampling depth. Groundwater samples are conveyed to the surface via small-diameter tubing that is attached to a fitting inside of the profiler tip and passes up through the inside of the threaded steel pipes. The internal tube is made of either stainless steel or Teflon to minimize sorption of organic compounds.

At sites where groundwater is shallow (i.e., less than 25 feet below land surface [ft bls]), samples are collected using a peristaltic suction-lift pump. Samples are contained in 40-milliliter (mL) glass vials placed in the sampling line, upstream from the peristaltic pump. Doing so minimizes the loss of volatile organic compounds (VOCs), since the sample is never exposed to the atmosphere.

Subsequent sampling depths could be any given distance below the previous depth, but typically range between 2 and 5 feet deeper than the initial depth. To prevent the ports from clogging as the tool is pushed through the soil, de-ionized water is slowly pumped through the inner tube and out of the sampling ports as the tool is being advanced. Because the tubing is purged between samples, several depth-discrete groundwater samples are collected in one push, without having to remove, clean, and re-insert the tool. Also, because the tool can be pushed through clay and silt beds without plugging, the profiler is effective for sampling multiple water-bearing zones at sites with stratified geology.

2.1.2 Direct-Push Technology Sampling Method

The DPT sampling tool with this technology consists of a stainless steel screen. The screen tip is attached to heavy-duty threaded steel pipe that extend to the ground surface. The sampling tool is advanced by pushing, pounding, or vibrating the steel pipe into the ground. Pipe lengths are continually added as the tool is advanced deeper into the ground to the first sampling depth. Groundwater samples are conveyed to the surface via small-diameter tubing that is attached to a fitting inside of the sampling tip and passes up through the inside of the threaded steel pipes. The internal tube is made of either stainless steel or Teflon® to minimize sorption of organic compounds.

At sites where groundwater is shallow (i.e., less than 25 ft bls), samples are collected using a peristaltic suction-lift pump. Samples are contained in 40-mL glass vials placed in the sampling line, upstream from the peristaltic pump. Doing so minimizes the loss of VOCs, since the sample is never exposed to the atmosphere.

However, unlike the Waterloo Profiling type device, after the sample is collected, the sampling tool needs to be brought back to the surface and decontaminated prior to going deeper.

2.2 Boring Installation and Locations

Two soil borings will be advanced to depths of approximately 15 feet bls to confirm the presence of the shallowest first aquitard/aquiclude below the water table (see Figure 2-1). The Geoprobe-type sampler will be advanced to collect continuous soil samples in clear acetate sleeves. Sleeves will be brought to the surface and visually classified by a hydrogeologist or engineer. Upon completion, soil boring holes will be pressure-grouted with bentonite grout. The hole will be grouted with a tremmie pipe from bottom to top. The soil brought to the surface will be managed as IDW.

The profiler will be advanced at up to 30 predetermined grid locations shown in Figure 2-1. The grid was developed to encompass the area where CB/DCB has been detected in the groundwater (plume area), based on previous analysis of groundwater samples. For the initial four borings, a groundwater sample will be collected in each vertical profiler boring at approximately every 30 inches nominally (on the order of 24 to 36 inches) to sample the vertical profile of the shallow groundwater from the water table surface to approximately 15 ft bls. These initial four borings will be in the vicinity of monitor well GELGW015. The proposed vertical depth locations are shown in Figure 2-2; however, these locations may change if new reported field results indicated different sampling interval could provide more valuable results.

Samples will be analyzed for CB and DCB in an onsite mobile laboratory. The number of groundwater samples collected and the specific depths to be collected in subsequent samples will be adjusted based on these initial results.

Approximately eight additional groundwater sampling locations will be in the marsh areas to the southeast of the main grid. The bore hole will be started/continued with a hand auger to the extent required, but the groundwater will be sampled by hand-advancing the sampling tool. A groundwater sample will be collected in each of the three marsh area locations at approximately 30 inches nominally (on the order of 24 to 36 inches) to sample the vertical profile of the shallow groundwater from the water table surface to approximately the top of the aquitard/aquiclude. The location of this zone is estimated as approximately 15 ft bls at the location of the monitor wells on the east side of SWMU 196. It will be at a shallower locations (e.g., 7 to 8 feet) in the marsh areas. Consequently, it is anticipated that only one to two samples will be collected from each boring location in the marsh area.

These locations may change if new field results indicate a different sampling interval could provide more valuable results.

The vertical profiler locations will be identified as 196VP001, 196VP002, etc. The depth will be added to the location identification following a hyphen.

2.3 Field Operations

CH2M-Jones will subcontract with a vendor to advance the vertical profiler points in the proposed locations and collect groundwater samples. CH2M-Jones will provide a field hydrogeologist or engineer who will be responsible for all field operations. The profiler will be advanced in the groundwater formation to predetermined depths, where groundwater will be pumped to the surface for collection and proper preservation, labeling, and transport to the onsite mobile laboratory.

Once the sample is collected, the tubing will be purged in the locations from which the sample was collected. Typically, two to three tube volumes are purged prior to advancing the tool to the next depth interval. The purge water will be primarily water collected from the formation, with some deionized water. The next closest sampling interval will be no less than two feet. This distance is adequate to avoid any potential interference from the above sampling locations.

CH2M-Jones will subcontract with a vendor for onsite laboratory testing of the groundwater samples. Samples will be delivered to the laboratory for analysis by EPA Method 8021 (including DCBs). EPA methods and/or standard operating procedures (SOP) for screening methods will be followed to meet Data Quality Objectives (DQO)

Level II Criteria. The subcontracted laboratory will meet EPA DQO Level II criteria, as specified in the Comprehensive Sampling and Analysis Plan (CSAP) (EnSafe, 1996).

A certified State of South Carolina well driller will be used for this project.

2.4 Groundwater Sampling and Testing

Field procedures and groundwater analyses will follow standard procedures found in the approved CSAP portion of the RFI Work Plan (Ensafe/Allen & Hoshall, 1994). The CSAP outlines all monitoring procedures to be performed during the investigation in order to characterize the environmental setting, source, and releases of hazardous constituents. The CSAP also includes the Quality Assurance Plan (QAP) and Data Management Plan (DMP) to verify that all information and data are valid and properly documented. Unless otherwise noted, the sampling strategy and procedures will be performed in accordance with the EPA Environmental Services Division *Standard Operating Procedures and Quality Assurance Manual* (ESDSOPQAM, 1996).

The completed soil boring and vertical profiler holes will be filled to the ground surface with a bentonite grout, in accordance with Rule 61-71.10.B of the South Carolina Well Standards and Regulations. Locations will be marked with wooden stakes, flags, or paint (indoors only) for the survey team to establish location coordinates and elevation of ground surface.

The results of the groundwater characterization investigation will be summarized in a Phase II IMWP, which will be submitted to the Navy and SCDHEC approximately four weeks after completion of the field operations. The Phase II IM WP will document the field activities completed during the study, summarize groundwater results, and provide a proposed approach to abate the source areas. CH2M-Jones will incorporate the data into geographic information systems (GIS) database.

2.5 Permits

2.5.1 U.S. Army Corps of Engineers Nationwide (Wetlands) Permits

Installation of temporary wells in wetlands is permissible per the U.S. Army Corps of Engineers (USACE) Nationwide Permit (NWP) Program (USACE, 2000). The NWP program requirements are included in the Code of Federal Regulations and are summarized below.

An NWP is issued to encompass survey activities including core sampling, seismic exploratory operations, plugging of seismic shot holes, and other exploratory-type bore holes, soil survey and sampling, and historic resources surveys. Discharges and structures associated with the recovery of historic resources are not authorized by this NWP.

The drilling and discharge of excavated material from test wells for oil and gas exploration is not authorized by this NWP; however the plugging of such wells is authorized. Fill placed for roads, pads, and other similar activities is not authorized by this NWP. The NWP does not authorize any permanent structures. The discharge of drilling muds and cuttings may require a permit under section 402 of the Clean Water Act (Sections 10 and 404).

The following subsections present the general conditions that must be followed to allow for validity of authorizations by an NWP:

Navigation

No activity may cause more than a minimal adverse effect on navigation.

Soil Erosion and Sediment Controls

Appropriate soil erosion and sediment controls must be used and maintained in effective operating conditions during construction. All exposed soil and other fills, as well as any work below the ordinary high water mark or high tide line, must be permanently stabilized at the earliest practicable date.

Aquatic Life Movements

No activity may substantially disrupt the movement of those species of aquatic life indigenous to the water body, including those species that typically migrate through the area, unless the activity's primary purpose is to impound water. Culverts placed in streams must be installed to maintain low flow conditions.

Equipment

Heavy equipment working in wetlands must be placed on mats. Otherwise other measures must be taken to minimize soil disturbance.

Regional and Case-by-Case Conditions

The activity must comply with regional conditions that may have been added by the division engineer (see 33 CFR 330.4[e]), as well as with any case-specific conditions added by the USACE or by the State or tribe in its Section 401 water quality certification and Coastal Zone Management Act consistency determination.

Endangered Species

No activity is authorized under any NWP that likely jeopardizes the continued existence of a threatened or endangered species, or a species proposed for such designation, as identified under the Federal Endangered Species Act, or which will destroy or adversely modify the critical habitat of such species. Non-federal permittees must notify the District Engineer if any listed species or designated critical habitat might be affected or is in the vicinity of the project, or is located in the designated critical habitat. Activities must not begin until notified by the District Engineer that the requirements of the Endangered Species Act have been satisfied and that the activity is authorized.

For activities that may affect Federally listed endangered or threatened species or designated critical habitat, the notification must include the name(s) of the endangered or threatened species that may be affected by the proposed work or that use the designated critical habitat that may be affected by the proposed work. As a result of formal or informal consultation with the Fish and Wildlife Service or National Fisheries Marine Services, the District Engineer may add species-specific regional endangered species conditions to the NWPs.

Activities under this permit must use Best Management Practices (BMPs) to minimize disturbance to the wetlands and inhabitants. BMPs include:

- Avoidance of discharge
- Placement of heavy equipment working in wetlands on mats
- Removal of temporary fills
- Minimization of disturbance to vegetation

Notification to District USACE may be made after the fact within 30 days of the activity, and include a description of the activities and location shown on a plat. (USACE, 2000).

2.5.2 SCDHEC Well Installation Request

In accordance with R.61-79.265 Subpart F of the South Carolina Hazardous Waste Management Regulations and R.61-71 of the South Carolina Well Standards and Regulations, a request for the advancement of the vertical profiler locations is required to be submitted to SCDHEC two weeks prior to the scheduled activity. The written request provides the purpose of the vertical profiler activity and consists of well construction details, if required, and a map depicting the proposed vertical profiler locations. In addition, because the vertical profiler locations are considered temporary, the request will provide the method used for abandonment.

2.5.3 SCDHEC Underground Injection Control Permit Application

An approved Underground Injection Control Permit will be approved prior to the initiation of field work.

Figure 2-1
Proposed Boring and Sampling Locations
SWMU 196
Charleston Naval Complex

CH2MHILL

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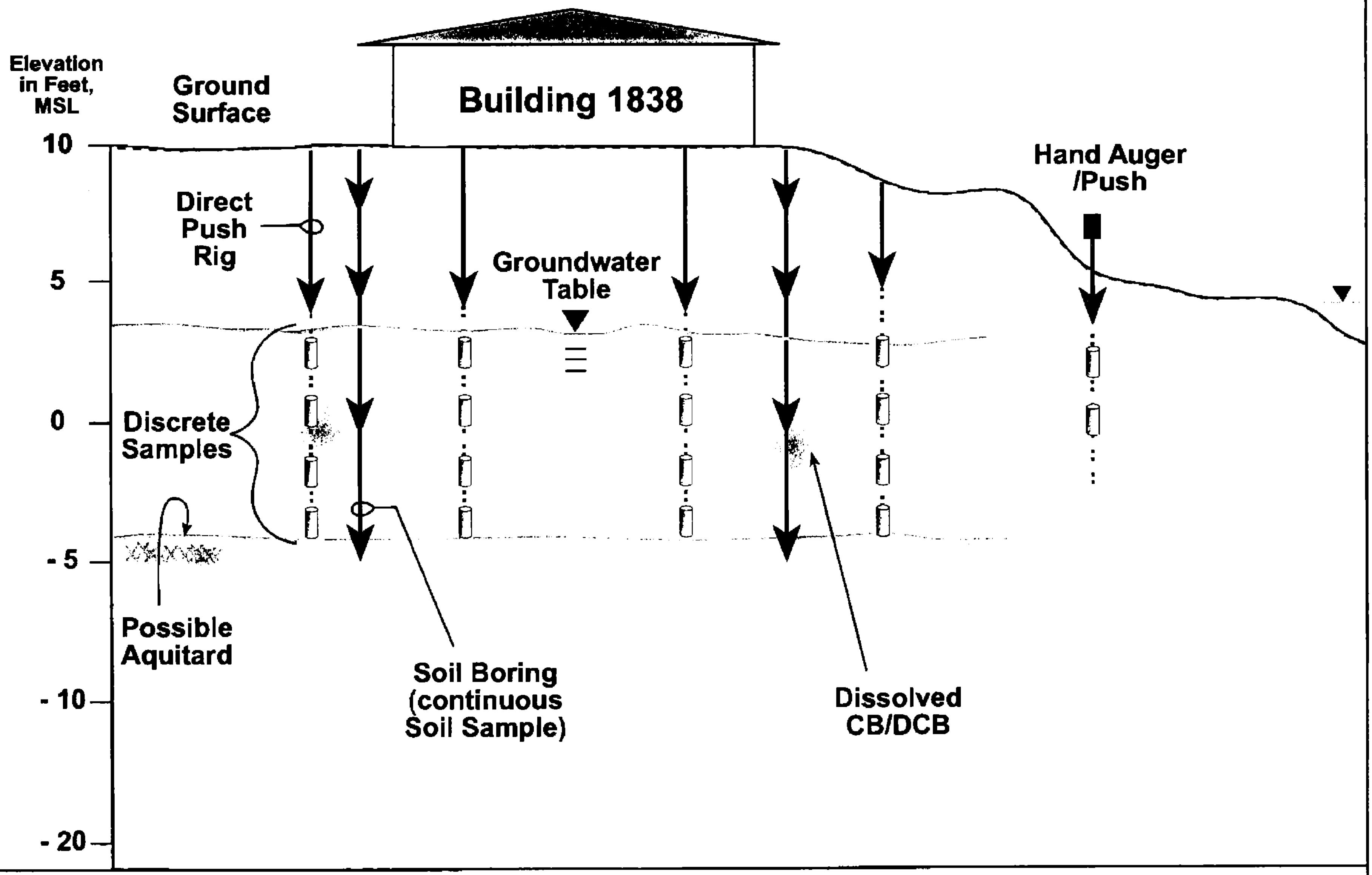

Figure 2-2
Proposed Sampling Profile
SWMU 196
Charleston Naval Complex

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Investigative Derived Waste

3.0 Investigative-Derived Waste

IDW that is generated during this effort will include purge water from the groundwater sampling activities and possibly soil cuttings. IDW will be collected in labeled 55-gallon drums or portable tank for proper handling. Contained IDW will remain on site temporarily until transported to the less than 90-day storage facility located at Building 1824. Once the analytical results have been reviewed, the 55-gallon drums or portable tank containing the groundwater contents will be transported , as required, to a permitted and licensed facility for treatment or disposal.

References

4.0 References

EnSafe, Inc. *Zone H RCRA Facility Investigation Report, RFI Addendum.* Volume I of V, Section 2.4. May 5, 2000.

EnSafe, Inc./Allen & Hoshall. *Final Comprehensive Corrective Action Management Plan.* August 30, 1994.

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U.S. Environmental Protection Agency (EPA). Advance Notice of Proposed Rulemaking (61 CFR 19432, May 1).

U.S. Environmental Protection Agency (EPA). *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual.* Region IV, Environmental Services Division. 1996.

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Stratigraphy and Site Profile Sketch

APPENDIX A

Stratigraphy and Site Profile Sketch

The text that follows provides a brief description of subsurface soil conditions at the site, based on a review of the RFIs previously performed by EnSafe.

Stratigraphy

Subsurface soil conditions at the site vary considerably according to available boring information (see Figure 2-1 for plan locations per RFI Addendum [May 2000]). The following monitor well boring installation logs were used to construct a site profile: 009020, 009021, 009022, 009023, 009023D, 196001, 196002, 196002D, and 196003. The profile sketch is provided in Figure A-1 of this appendix.

The "009" series borings were completed in June-July 1998, and the "196" series in December 1999-January 2000. Limited correlation of soil classification among borings complicates the development of a typical site profile. Limited correlation is somewhat attributed to various descriptions provided by different persons logging the borings, and also to the heterogeneous nature of the fill deposits. However, general conclusions were developed, as discussed in the text that follows.

Upper Site Soils

The upper site soils (from the surface to a depth of about 15 ft bls are fill materials consisting of silts, sands, and clays. Where reported, soil consistency was typically soft or loose with some stiff clay lenses (qualitative). Clays were predominant in the bottom ten feet of this zone and were typically organic (organic vapor analyzer responses and odor descriptions). The water table was reported to be 4 to 5 ft bls under vegetated areas and 7 to 8 ft bls under paved areas. In the base of the borings, at about 3 to 5 ft mean sea level (msl), a fairly consistent layer of plastic and mottled clay was encountered. Current interpretation of this layer is that it forms the first aquitard/aquiclude below the water table. Shallow wells are screened (sand-packed) throughout most of the upper layer of site soil, primarily between a top of 1 to 2 ft bls to a bottom of 14 ft bls.

Lower Site Soils

The lower site soils (from a depth of about 15 ft bls to a depth of about 40 feet bls) are calcareous marine deposits, consisting primarily of plastic silts and clays, with a sand layer from about 25 to 34 ft bls. At the base of this sand layer lies the Ashley Formation, which consists of stiff, plastic, clayey silts. The silts and clays are interbedded with frequent descriptive changes and thin layers of sand. Deep wells are screened (sand-packed) in the bottom 12 to 13 ft of this layer, primarily between a top of 24 ft bls to bottom of 37 ft bls.

There is no apparent difference between the groundwater levels of the shallow and deep wells at this site. Shallow groundwater flow at the site is toward the northeast and east.

Correlation of soil descriptions among the shallow borings and between the shallow and deep borings for the common depth interval (top 15 ft) is not definitive, confirming a zone of highly variable deposits. The two deeper soil borings are fairly consistent and reveal an undisturbed marine clay deposit. However, site stratigraphy agrees with general descriptions from Section 3.0 of the final RI report, as follows:

- Variable upper sediments (Wando Formation) consisting of up to three layers:
  - Upper sands; this layer is not found at the site; instead, upper materials are fill soils consisting of sand, silt, and clay mixtures.
  - Marsh clay; an aquitard between upper and lower sands, found at the site at depths of about 12 to 15 ft bls.
  - Lower sands; represented at the site by silty sands in a zone from 25 to 35 ft bls. These sands are semi-confined and have groundwater elevations the same as the water table above the Marsh mud.
- The Ashley Formation starts at a depth of 35 ft bls at the site (below the lower sands) and forms an aquitard.

Direct-Push Technology Subsurface Soil Investigations

In April 1999, a source area investigation for groundwater contamination was conducted at SWMU 196. Fourteen DPT subsurface soil samples (196SP001…Figure 1-2) were collected (3-5 ft bls) and analyzed for VOCs, semi-volatile organic compounds (SVOCs), and pesticides/polychlorinated biphenyls (PCBs). Of the SVOCs, DCBs exceeding soil to groundwater Soil Screening Levels (SSLs) were found in 196SP013 (northwest, in front of building) and were detected below SSLs in 196SP001 (off the northwest corner of building).

Groundwater Investigations

The RFI Addendum summarized groundwater investigations in 1998 and 1999 (May, 2000). Significant detections of dissolved DCBs in groundwater occurred consistently in front and back of Building 1838 in the shallow groundwater. The most significant occurrences were in 009020, 009021, and GEL015 directly to the east of Building 1838 (see Figure 1-2). DCBs were also found in temporary well 196DF02 (6 micrograms per liter [µg/L] 1,3-DCB and 23 µg/L 1,4-DCB); chlorobenzene was found in temporary wells 196DF01 (2 µg/L) and 196DF02 (3,500 µg/L).

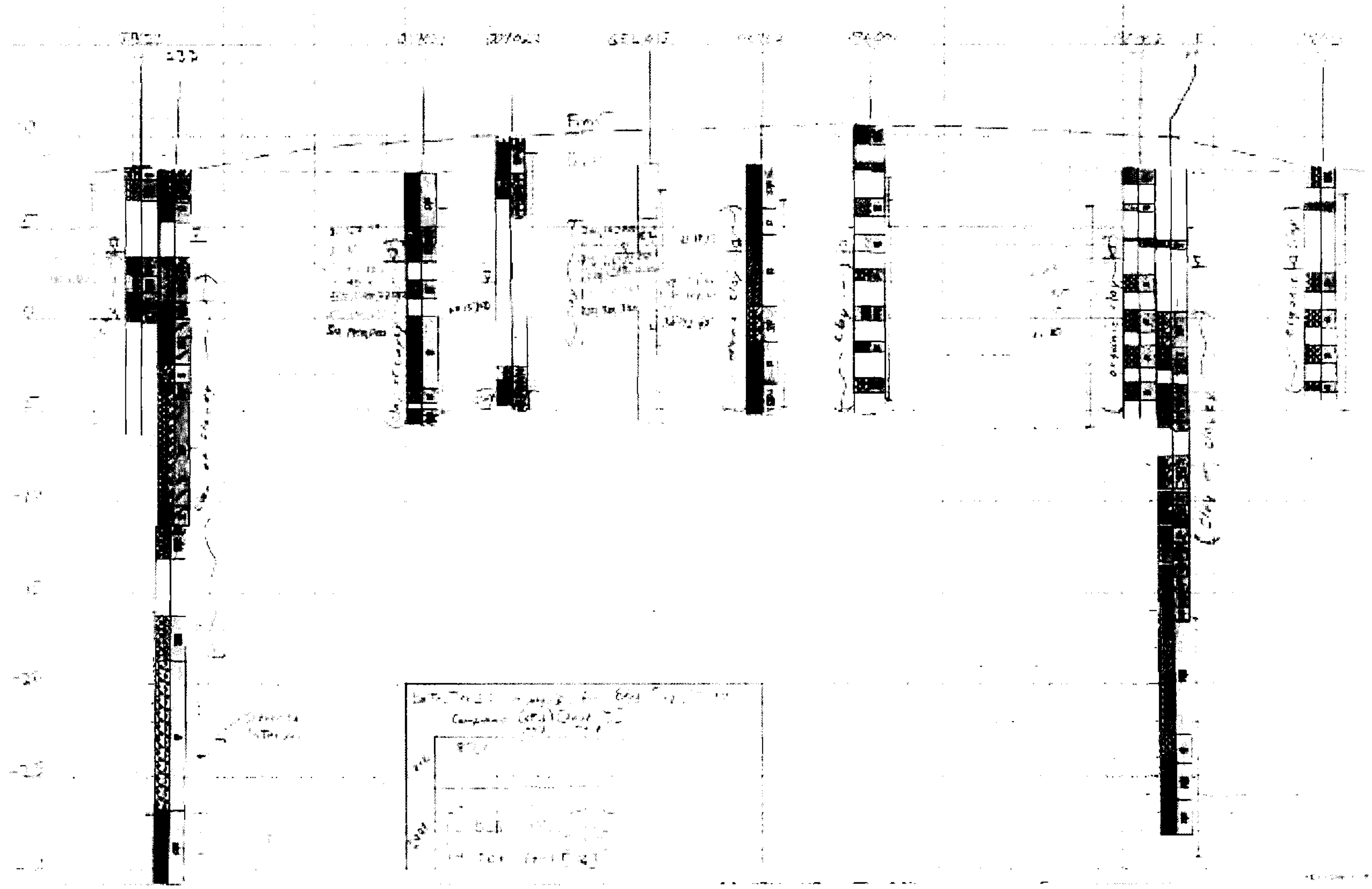

Figure 1
Site Profile Sketch
SWMU 196
Charleston Naval Complex
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Product Technical Literature

PRECISION TECHNICAL NOTE No.3

The Waterloo Profiler for Groundwater Sampling

The Waterloo Profiler is a new direct-push (DP) groundwater sampling tool developed by researchers at the University of Waterloo in Ontario, Canada[1]. The Profiler is the only DP tool designed to collect depth-discrete groundwater samples in a single hole with one probe entry. With the Waterloo Profiler, site investigators can quickly delineate vertical profiles of contaminants dissolved in groundwater.

Why Vertical Profiling is Necessary

Recent long-term natural gradient tracer studies show that in most granular aquifers, very little vertical mixing of contaminants occurs as the groundwater flows along its flow path[2,3,4,5]. Depth-discrete groundwater sampling (referred to as vertical profiling) at these sites shows that the concentration of dissolved organic compounds often varies by several orders of magnitude over vertical distances of one foot or less. This indicates that significant vertical mixing does not occur in most environments; if it did, the contaminants would be more evenly distributed and concentrations would be more uniform.

Groundwater mixing, also referred to as hydrodynamic dispersion, is a function of the groundwater velocity and the dispersivity (α) of the formation. Numerical simulations of data collected during the natural gradient tracer tests show that vertical dispersivity (α_V), which controls vertical mixing, is much lower than was thought in the 1970s and early 1980s[7]. This explains why very little vertical mixing of contaminants occurs in nature, even in relatively homogeneous materials.

If dissolved contamination is highly stratified, can samples collected from conventional monitoring wells provide an accurate representation of the true concentration and distribution of contaminants in groundwater? The answer is no. When a conventional monitoring well is sampled, clean or slightly-contaminated water is drawn into the well, diluting the sample. Therefore, even with screen lengths as short as 5 or 10 feet, monitoring wells yield samples that are composited over the screened interval. Thus, high concentrations of contaminants present in a thin zone – and even non-aqueous phase liquids (NAPLs) – are significantly diluted in the process of sampling conventional monitoring wells. In some cases, the contamination can be diluted below the detection limit of the chemical analytical method.

Moreover, for non-biodegradable contaminants (like most chlorinated solvents and MTBE), if significant mixing with clean water does not occur as groundwater flows in the subsurface, the high solute concentrations in the contaminated zone are maintained. Thus, thin zones with high concentrations of contaminants can flow for great distances without being diluted. A recent investigation at an industrial facility – where detailed vertical monitoring was performed – identified a high-strength core of contamination that extends for over 7 kilometers[6].

Figure 1. Depth-discrete groundwater samples are drawn through screened ports in the tip of the sampling tool. The ports are connected to an internal fitting inside of the tool (shown at left). Tubing attached to the internal fitting and running inside of the steel pipe conveys the water sample to the surface.

Inaccurate delineation of groundwater contamination can have tremendous consequences. Without an accurate understanding of the true magnitude and distribution of contamination, it is not possible to make intelligent corrective action decisions. Underestimating the maximum contaminant concentrations invalidates any risk assessment. Not identifying free product or localized contaminant hot spots may expose nearby receptors to unacceptable risks. And, without knowing the true distribution of subsurface contamination, it is impossible to design effective active or passive remediation systems.

Regulators and site investigators across North America are discovering that collecting multiple, closely-spaced, depth-discrete groundwater samples – i.e., vertical groundwater profiling – is necessary to define the true extent and distribution of dissolved contaminants in the subsurface.

Description and Operation of the Waterloo Profiler

The Waterloo Profiler collects discrete groundwater samples from numerous depths during a single push. Figure 1 shows the tip of the Waterloo Profiler, which has screened ports located at the tip of the tool. The Profiler tip is attached to 3-foot lengths of heavy-duty threaded steel pipe that extend to the ground surface. The Profiler is advanced by pushing, pounding, or vibrating the steel pipe into the ground using one of Precision's custom-made sampling rigs. Three-foot lengths of pipe are continually added as the tool is advanced deeper into the ground to the first sampling depth. Groundwater samples are conveyed to the surface via small-diameter tubing that is attached to a fitting inside of the Profiler tip and passes up through the inside of the threaded steel pipes.

At sites where groundwater is shallow (i.e., less than 25 feet below the ground surface), samples can be collected using a peristaltic suction-lift pump (Figure 2). Samples are collected in 40 ml glass vials placed in the sampling line, upstream from the peristaltic pump. Positioning the glass vials in the sampling line upstream from the peristaltic pump minimizes the loss of volatile organic compounds (VOCs) since the sample is never exposed to the atmosphere. However, at sites where groundwater has high concentrations of dissolved gases such as carbon dioxide or methane, pressure changes during sampling can cause bubbling in the sample line as the dissolved gases come out of solution. In such environments, VOCs in the groundwater can partition into the bubbles, reducing the concentration in the water. A recent study by Baerg et al. indicates that the negative bias in samples collected using a peristaltic pump is on the order of 12% for tetrachloroethene (PCE) and 7% for trichloroethylene (TCE)[7]. While this error is not insignificant, the advantage of being able to delineate the plumes in detail outweighs the sampling bias caused by the sample collection method, especially when the natural variation in the samples is in the order of three to four orders of magnitude. Nevertheless, the investigator is cautioned to be aware that negative biases exist when using peristaltic pumps, and to consider not only the partial pressures of dissolved gases, but also the volatility of the target analyte. Additional discussion of sample bias associated with the Waterloo Profiler is presented by Pitkin, et al.[8].

Once a sample is collected in the 40 ml vials, new glass vials are placed in the sample holder and the Profiler is pushed to the next sampling depth. The next sampling depth can be any distance below the previous depth, but usually ranges between 2 and 5 feet deeper. To prevent the ports from clogging as the tool is pushed through the soil, deionized water is slowly pumped through the inner tube and out of the sampling ports as the tool is being advanced. Note that only a very small amount of water is injected – typically less than 10 milliliters per minute – just enough to keep the ports from becoming plugged. For injection pressures up to approximately 50 pounds per square inch (psi), the water is injected by reversing the flow on the peristaltic pump. In addition to keeping the ports open, injecting DI water while advancing the tool purges the tubing of the water left over from the previous sampling event. This prevents cross contamination of the next groundwater sample.

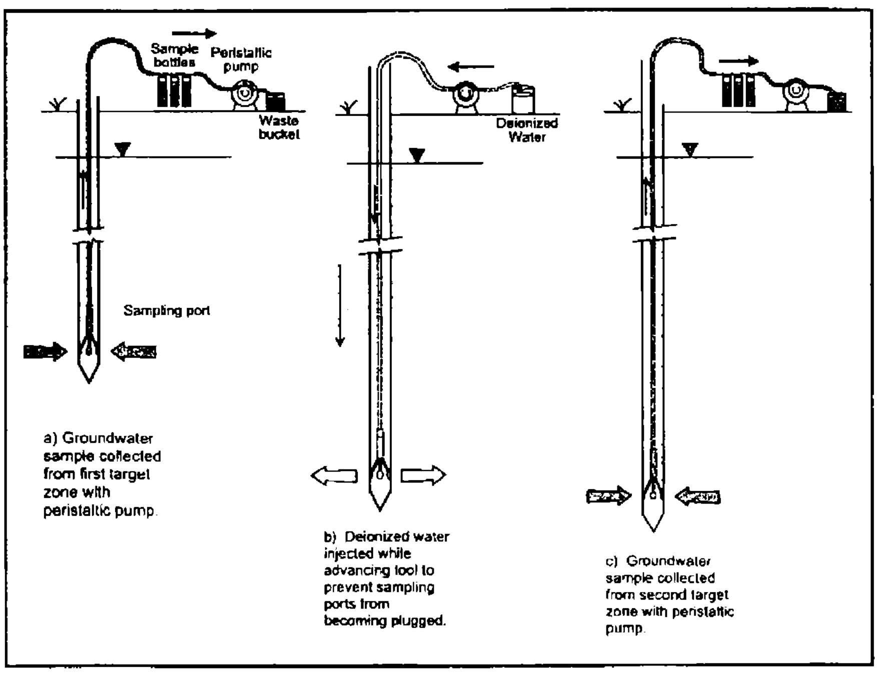

Figure 2. Collecting depth-discrete groundwater samples with the Waterloo Profiler

Note that the pressure/flow relationship of the injection water can be monitored to provide an indication of the hydraulic conductivity of the formation. This way, geologic contacts (i.e., the contact between a sand and an underlying clay confining unit) can be accurately identified as the profiler tool is advanced.

Once the tool has been advanced to the next sampling depth, the flow of the pump is reversed, and groundwater from the aquifer is again extracted. Purging of the system is required, since the tubing and ports now contain DI water that had been pumped down through the system. The electrical conductivity of the extracted groundwater can be monitored during purging. Several other chemical parameters such as salinity, temperature, pH, and dissolved oxygen (DO) can be monitored using in-line sensors mounted in flow-cells in the sampling line. Once the investigator is confident that formation water is being extracted, the 40 ml glass sample vials are removed and capped, ready to be analyzed by the on- or off-site laboratory.

The primary advantage of the Waterloo Profiler is that because the tubing is purged between samples, several depth-discrete ground-water samples can be collected in one push, without having to remove, clean, and re-insert the tool.

Sealing the Hole Created with the Waterloo Profiler

Probe holes should be sealed to prevent the holes from becoming conduits for contaminant migration. This is espe-

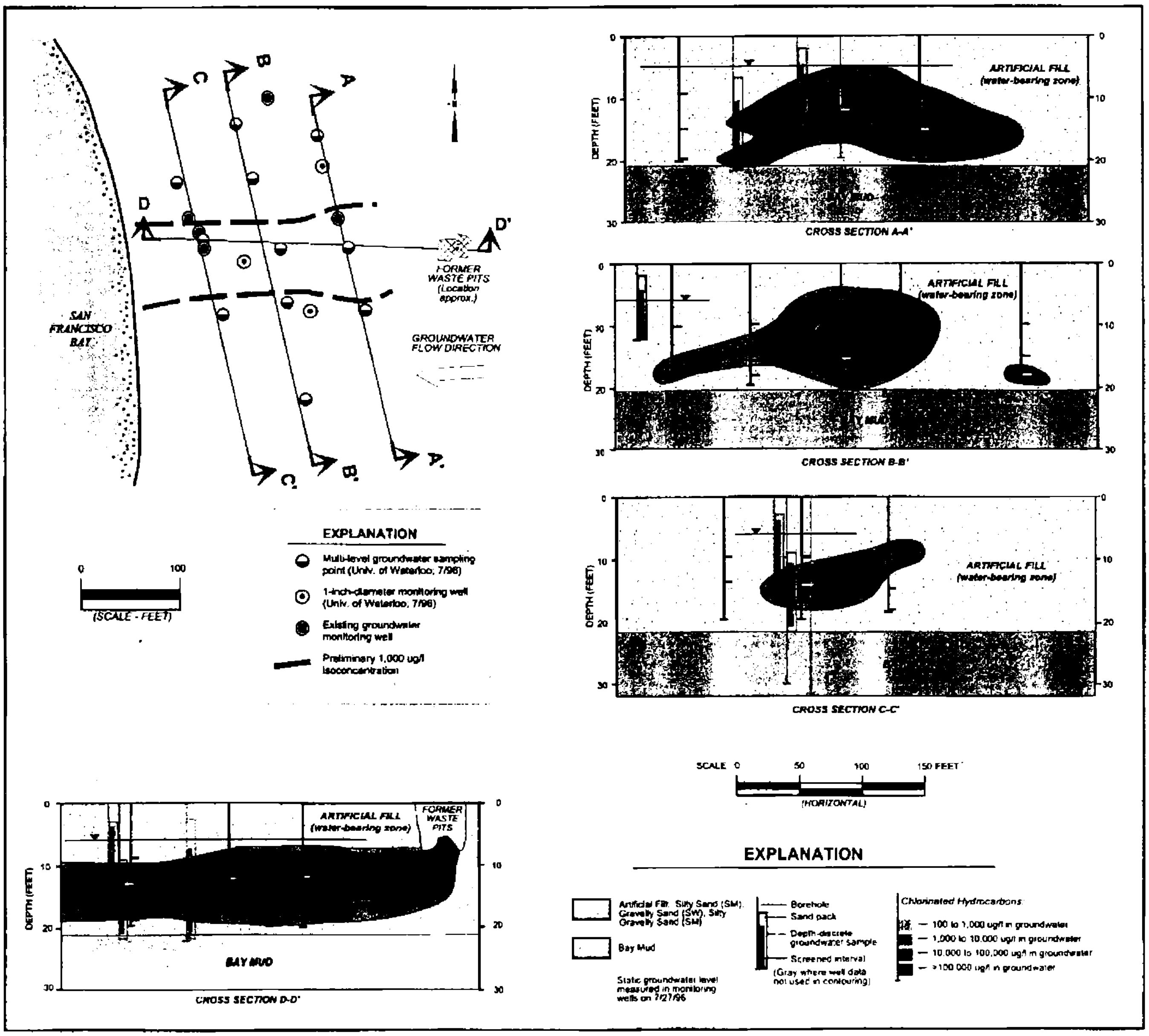

Figure 3. Map and transects from a site characterization at Alameda Naval Air Station in California. Note the great vertical variation in the concentration of dissolved contaminants, even in this homogeneous sand.

cially important at sites where DNAPL is present that could flow down the open probe holes and contaminate deeper aquifers. In most homogeneous sands, the sand will collapse as soon as the Profiler is withdrawn, restoring the original permeability of the formation. However, in other geologic formations, the soil may not collapse, and other methods of sealing the probe hole are necessary. The Waterloo Profiler is equipped with a knock-out disposable tip that facilitates reliable retraction grouting (Figure 1). Once the last groundwater sample has been collected, cement or bentonite grout is pumped down the steel pipe using a high-pressure grout pump. The disposable tip separates from the rest of the tool upon pull back, and grout flows out of the pipe into the probe hole. The grout is continuously pumped, filling the probe hole as the pipe is removed. This ensures that the probe hole is effectively sealed. Retraction grouting using the Waterloo Profiler is much more reliable than re-entry methods used with other sealed-screen groundwater sampling systems[9].

Case Study

The Waterloo Profiler was used to delineate the areal and vertical extent of a plume of chlorinated organics and petroleum hydrocarbons at a portion of Alameda Naval Air Station in California. The investigation was performed to define the optimum location and depth of an innovative in-situ reactive-wall funnel and gate remediation system[10]. Continuous soil cores were first collected with Precision's Enviro-Core system to define the site geology (the Enviro-Core soil coring system is described in Technical Note # 1). Next, depth-discrete groundwater samples were collected with the Waterloo Profiler at 14 locations (Figure 3). The locations were along three transects drawn perpendicular to the presumed plume orientation. Groundwater samples were analyzed on site for chlorinated organic compounds and petroleum hydrocarbons by GC/MS methods.

As shown in Figure 3, Precision's investigation accurately delineated the dissolved plume in three dimensions. The plume does indeed have a very concentrated core, with concentrations of vinyl chloride as high as 130,000 ug/l, that had been missed by the existing conventional monitoring wells. Projection of concentration contours to the ground surface shows that the plume emanates from a former waste disposal pit, and flows to the west where it discharges into San Francisco Bay. Note that groundwater samples collected from the base of the aquifer had much lower concentrations of all compounds than samples collected higher up in the aquifer. This is conclusive evidence that a pool of DNAPL does not occur atop the Bay Mud aquitard in that part of the site.

The site characterization was comprehensive and yielded accurate data that the investigators needed to install the passive remediation system. Yet, the investigation was neither lengthy nor costly. Precision performed the entire investigation in 4 days at a cost slightly under $10,000.

Maximum Depth, Productivity, and Limitations

Like other direct-push groundwater sampling tools, the Waterloo Profiler is intended for use in unconsolidated sand and gravel formations. The maximum sampling depth depends on the site-specific soil conditions. It has been advanced to depths greater than 100 feet near Cape Canaveral, Florida and Cape Cod, Mass.

Sample collection is the most time-consuming part of the operation; advancing the sampling tool usually takes very little time. In coarse-grained sands and gravels, sample collection takes less than 10 minutes per sample. In fine- to medium-grained sand, 20 to 30 minutes is typically required to purge and collect a sample. In sediment finer than a fine-grained sand, collecting groundwater samples with the Waterloo Profiler is time consuming and may not be economically feasible.

References

[1] Pitkin, S.E., Ingleton, R.A., and Cherry, J.A. Use of a Drive Point Sampling Device for Detailed Characterization of a PCE Plume in a Sand Aquifer at a Dry Cleaning Facility. In Proceedings of 8th Annual Outdoor Action Conference: NGWA, 1994.

[2] Mackay, D.M., Freyberg, D.L., and Roberts, P.V. A Natural Gradient Experiment on Solute Transport in a Sand Aquifer 1. Approach and Overview of Plume Movement. Water Resources Research 22(13):2017-2029, 1986.

[3] Frind, E.O. and Hokkanen, G.E. Simulation of the Borden Plume Using the Alternating Direction Galerkin Technique. Water Resources Research 23 (5):918-930, 1987.

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[7] Baerg, D.F., Starr, J.A., Cherry, J.A., and Smyth, D.A. Performance Testing of Conventional and Innovative Downhole Samplers and Pumps for VOCs in a Laboratory Monitoring Well. 1992.

[8] USEPA, 1997, Tools for Expedited Site Characterization, Washington, D.C. (in press).

[9] Pitkin, S.E., Cherry, J.A., Ingleton, R.A., and Broholm, M. Assessment of cross contamination associated with the Waterloo Profiler for direct-push groundwater sampling. Ground Water Monitoring and Remediation, 1997. (in press).

[10] University of Waterloo, 1996. Workplan for Semi-Passive Groundwater Remediation Demonstration Project at Site 1, Alameda Naval Air Station, California, September 1996.

Appendix C

Responses to SCDHEC Comments

Response to Comments from
Susan Peterson (SCDHEC) on the
Phase I – Source Area Delineation Interim Measure Work Plan,
Rev. 0, (September 2000)

1. October 16, 2000 conference call

The Navy's contractor has clarified the following issues to the Department's satisfaction:

a) The Navy intends to place the initial 4 borings (line 24 of Section 2.2) in the vicinity of GELGW015.

b) The yellow groundwater well symbols (shown on Figures 1-2 and 2-1) are not defined in the Key. These symbols represent previously installed groundwater wells.

c) The three additional groundwater samples proposed for the marsh area (line 1 of Section 2.2 on page 2-5) will not be subject to the same sampling scheme as proposed for the initial 4 borings (described in Section 2.2).

Response: Comment Noted.

2. Modification of Figures 1-2 and 2-1

If the Navy plans to issue revised pages to this work plan, please address Comment 1-b by either deleting the symbols from the figures or including the symbols in the Key, noting the applicable report.

Response: **CH2M-Jones intents to submit a revised version of the IM Work Plan. The above request will be incorporated into the Revision 1 submittal.**

3. Groundwater sampling in marsh, Section 2.2, page 2-5

Please explain the estimated number of groundwater samples to be collected from each marsh boring, in addition to the proposed depths of each groundwater sample. Please revise this section to provide more detail (similar to the sampling scheme of the 4 initial borings on page 2-3). The text states that the groundwater will be sampled by hand-advancing the profiler and collecting samples as described above. As currently written, the Department does not understand what is meant by "as described above."

Response: The subject paragraph will be revised to: "Approximately three additional groundwater sampling locations will be in the marsh areas to the southeast of the main grid. The bore hole will be started/continued with a hand auger to the extent required, but the groundwater will be sampled be hand-advancing the sampling tool. A groundwater sample will be collected in each of the three marsh

area locations at approximately 30 inches nominally (on the order of 24- to 36-inches) to sample the vertical profile of the shallow groundwater from the water table surface to approximately the top of the aquitard/aquiclude. The location of this zone is estimated as approximately 15-ft-bls at the location of the monitor wells on the east-side of SWMU 196. It will be at a shallower locations (e.g., 7-8 feet) in the marsh areas.

Given that these comments are not substantial in nature, the Department would like to resolve these comments as quickly as possible in order to implement the work plan.

Response: **Comment Noted.**

Response to Comments from
Mike Danielsen (SCDHEC) on the
Phase I – Source Area Delineation Interim Measure Work Plan, Rev. 0,
(September 2000)

1. **Page 2-1, Section 2.0, lines 8-11**

   The text states that the sampling will begin in the vicinity of GEL 15 and proceed outward until the extent is defined. This plan does not specify if any contingent locations are proposed if the grid points are completed and delineation is not completed. Please clarify if contingent locations will be proposed.

   Response: **Five contingent locations have been added. Three vertical profile points have been added on the southeast side of the grid. Additionally, two contingent locations have been added to the marsh area. Please see Revised Figure 2-1 for contingent sampling locations.**

2. **Page 2-3, Section 2.1, lines 7-9**

   The text states that DI water will be pumped through the ports to prevent clogging, and after each sample to purge the left over water from the previous sample. The text does not state the following:

   i.) Once the sample has been taken, the purging will be done in the same location that the sample was taken. It is assumed that the probe will be purged as it is being driven down to the next sampling location, which would create a smear zone and make subsequent samples non-representative for the formation the Navy is trying to delineate.

   ii.) The minimum distance from the previous sample location/purging to the next sample to avoid drag down.

   iii.) Because DI water will be injected into the sampler to prevent clogging, an underground injection permit may be required. Please contact Todd Adams at 803-898-3549 to verify this issue. The approval of the IM Work Plan and field implementation is contingent upon an UIC permit or official waiver from the Bureau of Water.

   Please revise to clarify these issues.

Response: **Once the sample is collected, the tubing will be purged in the location from which the sample was collected. Typically, two to three tube volumes are purged prior to advancing the tool. The next closest sampling interval will be no less than two feet. This distance is adequate to avoid any potential interference from the previous sampling locations. CH2M-Jones will provide the agreed upon information for the UIC permit.**

3. **a.) Page 2-3, Section 2.2, lines 16-17**

   The text states that the borings will be advanced to a depth of 15 feet bls. The text is not clear if this is the expected depth of the nearest confining unit. Please clarify.

   Response: **The text will be revised to state "Two soil borings will be advanced to depths of approximately 15 feet bls to confirm the presence of the shallowest first aquitard/aquiclude below the water table."**

   b.) Page 2-3, lines 17-19

   The text states that acetate sleeves will be brought up and visually classified. The text does not state how the soil will be handled after classification. Please clarify.

   Response: **The text will be revised to state that the soil will be managed as investigative derived waste.**

   c.) Page 2-3, lines 19-20

   The text states that upon completion the soil boring will be pressure grouted with bentonite grout. The text does not state if a plug can be knocked out and the boring will be grouted on removal of the probe or re-entry will be needed to grout. Please clarify.

   Response: **Re-entry will be needed to grout the whole. The hole will be grouted with a termmie pipe; the grouting will proceed from the bottom of the whole to the top using bentonite grout.**

4. **Page 2-5, Section 2.3**

This section does not mention if a South Carolina Certified well driller will be used to install and abandon the borings, or whether the onsite lab will be South Carolina certified lab. Please clarify.

Note. A South Carolina certified well driller is required to install and abandon the proposed temporary wells, and if the sampling analysis results will be used to make risk management decisions, the lab must be South Carolina certified as well.

Response: **The text will be revised to make clear that a certified South Carolina well driller will be used to perform the work. As the data will not be used to make risk management decisions and will be only of a DQO Level II quality, the use of a state certified laboratory is not considered necessary. We would like to keep the option open of using a mobile laboratory.**

5. **Page 2-5, Section 2.3, lines 11-14**

The text states that the profiler will be advanced into the groundwater formation to predetermined depths. This is contradictory with section 2.1, page 2-3, lines 6-7, that state sampling depths could be any given distance below the previous depth, but typically range between 2 and 5 feet deeper than the initial depth. Please clarify.

Response: **The specific depth from which each is collected will be made by the Field Team Leader. In this context, both of the above referenced statements are correct.**